# Baffinland Iron Mines Corporation

## Shipping and Marine Wildlife Management Plan

## BAF-PH1-830-P16-0024

## Rev 6

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# 1 INTRODUCTION

## 1.1 PURPOSE

The Baffinland Iron Mines Corporation (Baffinland) was formed specifically to develop the Mary River Iron Ore Deposit Project (the Project) on the coast of Nunavut. The approved development, the largest planned in the history of Nunavut, is located about 160 km south of the community of Pond Inlet (Mittimatalik) and 1000 km northwest of Iqaluit, the capital of Nunavut (Figure 1).

The long term viability of the Project depends on the constant supply of iron ore to overseas markets requiring shipping on a 12 month-per-year basis. Accordingly, the Shipping and Marine Wildlife Management Plan (SMWMP) has been developed to:

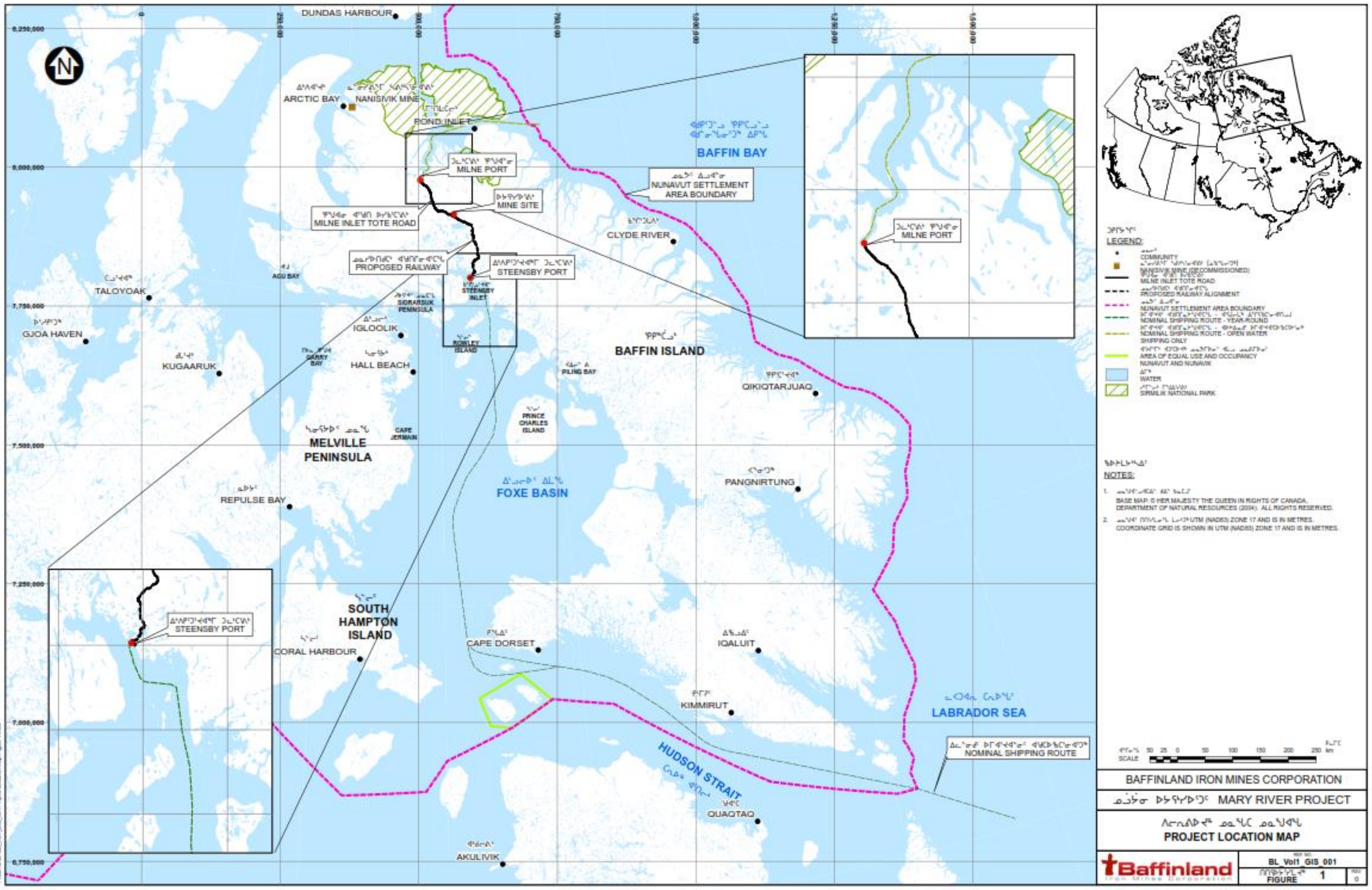
- Address the issues of concern to Inuit with respect to shipping.
- Establish rules and procedures applicable to open water and winter shipping during the construction, operational and decommissioning phases of the Project.
- Provide for Inuit involvement in the planning, environmental management and decision-making processes related to shipping.

The SMWMP is a part of the Baffinland Environmental Management System (EMS) and reflects the Baffinland commitments respecting shipping. Specifically, the SMWMP:

- Describes the means whereby Baffinland ships construction materials and equipment to the site, and export iron ore from the Milne Port Site and the Steensby Port Site.
- Describes the management of the shipping operation, including the design, commissioning and operation of a dedicated Iron Ore carrier to be employed for year round operations. The SMWMP also describes the specification and procedure in place for charter and operation of suitable vessels to export iron ore on a seasonal basis.
- Addresses the management, routing and operation of ships and describes how the vessels will navigate through and in the vicinity of ice; and.
- Describes the monitoring and mitigation measures, and adaptive management procedures to be employed in addressing concerns related to marine wildlife, including mammals and birds.

It is noted that in all matters of marine transportation, the Master of the vessel has an overriding obligation to protect the safety of his vessel, crew and the environment for which he is ultimately responsible and, notwithstanding anything contained in this SMWMP, the Master will always be guided by this principle.

**FIGURE 1 PROJECT LOCATION MAP**



## 1.2 REGULATORY FRAMEWORK

On December 28, 2012 the Nunavut Impact Review Board (NIRB) issued a Project Certificate (No. 005) for the Mary River Project, subject to terms and conditions listed within the authorizing document. On May 28, 2014 NIRB amended the Project Certificate to reflect modifications to the Project associated with the Early Revenue Phase Proposal. Relevant sections of the NIRB Certificate (as amended) are addressed within this Shipping and Marine Wildlife Management Plan. A Table of Concordance (Appendix 7) provides guidance to link sections of the SMWMP to specific NIRB Terms and Conditions.

In accordance with Term and Condition # 77 of the NIRB Certificate, a Marine Environment Working Group (MEWG) has been established to provide advice and recommendations related to environmental monitoring and implementation of mitigation measures for the protection of the marine environment. The Terms of Reference for the group have been agreed amongst the founding parties, and a copy tabled with NIRB.

Canada is an active member of the International Maritime Organization (IMO) and is a signatory to IMO agreements such as the International Convention for the Safety of Life at Sea (SOLAS), the International Convention for the Prevention of Pollution from Ships (MARPOL), the International Loadline Conventions, the International Safety Management Code (ISM) and the IMO International Convention for the Control and Management of Ships' Ballast Water and Sediment. The majority of operations described in this SMWMP are marine or port-related and are federally regulated by Transport Canada through the Canada Shipping Act and various International Regulations augmented by various Shipping Notices and Publications.

Up-to-date versions of these Acts and Regulations are available on the internet on the Transport Canada Site – http://www.tc.gc.ca

### 1.2.1 APPLICABLE LEGISLATION, REGULATIONS, ACTS AND GUIDELINES

The Fisheries Act is the main environmental legislation addressing environmental protection of the marine environment. The transportation of all cargoes between Canadian ports is regulated by the Government of Canada through a variety of legislation, including:

- Canada Shipping Act
- IMO Code for the Safe Handling of Bulk Cargoes
- Canada Labour Code
- IMDG Code for the Safe Handling of Dangerous Goods
- Canadian Transportation Accident Investigation and Safety Board Act
- Canadian Transportation Act
- Canadian Transportation of Dangerous Goods Act
- Department of Transport Act
- Marine Transportation Security Act

- Navigation Waters Protection Act
- Oceans Act
- Arctic Waters Pollution Prevention Act and Regulation
- Safe Containers Convention Act; and
- Ballast Water Control and Management Regulations.

The following regulations issued under the Canada Shipping Act regulate Canadian vessel operations and foreign vessels while operating in Canadian waters:

- Aids to Navigation Protection Regulations
- Air Pollution Regulations
- Boat and Fire Drill Regulations
- Charts and Nautical Publications Regulations
- Dangerous Chemicals and Noxious Liquid Substances Regulations
- Classed Ships Inspection Regulations
- Collision Regulations
- Crew Accommodation Regulations
- Dangerous Bulk Materials Regulations
- Dangerous Goods Shipping Regulations
- Eastern Canada Vessel Traffic Services Zone Regulations
- Fire Detection and Extinguishing Equipment Regulations
- Garbage Pollution Prevention Regulations
- Home-Trade, Inland and Minor Waters Voyages Regulations;
- Hull Inspection Regulations
- Marine Transportation Security Regulations
- Life Saving Equipment Regulations
- Marine Certification Regulations
- Marine Crewing Regulations
- Marine Machinery Regulations
- Navigating Appliances and Equipment Regulations
- Non-Canadian Ship Safety Order
- Oil Pollution Prevention Regulations
- Pilot Ladder Regulations
- Pollutant Discharge Reporting Regulations
- Pollutant Substances Regulations
- Response Organizations and Oil Handling Facilities Regulations
- Safe Working Practices Regulations
- Safety Management Regulations
- Ship Station Radio Regulations

- Ship Station Technical Regulations
- Ships' Tonnage Survey and Measurement Fees Regulations
- Shipping Casualties Reporting Regulations
- Shipping Inquiries and Investigations Rules
- Ships' Crews Food and Catering Regulations
- Ships' Elevator Regulations
- Steering Appliances and Equipment Regulations
- Tackle Regulations
- Vessel Traffic Services Zones Regulations; and
- VHF Radiotelephone Practices and Procedures Regulations.

## 1.3 BAFFINLAND'S COMMITMENTS

Baffinland is committed to providing the necessary human, material and financial resources to implement and maintain its Health, Safety and Environment Management System. Baffinland's Sustainable Development Policy is presented below.

## SUSTAINABLE DEVELOPMENT POLICY

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

Everything we do is underpinned by our responsibility to protect the environment, to operate safely and fiscally responsibly and with utmost respect for the cultural values and legal rights of Inuit. We expect each and every employee, contractor, and visitor to demonstrate courageous leadership in personally committing to this policy through their actions. The Sustainable Development and Human Rights Policy is communicated to the public, all employees and contractors and it will be reviewed and revised as necessary on a regular basis. These four pillars form the foundation of our corporate responsibility strategy:

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

# 1.0 HEALTH AND SAFETY

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

# 2.0 ENVIRONMENT

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

# 3.0 UPHOLDING HUMAN RIGHTS OF STAKEHOLDERS

- We respect human rights, the dignity of others and the diversity in our workforce. Baffinland honours and respects the unique cultural values and traditions of Inuit.
- Baffinland does not tolerate discrimination against individuals on the basis of race, colour, gender, religion, political opinion, nationality or social origin, or harassment of individuals freely employed.
- Baffinland contributes to the social, cultural and economic development of sustainable communities in the North Baffin Region.
- We honour our commitments by being sensitive to local needs and priorities through engagement with local communities, governments, employees and the public. We work in active partnership to create a shared understanding of relevant social, economic and environmental issues, and take their views into consideration when making decisions.
- We expect our employees and contractors, as well as community members, to bring human rights concerns to our attention through our external grievance mechanism and internal human resources channels. Baffinland is committed to engaging with our communities of interest on our human rights impacts and to reporting on our performance.

# 4.0 TRANSPARENT GOVERNANCE

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

## 4.1 FURTHER INFORMATION

Please refer to the following policies and documents for more information on Baffinland's commitment to operating in an environmentally and socially responsible manner:

Health, Safety and Environment Policy
Workplace Conduct Policy
Inuktitut in the Workplace Policy
Site Access Policy
Hunting and Fishing (Harvesting) Policy
Annual Report to Nunavut Impact Review Board
ArcelorMittal Canada Sustainability and Corporate Responsibility Report

If you have questions about Baffinland's commitment to upholding human rights, please direct them to contact@baffinland.com.

Brian Penney
Chief Executive Officer
March 2016

## 1.4 MARINE ENVIRONMENT WORKING GROUP

Baffinland has cooperated with government regulatory and resource management agencies to establish a Marine Environment Working Group (MEWG). The group comprises membership from Environment Canada, Fisheries and Oceans Canada, Parks Canada, the Government of Nunavut, the Qikiqtani Inuit Association, and Makivik Corporation. Liaison is maintained with the Mittimatilik Hunters and Trappers Organization through their participation on the interim Pond Inlet Community Advisory Group. Baffinland chairs the group and the membership shares in the provision of administrative support and facilitation services.

The MEWG consults with and provides advice to Baffinland 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. Rather, the MEWG serves 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. The MEWG attempts to meet twice a year, pre- and post-field season.

Revisions to the SMWMP will be circulated to the MEWG for review and comment as appropriate.

## 1.5 RELATIONSHIP TO OTHER MANAGEMENT PLANS

This plan should be viewed in concert with the following additional plans that have been prepared for the Project:

- Environmental Protection Plan (EPP);
- Emergency and Spill Response Plans (Spill at Sea Response Plan; Fuel Storage Facility Oil Pollution Emergency Plan – Milne Inlet and Steensby Port);
- Marine Environmental Effects Monitoring Plan; and
- Interim Closure and Reclamation Plan.

## 1.6 MANAGEMENT PLAN REVISION

The Shipping and Marine Wildlife Management Plan will be updated as required on the basis of management reviews (as outlined in Section 5), incident investigations, regulatory changes or other Project related changes.

# 2 TARGETED VALUED ECOSYSTEM COMPONENTS

Valued Ecosystem Components (VECs) are defined as aspects of the biophysical environment considered to be "of vital importance to a particular region or community" (NIRB 2009).

The following VECs, as identified in the Baffinland Iron Mines Inc. Environmental Impact Statement for the Mary River Project, can be expected to interact with the shipping activities associated with the Project. Each is listed below with a brief comment on the nature of the anticipated interaction:

**Culture, Resources and Land Use**

Vessel traffic through landfast ice, as well as port traffic associated with construction and operation, have the potential to interact with resource harvesting and travel patterns.

**Air Quality, Noise and Vibration**

Vessel machinery, including the main engines will discharge exhaust gas to the atmosphere. Cargo transfer, especially of iron ore will release some quantities of dust to the atmosphere.

Vessel machinery as well as the movement of the vessel through water and ice will create noise and vibration that will propagate through the atmosphere as well as through the water.

**Sea Ice**

The distribution of sea ice and its relationship to open water plays an important role in determining the distribution, movement patterns, and abundance of marine biota, ranging from microalgae and associated secondary producers, through to foraging fish such as Arctic cod. The distribution of marine mammal species such as the Atlantic walrus or of seabird breeding colonies is largely determined by the presence of annually recurring polynyas, shore flaw and lead systems that occur in the sea ice. Polynyas and shore lead systems may be caused by wind, tidal fluctuations, currents, up-wellings, or a combination of those factors and, along with ice edges in general, are characterized as sites of increased biological activity. In addition, stable areas of landfast ice provide both whelping habitat for seal species as well as important hunting areas for Inuit. Vessel transits during the period of marine ice cover have the potential to affect ice through delay in ice formation, acceleration of break-up, and changes on pan size of pack ice.

**Marine Environment (water and sediment quality)**

Vessel discharges (sewage, solid waste, ballast water) have the potential to alter water and sediment quality.

**Marine Habitat and Biota**

Project activities with the potential to affect marine habitat and biota include habitat loss due to the placement of Project footprints in the marine environment (i.e., permanent infrastructure) and physical habitat alteration through phenomena such as dust deposition or re-suspension of sediments due to prop wash from ships.

Project-related changes in water and/or sediment quality have the potential to affect the health and condition of marine biota, especially Arctic char.

**Marine Environment (wildlife and habitat)**

Of the twenty-two marine mammal species known or expected to occur along the proposed shipping routes into Steensby and Milne inlets and along the proposed shipping routes in Baffin Bay and Davis Strait, seven were selected as indicator species in the EIS: ringed seal (*Pusa hispida*), bearded seal *(Erignathus barbatus*), walrus (*Odobenus rosmarus*), beluga whale (*Delphinapterus leucas*), narwhal (*Monodon monoceros*), bowhead whale (*Balaena mysticetus*), and polar bear (*Ursus maritimus*). With the exception of one population of beluga whales (Ungava Bay population listed as 'Endangered' and perhaps extirpated), all populations of cetaceans selected as indicator species are listed as a species of 'Special Concern' by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC); polar bear and walrus are also listed as 'Special Concern'. Ringed seals are currently listed as 'Not At Risk' by COSEWIC while bearded seals have not been reviewed by COSEWIC. The Polar bear is the only marine mammal indicator species currently listed on the *Species at Risk Act* (*SARA*) with a status of "*special concern*".

Vessel discharges (sewage, solid waste, ballast water), the sight of the vessels and their movement, vessel noise and vibration, vessel wakes as well as accidental spills and releases have the potential to interact with marine wildlife and habitat with resulting effects on life cycle activities. Collisions have the potential to induce direct mortalities.

**Birds**

Marine bird Indicator Species are snow geese (*Chen caerulescens*), common (*Somateria mollissima*) and king (*Somateria spectabilis*) eiders, and red-throated loons (*Gavia stellata*) (AMEC 2010).

Vessel discharges (air emissions, sewage, solid waste, ballast water), the sight of the vessels and their movement, wakes and shoreline wash, as well as vessel noise and vibration have the potential to interact with birds and affect life cycle activities. Accidental spills and releases, especially of hydrocarbons have the potential to induce direct mortalities.

# 3 SHIPPING

Figures 2, 3 and 4 show the shipping routes associated with the Mary River Project. These routes have been established based on safe navigation, as well as environmental factors.

All iron ore carriers engaged with Baffinland will comply with current Canadian and applicable international legislation. Canada is a signatory to the International Maritime Organization (IMO) agreements and it follows that foreign vessels certified as being IMO compliant will meet Canadian Standards.

In order to ensure that all tonnage chartered for operation in Milne Inlet and Steensby Inlet is in compliance with the Baffinland Shipping and Marine Wildlife Management Plan, each vessel considered for the work will receive a limited audit of their condition, certification and operation of their International Safety Management System (ISM) prior to being placed on charter. All vessels which utilize the Milne Inlet Port and the Steensby Port must comply with Baffinland environment, health and safety policies and general site rules while at the Terminal. Appendix A presents a description of the proposed icebreaker-capable vessels that will be custom-built and dedicated to the Project.

## 3.1 CHARTER VESSEL SPECIFICATIONS

Baffinland has established a protocol for selecting chartered iron ore carriers. The standard is identical to the specifications for dedicated iron ore carriers and includes the requirement to have appropriate ice class, Canadian Arctic class (or equivalent) and familiarity with AIRSS to operate in the ice conditions forecast to be encountered during the projected periods of the voyages into Milne Inlet and Steensby Inlet.

An Ice Information Contractor will be engaged to forecast ice condition at the time of the vessel's planned loading and will advise what, if any, ice class is required.

The protocol and specification for chartered iron ore carriers is included in Appendix B.

### 3.1.1 PRE-CHARTER AUDIT/INSPECTION OF IRON ORE CARRIERS

All foreign-registered ships entering Canadian ports are liable to be inspected by Transport Canada to ensure compliance with the regulations and to confirm that the ships are safe for their crew and the environment when they proceed to sea. All of the major shipping countries have similar port state inspections. Ships failing to pass inspection can be held until they have been repaired and achieve compliance.

Baffinland will arrange for each candidate vessel (foreign and domestic) to be assessed before being placed on charter, to ensure that the vessel is capable of operating in the ice conditions that are forecast for Milne Inlet and Steensby Inlet during the period of operation. Appendix C provides a copy of the Baffinland pre-charter bulk carrier ice capability assessment. In order to ensure that the chartered vessel can load and carry the iron ores safely and efficiently, vessels that meet the required criteria for navigating in the forecast ice conditions will undergo a limited audit to ensure conformance with the ISM system before the vessel is chartered. This limited audit will be an adaptation of the ISM internal audit and the ship inspection will follow the Transport Canada port state inspection format. A copy of the Baffinland pre-charter bulk carrier inspection checklist and limited audit is provided in Appendix D.

## 3.2 CONSTRUCTION SHIPPING

During Early Revenue Phase construction, containerized equipment and materials will be shipped to Milne Inlet. During the main project construction, equipment and material will also be shipped to Steensby Port Site. Personnel, equipment and materials will also be flown into the Mine Site airstrip. Items bound for the Mine Site will be shipped to Milne Inlet during open water (August to early October) and then transported over the Milne Inlet Tote Road year-round, with possible short interruptions during storms and when driving conditions are unsafe. A floating dock at Milne Inlet and a temporary dock at Steensby Port will be constructed to facilitate rapid off-loading of ships delivering supplies other than fuel. The floating dock at Milne Inlet will continue to be used during operation.

Neither cargo, tankers nor ore vessels will be serviced at either Milne Inlet or Steensby Port Site.

Fuel (diesel, gasoline and jet fuel) will be delivered to both port locations by tankers which will be off-loaded into holding tanks using the commonly-employed floating hose fuel transfer method. Both ports will have a Transport Canada approved OPEP which will be reviewed and resubmitted annually. Milne Port OPEP (SD-ERP-002) is provided in the Final Environmental Impact Statement for the Mary River Project (see Volume 10, Appendix 10C-2 and Steensby Port OPEP (SD-ERP-003) is in Volume 10 Appendix 10C-3.

The potential for accidental releases during ship-to-land transfer has been identified as a risk and, consistent with prudent practice, the shipping contractor will establish appropriate loading and off-loading procedures using guidance from legislation such as the *Arctic Waters Pollution Prevention Act, Arctic Shipping Pollution Prevention Regulation, and the Regulation for the Prevention of Pollution from Ships and Dangerous Chemicals* to prevent or quickly contain any spills or releases of fuel during ship-to-land transfers. Port contingency and vessel-specific response plans will be developed to address issues relating to:

- Appropriate fuel intake devices that prevent overflows.
- Spill fuel collection and recycling or destruction facilities, where applicable.
- Infiltration and other devices including porous pavement, soak-away pits or dry wells, seepage or infiltration trenches, percolation basins, catch basins, to contain spills.

At Milne Port in 2011, the approved five (5) million litre fuel tank for P-50 diesel was constructed along with an ancillary fuel transfer module and an engineered lined storage containment area. The 5 million litre tank was commissioned in 2012 and all diesel fuel was transferred from the bladders in the existing bulk fuel storage facility in Milne Port to the new tank via tanker trucks. In 2013, additional fuel storage and distribution infrastructure were installed at Milne Port within an engineered, lined secure containment system, including one (1) x 5 ML P-50 diesel fuel steel tank two (2) x 12ML P-50 steel fuel tanks, and three (3) x 750,000L Jet-A steel fuel tanks. In 2014 the 3rd approved 12ML P-50 steel tank was constructed within the same containment structure. The Milne Port site bladder bulk fuel storage facility was decommissioning in 2013.

To facilitate bulk fuel deliveries, a land-based permanent fuel tank farm will also be constructed at Steensby Port Site.

## 3.3 OPERATIONS SHIPPING

During the Operations Phase, dedicated voyages to re-supply materials and equipment will travel to Milne Port (and once constructed – to Steensby Port) during the open water season using ships of the type currently used to support the Mary River Project and other northern sealift operations. Fuel will be delivered by sealift tankers during the open water season.

Current operation of the Early Revenue Phase requires chartering market vessels to transport ore during the open water season, as permitted. The longer-term economic viability of the Baffinland Project requires the constant supply of iron ore to customers, and therefore delivery of iron ore to market must occur on a 12 month-per-year basis. Iron ore will be shipped from the two ports, (Steensby Port Site and Milne Inlet using the routes presented in Figure 2, 3 and 4. The ore carriers will maintain a digital record of their travel routes within the RSA. Baffinland will compile this information for each vessel and submit a report to Environment Canada annually.

Baffinland has engaged Fednav, a Canadian ship owner and operator, to assist with meeting shipping operations requirements.

The dedicated fleet of icebreaking cape-size ore carriers will transport most of the ore to market supplemented by the use of ships chartered on the open market during the open water season, and operating from Milne Port as well as Steensby Port. The ships will operate in accordance with two primary legal instruments regulating ship traffic in the Canadian Arctic: the *Canada Shipping Act*, and the *Arctic Waters Pollution Prevention Act*, and their associated regulations.

During vessel transits, there may be a requirement for vessels to moor off while awaiting access to the port facilities. In the Project Environmental Impact Statement (and Addendum) potential locations were identified for areas proximate to the port sites. Baffinland has consulted 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 th e shipping routes within the Nunavut Settlement area. Feedback received from community consultations have, and will continue to be, incorporated into the SMWMP.

Vessel docking will be assisted in the ice-free period by harbour tugs and lines personnel on the docks. Traditionally, Fednav has operated ice-breaking bulk carriers in Canada's Arctic for several decades without the assistance of tugs or ice breakers. Consideration is being given to chartering one or more ice management vessels in the first year of operation, to evaluate whether these support vessels improve ice management at the ore dock. In addition, two to four ice-capable harbour tugs will be available to assist in manoeuvring at dockside.

**FIGURE 2 SHIPPING ROUTES THROUGH HUDSON STRAIT, MARY RIVER PROJECT**

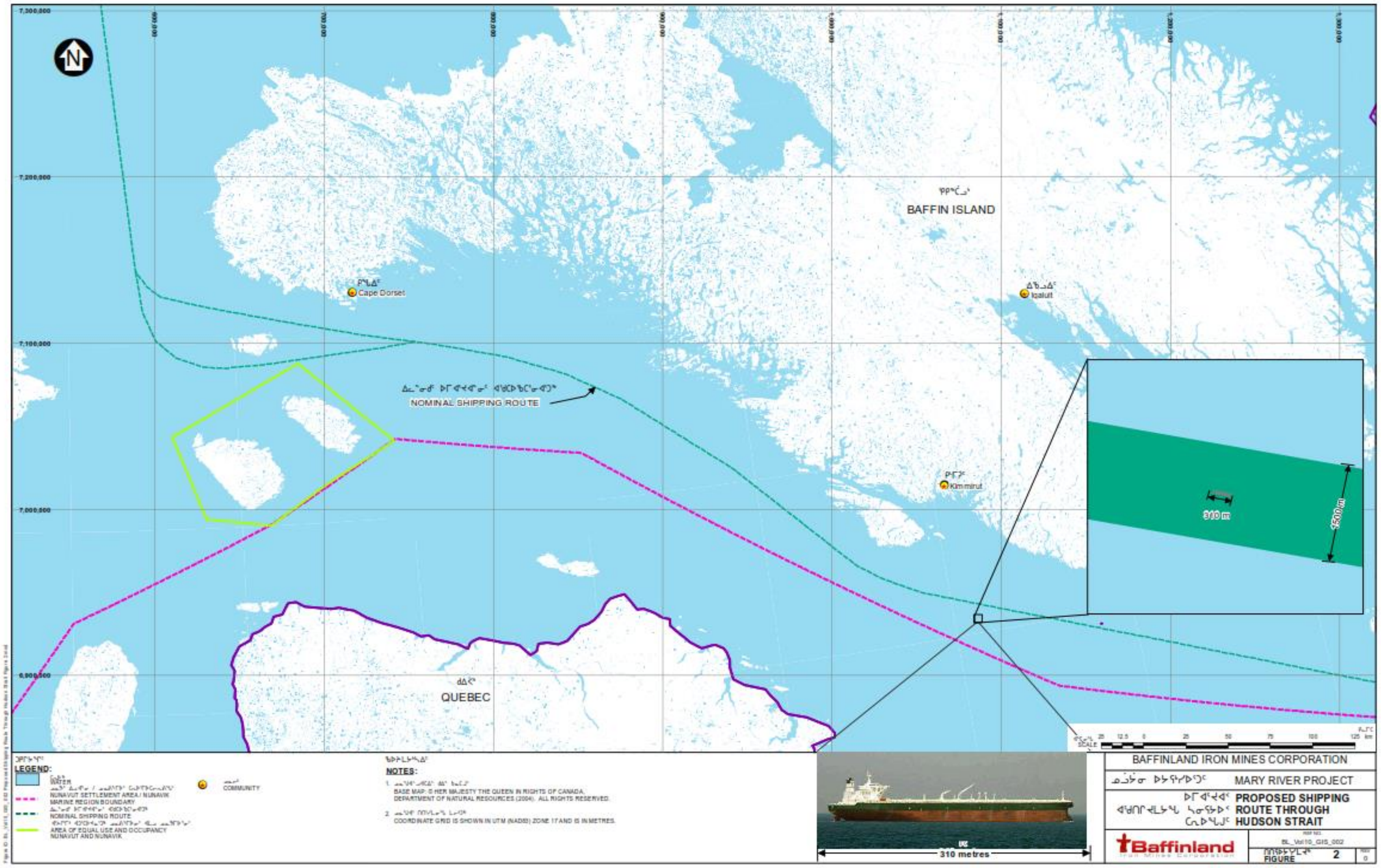


**FIGURE 3 SHIPPING ROUTE THROUGH FOXE BASIN, MARY RIVER PROJECT**

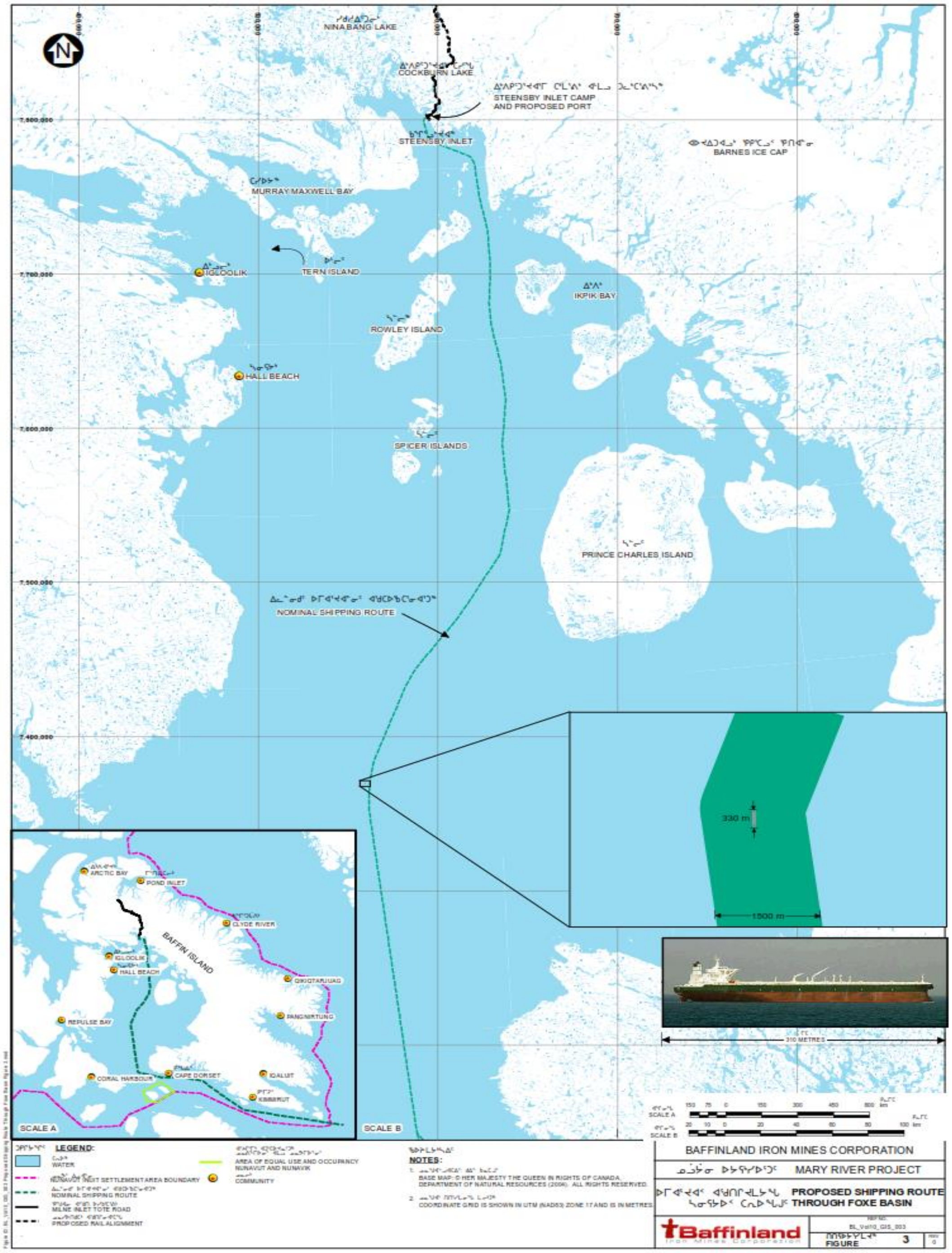
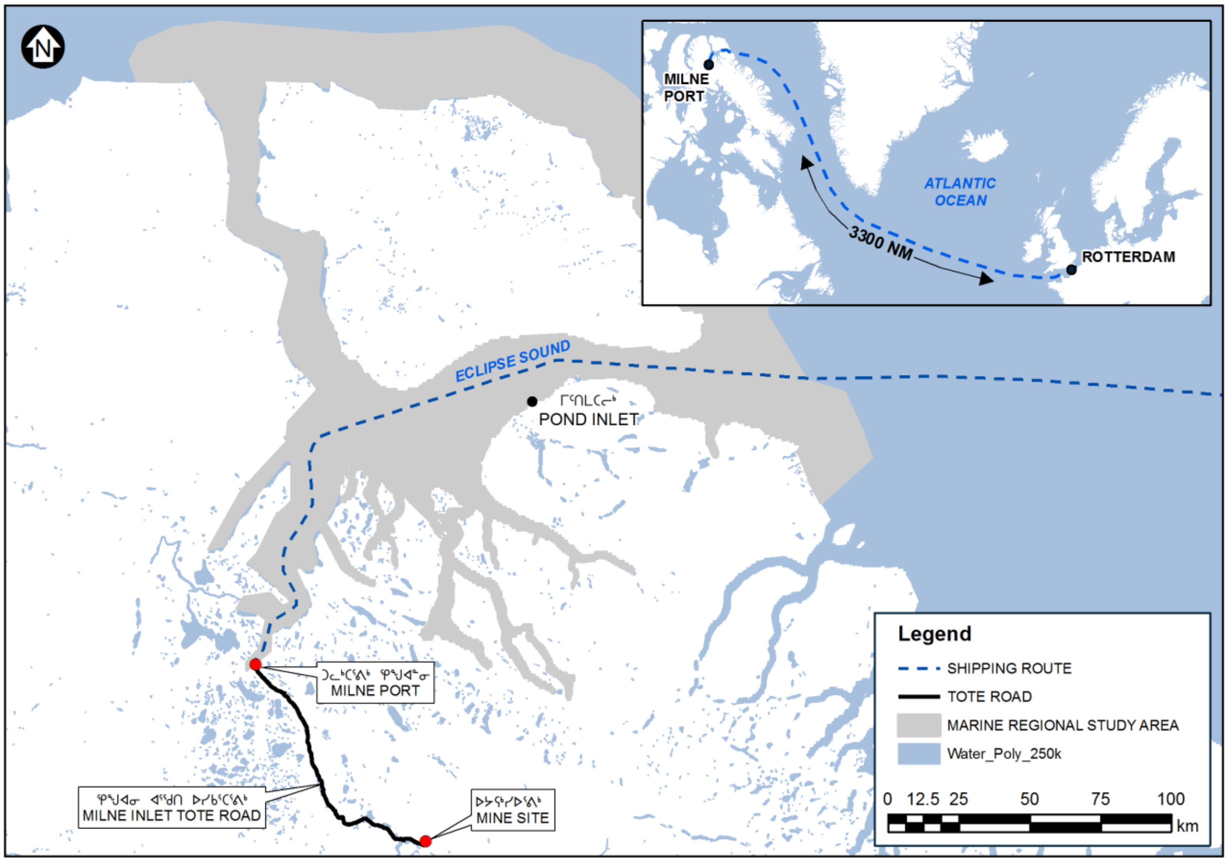



**FIGURE 4 SHIPPING ROUTE THROUGH MILNE INLET, ECLIPSE SOUND AND POND INLET, MARY RIVER PROJECT**




### 3.3.1 SHIP LOADING AND UNLOADING

Ships loaded with equipment and supplies for a full year of Project operation are docked at the Milne Port floating freight dock and unloaded (either directly or via lightering barges) during the open water season. Goods are stored in Milne Inlet laydown areas for transfer to vehicles that transport the goods to the Mine Site along the Tote Road. Most goods are transported in containers that will limit spills and facilitate transfer from ship to shore and transport to the Mine Site. Fuel is transported in tankers and offloaded from the moored vessel by means of floating hoses.

Fuel for shipping is to be purchased only from accredited suppliers that can provide assurance that the fuel used for shipping conforms to Canadian regulations (*Benzene in Gasoline Regulations, 1997; Contaminated Fuels Regulations, 1991; Gasoline Regulations, 1990; Fuel Information Regulations, No. 1, 1999; Sulphur in Diesel Fuel Regulations, 2002; Sulphur in Gasoline Regulations, 1999*).

Lump and fine ore stockpiles will be loaded on two 3,500 t/h shiploaders through mobile equipment (front-end loaders) and a conveyor. Ore Ships will dock at the Ore Dock and load at a maximum capacity of 3,000 to 5,000 tonnes per hour with minimal trimming of the cargoes. The shiploaders will operate at an average rate of 2,000 to 2,500 tonnes/hr for 20 hours per day providing a daily capacity of 40,000 to 50,000 tonnes depending upon the ship being loaded.

After each shipping season has been concluded, the barges at Milne Inlet are moved to shore or to a safe designated area until the start of the following year's shipping season.

### 3.3.2 SCHEDULE

Once Milne Port is in full operation, annual ore shipments will reach 4.2 million tonnes. Ultimately the Project will require the transportation of approximately 22.2 million tonnes of iron ore per annum from the two ports. Seasonal shipping operations at Milne Port will employ a fleet of 18 to 28 vessels.

The ice-free period in Milne Inlet typically extends from July 15 to 20 through October 15 to 20. During this period each year iron ore will be shipping using Supramax (Ice class 1C) (~55,000 dwt), Panamax (~70 000 dwt) and Post Panamax at approximately 110,000dwt. Of the 90 day shipping window at Milne Inlet, allowance has been made for time lost, so that a conservative assumption is that shipping can rely on 70 effective ship loading days during the ice-free period. A range of 40 to 45 shiploads will be scheduled during this period. Ships will arrive every second day, with each arrival scheduled to coincide with the completion of loading of the previous ship. Each round trip of a ship from Milne Inlet to a port in Europe is estimated to take 25 to 27 days at an average speed of 14 knots. The vessels will travel at a speed of 7 – 10 knots when transiting through Eclipse Sound and Milne Inlet.

### 3.3.3 SAFETY

The safety of the ship, her crew and the environment is a primary concern of Baffinland who recognize that the waters in which the ore carriers and other support vessels operate are subject to severe storms, icebergs, pack ice and land-fast ice throughout a large part of each year. Baffinland requires that the ship-owner/operator of the candidate ships and other ships will have as priorities safety of life, protection of the environment, and the preservation of ship and cargo.

As an important safety measure Baffinland prohibits Project employees, while actively employed on the Site, from recreational boating, fishing, or harvesting of marine wildlife within the Project area. This area includes Milne Inlet and Steensby Inlet.

While Baffinland and the ship's managers wish to obtain the maximum efficiency in all of the company's chartered ship operations, it is recognized that the Master of a ship has sole responsibility for the safety of the ship, crew and cargo, and the protection of the environment. The Master has the authority to adjust speed, heave to, deviate, seek shelter or enter a port of refuge to re-stow cargo or seek medical assistance should environmental conditions or the condition of the vessel, the machinery, safety of the crew or cargo require such a precaution. Under such circumstances the Master shall immediately report the circumstances and his intentions to the charterer and the ship manager's "Designated Person Ashore" and maintain a full record of the event and actions taken to secure the safety of the ship.

Baffinland requires that candidate ship-owner/operators have a safety and operating management system based on the principles of the International Safety Management Code (ISM Code). The objective of the ISM Code is to ensure safety at sea, prevention of human loss of life or injury and avoidance of marine environment pollution. To achieve this objective, the Code requires that the ship-owner/operator share fully with the vessel personnel the responsibility to maintain a safe ship. The Code establishes a clear and concise safety management system, including, as examples, the following functional requirements:

**A safety and environmental protection policy.** By considering the nature of the waters that vessels are to travel within, standards of watch keeping are reinforced with additional lookouts on the bridge and engineers in the machinery space. The manoeuvring ability of machinery and the operation of steering gear are tested prior to arrival or departing in a passage where navigation is restricted or where the route is close to shore. Strict measures regarding the handling and transfer of bunker and cargoes are established. Masters will be required to navigate within established channels.

**Levels of authority and lines of communication defined.** This ensures that safety remains a high priority and that the lines of communication between shore and ship personnel remain open. Responsibilities are clearly defined and contacts to provide the ship with round the clock shore support are mandatory.

**Procedures for reporting accidents and non-conformities with the Code.** The method of recording non-conformities, establishing corrective measures, and ensuring open dialogue between all parties is to be documented and reviewed.

**Procedures to prepare for and respond to emergency situations.** Ships must have a set of operating manuals that supplement and support regulatory requirements and vendor instructions. These manuals evolve from standard practices and procedures, and they are to be tailored to individual ships. The objective is to document and provide guidance and instruction on the safe handling and operation of all shipboard equipment. Clear instruction is provided with regard to pre-arrival and departure check lists, navigation, handling of cargoes, bunkering, stability conditions, and the stresses imposed and acceptable to each concentrate carrier. The manuals are a concise guide for both ship and shore personnel to ensure safe operation, with emergencies considered and responses planned.

In addition, ship and shore personnel engaged in operations must be aware of hazards arising from cargo operations and from the materials and iron ores being handled. This includes the provision of Material Safety Data Sheets (MSDS) information and any additional training required.

### 3.3.4 NAVIGATION

All vessels entering Canadian ports, whether Canadian or foreign registered, are required to carry charts and marine publications as set out in the Canadian Charts and Nautical Publications Regulations 1995.

**Note 1:** Details of Canadian routes and reporting requirements are set out in the Annual Notice to Mariners which is normally re-issued every April.

**Note 2:** In order to maintain the above listed items corrected up-to-date, the vessel must obtain copies of the Weekly Notices to Mariners.

While adequate charts exist to support shipping to Steensby Port and Milne Port, supplemental information will improve navigability, in terms of identification of candidate mooring areas, and marine hazards that may occur outside the shipping route, but may not be charted. For these reasons, Baffinland has contracted for the production of marine charts for the approaches to both Steensby and Milne inlets. In 2014, the Canadian Hydrographic Service entered into an agreement with Baffinland for the collection of supplemental information along the shipping route to Milne Port.

In 2014, Baffinland established a temporary tidal gauge in Milne Inlet. The gauge served to provide a baseline for ongoing bathymetric surveys being carried out in the area. Upon completion of the construction of an Ore Dock at Milne Port (2015) a permanent tide gauge will be installed and tied to a surveyed location. This gauge will server to monitor the relative sea levels and storm surges at Milne Inlet.

#### 3.3.4.1 ICE NAVIGATION

Enfotec Technical Services, the ice navigation consulting arm of Fednav, conducted an ice and marine shipping assessment in support of the Project (Enfotec 2010). This assessment provided a description of the ice conditions that occurred along the access route to potential port sites for the Mary's River iron ore Project at Milne Inlet, Nanasivik, East of Baffin Island (collectively the North Baffin Sites) and Steensby Inlet, Nunavut. The study included a detailed analysis of the series of winter ice atlases of the region compiled by the Canadian Ice Service since 1990, as well as numerous satellite images, to delineate areas of old ice concentration, ridged and pressured ice, as well as shear zone locations. The ice study supported the preference for Steensby Port Site as a year-round destination, defined the proposed shipping lanes, and determined the appropriate ice class of the proposed vessels for each candidate route.

Ice conditions along the Northern shipping route to Milne Inlet (extracted from Enfotec 2010) are as follows:

- Freeze-up occurs rapidly in access channels to Milne Inlet in early October as new/young ice spreads south-eastward from Lancaster Sound and northern Baffin Bay.
- Old ice covers the eastern entrance to Pond Inlet by early November.
- The development of typical winter conditions for access to Milne Inlet occurs by mid-December. Pressure ridges can begin to form along the Baffin coast at this time.
- Landfast ice in Pond Inlet, Eclipse Sound and Milne Inlet can be ridged and comprise 3/10 to 6/10 old ice concentrations
- Melting of landfast ice starts in late June in Milne Inlet.
- Fracturing and clearing of landfast ice in Eclipse Sound and Pond Inlet occurs during July. A cool summer may delay fracturing of ice until mid-August.

Ice conditions along the Southern shipping route (extracted from Enfotec 2010) are as follows:

- The waterway in the access to the proposed Steensby Port Site develops land-fast ice each winter. The southern anchor of the shore fast ice reaches Koch Island. The boundary between the land-fast ice and the mobile pack ice of the northern Foxe Basin represents a diverging ice edge over the winter with the result that an open water lead is usually present off the fast ice edge. The additional benefit of this diverging condition is that no shear ridge occurs along the landfast ice edge in winter. There is an average of 35 nautical miles of landfast ice leading to the Steensby Port Site.

- The closest ice thickness measurement station to Steensby Port Site is located to the southwest at Hall Beach. Measurements at this station have recorded average ice thickness at the end of the winter's growth of 192 cm with extremes of over 250 cm. These thicknesses average 5% to 10% more than those recorded at Pond Inlet. The landfast ice is very level with few ridges or leads and there is no possibility that old ice can become entrained in the landfast ice as can be the case in Eclipse Sound.
- The first sign of the spring break-up is the widening of the leads found in northern Foxe Basin and along the south coast of Baffin Island during the month of April and May as solar radiation increases in the region.
- Ice reduction is slow and gradual during the months of June and July as Hudson Strait clears of sea ice and the ice edge in the Foxe Basin retreats northward.
- The landfast ice of Steensby Port Site starts to fracture in late June along the southern portions and progresses to complete fracture of the Inlet by the fourth week of July.
- The pack ice of the Foxe Basin continues to reduce during the months of August and September as strips and patches of ice in the basin gradually melt. In rare cool summers some of this remnant pack ice will remain in the Foxe Basin to become second year ice by October 1.
- Sea ice can commonly occur in the access channels up until the month of September before clearing. The incidence of first year ice surviving the summer's melt has reduced in recent years and now only occurs approximately in 10% of summers.
- Freeze-up starts in late October with new/young ice expanding southward from northern Foxe Basin and extending eastward through Hudson Strait by December.

## 3.4 INSURANCE AND COMPENSATION

### 3.4.1 INSURANCE

The ship owner is responsible for insuring the ship hull and machinery. Baffinland requires each owner to have in place cargo insurance to satisfy the carrier's responsibilities under the *Canadian Carriage of Goods by Water Act.* In addition there is a requirement for the vessels to have standard Protection and Indemnity insurance covering third party claims, including pollution cover, to satisfy the requirements for clean-up, civil liberty and compensation for pollution as required under Part XVI of the *Canada Shipping Act.*

### 3.4.2 COMPENSATION

The *Canada Shipping Act*, under Part XVI provides the authority and the legislative process for addressing Civil Liability and Compensation for Pollution. This section is in compliance with the *International Convention on Civil Liability for Oil Pollution Damage*, concluded in Brussels on November 29, 1669 and as amended by any protocol that is in force for Canada.

The Civil Liability and Compensation section of the *Canada Shipping Act* establishes the responsibility and procedures for polluters to compensate affected parties for liabilities. It further provides for and requires the ship owner to provide a guarantor under a contract of liability insurance or other similar security relating to a ship owner's liability under the *Canada Shipping Act.*

Section 702 of the Act provides the authority to establish the Canadian Ship-source Oil Pollution Fund. In addition, Canada supports the *"Fund Convention"* meaning the *International Convention on the Establishment of an International Fund for Compensation for Oil* concluded in Brussels on December 18, 1971, and the Protocol concluded in London on November 19, 1976.

*The Canada Shipping Act* through Part XVI establishes the liability of the ship owner for pollution. Section 677 (1) states that the Owner of the ship is liable for the following:

- For oil pollution damage from the ship.
- For costs and expenses incurred by:
    - The Minister of Fisheries and Oceans.
    - A response organization to whom a certificate of designation has been issued pursuant to subsection 660.4(1).
    - Any other person in Canada.
    - Any person in a state, other than Canada, that is a party to the Civil Liability Convention. In respect of measures taken to prevent, repair, remedy or reduce oil pollution damage from the ship, including measures taken in anticipation of a discharge of oil from the ship, to; or
    - The extent that the measures taken and the costs and expenses are responsible, and for any loss or damage caused by such measures; and
- For costs and expenses incurred:
    - By the Minister of Fisheries and Oceans in respect of Measures taken to pursuant to paragraph 678(1) (a) in respect of an monitoring, or in relation to the direction of the taking measures or their prohibition, pursuant to paragraph 678 (1) (b) or (c), or
    - By any other person in respect of measures the person was directed to take, or prohibited from taking, pursuant to paragraph 678 (1) (b) or (c), to the extent that the measures taken and the costs and expenses are reasonable, and for any loss or damage caused by such measures.

Under the Act, the Minister is provided with the authority to take necessary measures, as the Minister deems appropriate. Section 678 (1) states that where the Minister believes on reasonable grounds that a ship has discharged, is discharging or is likely to discharge a pollutant, the Minister may:

- Take such measures as the Minister deems necessary to repair, remedy, reduce or prevent pollution damage from that ship, including the removal or destruction of the ship and its contents, and may sell or otherwise dispose of the ship and its contents.
- Monitor the measures taken by any person to repair, remedy, reduce or prevent pollution damage from the ship; or

- Where the Minister considers it necessary to do so, direct any person to take measures referred to in paragraph (b), or prohibit any person from taking such measures.

Baffinland will continue to develop policies that will provide safe operations and all events will be planned with the intent of reducing, to the greatest degree possible, accidental discharges.

### 3.4.3 IDENTIFICATION OF THIRD PARTY LIABILITIES

Section 712 of Part XVI of the *Canada Shipping Act* provides the instrument for claims for loss of income due to a pollution event for:

- An individual who derives income from:
  - Fishing
  - The production, breeding holding or rearing of fish; or
  - The culture or harvesting or marine plants.
- The owner of a fishing vessel who derives income from the rental of fishing vessels to holders of commercial fishing licenses issued in Canada.
- An individual who derives income from the handling of fish on shore in Canada directly after the landing thereof from fishing vessels.
- A person who fishes or hunts for food or animal skins for his own consumption or use .
- A person who rents or charters boats in Canada for sport fishing; or
- A worker in a fish plant in Canada.

A person affected as a, result of a discharge of oil from a ship and whose losses are not recoverable otherwise under any other law, may, within a prescribed time limit, file a claim with the Administrator for past or future loss.

## 3.5 EXPERIENCE OF OTHERS AND LESSONS LEARNED

Appendix A presents a discussion of the experience with winter shipping for two northern Canada mining projects – Voisey's Bay and Raglan. The lessons learned are summarized below>

### 3.5.1 VOISEY'S BAY

In the context of shipping in northern Labrador (Voisey's Bay) the following observations of relevance to this Project can be made:

- As a safety measure the ships track through land-fast ice in areas of other (snowmobile) traffic is clearly marked to ensure it is visible to travellers. Similar markings might be practical for the Mary River Project.
- The provision of "safe crossing" locations across the ships track is reliant on timely track refreeze rates, and this timing is variable given the weather conditions experienced near the Voisey's Bay Project Site.

- In order to deal with the issue of variable timing of ice refreezing, pontoon ice bridges have been successfully developed and deployed, however the mechanics of such an operation would need to be modified to be practical for application in a situation of high frequency marine traffic and a relatively wide ships track (52m vs. 30 m).
- In order to avoid disruption in ice formation and to protect local ringed seal populations during whelping, shipping is suspended during two specified six week periods (December- mid-January during freeze-up and early-April-mid May).
- In order to utilize local aboriginal knowledge, local Inuit Advisor/Monitors are required aboard selected vessels and trips.
- Both VNL and the Inuit have benefitted from the Project. VNL has been able to develop the mine and extract and ship the nickel concentrate to market, economically and efficiently. The Inuit have benefitted through provisions of the IBA, direct employment at Site and through increased opportunities for Inuit businesses and other induced economic benefits.
- Despite various mitigation measures, there is still some concern expressed by residents over the restricting winter travel caused by the presence of the ships track.

### 3.5.2 RAGLAN MINES

In 2002, a site visit to the Raglan Mine was undertaken to gain a better understanding of the effects of winter shipping. The observations made serve as an overview of lessons learned from winter shipping at the Raglan Mine site. A 25 day old ship track was very easy to see from the ice (and from the ship's radar) due to the roughness of the area as compared with the undisturbed landfast ice. The track was also difficult to cross due to the rough surface.

- The ship had little effect on the land-fast ice outside the width of the vessel itself. The MV Arctic can stay within the previous track on each winter passage, so that the disturbed area is little greater than one ship width (approximately 22.5 m). Even though the refrozen ice within the track can be thicker than the surrounding undisturbed land-fast ice, the edges of the track tend to be the thickest areas, so that the vessel tends to stay within these two edges, except when the ship manoeuvres to dock and where it makes a "star" turn on departure.
- The ice left behind the vessel in the track was quite broken up and consisted of a range of about 2 – 3 m sized pans down to "slob" (frazil). The refreeze rate of the track was such that at least twenty-four hours would be required before a snowmobile could cross. The roughness of the track would also impede travel.
- A two- person team from Saluit use ice chisels to knock down the ridges and rough spots to produce a clear path across the ship's track. The "Ice Bridge" signs are placed in chiselled holes on either side of the track.
- In the ice bridge location (where the ship had pushed up the pieces), crossing on foot was possible within 24 hours after the ship had passed by. Once the rough ice has been chiselled, the snowmobiles passed as well.

# 4 PERFORMANCE INDICATORS AND THRESHOLDS

The environmental (including socio-economic) issues related to shipping have been summarized in Section 2.0, organized in terms of Valued Environmental Components (VECs) and the associated Indicators.

Subsequent sections of the Management Plan describe the operations that comprise marine shipping and include the specific actions to be taken with respect to mitigation and monitoring for potential environmental effects. In order to guide day-to-day operation of the shipping activity, the organization structure and associated roles and responsibilities of personnel engaged in shipping are defined, in particular with respect to achieving compliance with the Management Plan.

This section provides, in 1, a listing of the identified environmental issues and concerns associated with Shipping for the Project.

The relevant performance indicator associated with each issue is referenced (e.g., government regulated standard, International Standard or convention, EIS commitment or condition, Company-generated requirement). The applicable threshold(s) for achieving compliance with Baffinland performance standards are stated in as quantifiable manner as possible,

This table will be reviewed and revised on a regular basis and as a consequence of:

- Completion of the Project Environmental Assessment and any amendments to the Environmental Assessment.
- The collection of information from monitoring programs.
- Changes to applicable standards and regulations; and
- Improved Project definition through engineering design and detailed planning.

**TABLE 1: PERFORMANCE INDICATORS AND THRESHOLDS**

| VEC | Concerns/Issues | Indicator | Threshold |
|---|---|---|---|
| **Air Quality** | Ship emissions | Routine maintenance records | Compliance with regulated standards |
| **Marine Wildlife** | Noise and Vibrations | Noise envelope in the water;<br>marine mammal behavioral responses | To be established through EEM program feedback. |
| **Marine Water and Sediment Quality; Marine habitat and Biota; Marine Wildlife; Seabirds** | Onboard ship wastewater treatment | Ship records | Zero discharge at sea |
| | Ship solid waste management | Ship records | Zero discharge at sea |
| | Oily water treatment | Ship records | Zero discharge at sea |
| | Dangerous Goods and HazMat – spills | Ship documentation | Zero discharge at sea |
| | Oil Spill | Ship documentation | Zero discharge<br>*Arctic Waters Pollution Prevention Act*; compliance |
| | Introduction of Invasive species | Ship onboard documentation | Adherence to Ballast Water Management Plan |
| | Coastal erosion, shoreline habitat disruption | Mean water level; wave incursion extent | Exceedance of baseline conditions by a set percentage. |
| | Serious Harm to Productive fish habitat | Habitat Equivalent Units | Adherence to regulator requirements |
| **Land and Resource Use** | Altered travel patterns due to ships track | Information and communication in affected communities<br>Number of complaints related to shipping | To be established through EEM program feedback. |

# 5 ENVIRONMENTAL MANAGEMENT

Baffinland will operate its Health, Safety and Environment Management System in the context of a well-defined Sustainable Development Policy (Section 1.3). The specific environmental management practices to be followed in compliance with this policy are described in this section. Emphasis has been placed on Emergency Preparedness from the perspective of environmental protection. Also included is a description of measures to address Port Security, including smuggling, an activity that could have negative socio-economic effects. As appropriate, applicable external standards and regulatory requirements are cited in the text which follows.

## 5.1 ICE

Measures to ensure the safety of persons traveling by snowmobiles, sledges, and boats along Project shipping routes include the following:

- In order to maintain the integrity of the ice, the ship will follow, to the extent possible, in the ice track broken during the previous passage.
- In selected areas of landfast ice, the route will be marked by reflective poles on either side. This activity will normally be done by contractors working from snowmobiles.
- A well-marked detour will be provided at Steensby Port to enable snowmobile traffic to pass from one side of the ship track to the other.
- Notices (as described above) are provided of each vessel transit to inform others of the route, timing and related matters associated with each ships' passage; and
- During Operations, Public meetings will be held each year to:
  - Consult on the experience of the previous winter shipping season.
  - Identify any opportunities to reduce or avoid travel conflicts; and
  - Discuss plans for the upcoming season.

## 5.2 FISH AND FISH HABITAT PROTECTION

The Fisheries Act includes provisions to protect fish habitat. Baffinland applied for and received on June 30, 2014 A Fisheries Act Authorization (#1) for the infilling of fish habitat in Milne Inlet resulting from the construction of the ore dock and mooring structures. The Authorization identifies:

- measures to avoid and mitigate serious harm to fish;
- monitoring and reporting on these avoidance and mitigation measures;
- measures to provide offset for serious harm to fish habitat; and
- monitoring and reporting on these habitat offset measures.

During 2014 and 2015, Baffinland will implement the identified mitigation measures and the measures to provide habitat offset. The placement of coarse substrate around the perimeter of the ore dock and moorings will serve to provide an adequate quantity of relatively high quality habitat. Monitoring will be carried out over a six year period to confirm the stability of these rock features, and to establish the rate of biological settlement required to confirm use of the new habitat by fish species.

A report on construction monitoring will be completed and submitted to Fisheries and Oceans Canada in 2015.

## 5.3 MARINE WILDLIFE

In Volume 8 of the EIS and the EIS Addendum, specific mitigation measures for each the marine mammal species were discussed. The mitigation measures are summarized below in 2. (Note, any proposed use of acoustic deterrent devices in water {e.g. to direct seals away from blast zone} will be subject to community consultation before implementation).

Additional mitigation measures will be identified and implemented where justified (through monitoring programs) and subject to an assessment of their effectiveness. Potential adaptive management measures that might be considered could include such actions as:

a) Changes in the frequency and timing of shipping during periods of the year when interactions are found to be most problematical;
b) Further reducing shipping speeds; or
c) Identification of alternate routing.

**TABLE 2: MITIGATION MEASURES FOR MARINE MAMMALS**

| Project Activity | Mitigation Measure(s) | Species |
|---|---|---|
| **Construction Phase** | | |
| Dock construction: blasting (Steensby only), drilling (Steensby only), pile driving (Milne only), dredging, and vessel traffic near dock sites | • Docks to be designed to minimize footprint.<br>• Blasting control plan as per DFO blasting guideline (e.g., Wright and Hopky, 1998); meeting 100 kPa overpressure limit.<br>• Monitoring for marine mammals in the blasting safety zone (500 m).<br>• Drilling in late April/early May. Reduce vessel idling at dock site.<br>• Pile driving safety zone for marine mammals (200 m).<br>• Monitoring for marine mammals in the dock construction safety zone daily prior to work commencement.<br>• Noise levels to be determined to confirm compliance with safety zone. | Ringed Seal, Bearded Seal, Walrus, Beluga, Narwhal, Bowhead Whale, Polar Bear |
| | • Bubble curtain system | Ringed Seal, Bearded Seal, Walrus, Beluga, Narwhal, Bowhead Whale |
| | • Blasting in late May to ensure that pupping and nursing periods are avoided.<br>• Active deterrents to prevent seals from entering blast zone. | Ringed Seal, Bearded Seal |
| | • Use of bear monitors for on-ice activities. | Polar bear |
| Vessel traffic to/from Milne and Steensby ports (open-water period) | • Maintain constant speed and course when possible.<br>• Reduce vessel speed.<br>• Reduce vessel idling. Vessel to be designed to limit noise output.<br>• Shipboard Marine Wildlife Observers to be on select vessels to monitor interactions with marine mammals. | Ringed Seal, Bearded Seal, Walrus, Beluga, Narwhal, Bowhead Whale, Polar Bear |
| Aircraft Overflights | • Maintain altitude of 450 m over marine waters when possible.<br>• Aircrafts prohibited from flying over marine mammals for sightseeing or photography. | Ringed Seal, Bearded Seal, Walrus, Beluga, Narwhal, Bowhead Whale, Polar Bear |

**TABLE 2: MITIGATION MEASURES FOR MARINE MAMMAL (Cont'd)**

| Project Activity | Mitigation Measure(s) | Species |
|---|---|---|
| **Operations Phase** | | |
| Aircraft Overflights | • Aircraft prohibited from flying over walrus haulouts for sightseeing or photography.<br>• Walrus haulouts to be identified on maps prior to flights. | Walrus |
| Operation of worker camps | • Educate workers on bear safety.<br>• Work areas to be kept clean of garbage, food scraps and toxic materials.<br>• Use of bear deterrent devices. | Polar Bear |
| Vessel traffic to/from Milne Port | • Maintain constant course and speed when possible.<br>• Reduce vessel idling time at dock.<br>• Vessel to be designed to limit noise output.<br>• Shipboard Marine Wildlife Observers to be on select vessels to monitor interactions with marine mammals | Ringed seal, Bearded Seal, Walrus, Beluga, Narwhal, Bowhead Whale, Polar Bear |
| | • Reduce vessel speed | Ringed Seal, Bearded Seal, Beluga, Narwhal, Bowhead Whale |
| Vessel traffic to/from Steensby Port, including ice management at the dock | • Reduce vessel idling time at dock.<br>• Minimize footprint of ice disturbance at ore dock and along shipping route.<br>• Reduce vessel speed in pack ice and landfast ice.<br>• Shipping lane in landfast ice to be delimited with markers.<br>• Vessel to be designed to limit noise output.<br>• Shipboard Marine Wildlife Observers to be on select vessels to monitor interactions with marine mammals. | Ringed Seal, Bearded Seal, Walrus, Beluga, Narwhal, Bowhead Whale |
| | • Commence ice breaking activity prior to period of lair and breathing hole creation. | Ringed Seal, Bearded Seal |
| | • Maintain constant course and speed when possible. | Ringed Seal, Bearded Seal, Walrus, Beluga, Narwhal, Bowhead Whale, Polar Bear |

**TABLE 2: MITIGATION MEASURES FOR MARINE MAMMAL (Cont'd)**

| Project Activity | Mitigation Measure(s) | Species |
|---|---|---|
| **Closure Phase** | | |
| Aircraft Overflights | • Maintain altitude of 450 m over marine waters when possible.<br>• Aircrafts prohibited from flying over marine mammals for sightseeing or photography. | Ringed Seal, Bearded Seal, Walrus, Beluga, Narwhal, Bowhead Whale, Polar Bear |
| | • Aircraft prohibited from flying over walrus haulouts for sightseeing or photography.<br>• Walrus haulouts to be identified on maps prior to flights. | Walrus |
| Operation of worker camps | • Educate workers on bear safety.<br>• Work areas to be kept clean of garbage, food scraps and toxic materials.<br>• Use of bear deterrent devices. | Polar Bear |
| Vessel traffic: sealift removal of equipment and materials | • Maintain constant speed and course when possible.<br>• Reduce vessel idling.<br>• Vessel to be designed to reduce noise output.<br>• Shipboard Marine Wildlife Observers to be on select vessels to monitor interactions with marine mammals. | Ringed Seal, Bearded Seal, Walrus, Beluga, Narwhal, Bowhead Whale, Polar Bear |
| | • Reduce vessel speed in Milne Inlet. | Ringed Seal, Bearded Seal, Beluga, Narwhal, Bowhead Whale |
| Operation of worker camps | • Educate workers on bear safety; use of bear deterrent devices. | Polar Bear |

## 5.4 ONBOARD WASTE MANAGEMENT

All vessels are to have Waste Management Plans for sewage and solid waste.

### 5.4.1 SEWAGE

All vessels are to be fitted with an approved sewage treatment plant which operates to Canadian standards or a holding tank with sufficient capacity to meet the grey and black water requirements of the ship for the duration of her time in port. A diesel-fired incinerator for incinerating oil waste and sludge from the sewage plant is to be installed in the incinerator room on board. Vessels are not to discharge effluent from treated sewage while at Steensby Port or Milne Port.

### 5.4.2 SOLID WASTE

In accordance with MARPOL and the *Arctic Waters Pollution Prevention Act*, no solid waste materials or garbage will be disposed of in Canadian waters. As no facility exists to dispose of foreign or Canadian ship waste materials or garbage at either Steensby Port Site Terminal or Milne Port, such materials will either be incinerated or retained onboard and later disposed of in accordance with Canadian and International regulations.

## 5.5 INVASIVE SPECIES MANAGEMENT

Ballast is water taken on in chambers of vessels mainly to stabilize sea-going vessels by adding weight to them and maintaining a specified draft (the depth a vessel sits in the water). Vessels empty of cargo take on much more ballast than a fully laden ship. For icebreakers, ballasting is also used to keep the ice draft of the vessels constant and to stabilize the ship, thereby optimizing stresses in different loading conditions.

Fouling is the unwanted growth of biological material such as barnacles and algal on the surface of a hull submersed in water. Vessels not protected by an anti-fouling system may gather up to 150 kg fouling per square meter in less than six months at sea (IMO 2002). Even a small amount of fouling can lead to an increase of 40 to 50 % in fuel consumption. Fouling of vessel also acts as a method by which non-native organisms may enter into new waters.

### 5.5.1 BALLAST WATER MANAGEMENT

In order to reduce or eliminate the risk of invasive aquatic species and pathogens being introduced into Canadian waters as a result of shipping, all ships will exchange ballast water in accordance with the *Ballast Water Control and Management Regulations* (Transport Canada 2006). The regulations require that ships transiting to Canadian ports exchange ballast water at sea in deep water away from coastal zones. This measure limits the potential for foreign harmful aquatic organisms or pathogens to be released in Canadian waters where they may colonize. Baffinland is committed to conducting both a mid ocean exchange and, upon its coming into force, using an IMO and North American (Canadian) Coast Guard approved Ballast Water Treatment System ( BWTS) to treat ballast water. Ballast water will be exchanged in the mid-North Atlantic Ocean, which is part of the same ocean regime as Milne Port and Steensby Port.

The ballast water exchange will occur as per IMO Ballast Water Convention Regulation D-1 and as described in Section 6(1) of the Canadian Ballast Water Control and Management Regulations. The exchanged ballast water will then be treated by the BWTS onboard the vessel during the remainder of the voyage. While the specific BWTS has yet to be chosen, typical system involves a combination of the following techniques:

- Filtration (e.g., wedge wire, weave wire, membranes, hydro cyclones, flocculation and disc filter).
- Mechanical/Physical Mechanism (e.g., cavitation, vacuum, ultraviolet (UV) light, heat, oxygen stripping, and acoustic treatment); and
- Active Substance (e.g., ozone, sea water electrolysis, sea water electrodialysis, electro-dialysis, additives, and catalyst).

Upon arrival at the port, the ships will discharge the treated ballast water to allow for loading the ship with ore. During winter the full ballast is required to assist in ice breaking and so the entire amount of ballast water will be discharged at the ore dock. During summer, the ships may discharge ballast water along the shipping route before arriving at the dock. In such cases only a partial load of ballast will be discharged at the ore dock. Ballast Water Management Plans are specific to individual ships. Appendix E outlines the major elements and requirements of a plan acceptable to Baffinland. Appendix F outlines the IMO Ballast Water Treatment System Approval process.

#### 5.5.1.1 RISK ASSESSMENT

As a component of the Project Environmental Impact Statement and Addendum, Baffinland completed a risk analysis regarding ballast water discharge (See FEIS Addendum Vol 8 Appendix 8B-4). The risk analysis followed a methodology as developed and applied by Fisheries and Oceans Canada. The conclusion of the analysis ranked Milne Inlet (Early Revenue Phase) as “lower” compared to other Arctic and Northern ports. A revised assessment will be completed once additional data have been collected and a newly developed methodology has been finalized by research personnel at Fisheries and Oceans Canada.

#### 5.5.1.2 MONITORING AND SAMPLING

The ballast water monitoring plan will be incorporated into the Environmental Monitoring Program. The goals of the ballast water monitoring plan are to ensure that ballast water management procedures are working properly and to identify any non-native organisms that may be present within the discharged ballast water and waters surrounding the ports. Water chemistry data collected through a separate monitoring program will be incorporated into the results where applicable.

Monitoring and sampling procedures for treated ballast water discharge are to follow IMO Guidelines for Ballast Water Sampling (G2) MEPC.173 (58) and will be integrated into the Project AEEM Program. Monitoring and sampling of ballast water will occur onboard the vessel itself as well as dockside. Sampling onboard the vessel will occur in order to verify that a mid-ocean transfer has occurred. Onboard sampling will also serve to ensure that, once in place, any ballast water treatment systems are fully functional and in compliance. Onboard sampling will occur along the ballast water discharge line in order to capture an accurate representation of the treated ballast water that will be discharged. The sampling locations will be taken into consideration during the design of the vessel and selection of ballast water treatment system.

Sampling protocols are to be strictly followed and in conformance with quality control and assurance standards. To date the IMO does not recommend a specific sampling or analysis protocol. As more information becomes available and testing regimes are developed by manufacturers and nation members of the IMO, the sampling and analysis protocols will be updated to reflect these changes. Due to the fact that concentrations of organisms vary throughout the ballast water, it is recommended that, if possible, sampling should occur at various locations during the ballast water discharge process (Gollasch, 2006). At least two random samples will be conducted during sampling events.

In addition to the analysis of water samples, integrated water samples will be collected for phytoplankton analysis. Plankton net surveys for zooplankton and larval fish will also be conducted and residual sediment in the ballast tanks will be sampled to test for phytoplankton resting stages.

Monitoring and sampling protocols will be designed in consultation with appropriate territorial and federal agencies. In addition to the onboard sampling, control sites within Milne Inlet and Steensby Inlet and impact sites that are anticipated to interact with discharged treated ballast water within each port will be sampled. This program will be implemented as part of AEMP for the Project.

Samples will be analyzed at an accredited laboratory to determine whether the ballast water treatment system is functioning properly. Results will be reported annually.

#### 5.5.2 ANTI-FOULING MANAGEMENT

Baffinland is committed to meeting the IMO International Convention on the Control of Harmful Anti-fouling Systems on Ships. As per Annex I of the convention (and Schedule 6 of the Regulations for the Prevention of Pollution from Ships and for Dangerous Chemicals (2007-86)), the anti-fouling system will

- Not bear organotin compounds on their hulls or external parts or surfaces; or
- Bear a coating that forms a barrier to such compounds leaching from the underlying non-compliant anti-fouling systems.

In order to reduce or eliminate the risk of invasive aquatic species and pathogens being introduced into Canadian waters as a result of fouling of vessels, an anti-fouling system will be in place on all vessels that will arrive and depart from Milne Port and Steensby Port. The anti-fouling systems used have yet to be determined but will comply with the anti-fouling convention as well as be approved under the Pest Management Regulatory Agency of Canada and Regulations for the Prevention of Pollution from Ships and for Dangerous Chemicals (2007-86). This convention prohibits the use of dangerous organotin chemicals in anti-fouling systems. Any anti-fouling system that has a component listed under Annex I of the convention will not be used. The potential anti-fouling systems include:

- Organotin-free polishing type paint
- Organotin-free ablative type paint
- Organotin free conventional type paint
- Biocide-free silicon type paint; and
- Other biocide-free paints.

As the iron ore carriers to be constructed for the Project will exceed 400 gross tonnage, and undertake international voyages, the vessels will require an International Anti-fouling System Certification. Surveys will be conducted on new vessels to verify that the anti-fouling system complies with the IMO convention.

#### 5.5.2.1 ANTI-FOULING SAMPLING

Sampling of the anti-fouling system will follow the Guidelines for Brief Sampling of Anti-fouling Systems on Ships (MEPC.104 (49)). The number of samples taken will be representative of the ship's hull and occur at areas where the anti-fouling system is intact. A minimum of four (4) sample points, equally spaced down the length of the hull will be taken.

Sampling of the anti-fouling system will occur quarterly each year, as well as when the vessels are dry-docked. Sampling will not occur where the anti-fouling coating is visibly damaged or on block mark areas on the flat bottom of the ship (where intact anti-fouling system is not applied). Sampling adjacent to or below areas of damaged anti-fouling coating should also be avoided.

When an appropriate sample point on the hull has been selected, any fouling present should be removed with water and a soft sponge or cloth. Any organisms collected will be delivered to an accredited laboratory for species identification. If the sampling is occurring during dry-dock, sampling should occur after the hull has been water washed.

The number of samples taken at each sample site will allow for a retention quantity for back-up and storage. For dry samples, triplicate specimens of paint at each sampling point should be taken approximately 10 cm from each other. Should more than one type of anti-fouling system be present on the vessels, sampling will be taken from all anti-fouling systems when access is possible.

Samples will be sent to accredited and recognized laboratories meeting the ISO 17025 standard.

## 5.6 FUEL AND DANGEROUS GOODS

As there is a total prohibition in place with respect to the discharge of any oil, oily water or dangerous goods in Arctic waters, all vessels will:

- Comply with the *Oil Pollution Prevention Regulations* and maintain an approved shipboard oil pollution emergency plan (SOPEP).
- Have oil spill clean-up materials available onboard the vessel at all times.

- Conduct exercises with the Terminal staff at regular intervals to ensure ship and shore can co-operate to minimize the damage from any spill of fuel.
- Maintain an up-to-date oil transfer record book covering the disposal of engine room sludge and the discharge of oily water through a separator.
- Maintain a separate record book for oil cargo and the treatment and disposal of cargo slops.
- Provide copies of the Ships' Oil Spill Response Plans to Baffinland.
- Conduct exercises to test the ship and shore joint capability to handle an oil pollution incident in accordance with the provisions of the Ships' Oil Spill Response Plan and the Baffinland Oil Pollution Emergency Plan (OPEP).
- Ensure that all hazardous materials are stored and handled as per information provided in Material Safety Data Sheets (MSDS); and
- Ensure that all dangerous goods are transported as per requirements under the *Transportation of Dangerous Goods Act and Regulations.*

## 5.7 SECURITY

Security issues include both port security and smuggling prevention.

### 5.7.1 PORT SECURITY

Port security is governed by the Port Securities Transportation Act (Transport Canada). The aim of this legislation is to reduce the risk of security threats by preventing unlawful interference with the marine transportation system. This is achieved, in part by conducting background checks on marine workers who perform certain duties or who have access to certain restricted areas.

### 5.7.2 SMUGGLING PREVENTION

Customs and Immigration clearance are required for:

- Foreign registered vessels arriving from or sailing to an overseas destination; and
- Canadian registered vessels arriving from an overseas port.

Measures to prevent smuggling include:

- Bonded lockers are to be locked and sealed by Customs and Immigration officials on the vessel's arrival.
- The Master of each ship will inform crew that no alcohol or tobacco is permitted to be taken ashore.
- Any crew member who, on disembarking the vessel is found to be carrying alcohol or drugs, or is suspected of being under the influence of alcohol or drugs, will be returned onboard the vessel by security staff and will face disciplinary action.

## 5.8 EMERGENCY PREPAREDNESS

Emergency preparedness addresses the several unplanned events that can occur on a Project. The scope includes both measures to prevent these occurrences, as well as preparedness to respond when and if an event occurs. The following discussion relates to the aspects of Emergency Preparedness that have implications for the environment.

### 5.8.1 RISK ASSESSMENT AND MODELLING

As part of the preparation of the Project EIS (and EIS Addendum) Baffinland constructed oil spill scenarios which were employed to complete the effects assessment, and also served to define an appropriate level of emergency preparedness related to spill response. Prior to the commercial shipping of iron ore, additional fuel spill trajectory modeling will be carried out, including consideration of:

- Modeling of oil spills for both the Northern and Southern Shipping Routes in representative locations, identified in consultation with the MEWG.
- Locations to be selected at pinch points, the approaches to each port, shallow water and shoreline areas, areas of high currents, areas where marine life congregate.
- For both open water and ice covered conditions
- For losses up to and including a full tanker cargo
- For applicable types of bulk fuel.

The results of the dispersion modelling exercises will be incorporated into future effects predictions, as well as to improve preparedness planning. Additionally, a risk assessment of Project-related shipping accidents will be completed. The exercise will take into account areas along the shipping route where vessels may be vulnerable to environmental conditions such as sea ice. The exercise will take into account seasonal differences in level of risk.

### 5.8.2 ACCIDENTAL SPILLS OF FUELS AND CHEMICALS

Ships travelling to the Steensby Port Site and Milne Inlet on behalf of the Baffinland Project are required to have prevention and response equipment for accidental spills, and to have in place a Shipboard Oil Pollution Emergency plan (SOPEP) in conformity with the International Maritime Organization (IMO) as approved by the Det Norske Veritas Classification AS on behalf of the Government of Canada. Onboard environmental protection equipment will include containment booms, absorbent pads and oil spill dispersant. Any spills of petroleum or other hazardous materials will also be reported to the Environmental Emergencies 24 Hour Report Line.

Baffinland is working in collaboration with Transport Canada and Canadian Coast Guard to ensure there are sufficient resources in place (both spill response equipment and trained personnel) to provide an adequate response capability in the event of a spill.

### 5.8.3 EXTREME WEATHER CONDITIONS

Site conditions play an important role in the planning and execution of the Project. Northern Baffin Island has a semi-arid arctic climate with less than 200 mm of annual precipitation and an annual average temperature of about -15 ºC. The area experiences bitter cold in the wintertime and 24-hour darkness from November to January. Summers bring 24-hour daylight from May to August, but continued cool to cold conditions. Winter brings landfast ice in the marine inlets and along the coastline and sea ice in the main channels. The Ship's Master is responsible at all times for the safe navigation and operation of the vessel within the applicable laws of Canada, having special responsibility for the safety of life, the safety of the ship and the preservation of the environment. In order to meet these responsibilities, the Master has full authority to take whatever action considered necessary to successfully complete the voyage. This includes adjusting speed, seeking shelter, accepting assistance or deviating to save life.

### 5.8.4 MALFUNCTIONS DURING SHIPPING OPERATIONS AND REPORTING ACTION PROCEDURES

In the event of a malfunction or other incident during shipping operations within Steensby Inlet or Milne Inlet, the Ship's Master will immediately inform the port emergency control system requesting such assistance as may be practical. Outside of Steensby Inlet or Milne Inlet, the Master shall immediately report the incident verbally and later in writing to the nearest Transport Canada reporting station.

In the event any accidental contact occurs between a Project vessel and a marine mammal or an aggregation of seabirds, with resulting death or serious injury, the regional office of Fisheries and Oceans Canada (marine mammals) or Environment Canada (seabirds) is to be notified and supplied with information documenting the incident (date/time/location, affected species and condition, circumstances of the incident, weather and sea conditions, location/travel direction of the affected animal(s)). The Ship's Master will inform Baffinland Site personnel, who will contact the appropriate government agency. Annually, Baffinland will summarize any such incidents in its report to NIRB. In the event a ship-based Marine Wildlife Observer is onboard, they will be required to report any significant observation (e.g. threatened collision) to the ship master. Other vessel traffic would also be advised of any such threat.

### 5.8.5 UNFORESEEN EVENTS

During shipping operations unforeseen events or unanticipated interactions with the environment may occur, which may require intervention by the Ship's Master. Baffinland has adopted an adaptive management strategy for all phases of the Project which will prepare Project personnel to identify, resolve and learn from any unforeseen events. One of the main principles of an effective adaptive management strategy is to expect the unexpected and to be prepared to act quickly and decisively when it occurs. Examples of unforeseen events associated with Project shipping activities might include unanticipated startle reactions by marine mammals or unexpected attraction to ship's lighting by seabirds. If an unforeseen event were to occur, corrective actions would be taken by the Master of the vessel to avoid or reduce any adverse effects. In the case of the examples provided, these actions might include adjusting ships speed to reduce noise, or to maintain essential lighting only, in sensitive areas. Any such events, the subsequent corrective action taken and the degree of success will be documented to allow others to learn from these experiences, thus ensuring continual improvement.

# 6 ENVIRONMENTAL MONITORING

The marine aspects of the Project include shipping and port operations (docking, cargo transfer, marine discharges). Baffinland has implemented an environmental effects monitoring (EEM) program, in part to confirm the predictions of environmental effects. These programs are focused on the interaction between Project activities and the receiving environment, and in the establishment of cause-effect relationships that flow from these interactions. The results of the monitoring outlined in the specific EEM programs provide information that will serve to modify, add, or eliminate mitigation measures. Additional monitoring programs may be developed, if required, and could lead to the implementation of adaptive management measures. Environmental effects monitoring is conducted at three levels:

- **Research** – studies to establish basic monitoring parameters ( e.g. natural variability; potential for project-environment interaction), or to establish a baseline for future monitoring;
- **Surveillance** – studies to record natural environment phenomena and act as an “early warning” of changes, which, while not attributable to the Project, could require attention and possible design of a specific EEM program;
- **EEM** – full blown environmental effects monitoring based on a statistically robust study design capable of accepting or rejecting a Null Hypothesis, and focused on establishing a cause/effect relationship between environmental phenomena and Project attributes.

Compliance monitoring is also carried out to demonstrate that the conditions of applicable permits and approvals (e.g. with respect to limits on concentrations of discharges) have been met by the undertaking.

In design and execution of its Environmental Monitoring Program Baffinland is committed to applying rigorous standards for study design, analysis and reporting. All study designs will be provided to the MEWG for review and comment. All data will be analysed rigorously by experienced analysts, and all draft reports will be circulated to the MEWG for review prior to issuance as final documents. Additionally, affected communities will continue to be consulted on study design and to participate in implementation. Study results will be presented to community advisory groups for discussion.

In all monitoring programs, Baffinland engages direct Inuit participation in study planning, execution and interpretation of results.

In 2015, Baffinland developed a new plan, the Marine Environmental Effects Monitoring Plan (Appendix H), which addresses monitoring of marine ecology and marine mammals.

The objectives of the MEEMP are to:

- address regulatory requirements, especially those listed in NIRB Project Certificate No. 005;

- develop a comprehensive and integrated environmental monitoring program that includes follow-up as required;
- incorporate an ecosystem-based approach for monitoring and management of Project-related environmental effects; and
- coordinate all aspects of project-related marine environment effects monitoring.

## 6.1 CULTURE, RESOURCES AND LAND USE

Current shipping activity will occur exclusively along the North Baffin route arriving at Milne Inlet. Although the amount of shipping activity is modest, Baffinland has developed a ship tracking information procedure to ensure Inuit have knowledge of ships' positions. In accordance with articles 9.2.4 and 9.2.5 of the IIBA and NIRB Project Certificate conditions 102, 127, 164 and 180, every day when a vessel is in transit, the Baffinland Community Liaison Officers are advised of the position of each vessel relative to the nearby communities. In addition, ship locations are posted on the Baffinland Iron Mines website (www.baffinland.com) daily.

In 2014 Baffinland established a Community Advisory Group in Pond Inlet. One purpose of this group will be to engage in dialogue with respect to potential issues and concerns related to the Mary River Project. This initiative is intended to provide an effective means to engage Elders and community members in order to have community-level input into the Baffinland monitoring programs and mitigation measures, to ensure that these programs and measures have been informed by traditional activities, cultural resources, and land use where these may interact with features of the Mary River Project. The Community Advisory Group forum also provides a venue to discuss potential new resource harvesting opportunities and their interaction with Baffinland's Project activities.

### 6.1.1 ICE

Baffinland, in the Project Environmental Impact Statement (and Addendum) provided baseline information on landfast ice based on a long term dataset. This information was used to describe inter-annual variation. The baseline information will be updated annually and reported as an addendum to the Shipping and Marine Wildlife Management Plan.

Upon the commencement of Winter shipping, Baffinland will prepare annual reports to NIRB regarding Project–related ship track and sea ice information, including:

a) A record of all ship tracks taken along the shipping route throughout the shipping season;
b) An overlay of ship tracks onto ice cover imagery to illustrate avoidance of polynyas and shore leads;
c) A comparison of actual ship tracks to the nominal ship track for both open water and ice covered periods;
d) An assessment of the adherence to the nominal route and any changes in the zone of influence associated with actual tracks; and
e) A record of all reports on marine bird and mammal species present in the ships track.

The report will also summarize all incidents of significant deviations from the nominal shipping route as presented in the Project EIS and Addendum) for traffic to/from Milne Port and Steensby Port. Any implications for environmental effects will be discussed.

## 6.2 AIR QUALITY, NOISE AND VIBRATION

### 6.2.1 CLIMATE CHANGE AND GREENHOUSE GAS EMISSIONS

Baffinland will undertake initiatives to reduce greenhouse gas emissions. The success of these efforts will be monitored and reported in the Annual Report to NIRB. Additionally, the company will produce emissions calculations to determine the levels of sulphur dioxide ($SO_2$) and nitrogen oxide ($NO_x$) emissions generated by the Project based on fuel consumption and other relevant site data. Results will be included in the Annual Report to NIRB.

Baffinland will seek the participation of Inuit from affected and concerned communities in Nunavut when identifying and undertaking climate-change related studies and research.

### 6.2.2 WEATHER MONITORING

Baffinland operates meteorological monitoring stations at the Mine Site and at Milne Port. Additionally, temporary stations are periodically installed at specific locations to collect short-term data in support of research studies.

Baffinland is committed to explore and implement reasonable measures to make weather-related information accessible to the public on a continual basis throughout the life of the Project.

### 6.2.3 AIR QUALITY AND NOISE

Baffinland has produced an Air Quality and Noise Abatement Management Plan. This will be updated to reflect land-based monitoring station results for ship-based $S0_2$ and $NO_x$ emissions at the port sites. Additionally Baffinland will provide feedback on the forecasted emissions levels as presented in the Project Environmental Impact Statement (and Addendum). Actual site measurements of $SO_2$ and $NO_2$ will be reported and compared against predictions based on modelling. In cases where exceedances are measured, Baffinland will provide an explanation for the exceedance as well as a description of planned mitigation measures. Additional monitoring, as required, will be conducted to evaluate the effectiveness of mitigation measures.

During Milne Ore Dock construction, limits have been placed on permissible noise levels in the marine environment (DFO Fisheries Act Authorization). Monitoring is required to establish background levels, as well as peak levels from construction activities (infilling, vibratory pile driving, dredging). A report on construction monitoring will be completed in 2015.

## 6.3 MARINE WATER AND SEDIMENT QUALITY

Baffinland has developed a baseline sampling program to provide for effective monitoring of physical and chemical effects of ballast water releases, sewage outfall, and bottom scour by ship props. The sampling design was provided to the MEWG for comment by the group and to assign priorities for implementation. In 2014, a full baseline program was conducted based on the selection of physical, chemical and biological community/indicator components. The collected data will be used as input to a model that can serve to monitor sediment re-distribution at the port site, and for ballast water dispersion modeling. The program enabled the selection of appropriate biological indicators from candidate pelagic and benthic species. The field program included examination of potential mooring locations along the approaches to Milne Inlet.

### 6.3.1 DOCK CONSTRUCTION MONITORING

During construction of the Milne Ore Dock, measures were taken to protect marine water and sediment quality. Conditions of the Fisheries Authorization for the work have been incorporated into site environmental protection plans. Limits have been placed on allowable levels of turbidity in waters surrounding the work site. Monitoring has been employed to confirm the effectiveness of protection measures. Turbidity levels are to be measured in both the construction zone as well as at control locations. Regular surveys are conducted to establish the presence of marine mammals within the construction zone. Noise monitoring has been conducted to establish ambient levels and to determine the zone of influence from vibratory pile driving, infilling and dredging.

### 6.3.2 WAKE EFFEECTS

In the Project Environmental Impact Assessment (and Addendum) Baffinland predicted the potential effect of ship wakes on proximate shorelines. It was concluded that no measurable changes would occur. This prediction will be re-evaluated should the company consider changes to the shipping routes that will result in vessel traffic passing closer to sensitive shorelines.

In the Project Environmental Impact Assessment (and Addendum) Baffinland considered the potential for vessel movements (propeller wash) and port construction and operation (shoreline structures) to redistribute sediments. Baffinland will complete hydrodynamic modeling in the Milne Inlet Port area to identify potential zones of sediment erosion and deposition. The work will include consideration of metals in sediment and their potential for biological uptake into the food chain. In 2014, baseline information was collected on water column characteristics and sediment quality. This data, along with the existing baseline will enable the company to develop its modeling capability. Future updates to the sediment redistribution model will be carried out as Project ships are designed, constructed and brought into service on the Project.

### 6.3.3 BALLAST WATER

In the Project Environmental Impact Assessment (and Addendum) Baffinland predicted the temperature and salinity gradients that will be produced by ballast water discharge. The model will be revised and re-run as more information becomes available with respect to oceanographic phenomena (bathymetry, current regime, thermal profiles). In 2014, survey programs were carried out in Milne Inlet to improve the knowledge of bathymetry and physical oceanography. These data will be used to improve the ballast water dispersion model and to inform sampling sites for ongoing monitoring.

As well, in 2014, additional biological baseline sampling was conducted in Milne Inlet and approaches. The identified species will form a basis for future invasive species monitoring. The sampling protocols applied represent a high level of detail and address the full range of marine habitat types. The selected sampling locations will be employed in long term monitoring to detect changes in marine habitat and organisms, especially non-native species introductions that might be related to Project-related shipping. The initiation of this program in 2014, will supplement data collected since 2008. The accumulated baseline is considered to be of adequate duration and scope to provide the ability to detect future changes that can have biological consequences.

## 6.4 MARINE BIOTA AND HABITAT

The Project Environmental Impact Statement (and Addendum) make predictions as to the effect of the Project-environment interactions. From this flows an Environmental Effects Monitoring Program which serves to confirm the effects predictions made, as well as to evaluate the effectiveness of mitigation measures.

Refer to Appendix H, the newly developed Marine Environmental Effects Monitoring Plan, for monitoring of marine ecology and marine mammals.

# 7 ROLES AND RESPONSIBILITIES

This chapter describes Roles and Responsibilities related to environmental issues in the shipping operations in support of the Mary River Project. The relevant Baffinland Corporate Management Structure, including titles and roles and responsibilities are listed below.

**Table 3: ROLES RELATED TO ENVIRONMENTAL RESPONSIBILITIES IN THE SHIPPING OPERATIONS IN SUPPORT OF THE MARY RIVER PROJECT**

| Baffinland Iron Mines Corporation | |
|---|---|
| **Position** | **Responsibilities and Accountabilities** |
| **Corporate** | |
| Chief Operating Officer | • Overall accountability for the Operation of the Project once constructed.<br>• Allocation of resources (human and financial) for the implementation of Baffinland's commitments and objectives related to health, safety and environment during Operations including Marine Transportation Activities.<br>• Accountable for on-site environmental, health and safety performance during Operations including Marine Transportation Activities. |
| VP Sustainability Development and Environmental Health and Safety | • Reports to the CEO<br>• Establishes corporate environmental policies and objectives. |

| Baffinland Iron Mines Corporation | |
|---|---|
| **Position** | **Responsibilities and Accountabilities** |
| | • Monitors and reports on Baffinland's performance related to environmental, health and safety policies and objectives and adaptive management initiatives.<br>• Responsible for community liaison on EHS issues.<br>• Provides liaison with regulatory authorities on EHS issues.<br>• Obtains necessary EHS-related permits and authorizations.<br>• Monitors compliance with terms and conditions of permits and licences.<br>• Conducts routine EHS audit of contractor performance while on site |
| Chief Procurement Officer | •<br>• Accountable for procurement and purchasing.<br>• Ensures that environmental commitments, policies and objectives are included in all contract documents. |

**TABLE 3: ROLES RELATED TO ENVIRONMENTAL RESPONSIBILITIES IN THE SHIPPING OPERATIONS IN SUPPORT OF THE MARY RIVER PROJECT (Cont'd)**

| Baffinland Iron Mines Corporation | |
|---|---|
| **Position** | **Responsibilities and Accountabilities** |
| **Mary River Operations** | |
| | • |
| Vessel Master | • The Master is responsible at all times for the safe navigation and operation of the vessel within the applicable laws of Canada, having special responsibility for the safety of life, the safety of the ship and the preservation of the environment |
| Marine Security Officer | • Overall accountability for all Port-related activities including iron ore export and marine resupply.Responsible for ensuring that all chartered vessels are audited, inspected and are shown to operate to the requirements of Baffinland for vessels engaged to export cargoes from or deliver goods to the Project.<br>• Responsible for ensuring that the vessels using the Terminal comply with the environmental undertakings set out by Baffinland.<br>• Responsible for ensuring that operations at the interface between ship and shore are carried out with due regard to the safety and health of employees and protection of the environment.<br>• Responsible for all aspects of cargo operations, including documentation, equipment provision and maintenance and cargo handling<br>• Responsible for ensuring all aspects of oil and fuel offloading, storage and transfer in the Port area are addressed in the Baffinland Environmental Protection Plan.<br>• Responsible for arranging the provision and maintenance of oil spill containment and recovery equipment. |
| Maintenance Superintendent | • Reports to the Maintenance Manager.<br>• Responsible for providing local contractors to train and provide Shipboard Marine Wildlife Observers and Inuit Monitors.<br>• Provides local weather and ice information in the port and Terminal area to every nominated vessel within 24 hours of that vessel's ETA and continuously updates this information while the vessel is enroute to a Project port.<br>• Arranges for the regular inspection and maintenance of Baffinland-owned aids to navigation provided for the designated routes. |
| | • |

**TABLE 3: ROLES RELATED TO ENVIRONMENTAL RESPONSIBILITIES IN THE SHIPPING OPERATIONS IN SUPPORT OF THE MARY RIVER PROJECT (Cont'd)**

| Baffinland Iron Mines Corporation | |
|---|---|
| **Position** | **Responsibilities and Accountabilities** |
| Environmental Manager | • Reports directly to VP Sustainable Development, Health, Safety and Environment and Indirect reporting and coordination with Operations VP and Director Environment<br>• Overall accountability for environmental staff and performance at site<br>• Coordinates implementation and monitors the performance of the Environmental Management System at site<br>• Liaises with the senior management, regulators and stakeholders<br>• Ensures effective monitoring and auditing of environmental performance of departments and contractors on site and identifies opportunities for improvement<br>• Monitors compliance with permits, licenses and authorizations<br>• Ensures all regulatory environmental monitoring and reporting requirements (monthly, annual) are met<br>• Leads and coordinates site permitting requirements.<br>• Initiates and oversees environmental studies<br>• Oversees investigations and reporting of environmental incidents to regulatory bodies, stakeholders and senior management<br>• Reviews and updates environmental management plans |
| Environmental Superintendent | • Reports to Environmental Manager<br>• Specific accountabilities for environmental monitoring and reporting<br>• Leads investigations and reporting of environmental incidents onsite<br>• Serves as the liaison for regulators during onsite inspections and visits<br>• Provides ongoing environmental education and environmental awareness training to all employees and contract workers<br>• Oversees environmental database management<br>• Prepares updates for management plans |
| Environmental Coordinators | • Reports to the Environmental Superintendent and Manager<br>• Specific accountabilities for environmental monitoring and reporting<br>• Provides day to day direction to Environmental staff onsite<br>• Serves as a liaison for regulators during onsite inspections and visits.<br>• Provides ongoing environmental education and environmental awareness training to all employees and contract workers<br>• Assists with environmental database management |
| Environmental Advisor | • Reports to the Environmental Superintendent and Manager<br>• Specific accountabilities for environmental monitoring and reporting<br>• Assists with environmental database management<br>• Prepare updates for management plans |
| Environmental Monitor and Technician | • Reports to the Environmental Superintendent or designate<br>• Assists with environmental database management<br>• Assists with monitoring and sampling activities as per the Project's management plans |
| QIA Monitor | • Works alongside the Baffinland Environment Department to ensure the proper implementation of all environmental management and monitoring plans<br>• Acts as the QIA liaison for onsite environmental matters |

| Baffinland Iron Mines Corporation | |
|---|---|
| **Position** | **Responsibilities and Accountabilities** |
| Bear Monitors | • Report to Environmental Coordinator.<br>• Provides polar bear safety training.<br>• Accompanies workers if working at the Port site, at a distance from camp facilities.<br>• Reports any incidents or other events to the Environmental Coordinator.<br>• Records all observed wildlife mortality reported by personnel. |
| Shipboard Marine Wildlife Observers | • Report to Environmental Coordinator.<br>• Provide specialist advice and input on types and behaviour of marine wildlife<br>• Responsible for recording observations of all marine wildlife and preparing monitoring reports |
| Health and Safety Manager | • Reports to VP Sustainability Development and EHS.<br>• Provides a source of expertise and technical review in the development of the contingency and emergency response plans.<br>• Is to be informed of any incident on site.<br>• Report any incidents or other events to senior management. |
| Contractors/Subcontractors | • Contractors/subcontractors are considered equivalent to Baffinland staff in all aspects of environmental management and control and their responsibilities in this respect mirror those of Baffinland personnel. Contractor personnel will be included in the onsite induction process.<br>• Contractors / subcontractors are required to comply with requirements of the EPP and related EMMP.<br>• Responsibilities of the contractor/subcontractor supervisors include the following:<br>◆ Conduct regular site check/inspection to ensure regular maintenance is undertaken to minimize environmental impacts.<br>◆ Provide personnel with appropriate environmental toolbox/tailgate meetings and training. |

## 7.1 BAFFINLAND MARINE TRANSPORTATION MANAGEMENT TEAM

Baffinland has in place a Marine Transportation Management Team. This Marine Transportation Management Team has expertise in shipping, environmental protection, safety, ice navigation and emergency response. The Team manages all aspects of the marine transportation system, including port operations.

### 7.1.1 MEMBERSHIP

The members of the Marine Transportation Management Team (and their location) are:

- Marine Security Officer - On Site
- Baffinland Maintenance Superintendent - On Site
- Baffinland Environment, Health and Safety Superintendent - On Site
- Ship Operations Superintendent - Montreal
- Ships' Master - Onboard vessel

### 7.1.2 PRIORITIES

With respect to shipping, the priorities of the team are:

- The safety of life
- The protection of the marine environment; and
- The preservation of the ship and her cargo.

The following outlines the Roles and Responsibilities of the Marine Transportation Management Team. Note: Individual team member Roles and Responsibilities are presented in Section 5.

### 7.1.3 ROLES AND RESPONSIBILITIES OF THE TEAM

The overall responsibilities of the Marine Transportation Management Team are:

- To manage and schedule shipments of cargoes in and out of Project ports.
- To be responsible for operating the Iron Ore Carrier and chartering and scheduling the Carriers.
- To ensure, prior to chartering a Carrier, a pre-charter audit and/or inspection is carried out on the vessel to confirm the condition of the vessel and that it is managed and operated in accordance with the ISM system with all certificates up to date; and
- To ensure that, wherever appropriate, the interfaces between the Terminal and the ships' emergency response plans are compatible.
- To review environmental monitoring and management practices and identify, as required, adaptive management measures to achieve environmental compliance.

The specific responsibilities of the Marine Transportation Team are listed below.

#### 7.1.3.1 HYDROGRAPHIC INFORMATION AND NAVIGATION AIDS

The Marine Transportation Management Team ensures:

- That hydrographic issues affecting the terminals or ships are brought to the attention of the responsible parties and those affected by the changes (i.e., Ships' Masters, Berthing Advisors, Inuit Advisor/Monitors); and
- That Baffinland-owned port aids to navigation are regularly maintained and confirmed as being operational and accurate.

#### 7.1.3.2 CARGO DOCUMENTATION

The Marine Transportation Management Team is responsible to establish:

- A documentation system for the cargoes including Bills of Lading, Cargo Quality Certificates, Cargo Manifests and MSDS information; and
- A system whereby advice of dangerous or hazardous materials cargoes is provided to the Ship's Master in good time to develop a cargo plan which provides safe and secure stowage always within the vessel's capacity.

#### 7.1.3.3 TRAINING

The Marine Transportation Management Team ensures:

- That the bulk loading operators are properly trained in the operation of the loading system and are capable of distributing the cargo throughout the holds as level as practical;
- That the ship and shore personnel engaged in loading and discharging the vessel are trained in the safe practices of stevedoring, crane operation and slinging of cargo; and
- That the personnel carrying out ship track marking are trained in safe practices for working on ice.

#### 7.1.3.4 SERVICES

The Marine Transportation Management Team provides:

- A Linesmen to assist vessels to berth.
- A Berthing Advisor to assist in vessel berthing and departure from the port.
- Shipboard Marine Wildlife Observers for selected passages of both the dedicated and non-dedicated iron ore carriers; and
- A ship track marking service to delineate the outer edge of the area where ice breaking is occurring in the vicinity of the port.

Note: Currently there is no pilotage service available for the voyages to Milne or Steensby port sites. However, in the event that a compulsory pilotage service is introduced, Baffinland will discontinue the provision of Berthing Advisors for the non-dedicated iron ore carriers.

#### 7.1.3.5 COMMUNICATIONS

The Marine Transportation Management Team ensures:

- That the Baffinland Port and Logistics Manager is informed of any delay to the vessel's schedule caused by mechanical defect, ice, heavy weather or diversion to assist a vessel in distress, and is informed of the vessel's revised estimated time of arrival at its destination; and
- That communications between the vessel and the loading terminals, emergency services, security staff and relevant authorities is established and that short-range VHF communications involved in cargo operations between ship and shore is effectively managed.

#### 7.1.3.6 SAFETY

- Safety is a major responsibility. The Marine Transportation Management Team ensures that ship and shore personnel engaged in operations are aware of hazards arising from cargo operations and from the materials and iron ores being handled. This includes the provision of MSDS information and any additional training and information (e.g., safety plan, tool box meetings, hazard analysis) required; and
- The Marine Transportation Management Team ensures that all personnel are provided with and wear the appropriate personal protection equipment (PPE) which shall be suitable for the task at hand under the existing weather conditions.

#### 7.1.3.7 ICE MONITORING

The Marine Transportation Management Team will monitor ice conditions and promulgate ice and navigation information within the Baffinland operations and to the local communities.

#### 7.1.3.8 EMERGENCY RESPONSE

The Marine Transportation Management Team is:

- The source of expertise and technical review in the development of the terminal contingency and emergency response plans (Milne Port OPEP – SD-ERP-002, and, Steensby Port OPEP SD-ERP-003).
- Responsible for co-ordinating assistance should a vessel experience a problem which cannot be dealt with by the ship's crew or the Ship's Master alone; and
- To be kept informed of any incident onboard the vessel which may result in a lost time accident or dangerous occurrence. All such incidents will be investigated by the Ship's Safety Officer and be reported to the Baffinland Health & Safety Manager. At no time can such investigation interfere with a formal Accident Investigation by Transport Canada and does not relieve the vessel from the Transport Canada reporting system.

Detailed emergency response procedures are contained in the Milne Port OPEP (SD-ERP-002) and the Steensby Port OPEP (SD-ERP-003).

#### 7.1.3.9 MONITORING REPORT

The Marine Transportation Management Team is responsible for producing an annual Monitoring report which includes:

- A record of all ship tracks taken along both shipping routes covering the entire shipping season.
- An overlay of ship tracks onto available ice imagery to identify shore leads and polynyas.
- A comparison of recorded ship tracks to the nominal shipping route and
- All onboard observations of marine mammal and seabird from reports.

## 7.2 TEAM MEMBER ROLES AND RESPONSIBILITIES

### 7.2.1 MARINE SECURITY OFFICER

The Marine Security Officer has overall responsibility for all marine transportation aspects of the SMWMP. In particular, the Port and Logistics Manager is responsible for:

- Appointment and leadership of the Marine Transportation Management Team.
- Protecting the safety and health of all persons working on the Project and protecting the environment by taking all reasonable actions including following appropriate codes and regulations;
- Ensuring annual review of environmental monitoring and mitigation measures to identify adaptive management measures as appropriate to achieve environmental performance standards respecting shipping; and
- The implementation of the Company's commitments and obligations regarding shipping.

- Coordinating the schedule of all vessels used to support the above operations. The Port and Logistics Superintendent controls the scheduling of supply, export and return cargo.
- Ensuring that all chartered vessels are audited, inspected and are shown to operate to the requirements Baffinland for vessels engaged to export cargoes from or deliver goods to the Project. The vessels must meet the agreed specifications for operations within the time frame and ice conditions expected during the charter.
- Maintaining direct communication with the Ship Operations Manager and the managers of iron ore chartered ships to advise the quantities and timing of each shipment.
- The operation of the port security system. The port at Milne Inlet will be registered as an approved port compliant with the Canadian and IMO ISPS Regulations; and
- The safety of shore-based marine related employees, site facilities, the quay and equipment supplied or operated to support the transportation operations.

#### 7.2.1.1 ENVIRONMENT, HEALTH AND SAFETY

The Baffinland Port and Logistics Superintendent is responsible for:

- The care of the marine and immediate shore environment.
- Ensuring that the vessels using the Terminal comply with the environmental undertakings set out by Baffinland.
- Ensuring that operations at the interface between ship and shore are carried out with due regard to the safety and health of employees and the preservation of the environment; and
- From time to time, participating in vessel inspections to ensure that environmental requirements are met.

#### 7.2.1.2 FUEL TRANSFER AND EMERGENCY RESPONSE

The Baffinland Marine Security Officer:

- Ensures the implementation of the Transport Canada approved OPEP for each Port (see Appendix 10C-2 for Milne and Appendix 10C-3 for Steensby).
- Ensure that the Port Site facilities and procedures for receiving fuel are compatible with those on the ship.
- Establishes an agreed oil offloading procedure with the vessel. This is addressed in the Baffinland Environment Protection Plan and is part of the vessel's procedures for the discharge of oil cargoes.
- Manages the Baffinland oil spill cleanup contract capabilities.
- Arranges for the provision and maintenance of oil spill containment and recovery equipment suitable to contain/recover a spill from a vessel in Milne Port; and
- Arranges and supervises oil spill exercises to maintain ship and shore ability to deploy the oil containment boom and other equipment quickly and efficiently.

### 7.2.2 BAFFINLAND MAINTENANCE SUPERINTENDENT

The Maintenance Superintendent is responsible for the operation of a number of local manpower contracts which service the iron ore plant and iron ore storage and support the port and shipping operations as required. These services include, but are not limited to, the following:

- Providing local contractors to train and provide Inuit Advisor/Monitors.
- Ensuring that Inuit Advisor/Monitors are made aware of vessel schedules when arriving and departing from the Terminal.
- Ensuring adherence to the Baffinland communication protocol.
- Providing local weather and ice information in the port and Terminal area to every nominated vessel within 24 hours of that vessel's ETA in Steensby Port Site and continuously update this information whilst the vessel is approaching and transiting Steensby Inlet.
- Arranging for the regular inspection and maintenance of Baffinland-owned aids to navigation provided for the designated routes; and
- Gathering any hydrographic or navigation aid information which the Ship's Master may become aware of in the course of transiting in or out of Steensby Inlet and ensuring that the information is passed to the Canadian Coast Guard and Hydrographic Office.

### 7.2.3 BAFFINLAND PORT AND LOGISTICS SUPERVISOR

On a day-to-day basis the port services are operated by Port and Logistics Supervisors who report to the Port and Logistics Superintendent. These individuals manage the shore crew who are engaged in support operations related to the storage of iron ores ashore and are the direct point of contact for the Ship's Master using the ports. The duties and responsibilities of the Port and Logistics Supervisors are listed below.

#### 7.2.3.1 SHIP ENTRY AND PORT CLEARANCE

The Port and Logistics Supervisors provides notice to Customs and Immigration of the estimated arrival and departure times of foreign flag vessels and arranges transportation and accommodation for the persons providing these services as may be necessary.

#### 7.2.3.2 SHORE CARGO OPERATIONS

The Port and Logistics Supervisor:

- Provides crews to handle the vessel's mooring lines at the berth on arrival.
- Arranges shore activities associated with the arrival, berthing, discharge and loading of cargo; and
- Boards vessels to agree the order of discharge, confirms the contents of cargo fuel tanks and the order of discharge and loading with the Ship's Master.

#### 7.2.3.3 SAFETY

The Port and Logistics Supervisor:

- Participates in a joint ship and shore briefing and safety meeting on the order and method of discharge and highlights any special handling procedures for dangerous or hazardous cargoes, safety, health or, environmental concerns.
- Is responsible for the maintenance, inspection and operation of fire systems installed at the quay.
- Has the authority to stop or shut down any operation which is considered hazardous or which may result in damage to the iron ore cargo. For example, heavy rain, snow, ice accumulation, windblown iron ores, or vessels improperly secured against the weather; and
- Is a first line responder in the case of an oil spill from ship or shore.

#### 7.2.3.4 COMMUNICATIONS

The Port and Logistics Supervisor:

- Establishes communications between ship and shore to suit every aspect of the cargo operation.
- Provides VHF radios for crew communication with stevedores; and
- Makes contact with vessels and agrees the boarding location and boarding method for the Inuit Advisor/Monitor and ensures that this information is passed to the Inuit Advisor/Monitor.

#### 7.2.3.5 DOCUMENTATION

The Port and Logistics Supervisor:

- Is responsible for recording the numbers and quantities of cargo received and loaded to the ship and recording damage or shortages. Notice of damage and shortages is to be brought to the Master's attention in writing.
- Receives and acknowledges receipt of protests from the Masters of vessels alleging damage to the vessel or quay; and
- Provides cargo documentation, bills of lading and certificates for iron ores, signs cargo manifests for re-supply cargo and provides a manifest for all return cargo. Cargo figures will be confirmed by means of a draft survey conducted jointly by the ship's staff and the Marine Transport Supervisor.

#### 7.2.3.6 CARGO HANDLING EQUIPMENT

The Port and Logistics Supervisor:

- Provides, maintains and certifies slings and lifting equipment used by the vessel's cranes.
- Is responsible for the care, maintenance and certification of the cargo fuel hoses and the receipt of fuel discharged by the vessel; and
- Maintains and operates the mooring boat and any winches, lines, spill containment booms or other equipment which are part of the mooring system on the quay.

#### 7.2.3.7 CARGO OPERATIONS

The Port and Logistics Supervisor:

- Provides the manning and equipment required to remove general cargo offloaded by the ship's cranes. All cargo to be removed from the quay to the storage area; and

- Is responsible for the operation of the iron ore loading system including:
  - The training of the bulk loader operators and instruction on requirements to distribute cargo evenly in each hold, maintain weight control and not to exceed planned quantity in each hold.
  - Providing the vessel with cargo quality certificates; and
  - Providing the crew and equipment, if necessary, to trim iron ores to the Master's requirements.

Note: The Ship's Master may only accept goods which are properly identified, packaged and are accompanied by the appropriate documentation. Acceptance is also subject to the vessel being able, in the sole opinion of the Master, to provide the stowage required to carry the goods safely.

#### 7.2.4 BAFFINLAND ENVIRONMENT SUPERINTENDENT

The EH&S Superintendent responsibilities include:

- Development and Maintenance of the Site Environmental Protection Plan, including port and marine aspects.
- Conduct of and reporting on all required environmental monitoring programs, including environmental effects and compliance monitoring to marine operations.
- Development of Oil Spill Contingency Plans.
- Development of Site Closure and Progressive Remediation Plans.
- Assistance and support in the development of an Emergency Response Plan, including associated training, exercises and equipment purchases.
- The provision of an auditing service, where necessary, to the Project with respect to environment, health and safety compliance.
- The provision of health and safety systems and standards for various aspects of marine transportation and cargo handling operations at the Project site;
- Annual (or, as required, more frequent) reporting on the results of environmental effects monitoring programs, including the identification of potential requirements for adaptive management measures; and
- The securing of consulting services, where necessary, to the Project with respect to environment, health and safety.

#### 7.2.5 SHIP OPERATIONS SUPERINTENDENT

The Ship Operations Superintendent reports to the Port and Logistics Manager and functions to:

- Liaise with the vessel's Master to establish the maximum quantities and grades of cargo which can be safely loaded on the ship on each occasion, taking into account the season and the amounts of fuel, lubricants and stores and any return cargo which will remain onboard when the vessel sails from the Baffinland Terminal. The Ship Operations Superintendent ensures safe and efficient cargo operations between ship and shore with full regard for the preservation of the environment; and
- Keep the Port and Logistics Manager advised of any delays to the vessel, whether caused by ice, weather or mechanical fault.

#### 7.2.5.1 DESIGNATED PERSON ASHORE

- The Ship Operations Superintendent will have a Designated Person Ashore (DPA) as required by the ISM system. The DPA or his deputy is the point of contact for the ship in the event of any emergency onboard and it is the DPA's duty to call out the Company's Emergency Response Team.
- On a day-to-day basis the DPA is a member of the ISM system ashore and is directly involved in the safety of the ship and its crew.
- Should the ship managers fail to respond to safety concerns such as may be minuted in the ship's safety committee meetings, the DPA is responsible to take the concerns as far as may be required to get legitimate concerns addressed; and
- The Ship Operations Superintendent/DPA will be responsible for the shipboard oil pollution emergency plan (SOPEP) and the contract with the ECRC oil spill cleanup organization.

#### 7.2.5.2 EMERGENCY RESPONSE TEAM

- The Ship Operations Superintendent will maintain an experienced onboard Emergency Response Team provided with the information required to support the ship in an emergency. An emergency response center outfitted with the necessary ship drawings, specifications, contingency plans, communications systems and contact numbers for relevant emergency support services is maintained in the ship managers offices; and
- The Emergency Response Team will be familiar with the vessel's contingency plans and responsible for supporting the Ship's Master by arranging assistance such as tug support, casualty evacuation, contacting the next of kin, dealing with the media, and related actions.

### 7.2.6 MASTER

The Master is responsible at all times for the safe navigation and operation of the vessel within the applicable laws of Canada, having special responsibility for the safety of life, the safety of the ship and the preservation of the environment. In order to meet these responsibilities, the Master has full authority to take whatever action which the Master considers necessary to successfully complete the voyage. This includes adjusting speed, seeking shelter, accepting assistance or deviating to save life. In addition, the Master has the responsibilities listed in the sections below.

#### 7.2.6.1 SHIP LOADING/DISCHARGE

The Master:

- Decides when it is safe to sail and when it is safe to enter the port and berth or when to bring the ship to anchor to await better weather.
- Is responsible for the provision of the cargo plan plus the loading, safe stowage and protection of all cargo carried onboard from the time the cargo is loaded over the ship's side until it is discharged over the ship's side; and
- Is responsible for ensuring that the vessel safely loads the intended cargo for the planned voyage. On completion the Master agrees all quantities of cargo loaded or discharged and signs the appropriate documentation before the vessel sails.

#### 7.2.6.2 PROJECT ENVIRONMENT

- Through Baffinland and the Ship Operations Superintendent, the Master shall be made aware Baffinland requirements and obligations that may affect navigation and will ensure the ship's compliance with all of the identified environmental concerns whilst at sea or in port; and
- The Master will co-operate to the extent practicable with the Shipboard Marine Wildlife Observer to ensure the protection of the environment, wildlife and any fishing, sealing or other sensitive operations within the vessel routing.

#### 7.2.6.3 ISM SYSTEM

The Master is responsible for:

- The operation of the ISM system onboard ship maintaining the established relationships with the Ship Operations Superintendent and/or the Designated Person Ashore; and
- Ensuring that regular safety meetings are held and that actions minuted at these meetings are passed to the ship managers for action and that actions agreed by the ship managers are put into effect onboard.

Note: Fire and Abandon Ship exercises shall be held in accordance with Transport Canada Regulations. Additional exercises will be arranged to ensure the crew's familiarity with the contingency plans established for the vessel including joint exercise with the shore managers.

#### 7.2.6.4 ACCIDENT REPORTING

- In the event of an accident causing personal injury or loss of life, oil spill, or other incident within Steensby Inlet the Ship's Master will immediately inform the port emergency control system requesting such assistance as may be practical; and
- Outside of the port areas, the Master shall report the incident verbally and later in writing to the nearest Transport Canada reporting station.

#### 7.2.6.5 PASSAGE PLANNING

- The Master approves the passage plan taking account of routing for ice, weather, etc. and advises Baffinland of expected departure and arrival at the destination terminal.
- The Master decides when to sail, retracing to the extent possible the agreed route used to enter the port during the winter season; and
- The Master reports the vessel's departure to NORDREG and confirms the latest ice information and planned route. The system is reversed on the return voyage.

#### 7.2.6.6 COMMUNICATION

- The Master is responsible for the provision of daily position and progress reports to the Ship Operations Superintendent and Baffinland. The estimated time of arrival at the pilot station/ice edge/destination/berth will be updated every 24 hours and every four (4) hours within the last 24 hours before arrival.

- Changes to the estimated times shall be reported by the Master to the Terminal in order that the provision of mooring gangs, and cargo handlers can be properly coordinated.
- The Master provides the Terminal with a formal Notice of Readiness to Load/Discharge; and
- The Master of a foreign flag vessel, or the vessel's agent, is responsible to ensure that Customs, Immigration and Port formalities are completed before sailing.

# 8 ENVIRONMENTAL REPORTING

Baffinland is responsible to implement environmental mitigation and adaptive management measures and to carry out monitoring of the effects of shipping as set out Nunavut Impact Review board (NIRB) Certificate #005. As well, Baffinland is responsible for conducting monitoring programs as described in the marine section of the Environmental Effects Monitoring Plan approved by the Government of Canada and the Government of Nunavut. On a regular basis, the Marine Environmental Working Group reviews and recommends amendments to the Environmental Effects Monitoring Program as it pertains to the marine environment.

## 8.1 REPORTING REQUIREMENTS

All monitoring reports pursuant to the Project Certificate and various regulatory requirements of the Project are to include information on sampling protocols, personnel, dates, locations and results of analysis. All results are to kept and maintained throughout the life of the Project and EIS and EEM predictions will be updated as new baseline information is collected. A Project-specific web page (www.baffinland.com) has been developed as a means of making all non-confidential monitoring and reporting information available to the general public. To the fullest extent possible, all results will be available in English and Inuktitut.

The responsibilities for reporting and documentation by various teams and individuals are discussed in section 7.0 of this Shipping and Marine Wildlife Management Plan.

### 8.1.1 PORT INFORMATION MANUAL

Baffinland will produce a Port Information Manual to provide the Ship's Masters with an overview of the environment (particularly the ice regime) and port operations, as well as procedures required by Baffinland when navigating to Steensby Port Site or Milne Inlet Port. Additional copies of the Port Information Manual will be maintained at each Terminal.

### 8.1.2 VESSEL OPERATIONS MANUALS

All vessels navigating to Steensby Port Site or Milne Inlet Port will have operations manuals developed according to the ISM Code principles.

### 8.1.3 BAFFINLAND PLANS AND PROCEDURES

As part of its Environmental Management System (EMS), Baffinland has developed a number of plans and procedures. These include an Emergency Response Plan and a variety of Standard Operating Procedures for the Steensby Port Site Terminal and the Milne Inlet Port. Copies of all relevant Baffinland procedures and EMS plans are maintained at the Terminal and accessible through the Port and Logistics Manager.

#### 8.1.4 CARGO DOCUMENTATION AND OTHER SHIPPING-RELATED DOCUMENTATION

Copies of necessary cargo documentation forms will be supplied by Baffinland and maintained at the Port Site. Copies of other necessary shipping-related forms will be obtained by Baffinland and maintained at the Terminal.

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# Appendix A:
# Iron Ore Carrier, Winter Shipping, Lessons Learned

## A.1 Iron Ore Carrier

The ±190,000 DWT icebreakers will be designed as Polar Class 4 vessels, which relate to Canadian classification between a CAC 3 and CAC 4 design. Appendix 1 provides a conceptual sketch of the vessel.

These ships will have approximate dimensions of:

- Length – 329 m
- Beam – 50 to 53 m; and
- Maximum draft of 20 m when fully loaded.

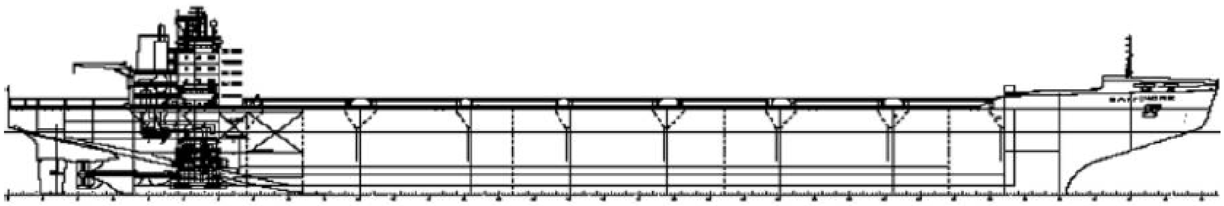
The ore carrier will have the following design features:

- Twin nozzle propellers (7.5 to 8.0 m diameter)
- Twin rudders (one behind each propeller) – approximately 11 m high by 6 m wide
- Full power: 42,500 hp per shaft with engine running at constant 78 rpm; and
- Shaft centerline approximately 6.5 to 7.0 m above vessel baseline.

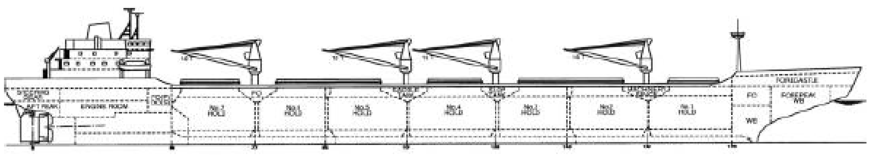
While also a subject of ongoing evaluation, it is expected that at least one of the icebreaking ore carriers will be equipped with an additional fuel tank holding in the order of 5 ML of diesel fuel, in addition to the ship's own fuel tank to act as back up to the planned fuel sea lift during the open water season.

The ore carriers will be powered by marine fuel oil (380 cSt).

Proposed ±190,000 DWT Capacity Ice-breaker



28,000 DWT Capacity MV Arctic (Owned and Operated by Fednav)



| | Mary River | MV Arctic | Difference |
|---|---|---|---|
| Length Overall (m) | 329.0 | 220.8 | 149% |
| Beam (m) | 52.0 | 22.9 | 127% |
| Depth (m) | 27.0 | 15.2 | 78% |
| Draft (m) | 20.0 | 11.5 | 74% |
| Displacement (mt) | 248,000 | 41,300 | 500% |
| Ore Cargo (mt) | ±190,000 | 28,500 | 595% |

| REV | DATE | DESCRIPTION | PREP'D | CHK'D | APP'D |
|---|---|---|---|---|---|
| A | - | ISSUED WITH REPORT | - | - | - |

BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT

ICE BREAKING ORE CARRIER
CONCEPTUAL DESIGN

Knight Piésold CONSULTING | P/A NO. NB102-181/25 | REF. NO. 8 | FIGURE 3-3.9 | REV A

A-2 WINTER SHIPPING

The total annual estimated 204 transits by the icebreaking ore carrier fleet to and from Steensby Port Site correspond to some 136 transits that will occur during the period November through June, when air temperatures result in the formation of ice within the ship track. Evidence of the ship track in the mobile pack ice south of the Steensby Port Site fast ice edge will quickly disappear due to the movement of the ice by winds and tide.

A-2-1 ROUTES THROUGH LANDFAST ICE

Within the landfast ice of Steensby Port Site, the ship track will remain throughout the winter. As a result of the extreme cold, the ship track will quickly begin to refreeze following the passage of the vessel and, due to the frequency of transit through the track; ice formation will be continuous resulting in the build-up of rubble in the track over time. Consequently, the width of the disturbed ice will gradually widen from the initial track of 50 metres to a zone up to 1.5 km wide by late winter.

A-2-2 SHIP TRACK MARKINGS

In sections of the track through landfast ice, markers will be established as a caution for travellers who may be on snowmobile and using the area for hunting, travel or other activities. Reflective highway markers will be used and placed along the outer edge of the ship track with the line of markers aligned approximately 500 m clear of the actual ships track. The markers are fibreglass construction approximately 1.5 m long 150 mm wide and 50 mm thick. The surfaces are coated with high visibility reflective paint; Red markers will be used on the eastern boundary and green markers to the west (red right returning). The markers will be placed early each winter season when the ice is safe for snowmobile travel. Weekly patrols will be carried out to ensure the markers are operational and to observe for any signs of travel or other usage in the area of the ships track. Late in each season, the markers will be removed and stored for subsequent re-deployment.

Public notices will be issued to advice communities and travellers of the installation and removal of the markers, informing of their general location and colour coding.

A-2-3 PACK ICE TRANSIT

Evidence from the MV Arctic (another ore transport ship providing winter transport through Hudson Strait) transit of Hudson Strait in winter indicates that the ship track is indiscernible in the pack ice within six hours of the ship passing.

A-2-4 COAST GUARD ICE BREAKER ASSISTANCE

It is not expected that vessels travelling to Steensby Port Site will require icebreaker escort. However, in the event of need, requests for icebreaker support will be made to the Canadian Coast Guard (CCG) or NORDREG.

A-2-5 INUIT ADVISORS

Local residents with extensive knowledge of the area may be called upon to assist in an advisory capacity to the ship's Master and provide information such as:

- Local tidal information.
- Environmentally sensitive areas or life cycle activities of birds and mammals along the route and possible means to avoid them.
- Harvesting cycles and fishing activities.
- Travel patterns and level of activity.
- Land mass identification.
- Local ice information.
- Communication with ice monitors.

In addition, the Inuit Advisor may monitor and report on the ship's performance with regard to environmental matters. A checklist can be developed to identify compliance issues and activities that can be viewed and audited. At the end of a voyage, the completed form would be co-signed by the Inuit Advisor and the Ships Master or their representative. The signed-off form would be submitted to the Baffinland Marine Transportation Management Team for review and action, as necessary. The frequency of trips by the Inuit Advisor would probably not exceed one to two a month. The participation rate would be reviewed and adjusted annually as experience is gained with vessel performance.

Inuit Advisors would be selected, and, if necessary, trained for ice observation and monitoring in order to provide reliable and timely information to the ship. As necessary, the Inuit Advisors would use observations from on-ice travel and other available information to enhance safety and expedite travel.

A-3 LESSONS LEARNED

A-3-1 VOISEY'S BAY

Voisey's Bay Nickel Company, now Vale Newfoundland and Labrador Ltd. (VNL) began operation of a nickel-copper-cobalt mine and concentrator operation at Voisey's Bay Labrador in 2005. Ore is mined from an open pit mine, processed on site and shipped to markets in the south. Approximately 1,250,000 tonnes of nickel-copper-cobalt concentrates and some 150,000 tonnes of copper concentrate are shipped out annually. Most of the nickel-copper-cobalt concentrates and all of the copper concentrate is shipped in the "open water" season - that period when no land-fast ice is present. Up to four cargoes are shipped through land-fast ice in the January to March period. The mine is a fly-in/fly-out operation, employing approximately 450 people working on a two-week rotation. The shipping Port in Edwards Cove, Anaktalak Bay is approximately 35km south of Nain, the closest community to the mine site. The east-west shipping route crosses seven travel routes used by small boats and snowmobiles that transit to cabins or other communities along the coast.

During construction, all shipping was carried out during the open water season. Mine and mill production started in 2005 with the first winter shipping in January 2006. At the time it was first proposed, the Voisey's Bay project was within the overlapping land claim areas of the Labrador Inuit Association (LIA) and the Innu Nation. The LIA land claim has subsequently been settled and the territory around which the Project is located is now known as Nunatsiavut and is governed by the Nunatsiavut Government. The Innu Nation land claim is still under negotiation with the federal and provincial governments. Impact Benefits Agreements have been signed between VNL and both aboriginal organizations.

**Impacts Benefit Agreement**

In March, 1999, following completion of the environmental assessment and release of the Panel report, the Government of Canada and the Government of Newfoundland and Labrador gave the Company approval to proceed with the project. The next step was the negotiation of Impacts and Benefits Agreements with the Innu Nation and the LIA. Agreement on the IBA between the LIA and the Company was reached in 2002 and included a commitment that the Company and LIA would negotiate a Shipping

Agreement to address the terms and conditions of shipping in open water and through land-fast ice in winter. Inuit ratified the IBA in June, 2002 and the IBA was signed in July of that same year. As follow-up, a Shipping Agreement was negotiated and signed within one year following the signing of the IBA. The Shipping Agreement addressed a number of issues, including:

- Ship design
- A test run into land-fast ice along the proposed shipping route using the MV Arctic
- The construction of "ice bridges" across the ship's track
- The schedule for winter shipping and the identification of sensitive periods
- Identification and agreement on a shipping route as well as safe anchorages along the route
- Design of an environmental effects monitoring plan for the marine environment; and
- Use of local Inuit Advisor/Monitors on board ships.

The Shipping Agreement sets out terms and conditions to apply to winter shipping that are: grounded in Inuit experience; require Inuit involvement in the implementation and ongoing monitoring of winter shipping; and respect and protect the relationship of Inuit to the sea, sea ice and the marine resources while taking into account the operational needs of the project. (Rowell and Metcalfe, 2005)

**Operations**

After four years of operation, there have been few unanticipated consequences associated with winter shipping; however, it has been noted that the ice-freeze rates of the 30m wide ship's track has been slower than predicted. Rather than the two to five hours predicted in the EIS, the track has taken up to several days to re-freeze resulting in subsequent delays in the provision of safe crossing sites. During the winter of 2006 the *MV Umiak 1* made eight transits of Anaktalak Bay between January 23 and February 21 (Sikumiut 2008a). In terms of weekend travel, of the eight weekend days, there were four with unsafe track. Three out of four weekends had some period of time where the track was unsafe and there was one occasion when the track was unsafe for the entire weekend. Similarly, in 2007 of the eight transits of the *MV Umiak 1* between January 23 and April 4, there were seven weekend days with unsafe crossings and seventeen with safe crossings. In total, six out of twelve weekends had some period of time where the track was unsafe, including one weekends where the track was unsafe for the entire period (Sikumiut, 2008a).

VNL provides the local community residents along the North Coast with information on vessel transits through a variety of means, including Notices to Mariners, public radio broadcasts, posted signs, web-site notification and a dial-in phone number. Each year, in advance of the winter shipping season, a series of public open-house style meetings are held to inform people of the winter plans and to receive feedback on aspects of the shipping program (provision of notices, placement of markers, signs and crossings, use of the detour).

For those who choose to do so, a detour route has been made available so that travellers can come ashore at the Edwards Cove port and follow a designated trail around the dock to reach the opposite side of the ships track. As compensation for the extra travel distance, gas is made available at the Port Site for snowmobiles.

VNL has contracted an Inuit company to carry out its Ship's Track Maintenance Program. A work team marks the ship's track to ensure it is visible to the public. Up to approximately 70 km of track are marked annually with green markers on the south side and red on the north side. A higher density of markers is provided around the port area where the area of disturbed ice is relatively greater due to vessel turning and docking manoeuvres. These markers provide the travelling public with a better sense of the track presence and orientation, thereby adding an extra element of safety.

The Inuit company also establishes and marks the safe crossing locations at designated locations along the route. In 2007 VNL commissioned the development of a pontoon-type bridge in order to shorten the period of time it takes before snowmobile traffic can safely resume crossing the track. A prototype was successfully tested and a full system fabricated and deployed in the 2008 winter shipping season (Sikumiut, 2009). The pontoon units take between two and four hours to deploy and about the same amount of time for recovery by two three-person work crews (one each side) using snowmobiles and some specialty equipment (line throwers, winches). A second unit is to be placed into operation for the 2011 shipping season.

**Community Monitoring**

Socioeconomic surveys (Sikumiut 2008a, Sikumiut 2008b) conducted in 2007 as part of the environmental effects monitoring program for the project have identified the following concerns expressed by survey respondents (residents of Nain) regarding winter shipping:

- The Ship's winter track has restricted spontaneity about when and where to travel.
- Safety concerns regarding ice thickness in the track had led some to choose not to travel across the track, but to use a detour, or not to travel at all.
- Reduction in amount of travel people do due to the presence of the Ship's track.
- Concerns regarding the reliability of the signal equipment (beacons and poles) used at designated crossing locations.
- Some felt that the signage used at main crossing locations included too much information and was not explicit enough.
- Some expressed a continuing concern that the presence of winter shipping would reduce the amount of time spent in the country, and hence the access to wild food.
- Some secondary effects were raised as concerns, including the reduced opportunity to pass on traditional knowledge to younger generations, as well as a potential reduction of women's role as women have more responsibilities on the land than in the community.
- There was an expressed wish among some respondents for improved communications to the public regarding track crossings.

It is evident from these responses that there are individuals in Nain who are being affected, (or perceive that they are being affected) by the project and that, while the mitigation measures implemented for the ship's track have been effective, some residual effect remains. During community meetings held at the end of each winter shipping season, residents have expressed strong support for the use of the pontoon crossings and many felt that this device and its rapid deployment appears to have addressed many of their concerns. The use of an aboriginal company to provide the ship track maintenance service was seen as a very positive step. In fact, the most popular means of checking on vessel transits and condition of the track was through direct contact with the contractor's Inuit field personnel.

**Lessons Learned and Project Implications**

In the context of shipping in northern Labrador (Voisey's Bay) the following observations of relevance to this Project can be made:

- As a safety measure the ships track through land-fast ice in areas of other (snowmobile) traffic is clearly marked to ensure it is visible to travellers. Similar markings might be practical in the approaches to Steensby Inlet.
- The provision of "safe crossing" locations across the ships track is reliant on timely track refreeze rates, and this timing is variable given the weather conditions experienced near the Voisey's Bay Project Site.
- In order to deal with the issue of variable timing of ice refreezing, pontoon ice bridges have been successfully developed and deployed, however the mechanics of such an operation might not be practical for application in a situation of high frequency marine traffic and a relatively wide ships track (52m vs. 30 m).
- The provision of a detour route provides safe passage, albeit longer travel time, around the ship track. Such a route needs to be clearly marked and easily accessible for travellers.
- In order to avoid disruption in ice formation and to protect local ringed seal populations during whelping, shipping is suspended during two specified six week periods (December - mid-January during freeze-up and early-April-mid May).
- In order to utilize local aboriginal knowledge, local Inuit Advisor/Monitors are required aboard selected vessels and trips.
- Both VNL and the Inuit have benefitted from the Project. VNL has been able to develop the mine and extract and ship the nickel concentrate to market, economically and efficiently. The Inuit have benefitted through provisions of the IBA, direct employment at Site and through increased opportunities for Inuit businesses and other induced economic benefits.
- Despite various mitigation measures, there is still some concern expressed by residents over the restricting winter travel caused by the presence of the ships track.

A-3-2 RAGLAN MINES

The Raglan nickel-copper mine is situated near the Hudson Strait, on the north shore of the Ungava Peninsula, in Nunavik. The concentrate is shipped from Deception Bay via Hudson Strait. The mine began production in 1997 after more than 30 years of exploration, negotiation, and development. In August

2006, Xstrata PLC acquired ownership of Falconbridge Limited and has been operating the Raglan mine under the Xstrata Nickel business unit since that time. Today, the nickel and copper-producing facility operates three underground mines and one open-pit mine. The ore is crushed and treated at the Raglan Mill and the concentrate is trucked 100 km to the Deception Bay Port where it is stored and transferred to ships for transport. The nearest Inuit villages to the Raglan site are Salluit and Kangiqsujuaq. The current mine life is estimated at more than 30 years (NR Canada website http://www.nrcan.gc.ca/smm-mms/abor-auto/htm/rgl-07-eng.htm).

In 1995, the Raglan Agreement was signed between the mine operator, the Qaqqalik Landholding Corporation of Salluit, the Salluit community, the Nunaturlik Landholding Corporation of Kangiqsujuaq, the Kangiqsujuaq community, and Makivik Corporation, which oversees the political, social, and economic development of Nunavik. The agreement includes profit-sharing measures and trust fund payments over an 18-year period. The agreement also guarantees preferential hiring and contracting to local, qualified Inuit employees and businesses. The Raglan Committee meets several times each year to discuss environmental concerns and to report on the progress of the agreement. Inuit representatives from Salluit, Kangiqsujuaq, and Makivik Corporation occupy half of the committee's six seats with mining company officials holding the balance.

**Environmental Mitigation Measures:**

Environmental mitigation measures were identified in the project Environmental Impact Statement (Falconbridge, Raglan EIS 1994). Measures to reduce the effects of winter shipping include the following:

- The number of ship voyages for supplying of goods and shipping of concentrate is limited to six per year (three in winter).
- Shipments are not made during the period from mid-March to mid-June to avoid seal whelping (delivery and nursing of seal pups) as well as the period during which hunting activities are favoured.
- "S" movement of ship through the ice will facilitate ice re-formation and prevent early ice break-up of Deception Bay ice cover. Such movement allows for "pieces to fit together like a jigsaw puzzle".
- Staff will take training courses on procedures to follow in order to prevent any risk of accidental hydrocarbon spills.
- Local communities are advised of the schedule and route of vessels accessing Deception Bay during the ice season to minimize the risk of snowmobiles encountering open channels and to minimize interference with hunting and fishing activities.
- A protocol will be set up for advising of the passage of ice breakers in high risk areas, particularly Deception Bay and the boundary of Hudson Strait and Deception Bay, in order to minimize safety risks to area snowmobilers. The protocol will consider the nature of the ice cover in the bay and the time required for refreezing of the path cut by the icebreakers during the various seasons. Some mitigation measures, in particular the creation of ice bridges at passages chosen by Inuit users, will be applied by work crews to ensure safe passage in the ship's path.

**Lessons Learned**

In 2002, as part of an ongoing dialogue towards developing the Shipping Agreement between Voisey's Bay Nickel Company and the Labrador Inuit Association, a site visit to the Raglan Mine was undertaken by representatives of both parties to gain a better understanding of the effects of winter shipping. The observations of this team serve as a good overview of lessons learned from winter shipping at the Raglan Mine site. The observations and conclusion presented in Site Visit Report (Dicker *et al.* 2002) include the following:

- A 25 day old ship track was very easy to see from the ice (and from the ship's radar) due to the roughness of the area as compared with the undisturbed landfast ice. The track was also difficult to cross due to the rough surface.
- The MV Arctic travelled easily through Deception Bay through 0.6m thick land-fast ice at a speed of 11 knots.
- The ship had little effect on the land-fast ice outside the width of the vessel itself. Cracks tended to run parallel to the track, not perpendicular. The ice adjacent to the track did not tend to separate and move into the track.
- Standing 50 -100 m from the vessel as it travelled through the land-fast ice, it was possible to feel a slight vibration in the ice and hear the vessel. The most notable noise was from the breaking ice, however overall the noise level seemed quite low.
- The MV Arctic can stay within the previous track on each winter passage, so that the disturbed area is little greater than one ship width (approximately 22.5 m). Even though the refrozen ice within the track can be thicker than the surrounding undisturbed land-fast ice, the edges of the track tend to be the thickest areas, so that the vessel tends to stay within these two edges, except when the ship manoeuvres to dock and where it makes a "star" turn on departure.
- The ice left behind the vessel in the track was quite broken up and consisted of a range of about 2 – 3 m sized pans down to "slob" (frazil). The refreeze rate of the track was such that at least twenty-four hours would be required before a snowmobile could cross. The roughness of the track would also impede travel.
- We observed the process of establishing the ice bridge once the vessel had pushed back a pile of rubble. A crossing location is selected where the ice has become well consolidated, but is relatively smooth. A two- person team from Saluit use ice chisels to knock down the ridges and rough spots to produce a clear path. The "Ice Bridge" signs are placed in chiselled holes on either side of the track. The entire operation took about thirty minutes.
- In the ice bridge location (where the ship had pushed up the pieces), we crossed on foot within 24 hours after the ship had passed by. Once the rough ice was chiselled, the snowmobiles passed as well.
- Hunters showed up within one hour of completion of the ice bridge; however it is not clear whether this was a coincidence or evidence that the communication protocol was working efficiently.

The site visit team also identified two other issues:

- According to the Captain, ballast water transfer procedure is fairly routine and does not impede ship progress. In any case, it is a simple matter to confirm that ballast water exchange has occurred (e.g., by testing salinity). [1]
- The flagging material and the swivel arrangement that is used to mark the road at the Raglan site appear to be a good solution to the severe wind and temperature conditions along the road route.

Ballast water (freshwater) taken on at Quebec City is exchanged for salt water in the Gulf of St. Lawrence and as required by Ballast Exchange Guidelines is exchanged again off Labrador outside the continental shelf.

# Appendix B:
# Alternative Iron Ore Vessel Selection Protocol and Specifications

## B.1 Alternate Iron Ore Vessel Selection Protocol and Specifications

### *B.1.1 APPLICATION OF VESSEL SELECTION PROTOCOL*

Baffinland will utilize this vessel selection protocol for the selection of bulk cargo vessels that are adequate for all expected conditions when utilized as an alternate vessel for the transport of iron ore from the Steensby Port Site Terminal when the dedicated iron ore carriers are not available or when market conditions dictate the use of non-dedicated vessels, and a vessel for the transport of iron ore from the Milne Inlet Terminal.

### *B.1.2 VESSEL SELECTION PROTOCOL COMPONENTS*

This vessel selection protocol is comprised of the following components:

1. Minimum general requirements for all alternate iron ore vessels; and
2. Minimum ice navigation requirements for all alternate iron ore vessels required for shipping through waters which may contain ice during the Open Water Shipping Season.

### *B.1.3 MINIMUM SPECIFICATIONS FOR VESSEL SELECTION*

This vessel selection protocol defines minimum specifications for selecting suitable vessels to:

1. Safely transport iron ore during the Winter Shipping Season.
2. Safely transport iron ore during the Open Water Shipping Season; and,
3. Ensure adequate vessel performance under all expected conditions.

### *B.1.4 MINIMUM GENERAL REQUIREMENTS FOR ALTERNATE IRON ORE CARRIERS AND IRON ORE CARRIERS*

All vessels chartered by Baffinland as iron ore carriers or as an alternate vessel for the transport of iron ore will meet the general vessel requirements listed below:

1. All vessels will be confirmed to be compatible with the (Steensby or Milne Inlet as applicable) Port Site Terminal and able to unload and load the required cargos in a safe manner.
2. All vessels will meet all applicable requirements of the Canada Shipping Act.
3. All vessels will comply with IMO regulations under the Safety of Life at Sea Convention (SOLAS) of 1974 (and later amendments), or the equivalent Canadian standards defined in the Canadian Shipping Act.
4. All vessels will be equipped with navigation equipment and appliances as specified in the “Standards for Navigating Appliances and Equipment” (TP3668E) issued by the Marine Safety Directorate of Transport Canada or navigation equipment, which is compliant with the IMO standards (SOLAS 1974) and normally referred to as “convention” ships. Specific equipment will include:

    a. A standard and a steering magnetic compass.

b. One gyrocompass for normal operations with repeaters located at the main steering location and at the emergency steering position.
c. Two navigational radars, each capable of independent operation, one of which operates in the 9GHz frequency band.
d. An automatic radar plotting aid.
e. Electronic position fixing equipment suitable for use at all times throughout the voyage to establish and update the ship's position by automatic means.
f. One echo sounder (sounding apparatus).
g. A device to indicate speed and distance.
h. An approved daylight-signaling lamp.
i. An internal communications system.
j. Suitable navigation charts for the port site at Steensby Port Site and for the shipping routes; and,
k. At least one pair of binoculars.

5. Baffinland will require ships to comply with the regulations governing discharge of solid and liquid waste specified in the Canadian Arctic Water Pollution Prevention Act (AWPPA). Ships will be required to have adequate holding tanks or containers for on-board retention of bilge water, oil waste, sewage water and solid waste. Baffinland will show preference to ships, which have facilities to contain grey water when in Canadian waters.
6. All vessels will be equipped to comply with ballast water handling in compliance with the Baffinland Inuit Impacts and Benefits Agreement.
7. All vessels will have communication equipment that meets the Canadian Shipping Act, Ship Station (Radio) Technical Regulations, 1999 or as it may be amended from time to time, which specifies that all radio equipment on-board a ship shall:

   a. Meet the applicable performance standards set out in International Maritime Organization Resolution A.694(17), entitled General Requirements for Shipborne Radio Equipment Forming Part of the Global Maritime Distress and Safety System (GMDSS) and for Electronic Navigational Aids.
   b. Be certified by a country to which the Safety Convention applies as having passed the tests set out in standard IEC 945 of the International Electrotechnical Commission, entitled Maritime Navigation and Radio communication Equipment and Systems - General Requirements: Methods of Testing and Required Test Results; and,
   c. Be the subject of a technical acceptance certificate if one is required under subparagraph 5(1)(a)(iv) of the Radio Communication Act.

8. All vessels shall have the following specific communication equipment as a minimum:

   a. VHF radio telephones.
   b. VHF radio installations.
   c. MF/HF radio installations; and,
   d. INMARSAT ship earth station.

9. All vessels will have on board the equipment, procedures and resources for use in the event of an oil spill as required to comply with the applicable regulations under the Canada Shipping Act, Part XV .

10. All vessels will be required to have a shipboard oil pollution emergency plan (SOPEP) that complies with the requirements under MARPOL convention.
11. Baffinland will show preference to vessels that do not use anti-fouling paints that contain Tributylin (TBT); and,
12. All vessels will comply with the Canadian Shipping Act requirements for Pilot Ladder Regulations (Sor/78-218), which specify that every ship shall be equipped with a pilot ladder or alternatively a mechanical pilot hoist and stipulate the type of ladder to be used, the materials of construction, the dimensions, the location and the means of securing.

##### *B.1.5 ADDITIONAL ICE NAVIGATION REQUIREMENTS FOR ALTERNATE IRON ORE CARRIERS DURING THE WINTER SHIPPING SEASON*

In addition to meeting its requirements, all vessels chartered by Baffinland for use as an alternate vessel for the transport of iron ore from the Steensby Port Site Terminal during the Winter Shipping Season when the dedicated iron ore carrier is not available will meet the following additional ice navigation requirements:

1. Vessels will be selected that respect Inuit concerns regarding the impact of the vessel on the land-fast ice related to the width of the vessel and the ice breaking bow form.
2. Baffinland will not select vessels that use anti-fouling paints that contain Tributylin (TBT) without prior consultation ; and,
3. Vessels will not be selected that require ice breaker support within the land-fast ice without prior consultation.

# Appendix C:
# Baffinland Pre-Charter Bulk Carrier Ice Capability Assessment

## C.1 Baffinland Pre-Charter Bulk Carrier Ice Capability Assessment

### *C.1.1 GENERAL*

The Baffinland pre-charter bulk carrier ice capability assessment will be carried out prior to finalization of any charter.

### *C.1.2 APPLICATION OF THE VESSEL SELECTION PROTOCOL*

The vessel selection protocol applies to vessels engaged in the export of iron ore according to the season during the planned period of the charter.

### *C.1.3 MINIMUM SPECIFICATIONS FOR VESSEL SELECTION*

These are the minimum requirements for vessel selection according to the season during the planned period of the charter.

### *C.1.4 CRITERIA FOR DETERMINING VESSEL PERFORMANCE IN ICE*

This is based on the Arctic Ice Regime Shipping System (AIRSS) calculation of ice numerals and Canadian Arctic Class or equivalent.

### *C.1.5 MINIMUM REQUIREMENTS FOR CARRIERS AND ALTERNATE IRON ORE CARRIERS*

The minimum requirements will be specified in the Baffinland original request to brokers for proposals for vessels, taking account of the season and projected ice conditions during the period of the charter.

### *C.1.6 VESSEL ICE CAPABILITY ASSESSMENT*

The main concern is to ensure that the carriers and alternate iron ore carriers selected are capable of operating in the ice conditions which are forecast for the period when the vessel will be operating in the approaches to Steensby Inlet or within Steensby Inlet.

The ice capability requirement is dependent on updated ice forecasting, based on current radar satellite information, related to the vessel's design, construction, ice performance, and operating procedures. The calculation is based on the following:

i. The ice numerals of a vessel being considered for operations into Steensby Inlet ice, which will be calculated under the Arctic Ice Regime Shipping System (AIRSS).
ii. The vessel's Class and Type in accordance with Canadian Regulations (i.e., Canadian Arctic Class or equivalent); and
iii. The thickness and character of the ice in Steensby Inlet during the period of the charter.

### *C.1.7 ICE CONDITIONS FORECASTS AND ICE CAPABILITY ASSESSMENT*

The following summary is provided as an aid to understanding Baffinland's vessel selection process for selecting vessels for operation into Steensby Inlet.

1. An Ice Information Contractor, with expertise in ice measurement, forecasting and routing, will be contracted to provide a forecast of the ice conditions expected in the Steensby Inlet area at the time of the proposed shipping.
2. The Owner and Managers of a vessel being considered for a charter shall be required to provide full details of the vessel's design, ice construction, machinery, class, etc. to the Baffinland Independent Contractor responsible for assessing the vessel's ice capability.
3. The Independent Contractor engaged by Baffinland shall consider the vessel's ice design and construction, ice performance and certificates to confirm if the vessel's ice numerals are positive and sufficient to enable the vessel to safely transit the forecast ice conditions in Steensby Inlet during the projected time frame.

This contract shall be established well in advance of the first charter vessel assessment to enable the Independent Contractor to provide Baffinland with a list of information required to carry out their assessment of the proposed vessel's ice capability.

4. Providing the vessel meets all of the required criteria for navigating in the forecast ice conditions, the Independent Contractor shall determine that the vessel under consideration is structurally and mechanically capable of safely completing the contemplated voyage and will provide that determination to Baffinland.
5. Providing the vessel meets all of the above requirements for the charter, the vessel shall be subject to a general inspection to confirm that the vessel remains in good condition, meeting all of the equipment requirements and operating procedures necessary for vessels operating into Canadian ports. The Surveyor will also ensure that the equipment requirements and operating procedure requirements listed out in the Baffinland Inuit Impacts and Benefits Agreement (IIBA) are satisfied. These equipment requirements and operating procedure requirements are all included in the Baffinland pre-charter bulk carrier inspection checklist (refer to Appendix 4).

The above inspection will be coupled with a limited audit to ensure that the vessel is operated in conformance with the International Safe Management regulations.

Providing that the vessel satisfies all of the above inspections and the limited audit, the vessel may be placed on charter.

**Note:** Surveyors conducting the pre-charter inspection will be informed of any special inspection requirements related to ice procedures and route planning not otherwise included in the Baffinland IIBA. The provision of a Berthing Master provides the necessary source of information and advice to a Master unfamiliar with the conditions in Steensby Inlet.

6. Twenty four hours before the chartered vessel enters the ice outside Steensby Inlet, the Ice Information Contractor shall provide an updated estimate and forecast of the ice conditions which the vessel will encounter in and outside of Steensby Inlet. The vessel's AIRSS ice numerals will again be calculated.

If the ice numerals remain positive for the updated ice report, the vessel may enter Steensby Inlet.

If the ice numerals are negative, the vessel may not enter port until ice conditions improve and positive numeral results.

# Appendix D:
# Baffinland Pre-Charter Inspection Checklist and Limited Audit

## D.1 BAFFINLAND PRE-CHARTER BULK CARRIER INSPECTION CHECKLIST AND LIMITED AUDIT

### *D.1.1 INTRODUCTION*

Baffinland Iron Mines Corp. has developed an Iron Ore mine at Mary River, Baffin Island, and shipping terminals at Steensby Port Site and Milne Inlet on Baffin Island in Nunavut.

In order to preserve the environment and the Inuit way of life, BAFFINLAND have signed the Inuit Impacts and Benefits Agreement (IIBA) which, among other things, provides for the shipment of Iron Ore.

### *D.1.2 SHIPPING OPERATIONS*

The Iron Ore Carrier will follow the same track in and out of Steensby Inlet, to the extent practicable, during each round-trip transit during the "Winter Shipping Season".

Carriers and alternate Iron Ore Carriers (should these be required) must be classed for ice navigation according to the expected ice conditions.

### *D.1.3 COMPLETION OF PRE-CHARTER BULK CARRIER INSPECTION AND LIMITED AUDIT*

It is not the intention that the Baffinland inspector/surveyor inspect a bulk carrier and carry out a complete ISM Type audit in the course of the vessel's normal turn-around in port.

However, an experienced surveyor can examine the vessel's documentation or computerized safety and maintenance programs in sufficient depth to satisfy themselves as to the standard of operation and management of the vessel. This information coupled with a visual inspection of the hull and superstructure, machinery spaces, deck and safety equipment is normally sufficient for the Charter to decide whether the vessel is capable of working safely in Canada or otherwise. In order to save time we suggest that the surveyor uses a digital camera to photograph points of interest, general layout of the vessel, hull condition, etc., or any items which cause concern.

The following pre-charter bulk carrier inspection checklist is a combination of a Transport Canada Ship Safety Checklist, which is the standard required for all foreign ships entering Canada, to which we have added the requirements as identified by Baffinland as the outcome of the Environmental Assessment Process.

The limited audit outlined is sufficient to confirm that the vessel is maintaining ISM Standards.

## PART 1 — PRE-CHARTER BULK CARRIER (INSPECTION As per the following checklists)

Section 1: General Information

| Section 1: General Information | | |
|---|---|---|
| 1.1 | Date this document completed | |
| 1.2 | Name of ship | |
| 1.3 | LR/IMO No. | |
| 1.4 | Date of name changes | |
| 1.5 | Flag | |
| 1.6 | Call sign | |
| 1.7 | INMARSAT number | |
| 1.8 | Ship's fax number | |
| 1.9 | Ship's telex number | |
| 1.10 | Ship's e-mail address | |
| 1.11 | Type of hull: (1) Single Hull, (2) Double Hull, (3) Double Bottom (4) Double Side, (5) Other (if Other, Specify) | |
| **Section 1.2: Ownership and Operation** | | |
| 1.12 | Registered Owner | |
| 1.13 | Full Address<br><br>Office telephone number | |
| 1.14 | Name of Operator (if different from above) | |
| 1.15 | Full Address | |
| | Office telephone number | |
| | Office fax number | |
| | Office email address | |
| | Contact person | |
| 1.16 | Contact person after hours telephone | |
| | Emergency callout number | |
| | Emergency callout pager number | |
| | Contact details for person responsible for oil spill response. | |
| 1.17 | Total number of ships operated by this Operator | |
| **Section 1.3: Builder** | | |
| 1.18 | Builder | |
| 1.19 | Date delivered | |
| 1.20 | If applicable, date of completion of major hull changes | |
| 1.21 | If major hull changes, what changes were made? | |

| | | |
|---|---|---|
| **Section 1.4: Classification** | | |
| 1.22 | Classification Society | LLOYDS REGISTER |
| 1.23 | Class Notation | |
| 1.24 | Date of last dry-dock | |
| 1.25 | Date next dry-dock due | |
| 1.26 | Date of last special survey | |
| 1.27 | Was last special survey an enhanced special survey? | |
| 1.28 | Date next special survey due | |
| 1.29 | If ship has Condition Assessment Programme (CAP) rating, what is the latest rating? | |
| 1.30 | Date of last annual survey | |
| 1.31 | Date of last boiler survey - port boiler | |
| 1.32 | Date of last boiler survey – starboard boiler | |
| 1.33 | If machinery on Continuous Survey are any item overdue or extended? | |
| 1.33.1 | If Yes give details: | |
| 1.34 | Is ship subject to any conditions of class, class extensions, outstanding Memorandums or class recommendations? | |
| 1.34.1 | If Yes, give details: | |
| **Section 1.4: Dimensions** | | |
| 1.35 | Length overall (LOA) | |
| 1.36 | Length between perpendiculars (LBP) | |
| 1.37 | Extreme breadth | |
| 1.38 | Moulded breadth | |
| 1.39 | Moulded depth | |
| 1.40 | Does ship have a bulbous bow? | |
| **Section 1.5: Tonnages** | | |
| 1.41 | Net Registered Tonnage | |
| 1.42 | Gross Tonnages | |
| 1.43 | Moulded depth | |

| | | | | | |
|---|---|---|---|---|---|
| **Section 1.6: Loadline Information** | | | | | |
| | | Freeboard | Draft | Deadweight | Displacement |
| 1.44 | Summer | | | | |
| 1.45 | Winter | | | | |
| 1.46 | Lightship | | | | |
| 1.47 | Normal Ballast Condition | | | | |
| 1.48 | Segregated Ballast Condition | | | | |

| | | |
|---|---|---|
| **Section 1.7: Recent Operational History** | | |
| 1.49 | Has ship been involved in a pollution incident during the past 12 months? | |
| 1.50 | Has ship been involved in a grounding incident during the past 12 months? | |
| 1.51 | Has ship been involved in a collision during the past 12 months? | |

Section 2: Certification and Documentation

| | Certificates | Issue Date | Expiry | Last Annual |
|---|---|---|---|---|
| 2.1 | CERTIFICATE OF REGISTRY | | | |
| 2.2 | SAFETY EQUIPMENT CERT | | | |
| 2.3 | SAFETY RADIO CERTIFICATE | | | |
| 2.4 | SAFETY CONSTRUCTION CERTIFICATE | | | |
| 2.5 | LOAD LINE CERTIFICATE | | | |
| 2.6 | IOPP | | | |
| 2.7 | ISM | | | |
| 2.8 | INTERNATIONAL SEWAGE POLLUTION | | | |
| 2.9 | USCG (LETTER OF COMPLIANCE) CFR | | | |
| 2.10 | UNATTENDED MACHINERY SPACE CERTIFICATE | | | |
| 2.11 | INTERNATIONAL TONNAGE CERTIFICATE | | | |
| 2.12 | MINIMUM SAFE MANNING CERTIFICATE | | | |
| Documentation - Are the latest editions of the following publications t·ted on board? | | | | |
| 2.13 | IMO *Safety of Life at Sea Convention (SOLAS 74)* | | | |
| 2.14 | IMO *International Code of Signals (SOLAS V-Reg 21)* | | | |
| 2.15 | IMO *international Convention for the Prevention of Pollution from Ships (MARPOI. 73/78)* | | | |
| 2.16 | IMO *Ships Routing* | | | |
| 2.17 | IMO *International Regulations for Preventing Collisions at* Sea *(COLREGS)* | | | |
| 2.18 | IMO *Standards of Training, Certification and* Watch *Keeping (STCW Convention)* | | | |
| 2.19 | Does the Vessel carry a SOLAS Safety Manual available to Crew? | | | |
| 2.20 | ICS *Guide to Helicopter/Ship Operations* | | | |
| | | | | |

Section 3: Crew Management

| Date of Minimum Manning Certificate | | | |
|---|---|---|---|
| | Minimum Manning | Officers | Rating |
| 3.1 | Minimum manning required | | |
| 3.2 | Actual required | | |
| 3.3 | Nationality | | |
| | Nationality | | |
| | Nationality | | |
| 3.4 | Common language used | | |

Section 4: Navigation Equipment

| 4.1 | Is the vessel equipped With the following equipment? | Yes/No | Type | No Of Units |
|---|---|---|---|---|
| 4.2 | Standard Magnetic Compass | | | |
| 4.3 | Steering Magnetic or Periscope compass | | | |
| 4.4 | Gyro Compass | | | |
| 4.5 | Gyro Repeaters | | | |
| 4.6 | Radar 1 X Band (9 GHz) | | | |

| | | | | |
|---|---|---|---|---|
| 4.7 | Radar 2 S Band (4 GHz) | | | |
| 4.8 | Are radars gyro stabilized? | | | |
| 4.9 | Radar plotting equipment | | | |
| 4.10 | ARPA | | | |
| 4.11 | Depth sounder with recorder | | | |
| 4.12 | Speed/distance indicator | | | |
| 4.13 | Doppler log | | | |
| 4.14 | Docking approach Doppler | | | |
| 4.15 | Rudder angle indicator | | | |
| 4.16 | RPM indicator | | | |
| 4.17 | Controllable pitch propeller indicator | | | |
| 4.18 | Bow thruster indicator | | | |
| 4.19 | Rate of turn indicator | | | |
| 4.20 | Radio direction finder | | | |
| 4.21 | Navtex receiver | | | |
| 4.21 | Satellite navigation receiver | | | |
| 4.22 | GPS | | | |
| 4.23 | Differential GPS | | | |
| 4.24 | ECDIS (Electronic Chart Display and Information System) | | | |
| 4.25 | EPIRB | | | |
| 4.26 | GMDSS Installation | | | |
| 4.26 | VHF Dual Installation | | | |
| 4.28 | VHF Portable hand Sets | | | |
| 4.29 | MFIHF Installation | | | |
| 4.30 | Inmarsat Installation | | | |
| 4.31 | Loran C receiver | | | |
| 4.32 | Course recorder | | | |
| 4.33 | Off — course alarm — gyro | | | |
| 4.34 | Off — course alarm — magnetic | | | |
| 4.35 | Engine order printer | | | |
| 4.36 | Anemometer | | | |
| 4.37 | Several pairs of binoculars | | | |
| 4.38 | Weather fax | | | |
| | | | | |
| | | | | |
| | | | | |
| | Other Equipment | | | |
| 4.40 | Does vessel carry sextant(s)? | | | |
| 4.41 | Does vessel carry a signal lamp? | | | |
| 4.42 | Are steering and machinery controlled from the bridge? | | | |
| 4.43 | Are bridge controls available on bridge wings? | | | |
| 4.44 | Internal communications system? | | | |
| 4.45 | P.A. system? | | | |
| 4.46 | Sound signals, whistle, and fog horn? | | | |
| 4.47 | Navigation lights? | | | |
| 4.48 | Two powerful searchlights? | | | |
| 4.49 | Does the vessel have properly equipped pilot ladder clw manropes? | | | |
| 4.50 | Does the vessel have a substantial accommodation ladder either side? | | | |
| 4.51 | Does the vessel have a short light weight gangway with side ropes? | | | |
| 4.52 | Does the vessel have current navigational charts for the port and route? | | | |

Section 5: Pollution Prevention

| | | |
|---|---|---|
| 5.1 | Is spill containment fitted under the cargo manifold? | |
| 5.2 | Is spill containment fitted under all bunker manifolds? | |
| 5.3 | Is containment fitted under the bunker tank vents? | |
| 5.4 | Is containment fitted around the deck machinery? | |
| 5.5 | Specify type of scupper plugs | |
| 5.6 | Are means provided for draining or removing oil from deck area/containment? | |
| 5.7 | Does the vessel have on board the equipment, procedures and resources for use in event of an oil spill? | |
| 5.8 | Does the vessel have a shipboard oil pollution emergency plan (SOPEP) that complies with the requirements of the MARPOL convention? | |
| 5.9 | Is the following pollution control equipment available to clean up oil spilled on deck? | |
| 5.9.1 | Sorbents? | |
| 5.9.2 | Non-sparking hand scoops/shovels? | |
| 5.9.3 | Containers? | |
| 5.9.4 | Emulsifiers? | |
| 5.10 | Does the vessel have a certified sewage system? | |
| 5.11 | Does the vessel have a sewage storage tank? | |
| 5.12 | Does the vessel have on board holding of bilge water? | |
| 5.13 | Does the vessel have on board holding of oily waste? | |
| 5.14 | Does the vessel have on board holding of solid wastes? | |
| 5.15 | is a garbage incinerator fitted? | |

## Part 2: LIMITED AUDIT OF THE OUTBOARD OPERATION OF THE ISM SYSTEM

| | |
|---|---|
| International Safety Management Certificate | |
| Issued By Classification Society Name | |
| Last 5 year renewal | Date: |
| Intermediate audit | Date: |
| Internal audit | Date: |
| Name of Designated Person Ashore (DPA) | |
| Contact Phone Number<br>Contact email address | |

| **General** | Yes /No |
|---|---|
| Are the ISM system manuals available to the crew? | |
| Are the Master, officers and crew familiar with the ISM system? | |
| Are crew familiar with the Ship's Contingency Plans & their responsibilities? | |
| Are crew familiar with safe working practices required onboard? | |
| Are crew wearing Personal Protective Equipment and Clothing as appropriate? | |
| Are safety signs exhibited throughout the vessel? | |
| Are ear defenders/plugs used in the machinery spaces? | |
| Are eye protectors available near burning and grinding gear? | |
| Is the Safety Officer named and familiar with his responsibilities? | |
| Are minutes of safety meetings kept and forwarded to Safety Officer/DPA? | |
| Are concerns raised at meetings dealt with effectively onboard? | |
| Are concerns beyond the ship's capacity attended to promptly by the ship's management? | |
| Is the secondary emergency control center maintained? | |
| Does the vessel have a Material Safety Data System (MSDS) in place? | |
| **Accommodation** | |
| Are the ship's accommodations clean, tidy and hygienic? | |
| Are lifejackets and survival suits stored in each cabin? | |
| Are fire extinguishers, alarms, etc. in place and in date? | |
| Are public rooms, mess rooms etc. clean, tidy and hygienic? | |
| Are the galley and food stores clean with refrigerators operational? | |
| Is proper food handling and food hygiene in effect? | |
| **General Exterior Inspection** | |
| Is the ship's hull in good external condition & well coated? | |
| Is the visible lower hull free from fouling? | |
| Is an organotin, tributalin or biocide based anti-fouling coating used? | |

| **Machinery Spaces** | | | | | | |
|---|---|---|---|---|---|---|
| Machinery Space | | | | | | |
| Main Engines | | | | | | |
| Generators | | | | | | |
| Boilers | | | | | | |
| Inert Gas System | | | Nitrogen | | $CO_2$ | Yes |
| General Cleanliness | Good | | | | | |
| Bilge Cleanliness | Good | | | | | |
| Oily Water Separator | | | | | | |
| Oil Sludge Tank | | | Capacity | 21.7 m3 | | |
| Ballast Pumps | | | Capacity | cu. metres/Hr | | |
| Sewage Pumps | Type | | | | | |
| Sewage Holding Tank | Capacity | | $m^3$ | | Days | |

| **Engine Rooms Records** | |
|---|---|
| Engine Room Log Book (Note engine/generator/bolier breakdowns in port or shut downs at sea during the last two voyages) | |
| Fuel consumption per day | Mt/Day |
| Lube oil consumption | Ltrs/Day |
| Planned Maintenance System (Note if up to date and any outstanding work) | |
| Oil record book (Must be up to date and signed by C/E and Master) | |

| Deck Log Book – For Last Voyages | |
|---|---|
| Average Speed | kts |
| Weather | |
| Are charts and publications corrected up to date? | |
| Has the Master been provided with a Port Information Book? | |
| Is the Master aware that he must carry all the necessary Canadian charts and publications before arrival in Canada? | |
| Are ballast transfer/changes recorded in a ballast log book records (Last Voyage)? | |

| Life Saving Appliances | | | | | | |
|---|---|---|---|---|---|---|
| Lifeboats | Total No | | Open/Enclosed | | | |
| | Type | | Motor | | Enclosed | |
| Davits | Type | | | | | |
| No. of Survivors | Capacity | | | | | |
| Rescue Boat | Condition | | | | | |
| Davits | | | | | | |
| Life Rafts | Date | | Capacity: | | | |
| Life Raft Davits for above | | | | | | |
| Survival/Immersion Suits | Total | | | | | |
| SARTS | | | | | | |
| Records of Lifeboat Drills, Fire Drills, etc. | | | | | | |
| Are post exercise debriefings held after each exercise and are all crew invited to comment as to how to improve the effectiveness of the fire team, first aid teams, etc.? | | | | | | |

## CREW CERTIFICATION

Requirements:

All crew to have Certificate of Training in Emergency Duties and Fire Fighting issued by an accredited institution. The Master, 1st Mate and two Senior Engineers shall be certified for all Emergency Command and Control Issues. At least two Officers shall be qualified GMDSS operators.

All new crew shall be provided with an orientation of the ship on joining. This will include an introduction to his duties, the emergency signals and his emergency station under the various contingencies.

A booklet setting out details of the vessel should be provided in each cabin along with notices showing how to don a lifejacket and or survival/immersion suit.

Every vessel shall have a SOLAS manual onboard available to all crew members. This manual describes in the common language(s) of the crew, each piece of safety equipment, its position onboard and how to operate it.

Check make up and qualifications of all watch-keeping Officers and Engineers.

Can the vessel operate with the machinery spaces unmanned (UMS)? If so, the machinery space must be manned by at least one watch-keeping engineer when the vessel is reduced to manoeuvring speed for entering or leaving port.

**Qualification of Master and Watch Keepers**

Crew First Aid Training: Numbers:

Advanced First Aid Training: Numbers:

Rescue Craft Training: Numbers:

| Crew | Certificate of Competency | | | Basic Safety Certificate | | Adv. Safety Certificate | |
|---|---|---|---|---|---|---|---|
| | Level | State | Date | State | Date | State | Date |
| | | | | | | | |
| Master | | | | | | | |
| | | | | | | | |
| 1st Mate | | | | | | | |
| 2nd Mate | | | | | | | |
| 3rd Mate | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| Chief Eng. | | | | | | | |
| 1st Eng. | | | | | | | |
| 2nd Eng. | | | | | | | |
| 3rd Eng. | | | | | | | |
| 4th Eng. | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| Seamen | | | | | | | |
| | | | | | | | |
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| | | | | | | | |
| | | | | | | | |
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| | | | | | | | |
| | | | | | | | |

| Other Information | Yes/No | Comments |
|---|---|---|
| The suitability of the winterization of the vessel's onboard systems and equipment, including deck and cargo equipment, evacuation craft, etc. for operation in cold temperatures and icing according to all expected conditions. | | |
| The provision of clear vision systems for unimpaired forward and astern vision in cold temperatures, icing, etc | | |
| The suitable of the vessel's navigation equipment and appliances for safe navigation through ice in all expected conditions. | | |
| The suitable of key safety-related and survival equipment for cold temperatures, ice and icing conditions – including survival kits and immersion suits. | | |
| Confirmation that the vessel's officers and crew are familiar with cold weather survival procedures and the environmental conditions which they can expect to encounter. | | |
| Confirm that the vessel's ice navigation history has established that the vessel has a record of successful navigation in ice conditions comparable to those expected in Anaktalak Bay during the voyage. | | |
| Confirm that the vessel's operating manuals include a clear statement of the operating limitations for the vessel and its essential systems in all anticipated ice conditions, temperatures and other environmental conditions. | | |
| Confirm that the vessel's operating manuals include passage planning procedures accounting for anticipated ice and other environmental conditions and transit speeds having due regard to the vessel's class and type in the anticipated conditions. | | |
| Confirm that the vessel's operating manuals include deviations from standard operating procedures when navigating in ice-covered waters, including the operation of machinery systems, remote control and warning systems, electric and electronic systems. | | |
| Confirm that the vessel has appropriate escape and evacuation procedures into cold water and ice, etc | | |
| Confirm that the vessel is adequately equipped and its crews are properly trained to provide effective damage control and minor hull repair under all expected conditions. | | |

# Appendix E:
# Standard Format for the Ballast Water Management Plan

## E.1 STANDARD FORMAT FOR THE BALLAST WATER MANAGEMENT PLAN

(as prescribed under A Guide to Canada's Ballast Water Control and Management Regulations (Transport Canada 2007))

### *E.1.1 Preamble*

The ballast water management plan should contain the information required by Regulation B-1 of the Control and Management of Ships' Ballast Water and Sediments, 2004 (the Convention).

For guidance in preparing the plan the following information is to be included. The plan should be specific to each vessel.

### *E.1.2 Introduction*

At the beginning of each plan, wording should be included to reflect the intent of the following text.

1. This Plan is written in accordance with the requirements of Regulation B-1 of the International Convention for the Convention and the associated Guidelines.
2. The purpose of the Plan is to meet the requirements for the control and management of ship's ballast water and sediments in accordance with the Guidelines for Ballast Water Management and the Development of Ballast Water Management Plans resolution MEPC.127(53) (The Guidelines). It provides standard operational guidance for the planning and management of ships' ballast water and sediments and describes safe procedures to be followed.
3. This Plan has been approved by the Administration and no alteration or revision shall be made to any part of it without the prior approval of the Administration.
4. This Plan may be inspected on request by an authorized authority.

**Note:** *The Plan is to be written in the working language of the crew, if the text is not in English, French, or Spanish, the plan is to include a translation into one of these languages.*

### *E.1.3 Vessel Particulars*

At least the following details should be included:

- Vessels' name
- Flag
- Port of registry
- Gross Tonnage
- IMO number*.

*In accordance with resolution A.600(15), IMO Ship Identification Number Scheme.

- Length (BP)

- Beam
- International call sign
- Deepest ballast drafts (normal and heavy weather)
- Total ballast capacity of the ship in cubic meters and other units if applicable to the ship
- A brief description of the main ballast water management method(s) used on the ship; and
- Identification (rank) of the appointed ballast water management officer.

#### *E.1.4 Index*

An index of sections should be included to reference the content of the Plan.

#### *E.1.5 Purpose*

Should contain a brief introduction for the ship's crew, explaining the need for ballast water management, and the importance of accurate record keeping

#### *E.1.6 Plans/Drawings of the Ballast Water Treatment System*

Plans or drawings of the ballast system for example:

1. Ballast tank arrangement
2. Ballast capacity plan
3. A ballast water piping and pumping arrangement, including air pipes and sounding arrangements
4. Ballast water pump capacities
5. The ballast water management system used onboard, with references to detailed operational and maintenance manuals held on board
6. Installed ballast water treatment systems; and
7. A plan and profile of the ship, or a schematic drawing of the ballast arrangement and sampling locations.

#### *E.1.7 Description of the Ballast System*

A Description of the Ballast System

#### *E.1.8 Ballast Water Sampling Points*

Lists and/or diagrams indicating the location of sampling and access points in pipelines and ballast water tanks.

A note that sampling of ballast water is primarily a matter for the authorized authority, and there is unlikely to be any need for crew members to take samples except at the express request, and under the supervision, of the authorized authority.

#### *E.1.9 Operation of the Ballast Water Management System*

- A detailed description of the operation of the Ballast Water Management System(s) used on board.
- Information on general ballast water management precautionary practices.

#### *E.1.10 Safety Procedures for the Ship and the Crew*

Details of specific safety aspects of the ballast water management system used.

#### *E.1.11 Operational or Safety Restrictions*

Details of specific operational or safety restrictions including those associated with the management system which affects the ship and or the crew including reference to procedures for safe tank entry.

#### *E.1.12 Description of the Method(s) Used on Board for Ballast Water Management and Sediment Control*

Details of the method(s) used on board for the management of ballast and for sediment control including step-by-step operational procedures.

#### *E.1.13 Procedures for the Disposal of Sediments*

Procedures for the disposal of sediments at sea and to shore

#### *E.1.14 Methods of Communication*

Details of the procedures for co-ordinating the discharge of ballast in waters of a coastal State

#### *E.1.15 Duties of the Ballast Water Management Officer*

Outline of the Duties of the Designated Officer

#### *E.1.16 Recording Requirements*

Details of the Record-keeping Requirements of the Convention

#### *E.1.17 Crew Training and Familiarization*

Information on the provision of crew training and familiarization

#### *E.1.18 Exemptions*

Details of any exemptions granted to the ship under Regulation A-4.

#### *E.1.19 Approving Authority*

Details and stamp of approving authority

# Appendix F:
# IMO Ballast Water Treatment System Approval Process

## F.1 IMO Ballast Water Treatment System Approval Process

A ballast water treatment system (BWTS) will be installed on the ore carriers to prevent non-native organisms from being accidentally introduced into Canadian waters. The BWTS will be selected based on various parameters such as system type, size and cost. The BWTS selected will also be IMO and North American (Canadian) Coast Guard Approved. Baffinland is committed to meeting the Phase 2 discharge standards as described by the IMO.

The IMO Phase 2 discharge standards are:

- 1 organism (dimension of 50u or greater) per 100 m3
- 10 organisms (dimension of 10 to 50) per 100 mL
- 1,000 bacteria and 10,000 virus per 100 mL
- 1 colony-forming unit (cfu) of Vibrio cholerae (O1 and O139) per 100 mL or 1 cfu of V. cholerae per g (wet weight) of zooplankton
- 126 cfu of Escherichia coli per 100 mL; and
- 33 cfu of intestinal enterococci per 100 mL.

The IMO has a two-step Procedure for Approval of Ballast Water Management Systems that make use of Active Substances (G9) (resolution MEPC.126 (53)). The first step, Basic Approval, requires that the manufacturer provide the IMO with detailed information on all active substances used in the process. All chemicals must be identified and described, including those generated onboard. Data required includes the following:

1. Data on effects on aquatic plants, invertebrates, fish and other biota including sensitive and representative organisms:

    a. Acute aquatic toxicity
    b. Chronic aquatic toxicity
    c. Endocrine disruption
    d. Sediment toxicity
    e. Bioavailability/biomagnification/bioconcentration; and
    f. Food web/population effects.

2. Data on mammalian toxicity:

    a. Acute toxicity
    b. Effects on skin and eye
    c. Chronic and long-term toxicity
    d. Developmental and reproductive toxicity
    e. Carcinogenicity; and
    f. Mutagenicity.

3. Data on environmental fate and effects under aerobic and anaerobic conditions:

    a. Modes of degradation (biotic and abiotic).

b. Bioaccumulation, partition coefficient, octanol/water coefficient.
c. Persistence and identification of the main metabolites in relevant media (ballast water, marine and freshwater).
d. Reaction with organic matter.
e. Potential physical effects on wildlife and benthic habitats.
f. Potential residues in seafood; and
g. Any known interactive effects.

4. The following physical and chemical properties for the Active Substances and Preparations and treated ballast water, if applicable:

   a. Melting point
   b. Boiling point
   c. Flammability
   d. Density (relative density)
   e. Vapour pressure, vapour density
   f. Water solubility/dissociation constant (pKa)
   g. Oxidation/reduction potential
   h. Corrosivity to the materials or equipment of normal ship construction
   i. Autoignition temperature; and
   j. Other known relevant physical or chemical hazards.

5. Analytical methods

Testing of the active substances and preparations must be done in accordance with internationally recognized guidelines, preferably Organization for Economic Cooperation and Development (OECD) Guidelines for Testing of Chemicals (1993). These tests must be carried out following a strict Quality Management Plan (QMP) and Quality Assurance Project Plan (QAPP).

A risk characterization must also be carried out by the manufacturer in order to receive the Basic Approval. The risk characterization must include:

- Screening for persistency, bioaccumulation and toxicity
  - Persistence test should be assessed in a simulation test system that determines the half-life under relevant conditions. The determination of half-life should include assessment of all relevant chemicals. Biodegradation screening tests may also be included.
  - Bioaccumulation tests should measure bioconcentration factors in marine (or freshwater) organisms. Where these tests are not applicable, Bio Concentration Factor (BCF) values may be estimated using quantitative Structure-Activity Relationship models.
  - Toxicity tests should cover the life stages for both acute and chronic toxicity.
- Toxicity test of the treated ballast water
  - Discharge testing should be performed in a laboratory using techniques to simulate ballast water discharge following treatment by the system.

- Provide both acute and chronic toxicity data using standardized test procedures.
- Tests should be conducted on samples draw from land-based test set-up.
- Tests should include multiple test species (a fish, an invertebrate and a plant) that address sensitive life-stages.
- Tests results provided:
  - Acute (24, 48, 72 and 96 hr)
  - Lethal Concentration
  - No Observed Adverse Effects Concentration
  - Chronic No Observed Effect Concentration.

Once the data has been submitted, the IMO will evaluate all the information. One major aspect they will be considering is whether the active substance or associated relevant chemicals are persistent, bioaccumulative or toxic (PBT) as per the criteria outline in Table 1.

**TABLE F. 1: CRITERIA FOR IDENTIFICATION OF PBT SUBSTANCES (FROM PROCEDURE FOR APPROVAL OF BALLAST WATER MANAGEMENT SYSTEMS THAT MAKE USE OF ACTIVE SUBSTANCES (G9) (RESOLUTION MEPC.126(53))**

| Criterion | PBT criteria |
|---|---|
| Persistence | Half-life:<br>• >60 days in marine water, or;<br>• >40 days in freshwater*, or;<br>• >180 days in marine sediment: or;<br>• >120 days in freshwater sediment.* |
| Bioaccumulation | • BCF > 2,000, or;<br>• $LogP_{octanol/water} \geq 3$ |
| Toxicity | Chronic NOEC , 0.01 mg/L |

** For the purpose of marine environmental risk assessment half-life data in freshwater and freshwater sediment can be overruled by data obtained under marine conditions.*

The second step, Final Approval, commences once a Basic Approval has been awarded and is conducted according to the Guidelines for Approval of Ballast Water Management Systems (G8) MEPC.174(58). This involves the manufacturer submitting information regarding the design, construction, operation and functioning of the system. This includes manuals, drawings, system limitations, routine maintenance and troubleshooting procedures.

The testing itself will require a QMP and QAPP to ensure that the quality control management is in place. A set of tests will be conducted onboard an actual vessel where the vessel will be required to:

- Uptake ballast water
- Store the ballast water
- Treatment of ballast water consistent with normal ballast water management (except in the control tank); and,
- Discharge of treated ballast water.

Land-based testing is also required and includes:

- The uptake of ballast water via pumping.
- Storage of ballast water for at least five days.
- Treatment of ballast water (except a control tank); and,
- Discharge of ballast water via pumping.

Samples will be taken from both the onboard and land-based tests to determine if the discharged ballast water meets the Phase One standards.

To receive Final Approval a system, must undergo various tests which include:

- Vibration tests
- Temperature tests
- Humidity tests
- Test for protection against heavy seas
- Fluctuation in power supply; and,
- Inclination test.

As well, all samples analyzed from the onboard and land-based testing must pass the D-2 Regulations set out by the IMO. Should all these tests pass then the ballast water treatment system will be awarded the Final Approval and be considered an approved IMO treatment system to meet Regulation D-2 of the BMW Convention.

As previously noted, the Project ore carriers will only employ BWTS that have received this IMO Final Approval.

# Appendix G:
# Table of Concordance with NIRB Certificate No. 005 (Amendment # 01) Terms and Conditions

**The following table includes the NIRB Project Certificate 005 conditions (as per amendment #01 issued May 28, 2014).**
**The listing is for only those Certificate conditions that relate to the marine environment and which, therefore are the responsibility of the Marine Environment Working Group.**
**The table indicates whether and where applicable NIRB conditions have been addressed within the Shipping and Marine Wildlife Management Plan.**

**Table of Concordance – NIRB Project Certificate (No. 005) Terms and Conditions**

| NIRB Condition # | NIRB Term and Condition | SMWMP Section/Reference Location |
|---|---|---|
| | **Meteorology and Climate – Climate Monitoring** | |
| 1 | The Proponent shall use GPS monitoring or a similar means of monitoring at both Steensby Port and Milne Port, with tidal gauges to monitor the relative sea levels and storm surges at these sites. | 3.3.4 |
| | **Air Quality** | |
| 7 | The Proponent shall update its Air Quality and Noise Abatement Management Plan to include an expanded regional study area and provide for land-based monitoring stations designed to capture operations phase ship-generated SO2 and NO2 emissions through Foxe Basin and along the Hudson Strait.<br>*Commentary: It is anticipated that continuous monitoring rather than passive monitoring will be required at the land-based monitoring stations to identify if hourly exceedances occur.* | 6.2.1 |
| | **Freshwater Aquatic Environment including Biota and Habitat** | |
| 44 | 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. | See SWAEMP |

**Table of Concordance – NIRB Project Certificate (No. 005) Terms and Conditions (Cont`d)**

| NIRB Condition # | NIRB Term and Condition | SMWMP Section/Reference Location |
|---|---|---|
| 48 | The Proponent shall engage with Fisheries and Oceans Canada and the Qikiqtani Inuit Association in exploring possible Project specific thresholds for blasting that would exceed the requirements of Fisheries and Oceans Canada's Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters (D.G. Wright and G.E. Hopky, 1998). | See SWAEMP |
| 48(a) | The Proponent shall develop plans to conduct additional surveys for the presence of arctic char in freshwater bodies and ongoing monitoring of arctic char health where applicable, within watersheds proximal to the mine, tote road and Milne Inlet Port project development areas, including but not limited to, Phillips Creek, Tugaat and Qurluktuk. The Proponent shall consult with the MHTO regarding the design, timing, and location of proposed surveys and ongoing monitoring. | 6.4; Appendix H |
| **Birds** | | |
| 73 | 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. | 1.4 |
| 74 | 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. | TEMMP |
| **Marine Environment, Marine Water/Ice and Sediment Quality** | | |
| 76 | The Proponent shall develop a comprehensive Environmental Effects Monitoring Program to address concerns and identify potential impacts of the Project on the marine environment. | 6; Appendix H |
| 77 | 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, the Government of Nunavut, the Qikiqtani Inuit Association 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 for the MEWG filed in the Final Hearing, but they are not bound by them. | 1. 1.4 |
| 78 | 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.<br>*Commentary: The annual update for pack and lackfast ice includes not only identification of the naturally-occurring effects, but also must include information on effects on floe size, cover and concentration of pack and landfast ice that may be attributed to icebreaking activities.* | 6.1.1 |
| 79 | 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. | 3.3.4 |
| 80 | Prior to commercial shipping of iron ore, the Proponent shall conduct a detailed risk assessment for Project-related shipping accidents, noting areas along the ship tracks where vessels may be particularly vulnerable to environmental conditions such as sea ice, and any seasonal differences in risk. This assessment shall inform mitigation and adaptive management plans. | 5.8.1 |
| 81 | The Proponent shall reassess the potential for ship wake impacts to cause coastal change following any further changes to the proposed shipping routes. | 6.3.2 |
| 82 | The Proponent is strongly encouraged to have its ore carriers subjected to sea trials to measure wake characteristics at various vessel speeds and distances from the vessel. | 3 ; 3.1 |
| 83 | The Proponent shall install tidal gauges at the Steensby Inlet Port and Milne Inlet Port sites to monitor relative sea level and storm surges. | 3.3.4 |
| 83 (a) | To identify potential for and conduct monitoring to identify effects of sediment redistribution associated with construction and operation of the Milne Port. | 6.3 |

**Table of Concordance – NIRB Project Certificate (No. 005) Terms and Conditions (Cont`d)**

| NIRB Condition # | NIRB Term and Condition | SMWMP Section/Reference Location |
|---|---|---|
| 84 | The Proponent shall update its sediment redistribution modeling once ship design has been completed and sampling should be undertaken to validate the model and to inform sampling sites and the monitoring plan. | 6.3 |
| 85 | The Proponent shall develop a monitoring plan to verify its impact predictions associated with sediment redistribution resulting from propeller wash in shallow water locations along the shipping route. If monitoring detects negative impacts from sediment redistribution, additional mitigation measures will need to be developed and implemented. | 6.3; 6.3.2 |
| 86 | Prior to commercial shipping of iron ore, the Proponent shall use more detailed bathymetry collected from Steensby Inlet and Milne Inlet to model the anticipated ballast water discharges from ore carriers. The results from this modeling shall be used to update ballast water discharge impact predictions and should account for density dependent flow and annual timescales over the project life. Additional sampling should also be undertaken to validate the model and to inform sampling sites and the monitoring plan. | 6.3.3 |
| 87 | 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. | 6.3; Appendix H |
| 88 | Prior to commercial shipping of iron ore and in conjunction with the Marine Environment Working Group, the Proponent shall provide an updated risk analysis regarding ballast water discharge to assess the adequacy of treatment and implications on the receiving environment. This risk analysis shall consider, but not be limited to:<br>a. Invasive species;<br>b. Seasonal oceanography;<br>c. Ballast water quality and quantity;<br>d. Receiving water quality;<br>e. Residual physical, chemical, and/or biological effects; and<br>f. Any risk assessment analysis regarding ballast water exchange and treatment efficacy in arctic waters. | 5.5.1.1 |
| 89 | 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 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. | 5.5.1 |
| 90 | The Proponent shall incorporate into its Shipping and Marine Mammals Management Plan provisions to achieve compliance with the requirements under the International Convention for the Control and Management of Ship's Ballast Water and Sediment (2004) or its replacement and as implemented by the *Canadian Ballast Water and Control Regulations* as may be amended from time to time. | 5.5.1 |
| 91 | The Proponent shall develop a detailed monitoring plan for Steensby Inlet and Milne Inlet for fouling that complies with all applicable regulatory requirements and guidelines as issued by Transport Canada, and includes sampling areas on ships where antifouling treatment is not applied such as the areas where non-native species are most likely to occur. | 5.5.2 |
| 92 | 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. | 5.6 ; 5.8 |
| 93 | Prior to construction, based on vessel selection and if so required, the Proponent shall reassess the risk analysis of using vessel-based fuel storage, including the potential environmental impacts of containment failure under a range of winter ice conditions, how a spill might spread and the impact of fuel if it does not volatilize to the atmosphere. | Not addressed |
| 94 | The Proponent shall consult directly with affected communities regarding its plans for over-wintering of fuel in Steensby Inlet, with discussion topics to include descriptions of the duration of proposed activities, vessel type, spill preparedness and emergency response protocols, environmental impact predictions and answers to community member questions. | Not addressed |

| | | |
|---|---|---|
| 95 | The Proponent shall meet or exceed all regulatory regulations and requirements as apply to the practice of overwintering a fuel vessel in at Steensby Inlet, with reporting to the NIRB and Transport Canada. | Not addressed |

**Table of Concordance – NIRB Project Certificate (No. 005) Terms and Conditions (Cont`d)**

| NIRB Condition # | NIRB Term and Condition | SMWMP Section/Reference Location |
|---|---|---|
| 96 | The Proponent will update the NIRB on the results of all compliance monitoring and site inspections undertaken by government agencies for the overwintering of a fuel vessel in Steensby Inlet. | Not addressed |
| 97 | Prior to the commercial shipping of iron ore, the Proponent shall conduct fuel spill dispersion modeling that will, at a minimum, consider:<br>a. Modeling of oil spills for both the Northern and Southern Shipping Routes, in representative locations, identified by the Proponent, in consultation with the Marine Environment Working Group along both Shipping Routes, and including:<br>i. Pinch points;<br>ii. The approaches into Steensby Inlet and Milne Inlet;<br>iii. Shallow water and shorelines; and,<br>iv. Areas that have been identified as having high flows and/or high concentrations of marine mammals, marine fish or seabirds.<br>b. Open water and, where applicable, ice-covered conditions;<br>c. Spill volumes up to and including loss of a full tanker cargo; and,<br>d. Differences in the quantity and properties of each type of bulk fuel transported by vessels when they are at, or in transit to, the ports at Steensby Inlet and Milne Inlet. | 5.8.1 |
| 98 | The Proponent shall incorporate the results of revised fuel spill dispersion modeling into its impact predictions for the marine environment and its spill response and emergency preparedness plans. | 5.8.1 |
| | **Marine Wildlife** | |
| 99 | The Proponent, working with the Marine Environment Working Group, shall consider and identify priorities for conducting the following supplemental baseline assessments:<br>a. Establish shipping season, inter-annual baseline in Steensby Inlet and Milne Inlet that enables effective monitoring of physical and chemical effects of ballast water releases, sewage outfall, and bottom scour by ship props, particularly downslope and downstream from the docks. This shall include the selection and identification of physical, chemical, and biological community/indicator components. The biological indicators shall include both pelagic and benthic species but with emphasis on relatively sedentary benthic species (e.g., sculpins). | 6.1; 6.3; Appendix H |
| | b. The collection of additional baseline data:<br>i. in Steensby Inlet on walrus, beluga, bearded seal anadromous Arctic Char abundance, distribution ecology and habitat use; and<br>ii. In Milne Inlet on narwhal, bowhead and anadromous Arctic Char abundance, distribution ecology and habitat use. | 6.4; Appendix H |
| | c. Enhance baseline data on marine wildlife (fish, invertebrates, birds, mammals, etc.) and to provide more details on species abundance and distribution found in the Project area. This shall include, but not be limited to the following: . | 6.4; Appendix H |
| | i. Aerial surveys for basking ringed seals throughout the landfast ice of Steensby Inlet and at appropriate control location; and | 6.4; Appendix H |
| | ii. . Shore-based observations of pre-Project narwhal and bowhead whale behavior in Milne Inlet that continues at an appropriate frequency throughout the Early Revenue Phase and for not less than three consecutive years. | 6.4; Appendix H |
| | d iv Enhance the baseline for affected freshwater systems, which includes control sites to detect Project-related changes before they cause significant harm | See FWSWMP and SWAEMP |
| 100 | The Proponent shall update its Shipping and Marine Wildlife Management Plan, to include avoidance of polynyas and mitigation measures designed for potential fuel spills along the shipping lane during the winter months, with consideration for the impact of spilled fuel on marine mammals when they might be less mobile or able to avoid contact with spilt fuel or fumes. | 6.1.1. |
| 101 | The Proponent shall incorporate into the appropriate monitoring plans the following items:<br>a. A monitoring program that focuses on walrus use of Steensby Inlet and their reaction to disturbance from construction activities, aircraft, and vessels; | 6.4; Appendix H |

**Table of Concordance – NIRB Project Certificate (No. 005) Terms and Conditions (Cont`d)**

| NIRB Condition # | NIRB Term and Condition | SMWMP Section/Reference Location |
|---|---|---|
| | b. Efforts to involve Inuit in monitoring studies at all levels; | 1.1 |
| | c. Monitoring protocols that are responsive to Inuit concerns; | 1.1; 1.4; 6.0 |
| | d. Marine monitoring protocols are to consider the use of additional detecting devices to ensure adequate monitoring through changing seasonal conditions and daylight; | 6.4; Appendix H |
| | e. Schedule for periodic aerial surveys as recommended by the Marine Environment Working Group; | 6.4; Appendix H |
| | f. Periodic aerial surveys for basking ringed seals throughout the landfast ice of Steensby Inlet, and a suitable control location. Surveys shall be conducted at an appropriate frequency to detect change inter-annual variability; | 6.4; Appendix H |
| | G Shore-based observations of pre-Project narwhal behavior in Milne Inlet, that continues at an appropriate frequency throughout the Early Revenue Phase (not less than three years); | 6.4; Appendix H |
| | h. Conduct landfast ice monitoring for the duration of the Project Operations phase, which will include: | 6.1.1 |
| | i. The number of ship transits that are able to use the same track; and, | 6.1.1 |
| | ii. The area of landfast ice disrupted annually by ship traffic; and | 6.1.1 |
| | i. Monitoring strategy focused on assessing and mitigating interaction between humans and wildlife at the port site(s). | 5.3 |
| 102 | The Proponent shall ensure that routing of project vessels is tracked and recorded for both the southern and northern shipping routes, with data made accessible in real time to communities in Nunavut and Nunavik. | 3.3 |
| 103 | The Proponent shall report annually to the NIRB regarding project-related ship track and sea ice information, including:<br>f. A record of all ship tracks taken along both shipping routes covering the entire shipping season;<br>g. An overlay of ship tracks onto ice imagery to determine whether ships are effectively avoiding shore leads and polynyas;<br>h. A comparison of recorded ship tracks to the expected nominal shipping route, and probable extent of year-round shipping during periods of ice cover and open-water;<br>i. An assessment of the level of adherence to the nominal shipping route and the spatial extent of the shipping zone of influence; and<br>j. Marine bird and mammal species and number of individuals attracted to ship tracks in ice. | 6.1.1 |
| 104 | Subject to safety considerations and the potential for conditions as determined by the crew of transiting vessels, to result in route deviations,<br>**a.** the Proponent shall require, for shipping to/from Steensby Port, project vessels to maintain a route to the south of Mill Island to prevent disturbance to walrus and walrus habitat on the northern shore of Mill Island. Where project vessels are required to transit to the north of Mill Island owing to environmental or other conditions, an incident report is to be provided to the Marine Environment Working Group and the NIRB within 30 days, noting all wildlife sightings and interactions as recorded by shipboard monitors.<br>**b.** The Proponent shall summarize all incidences of significant deviations from the nominal shipping routes for traffic to/from Milne Port and Steensby Port as presented in the FEIS and FEIS Addendum to the NIRB annually, with corresponding discussion regarding justification for deviations and any observed environmental impacts. | 6.1.1 |

**Table of Concordance – NIRB Project Certificate (No. 005) Terms and Conditions (Cont`d)**

| NIRB Condition # | NIRB Term and Condition | SMWMP Section/Reference Location |
|---|---|---|
| 105 | The Proponent shall ensure that measures to reduce the potential for interaction with marine mammals, particularly in Hudson Strait and Milne Inlet, are identified and implemented prior to commencement of shipping operations. These measures could include, but are not limited to: | 5.3 |

| | | |
|---|---|---|
| | a. Changes in the frequency and timing (including periodic suspensions) of shipping during winter months in Hudson Strait and during the open water season in Milne Inlet, i.e., when interactions with marine mammals are likely to be the most problematic;<br>b. Reduced shipping speeds where ship-marine mammal interactions are most likely; and<br>c. Identification of alternate shipping routes through Hudson Strait for use when conflicts between the proposed routes and marine mammals could arise. Repeated winter aerial survey results showing marine mammal distribution and densities in Hudson Strait would greatly assist in this task. | |
| 106 | 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. . | 6.4; Appendix H |
| 107 | The Proponent shall revise the proposed "surveillance monitoring" to improve the likelihood of detecting strong marine mammal, seabird or seaduck responses occurring too far ahead of the ship to be detectable by observers aboard the ore carriers. A baseline study early in the shipping operations could employ additional surveillance to detect potential changes in distribution patterns and behavior. At an ambitious scope, this might be achieved using unmanned aircraft flown ahead of ships, or over known areas of importance for seabirds or haul-out sites in the case of walruses, in accordance with the requirements of their Special Flight Operations Certificate. | 6.4; Appendix H |
| 108 | The Proponent shall ensure that data produced by the surveillance monitoring program is analysed rigorously by experienced analysts (in addition to being discussed as proposed in the FEIS) to maximize their effectiveness in providing baseline information, and for detecting potential effects of the Project on marine mammals in the Regional Study Area. It is expected that data from the long-term monitoring program be treated with the same rigor. | 6 |
| 109 | The Proponent shall conduct a monitoring program to confirm the predictions in the FEIS with respect to disturbance effects from ships noise on the distribution and occurrence of marine mammals. The survey shall be designed to address effects during the shipping seasons, and include locations in Hudson Strait and Foxe Basin, Milne Inlet, Eclipse Sound and Pond Inlet. The survey shall continue over a sufficiently lengthy period to determine the extent to which habituation occurs for narwhal, beluga, bowhead and walrus. | 6.4; Appendix H |
| 110 | The Proponent shall immediately develop a monitoring protocol that includes, but is not limited to, acoustical monitoring, to facilitate assessment of the potential short term, long term, and cumulative effects of vessel noise on marine mammals and marine mammal populations. The Proponent is expected to work with the Marine Environment Working Group to determine appropriate early warning indicator(s) that will ensure rapid identification of negative impacts along the southern and northern shipping routes. | 6.4; Appendix H |
| 111 | The Proponent shall develop clear thresholds for determining if negative impacts as a result of vessel noise are occurring. Mitigation and adaptive management practices shall be developed to restrict negative impacts as a result of vessel noise. This shall include, but not be limited to:<br>a. Identifications of zones where cumulative noise could be mitigated due to biophysical features (e.g., water depth, distance from migration routes, distance from overwintering areas etc.); and<br>b. Vessel transit planning, for all seasons, to determine the degree to which cumulative sound impacts can be mitigated through the seasonal use of different zones. | 6.2 |

**Table of Concordance – NIRB Project Certificate (No. 005) Terms and Conditions (Cont`d)**

| NIRB Condition # | NIRB Term and Condition | SMWMP Section |
|---|---|---|
| 112 | Prior to commercial shipping of iron ore, the Proponent, in conjunction with the Marine Environment Working Group, shall develop a monitoring protocol that includes, but is not limited to, acoustical monitoring that provides an assessment of the negative effects (short and long term cumulative) of vessel noise on marine mammals. Monitoring protocols will need to carefully consider the early warning indicator(s) that will be best examined to ensure rapid identification of negative impacts. Thresholds shall be developed to determine if negative impacts as a result of vessel noise are occurring. Mitigation and adaptive management practices shall be developed to restrict negative impacts as a result of vessel noise. This shall include, but not be limited to:<br>d. Identification of zones where noise could be mitigated due to biophysical features (e.g., water depth, distance from migration routes, distance from overwintering areas etc.);<br>e. Vessel transit planning, for all seasons;<br>f. A monitoring and mitigation plan is to be developed, and approved by Fisheries and Oceans Canada prior to the commencement of blasting in marine areas. | 6.4; Appendix H |
| 113 | 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. | 6.4; Appendix H |
| 114 | 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, taste) is maintained to address any additional monitoring issues identified by the MEWG relating to the commercial fishery. | 6.1 ; 1.4 |
| 115 | The Proponent is encouraged to continue to explore off-setting options in both the freshwater and marine environment to offset the serious harm to fish which will result from the construction and infrastructure associated with the Project. | 5.2 ; 6.3.1 |
| 116 | Prior to construction, the Proponent shall develop mitigation measures to minimize the effects of blasting on marine fish and fish habitat, marine water quality and wildlife that includes, but is not limited to compliance with the Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters (Wright and Hopky, 1998) as modified by Fisheries and Oceans Canada for use in the North and as revised from time to time. | 5.2; 5.3 |
| 117 | The Proponent shall ensure that blasting in, and near, marine water shall only occur during periods of open water. Blasting in, and near, fish-bearing freshwaters shall, to the greatest degree possible, only occur in open water. If blasting is required during ice-covered periods, it must meet requirements established by Fisheries and Oceans Canada. | 5.3 |
| 118 | The Proponent shall incorporate into the appropriate mitigation plan prior to construction, thresholds for the use of specific mitigation measures meant to prevent or limit marine wildlife disturbance, such as bubble curtains for blasting, and nitrate removal. | 5.2 |
| 119 | The Proponent shall, in conjunction with the Marine Environment Working Group, monitor ringed seal birth lair abundance and distribution for at least two years prior to the start of icebreaking to develop a baseline, with continued monitoring over the life of the project as necessary to test the accuracy of the impact predictions and determine if mitigation is needed. Monitoring shall also include a control site outside of the Project's zone of influence. | 6.4; Appendix H |
| 120 | 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:<br>a. Wildlife will be given right of way;<br>b. Ships will when possible, maintain a straight course and constant speed, avoiding erratic behavior; and<br>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.<br>*Commentary: As noted previously, unless otherwise stated, the term "marine mammals" as used throughout the Project Certificate includes polar bears.* | 5.3 |

**Table of Concordance – NIRB Project Certificate (No. 005) Terms and Conditions (Cont`d)**

| NIRB Condition # | NIRB Term and Condition | SMWMP Section |
|---|---|---|
| 121 | 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:<br>g. Date, time and location of the incident;<br>h. Species of marine mammal or seabird involved;<br>i. Circumstances of the incident;<br>j. Weather and sea conditions at the time;<br>k. Observed state of the marine mammal or sea bird colony after the incident; and,<br>l. Direction of travel of the marine mammal after the incident, to the extent that it can be determined. | 5.8.4 |
| 122 | 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. | 5.8.4; Appendix H |
| 123 | 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. | 5.3 ; 5.8.4; Appendix H |
| 124 | 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. | 3.3.3 |
| 125 | Prior to use of acoustic deterrent devices, the Proponent shall carry out consultations with communities along the shipping route to assess the acceptability of these devices. Feedback received from community consultations shall be incorporated into the appropriate mitigation plan. | 5.3 |
| 125a | 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. | 3.3 |
| 126 | The Proponent shall design monitoring programs to ensure that local users of the marine area in communities along the shipping route have opportunity to be engaged throughout the life of the Project in assisting with monitoring and evaluating potential project-induced impacts and changes in marine mammal distributions. | 6 ; 6.1 |
| 127 | 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. | 6 ; 6.1 |
| 128 | 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 Destruction of Fish and Fish Habitat (HADD). | 5.2; 1.2.1 |
| **Culture, Resources and Land Use** | | |
| 162 | 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, and land use as such may be implicated or impacted by ongoing Project activities. | 6.1 |
| 163 | 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. | 6 |
| 164 | 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. . | 6.1 |
| 166 | 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. | 6.1 |

| | | |
|---|---|---|
| 174 | The Proponent and the Canadian Coast Guard are required to provide spill response equipment and annual training to Nunavut communities along the shipping route to potentially improve response times in the event of a spill. | 5.8.2 |
| 175 | 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. | Not addressed |
| 176 | The Proponent is required to revise its spill planning to include additional trajectory modeling for areas of Hudson Strait, such as Mill Island, where walrus concentrate, as well as for mid-Hudson Strait during winter conditions as well as for the northern shipping route, including Milne Inlet, Eclipse Sound and Pond Inlet. | 5.8.1 |
| 177 | The Proponent shall enroll any foreign flagged vessels commissioned for Project-related shipping within Canadian waters into the relevant foreign programs equivalent to Transport Canada's Marine Safety Delegated Statutory Inspection Program. | 3.1 ; Appendix B |
| **Alternatives Analysis** | | |
| 178 | Subject to safety considerations and the potential for conditions, as determined by the crew of transiting vessels, to result in route deviations, the Proponent shall require project vessels to maintain a route to the south of Mill Island to prevent disturbance to walrus and walrus habitat on the northern shore of Mill Island. | 3 |
| **Transboundary Effects** | | |
| 181 | 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. | 1.4 |
| 182 | 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 | 1.4 |

# Appendix H:

# Marine EEM Plan

# Baffinland Iron Mines Corporation

## Marine Environmental Effects Monitoring Plan

## BAF-PH1-830-P16-0046

## Rev 0

**Prepared By:** Jennifer St. Paul Butler
**Department:** Environment
**Title:** Sustainability and Reporting Specialist
**Date:** March 17, 2016
**Signature:**

**Approved By:** Oliver Curran
**Department:** Environment
**Title:** Sustainable Development - Director
**Date:** March 17, 2016
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# 1 INTRODUCTION

Baffinland Iron Mines Corporation (Baffinland) is committed to implementing an Environmental Effects Monitoring (EEM) Program for the Mary River Project (the Project). The EEM program is a component of the Baffinland Environmental Management Program. This document is Baffinland's Marine Environmental Effects Monitoring Plan (MEEMP). The MEEMP addresses marine ecology and marine mammals. EEM plans also exist for the terrestrial environment (Baffinland 2015) and freshwater aquatic environment (Baffinland 2014).

The MEEMP has been developed in accordance with the principles described in the EEM Framework document (Baffinland 2012; Vol. 10 App 10D-13) and is intended to communicate EEM results to Baffinland, the Marine Environment Working Group (MEWG), regulators, resource managers and the Nunavut Impact Review Board (NIRB). The document will be modified on a regular basis, likely annually, as results from monitoring programs are analysed and assessed.

The objectives of the MEEMP are to:

- address regulatory requirements, especially those listed in NIRB Project Certificate No. 005;
- develop a comprehensive and integrated environmental monitoring program that includes follow-up as required;
- incorporate an ecosystem-based approach for monitoring and management of Project-related environmental effects; and
- coordinate all aspects of project-related marine environment effects monitoring.

## 1.1 CORPORATE COMMITMENTS AND REGULATORY REQUIREMENTS

The Mary River Project was awarded Project Certificate No. 005 by the Nunavut Impact Review Board (NIRB) in December 2012. Following a supplementary application (Early Revenue Phase-ERP) the certificate was amended in April 2014. A complete reconciliation between NIRB Certificate Conditions and Marine/shipping issues (relevant to the scope of the MEWG) are presented as Appendix G to the Shipping and Marine Wildlife Monitoring Plan (SMWMP 2015). The SMWMP presents the mitigation measures that resulted from Baffinland's planning process, as well from the regulatory review of the Project.

Table 1.1 below provides an overview of the linkages between the original effects predictions made in the Project Environmental Impact Statement (including the EIS Addendum for the ERP), the Project Approval conditions contained in the NIRB Certificate No. 005, and the monitoring program elements contained in this document.

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The residual environmental effects of project activities on each VEC were evaluated in the Final EIS Addendum (Baffinland 2013; Volume 8, Tables 8-4.12 & 8-4.17) and the significance rating and associated level of confidence is brought forward in Table 1.1. The NIRB terms and conditions that include monitoring requirements for the marine environment are listed according to each Project-environment interaction.

One of the key determinants of the requirement for monitoring is the level of certainty associated with each specific effects prediction. Combined with the regulatory requirements as issued by NIRB, the basis for the MEEMP is displayed in this overview table.

In the case of effects of construction activities (i.e., pile driving) at Milne Port, mitigation measures were implemented, acoustic measurements were taken, and visual monitoring was conducted in 2014 based on the approach outlined in the FEIS Addendum and the NIRB Project Certificate condition #14(a) requirement. A subsequent monitoring report was prepared by ERM (ERM 2015) and is not considered further in this document.

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**Table 1.1 Summary of Marine VEC Interactions Relative to EIS Predictions and NIRB Project Certificate Conditions.**

| Valued Ecosystem Component | Potential Project Interaction(s)[1] | Key Indicator(s)[1] | Significance Rating[1] | Level of Confidence[1] | Project Condition(s) |
|---|---|---|---|---|---|
| Marine Water Quality | Ballast water discharge from ore carriers at Milne Inlet | Changes in salinity and/or temperature of receiving environment | Not Significant | Medium | NIRB #86<br>NIRB #99 |
| | Site discharge to marine environment | Increases in total suspended solids (TSS) | Not Significant | High | NIRB #99 |
| | Dust deposition from activities at Milne Port | Increases in TSS | Not Significant | Medium | NIRB #99 |
| Marine Sediment Quality | Site discharge to marine environment | Increases in sediment metals, hydrocarbons;<br>Changes to sediment particle grain size | Not Significant | High | NIRB #83(a)<br>NIRB #99 |
| | Dust deposition from ore at Milne Port | Increases in sediment metals, hydrocarbons;<br>Changes to sediment particle grain size | Not Significant | Medium | NIRB #83(a)<br>NIRB #99 |
| | Propeller wash from vessel traffic to/from Milne Port | Changes to sediment particle grain size | Not Significant | High | NIRB #85<br>NIRB #86<br>NIRB #99 |
| Marine Habitat | Dust deposition from ore at Milne Port | Changes to habitat type/class;<br>Changes to benthic epifauna abundances. | Not Significant | Medium | NIRB #99 |
| | Propeller wash from vessel traffic to/from Milne Port | Changes to habitat type/class;<br>Changes to benthic epifauna abundances. | Not Significant | High | NIRB #83(a)<br>NIRB #85<br>NIRB #99 |
| Marine Biota: Benthic Fish | Site discharge to marine environment | Decrease in fish health/condition;<br>Decrease in population size. | Not Significant | Medium | NIRB #99 |
| | Dust deposition from ore at Milne Port | Decrease in fish health/condition;<br>Decrease in population size. | Not Significant | Medium | NIRB #99 |
| Marine Biota: Arctic Char | Site discharge to marine environment | Decrease in fish health/condition; | Not Significant | Medium | NIRB #113 |

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**Table 1.1 Summary of Marine VEC Interactions Relative to EIS Predictions and NIRB Project Certificate Conditions.**

| Valued Ecosystem Component | Potential Project Interaction(s)[1] | Key Indicator(s)[1] | Significance Rating[1] | Level of Confidence[1] | Project Condition(s) |
|---|---|---|---|---|---|
| | | Decrease in population size. | | | |
| | Dust deposition from ore at Milne Port | Decrease in fish health/condition; Decrease in population size. | Not Significant | Medium | NIRB #113 |
| | Propeller wash and ballast water from vessel traffic to/from Milne Port | Decrease in fish health/condition; Decrease in population size. | Not Significant | Medium | NIRB #85 NIRB #113 |
| Marine Biota: Aquatic Invasive Species | Ballast water discharge at Milne Inlet from ore carriers | Introductions of aquatic invasive species (Presence/ Absence). | "Lower"[2] | "High Level of Uncertainty"[2] | NIRB #87 |
| | Propeller wash and ballast water from vessel traffic to/from Milne Port | Decrease in fish health/condition; Decrease in population size. | Not Significant | Medium | NIRB #85 NIRB #113 |
| Narwhals | Disturbance from shipping along northern shipping route (Project Phase: Construction, Operation) | Changes in distribution/abundance | Not Significant | Low | NIRB #99, 101, 109, 110, 111, 112 |
| | Disturbance/hearing impairment during construction at Milne Port, notably pile driving (Project Phase: Construction) | Changes in distribution/abundance; Exposure to sound levels from pile driving that exceed established level. | Not Significant | High | NIRB #14(a) |
| | Ship strike | Mortality/serious injury | Not Significant | High | NIRB #106, 107, 108, 123 |
| Bowhead Whales | Disturbance from shipping along northern shipping route (Project Phase: Construction, Operation) | Changes in distribution/abundance | Not Significant | Low | NIRB #99, 109, 110, 111, 112 |
| | Disturbance/hearing impairment during construction at Milne Port, notably pile driving (Project Phase: Construction) | Changes in distribution/abundance; Exposure to sound levels from pile driving that exceed established level. | Not Significant | High | NIRB #14(a) |

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**Table 1.1 Summary of Marine VEC Interactions Relative to EIS Predictions and NIRB Project Certificate Conditions.**

| Valued Ecosystem Component | Potential Project Interaction(s)[1] | Key Indicator(s)[1] | Significance Rating[1] | Level of Confidence[1] | Project Condition(s) |
|---|---|---|---|---|---|
| | Ship strike | Mortality/serious injury | Not Significant | High | NIRB #106, 107, 108, 123 |
| Beluga Whales | Disturbance from shipping along northern shipping route (Project Phase: Construction, Operation) | Changes in distribution/abundance | Not Significant | Low to Medium | NIRB #109, 110, 111, 112 |
| | Disturbance/hearing impairment during construction at Milne Port, notably pile driving (Project Phase: Construction) | Changes in distribution/abundance; Exposure to sound levels from pile driving that exceed established level. | Not Significant | High | NIRB #14(a) |
| | Ship strike | Mortality/serious injury | Not Significant | High | NIRB #106, 107, 108, 123 |
| Ringed Seals, Bearded Seals, Walruses | Disturbance from shipping along northern shipping route (Project Phase: Construction, Operation) | Changes in distribution/abundance | Not Significant | High | NIRB #109, 110, 111, 112 |
| | Disturbance/hearing impairment during construction at Milne Port, notably pile driving (Project Phase: Construction) | Changes in distribution/abundance; Exposure to sound levels from pile driving that exceed established level. | Not Significant | High | NIRB #14(a) |

1. Information for the Potential Project Interactions, Key Indicators, Significance Rating and Level of Confidence are taken from FEIS Addendum Vol. 8, Section 5.
2. Significance rating and level of confidence determined from Chan *et al*. (2012); Relative Invasion Risk of Milne Inlet by Ballast-mediated Nonindigenous Species ranked "Lower" compared to other arctic ports (Baffinland 2013; Ballast Water Risk Assessment, FEIS Addendum Vol. 8, Appendix 8D-4, revised December 2013)

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# 2 EEM APPROACH

The purposes for conducting an EEM program are to:

1. provide data so that project activities can be scheduled and/or planned to avoid or reduce conflict;
2. evaluate the accuracy of effects predictions;
3. evaluate the effectiveness of mitigations;
4. identify unforeseen environmental effects;
5. provide an early warning of undesirable change in the environment;
6. improve the understanding of cause-effect relationships with respect to Project-induced change; and
7. assist in the identification of target species and linkages for monitoring;

There are three categories of study which follow from these purposes:

**Research** — background studies intended to establish need for, or parameters of, an EEM program. Research studies may address issues such as natural variability of a measured parameter or monitoring target, or examine the nature, extent or duration of a potential Project/VEC interaction. Research studies address Purpose no. 7 (above).

**Surveillance** — programs to produce information about the pattern of occurrence of target species/monitoring targets. Surveillance studies (e.g., to establish travel patterns of migratory animals through the Project area) address Purpose no. 1 and 5 (above) for EEM.

**EEM** — programs to address and quantify cause and effect linkages between Project activities and components of the receiving environment. The full rigor of design criteria would apply to this type of monitoring program, which would address one or more of Purposes no. 1 through no. 6 (above).

**Research** studies are conducted primarily to determine the need for further monitoring and if a program is deemed necessary, to identify target species and linkages. Research is usually only done once near the beginning of the Project. Upon the determination that an EEM program is necessary, either a surveillance program or an EEM program is initiated. **Surveillance** monitoring is usually short term and is typically designed to identify potential mitigation measures to avoid Project interactions. A surveillance program can also commonly serve to identify a change in conditions which could trigger an EEM. A full scale **EEM** program is typically long term and is usually multifaceted.

Some studies may be one-off research topics that address a fundamental question usually related to determining whether an interaction is possible or is occurring between the Project and the receiving environment. Other selected studies may be grouped into a surveillance category, including programs that can detect a change in the environment, but are not capable of establishing a clear cause and effect link to the Project. These surveillance programs can act as early warning indicators (EWI) and have the potential of triggering a full EEM Study.

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In developing the EEM program, Baffinland has sought to ensure that all relevant issues have been addressed, while avoiding the tendency to carry out a broad spectrum of poorly focused efforts. To accomplish this, emphasis is placed on monitoring and studying Project-induced change and addressing the challenge of establishing cause and effect relationships between the Project and the identified monitoring targets.

Monitoring which simply records change is not Effects Monitoring. EEM must be relevant to the Project and to the possible effects which the Project will have on the environment. EEM must be capable of establishing a relationship between any observed change in the environment and some feature of the Project.

In EEM, it is necessary to establish protocols for evaluating data to determine if there is a need to modify monitoring plans or develop and implement corrective action as per the procedure illustrated in Figure 2.1. Thus, thresholds will need to be established for each monitoring program in a number of possible ways:

- Exceedance of background or baseline data by a prescribed proportion (e.g., percentage);
- Exceedance of an established "no observable effects concentration";
- Exceedance of "meaningful change" threshold criteria;
- Exceedance of background or baseline data by an amount which is "statistically significant"; or
- Observance of levels which are known to cause an environmental effect.

For each monitoring program, appropriate thresholds will be established for the parameters and environmental effects being monitored. When thresholds are exceeded, the appropriate staff and management within Baffinland will be notified. As well, the appropriate regulatory agencies and monitoring partners will be notified and consulted. The cause of the exceedance and its nature will be investigated. An action plan will be developed and appropriate mitigation measures will be implemented. As per Baffinland's Environmental, Health and Safety (EHS) Management System requirement, the EEM program will be reviewed by the Marine Environment Working Group (MEWG), and, if necessary, modified to ensure that it continues to be relevant and appropriate.

As shown Figure 2.1, Baffinland's process for response to an identified effect includes a feedback loop to evaluate each program and achieve continuous improvement in EEM design and implementation. By proper selection of monitoring parameters, these can serve as EWI of change. Such indicators occur at the start of the pathway between a Project related influence (e.g., discharge) and a receptor or VEC. Generally, EWIs consist of the direct measurement of an environmental variable (e.g., metal levels in water) in the zone of influence (ZOI) (e.g., compliance monitoring for discharges containing metals).

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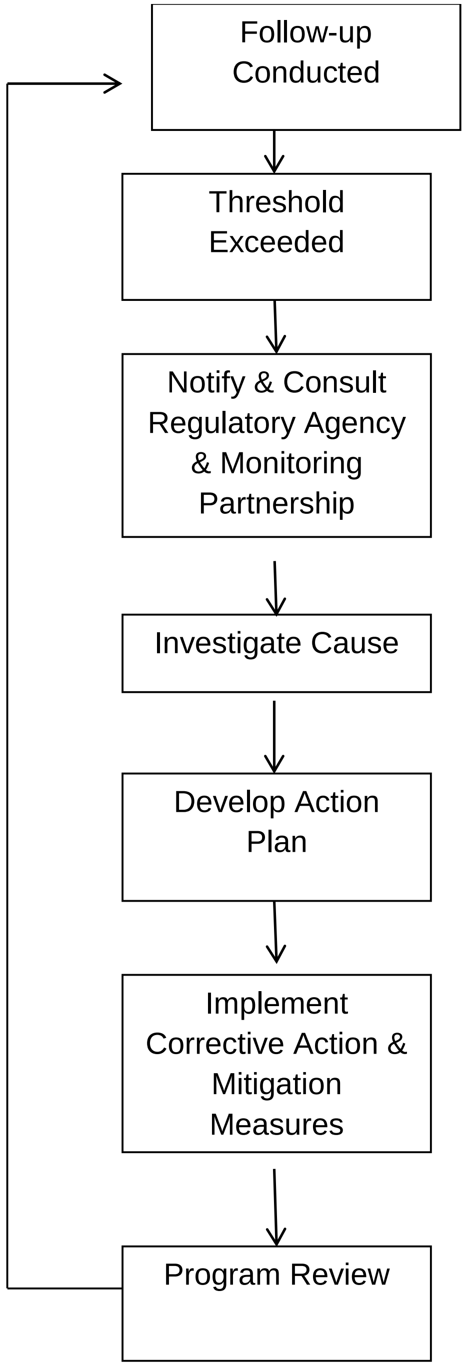


**Figure 2.1 Follow-up Threshold Exceedance Procedures.**

Surveillance level EEM studies can also serve as EWIs where an observed change in conditions could trigger a more complete EEM study, or increase the temporal and/or spatial scope of monitoring. Results from EEM studies could also serve to initiate other monitoring. An EEM program focused at one ecosystem level (e.g., benthic invertebrates) could produce evidence of change, which triggers further monitoring at other ecosystem levels (e.g., fish populations). In some cases, relatively short-term research programs are conducted as a means to identify or select an EWI. Based on the results of such preliminary studies, a full scale, properly designed EEM program may be initiated.

Program review can be triggered by an exceedance of an EWI. As well, an annual review will be conducted to assess the relevance of each program in light of Project activities, emerging developments in EEM methods and changes in issues or concerns as identified by Baffinland, its partners and stakeholders. The MEWG established for the Mary River Project will play an important role in providing input and review of the EEM Plan and results.

## 2.1 PROGRAM SELECTION CRITERIA

The set of criteria to be applied in considering candidate monitoring studies include:

- A credible 'cause and effect' relationship can be established;
- The identified effect has the potential to be negative:
  - The effect is considered significant;
  - The likelihood is high or moderate; and
  - The timing of interaction between the Project and the VEC will be sustained;
- A credible, unplanned event which could result in a significant negative effect; and
- The level of confidence in the predicted effect is low.

The result is a pattern of interconnected monitoring programs, each of which meets selection criteria and design requirements for marine EEM, and together, provide a comprehensive monitoring plan. Through examination of the measured changes in the selected indicators, conclusions can be drawn with respect to project interactions and impacts on the marine ecosystem.

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# 3 MARINE ECOLOGICAL EFFECTS MONITORING (MEEMP — ECOSYSTEM)

The MEEMP uses a scientific approach to address regulatory requirements, public concerns and reflect good environmental assessment practice. The goals and objectives of the respective monitoring program components are clearly stated to ensure the results are scientifically defensible and relevant. The objectives of the EEM studies address the need to confirm predictions and to confirm effectiveness of mitigation measures. Predictions of potential effects of Project activities on the marine environment are contained within the Project FEIS (Baffinland 2012) and include consideration of the spatial extent of effects. Predicted residual environmental effects are rated as "Not Significant" in cases where the effect is confined (e.g., to the Local Study Area). Thus monitoring of such effects will be in reference to the predicted geographic extent of measurable environmental changes. Changes that remain within the predicted boundaries will confirm effects predictions; conversely, should changes be detectable beyond the set boundaries, the effects prediction would need to be revised and adaptive management procedures considered.

For the purpose of EEM, the spatial extent of predicted effects will be referred to as the ZOI. From the FEIS, each interaction has been assigned a physical boundary based on available information of Project activities, including dust deposition modeling (Baffinland 2012; Volume 5, Section 2.6) and ballast water dispersion modeling (Baffinland 2012; Volume 8, Appendix 8B-3).

In addition to evaluating predictions and the effectiveness of mitigation measures, the various monitoring programs serve as early warning indicators that will help identify exceedances or unanticipated effects. Identification of such triggers will result in additional monitoring studies or the implementation of mitigation measures and/or corrective actions.

## 3.1 QUESTIONS FOR HYPOTHESIS FORMULATION

Several questions that arose during the review of the EIS and Addendum (ERP) were helpful in formulating the hypotheses needed to guide development of the MEEMP--Ecosystem. These include the following:

1. Will water quality deteriorate with respect to the Canadian Council of Ministers of the Environment (CCME) guidelines as a result of Project activities at Milne Port?
    a. Will water temperature increase due to ballast water discharge?
    b. Will nutrient concentrations change as a result of combined or confounding effects of ballast water discharge, site discharge and dust deposition?
    c. Will water quality variables (TSS, metals, hydrocarbons) increase due to site discharge and dust deposition in the marine environment?

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2. Will sediment quality variables change as a result of Project activities at Milne Port?
   a. Will particle grain size gradients change as a result of Project-induced re-distribution of sediment and/or dust deposition?
   b. Will metals increase as a result of dust deposition and/or site discharge?
   c. Will hydrocarbons increase as a result of dust deposition and/or site discharge?
3. Will the benthic marine habitat exhibit measurable changes due to Project activities at Milne Port?
   a. Will percent cover of macroflora change as a result of re-distribution of sediments from Project shipping propeller wash and/or dust deposition?
   b. Will the distribution of substrate types exhibit change as a result of re-distribution of sediments from Project shipping propeller wash and/or dust deposition?
4. Will the benthic marine fauna exhibit measurable changes due to Project activities at Milne Port?
   a. Will benthic marine epifauna abundance change as a result of Project-induced changes in marine benthic habitat?
5. Are there any identified differences in contaminant concentrations that can be attributed to the Project?
6. Do contaminant concentrations occur at levels where potential biological effects might occur?
7. Will changes to the marine habitat that can be attributed to Project activities reach an equilibrium at some point during Project operations?

## 3.2 MARINE ECOSYSTEM EEM CANDIDATE STUDIES SELECTION

To address the potential effects on the marine environment summarized in Table 1.1, a series of monitoring studies were developed with respect to benthic habitat, sediment, water quality, epibenthic community, and selected fish species (summarized in Table 3.1). A detailed justification for the level of monitoring is provided in Sections 3.2.1 to 3.2.7.

### 3.2.1 Benthic Habitat

Marine benthic habitat comprises several environmental components, including both physical (e.g., water depth, substrate character) and biological (e.g., floral and faunal communities) aspects. An integrated approach to investigating contaminant pathways in the marine benthic habitat could elucidate linkages between Project activities and environmental changes ultimately affecting biological communities. Underwater videography is a powerful technique that can collect data on multiple variables at one time within a large spatial extent around Milne Port. Furthermore, video data can be collected in large quantities and archived for selective analysis at any time. Depending on the extent of environmental change, high level changes in substrate characteristics, percent macroflora coverage, or the epibenthic community cover could be detected using underwater videography. These data could also help elucidate

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and/or corroborate any changes that might be observed in other datasets for physical or chemical variables.

**Table 3.1 Summary of EEM Studies According to Current Program Level.**

| Study Program Candidate | Type | Description |
|---|---|---|
| Benthic Habitat | EEM | Underwater videography to characterize benthic habitat, substrate type/class and compare changes over time as a function of distance from Milne Port to determine linkage to Project activities. |
| Sediment | EEM | Sediment samples to measure particle size fines percent and compare changes over time as a function of distance from Milne Port to determine linkage to Project activities |
| Sediment | Surveillance | Sediment samples to measure petroleum hydrocarbon concentrations at select stations and compare to CCME guidelines. |
| Sediment | EEM | Sediment samples to measure iron concentration gradient as a function of distance from Milne Port and compare changes over time to determine linkage to Project activities. |
| Water | Surveillance | Water sampling to measure TSS, salinity, temperature, pH, metals, nutrient and hydrocarbon concentrations at select stations and compare to CCME guidelines. |
| Epibenthic Community | EEM | Underwater videography to enumerate benthic epifauna and compare changes over time to determine linkage to Project activities. Supplemental information on macroflora percent cover and substrate classification used to elucidate potential response of benthic community to Project activities. |
| Fish: Sculpin species | Surveillance | Opportunistic sampling of contaminants in fish flesh (from mortalities) during routine monitoring of fish communities at Milne Port. |
| Fish: Arctic char | Surveillance | Opportunistic sampling of contaminants in fish flesh (from mortalities) during routine monitoring of fish communities at Milne Port. |
| Species Inventory (Aquatic Invasive Species) | EEM | Before/After, Presence/Absence of aquatic organisms in Milne Port (zooplankton, benthic infauna, benthic epifauna, macroflora, encrusting epifauna, fish). |

### 3.2.2 Sediment Quality

Marine sediments can provide a medium for transport and long-term storage of contaminants. As such, they represent a potential exposure pathway for contaminants to enter the marine food web through benthic organisms. Contaminants in sediments and their effects on the ecosystem have been studied extensively and regulatory standards exist to evaluate the level of contaminant accumulation in sediments.

Sediment quality variables that could be linked to Project activities include iron concentrations (iron ore dust deposition from stockpiles and loading at the Milne ore dock), particle size (dust deposition and

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redistribution of fines due to propeller wash and ballast water discharge at the ore dock), and hydrocarbon concentration (discharge to marine environment of treated waste and site run-off, and fuel and lubricant residues from shipping activity). Sediment quality analysis will be undertaken at an EEM level to quantify linkages between these monitoring candidates and Project activities.

### 3.2.3 Marine Water Quality

Several Project-related pathways exist for contaminants to enter the water column in the marine environment, including effluent and site drainage discharge at Milne Port (i.e., camp and maintenance shops, fuel depots, wastewater, wastewater management treatment facility, and ore stockpiles), ballast water discharge from vessels docked at port and direct dust deposition during ore loading at the ore dock. There are a number of potential site discharges at the port (e.g., sewage, site runoff, stock pile drainage, runoff from tank farm) and water quality monitoring will capture any potential effects in the marine environment from all discharges at the port. Contaminants entering the water column could be present over the short term and could possibly be captured by routine but instantaneous measurements of water quality. Since sampling efforts could potentially not capture contaminant concentrations that are deposited and disperse quickly, it is anticipated that water quality is not a suitable candidate for a full EEM. Water quality will therefore be addressed at a surveillance level with measurements commencing post-construction, beginning in 2015.

It is likely that water quality will be measured as part of an 'end-of-pipe' compliance monitoring program rather than be integrated into the MEEMP. Measurements of contaminants in other media, such as sediments where contaminants have the potential to accumulate over longer time scales, could potentially prove more useful for detecting environmental changes attributable to Project activities. Initially, water sampling at a surveillance level will be undertaken for selected variables (i.e., TSS, salinity, temperature, pH, metals, nutrient and hydrocarbons) at selected stations and compared to CCME Protection of Aquatic Life (PAL) guidelines. After initial monitoring results become available, Baffinland will discuss with regulatory authorities the requirement for continued surveillance monitoring.

### 3.2.4 Epibenthic Community

The epibenthic community represents a potential biological indicator of environmental change. It is an ideal candidate for monitoring because it represents a resident population of organisms in the study area exposed to Project induced effects, and the community is closely associated with the benthic marine habitat quality. The epibenthic community is also the likely pathway for contaminants to enter and/or affect the marine food web at higher trophic levels (i.e., fish and marine mammals). Changes, particularly for key indicator taxa, in abundance, relative abundance and community based diversity increase are potentially useful in monitoring project-related environmental changes over time.

The epibenthic community will be monitored at an EEM level to determine Project-induced changes above the natural variability of the ecosystem. The response of the epibenthic community to Project effects could be in relation to changes in marine habitat quality which are reflected in other attributes (i.e.,

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substrate characteristics, macroflora coverage) and these attributes will be monitored concurrently with the epibenthic community.

Initially, benthic infauna data collected in 2010 and 2013 were assessed through power analysis to determine sample size requirements to detect changes in benthic infaunal community structure as related to Project activities. The benthic community is a common monitoring target for environmental effects in the marine environment and is frequently included in monitoring programs conducted under Environment Canada's Metal Mining Effluent Regulations (MMER). The benthic community at Milne Inlet however, was characterized by low species diversity and abundance and had a depth stratified structure (SEM 2014). The power analyses determined the sample size requirements to detect a change in benthic community were prohibitive (D. Schneider, Pers. Comm.), both in terms of sample collection effort and analytical costs. Consequently, benthic infauna is not included as a monitoring target for the MEEMP.

### 3.2.5 Sculpin Species

Resident fish species like one of the sculpin species, could be a useful biological indicator of environmental change in the study area at a higher trophic level. A variety of sculpin species are present within the study area and these fish are largely benthic in nature (as adults), and have relatively small ranges. Additionally, they are not part of the local subsistence fishery, and therefore there is no anthropogenic pressure on the population(s) that could be a confounding effect on monitoring project interactions. Sculpin are an important link between Project-related effects and higher trophic levels, since they interact with the benthic and pelagic environments throughout their life cycle, and could be consumed by other fish, marine mammals and/or seabirds. These characteristics make sculpins an ideal candidate for monitoring Project-induced environmental change. Fish health (e.g., contaminant levels in fish tissue) will be monitored over time to establish linkages to Project activities. Collection of fish tissue requires sacrificing individuals, therefore to use a sculpin species in a destructive-sampling program, it was necessary to estimate the population size in the study area. If the population size is not adequate to support destructive sampling, the monitoring program itself could negatively impact the marine food web in Milne Inlet.

Consequently, a mark-recapture study was conducted in 2014 to provide an estimate of population size for each of the various species of sculpin in the study area. The results from this study did not provide any recaptures for use in a population estimate. Although the lack of recaptures could suggest a large population, low catch per unit effort (CPUEs) in 2013 and 2014 suggest small and relatively immobile populations and possibly a learned avoidance of fishing gear following release. The persistent low CPUEs indicate that the resident sculpin of any one species are not present in numbers adequate to support EEM studies and that sampling requirements for sacrificed fish would not be sustainable.

Sculpin species will be included in the MEEMP at a Surveillance Level. Sculpins will be sampled on a regular basis during routine monitoring of fish communities to detect trends in contaminant levels from incidental mortalities. This sampling will be opportunistic and will not adhere to any specific sampling design with respect to sample size, size class, age and/or sex. If monitoring results indicate increased levels of

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contaminants in sculpin flesh, then consideration will be given to expanding the scope of the monitoring program through discussions with regulators.

### 3.2.6 Arctic Char

Arctic char, although considered to be an important VEC during environmental assessment, are not a resident population in the study area. They are transient in the marine environment and there are no major char producing rivers in the vicinity of Milne Port.

Variability in the timing and duration of the marine migration of Arctic char, their spatial distribution while at Milne Port and constraints to the field sampling schedule and methods (i.e., focus on use of non-lethal sampling methods) may provide information that will not adequately characterize the Arctic char population or provide data that is not comparable from year to year. Most importantly, the transient nature of the Arctic char at Milne Port prevents direct linkages to be made with Project activities (i.e., exposure to Project-induced effects is minimal and not quantifiable). Consequently, it is inappropriate to include Arctic char in a rigorous sampling program intended to address project related effects.

To satisfy NIRB requirements relating to Arctic char, a monitoring program that evaluates contaminant levels in incidental mortalities is the most logical choice for this VEC. As with monitoring of sculpin species, a portion of the Arctic char population will be sampled on a regular basis during routine monitoring of fish communities to detect trends in contaminant levels from incidental mortalities. This sampling would be opportunistic and will not adhere to any specific sampling design with respect to sample size, size class, age and/or sex. Similarly, if monitoring results indicate increased levels of contaminants in char flesh, then consideration will be given to expanding the scope of the monitoring program through discussions with regulators.

### 3.2.7 Aquatic Invasive Species

Ballast water exchange at Milne Port and the potential for introduction of invasive species was identified as a concern. Introduced invasive species are typically from lower trophic levels (e.g., zooplankton, phytoplankton, benthic infauna) and can alter the ecosystem resulting in impacts at multiple trophic levels. Baffinland has committed to monitoring for the presence of aquatic invasive species (AIS) at Milne Port. A comprehensive inventory of aquatic species, at several trophic levels, was established through baseline studies (2008, 2012, 2013 and 2014) and this inventory will be used to assess potential changes in species composition during Project shipping operations. For AIS monitoring there would likely be a clear cause and effect between Project activities (shipping, ballast water exchange) and impact (introduction of an AIS).

AIS monitoring will be a simple Before/After experimental design, focusing on areas with highest potential for occurrence of invasive species, particularly the port infrastructure where the ballast water exchange will occur. Studies will be conducted at a full EEM level and will involve monitoring species occurrence at all levels of aquatic biota to detect non-indigenous species.

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## 3.3 MARINE ECOLOGY STUDY SCHEDULE

Table 3.2 is the proposed master schedule for the Marine Ecology EMP, by year, through to 2025. Several of the EEM programs are proposed to be monitored for a two to three year period initially, with a less frequent sampling schedule thereafter based on preliminary analyses and suitability of data collected to inform Project management. Programs at a research level (e.g., sculpin population levels) are for defined periods of time with continuation of monitoring at a higher level (surveillance or EEM) to be determined based on the research study results. Programs to be conducted at a surveillance level will be undertaken in accordance with the schedule in Table 3.2, subject to changes in response to any observed effects that could trigger an expanded monitoring program (both spatially and temporally). All marine ecology studies occur from late June through to September. The proposed seasonal schedule for years when the studies are conducted is summarized in Table 3.3.

**Table 3.2 Marine Ecology EEM Master Schedule.**

| Subject | Frequency | '14[1] | '15[1] | '16 | '17 | '18 | '19 | '20 | '21 | '22 | '23 | '24 | '25 | '26 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Benthic Habitat | First two years, then every third year | X | X | X | - | - | X | - | - | X | - | - | X | - |
| Water | First two years, then review[2] | - | X | X | X | - | - | - | - | - | - | - | - | - |
| Sediment | First three years, then every third year | X | X | X | X | - | - | X | - | - | X | - | - | X |
| Benthic epifauna | First two years, then every third year | X | X | X | - | - | X | - | - | X | - | - | X | - |
| Sculpin species | Non-destructive monitoring and opportunistic sampling of fish flesh - first three years, then every third year | X | X | X | X | - | - | X | - | - | X | - | - | X |
| Arctic Char | Non-destructive monitoring and opportunistic sampling of fish flesh - first three years, then every third year | X | X | X | X | - | - | X | - | - | X | - | - | X |
| Aquatic Invasive Species (Benthic Component) | First two years, then every third year | X | X | X | - | - | X | - | - | X | - | - | X | - |
| Aquatic Invasive Species (Fish and Zooplankton) | First three years, then every second year | X | X | X | X | - | - | X | - | - | X | - | - | X |

[1] 2014 was for filling in gaps of baseline data collection and initial evaluation of EEM protocols, 2015 is the first full year of EEM implementation, post- Milne Port ore dock construction.
[2] Blank years indicate monitoring schedule to be determined based on results of first two years of sampling.

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**Table 3.3 Marine Ecology EEM Monthly Schedule.**

| Subject | Frequency | Annual Cycle | | | |
|---|---|---|---|---|---|
| | | June | July | Aug | Sept |
| Benthic Habitat | Once per year in August or September | | | | X |
| Sediment | Once per year in the open water season | | | X | |
| Water | Every 2 weeks during open water period | | X | X | X |
| Epibenthic Community | Once per year in August or September | | | | X |
| Sculpin species | Once per year in August or September | | | | X |
| Arctic Char | Once per year in August | | | X | |
| Aquatic Invasive Species | Twice per year | X | | X | |

## 3.4 MARINE ECOLOGY EEM STUDY DESIGN AND DESCRIPTIONS

### 3.4.1 SAMPLING DESIGN

The sampling design for the MEEMP was based on key principles used for the design of EEM programs for other mining operations near coastal environments (e.g., Voisey's Bay EEM, 2006; INAC 2009; Environment Canada 2012) and in consideration of EEM programs currently in place for large developments with the potential of affecting the marine environment (e.g., offshore oil and gas development). Environment Canada (2012) identified three fundamental 'philosophical' approaches to EEM, as follows:

- Control Impact (C-I) or multiple-control impact (MC-I) designs, including before:after, control:impact (BACI), which are ANOVA-based designs used to detect significant differences between exposure and reference areas;
- Repeat measures (RM, e.g., annual measurements) gradient designs measuring biological responses along a gradient (e.g., effluent exposure) based on regression analyses or analysis of covariance (ANCOVA); and
- Multivariate statistical analyses comparing the reference condition approach (RCA) between potential 'test' stations to a selection of appropriate 'reference' stations.

In determining the most appropriate approach for the Milne Port MEEMP a number of factors were considered including:

- Sources of potential environmental perturbation (single or multiple);
- Configuration of Lower Milne inlet including bathymetry and oceanographic circulation;
- Baseline data collections;
- Statistical approach(es) to determining an effect;
- Methods applicable to arctic environments; and
- Accepted approaches used in other similar EEM programs.

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The design of the Milne Port MEEMP is based on repeated measures (RM) distance regression analyses where the same replicates (stations) will be re-sampled at specific time intervals (years). Stations were established along a distance gradient from a potential point source of environmental perturbation (e.g., chemical contamination or physical disturbance) associated with the Milne ore dock. The outfall from the Milne camp, including the ore stockpiles, are in the same general location and are considered within the spatial extent of a single point source. The RM regressions are similar to regressions based on single year data incorporating response variables that are some combination or integration of data from multiple years (e.g., difference from baseline or a before:after difference). Significant regressions of the multi-year response variable on the distance from the point source will indicate distance gradients in relation to some Project activity. The RM regression design is an alternative to the Before:After Control:Impact (BACI) analyses of variance (ANOVA) design and is considered more sensitive to change and therefore more powerful than the simple differencing between control and impact locations.

The structure of the MEEMP plots was based on a radial gradient design as described in detail in Environment Canada (2012) and advocated by Ellis and Schneider (1997). The radial gradient design removes the problem of having to select a suitable control site that must be similar to the potential impact sites but removed from any potential Project related effects. The gradient design enables physical, chemical and biological changes to be assessed as a function of distance from a point source. This design is very effective at elucidating the spatial scale of impacts and therefore can provide considerable insights into potential mitigations and/or alterations to Project activities to address any observed negative environmental effects. Radial gradient designs are effective at addressing threshold of effects as a function of distance and/or quantification (e.g., contaminant level) of effect.

The sampling program for the MEEMP was designed to collect data along four transects radiating out from the Milne Port potential point source of contaminants and/or physical impacts associated with shipping activities. For each transect, a gradient of a given response variable will be compared as a function of distance over time to identify changes that could be attributable to Project activities. Gradients of data collected during each monitoring year will be compared to the baseline gradients.

Gradients of monitoring targets or species will be calculated along four transects in the Milne Port area (Figure 3.1). Three transects originating from the Milne ore dock include: West Transect (WT); East Transect (ET); and North Transect (NT). A fourth transect — Coastal Transect (CT) — originates at the end of the East Transect and extends north along the eastern shore of Milne Inlet, terminating outside the predicted ZOI of project activities. The Coastal Transect captures a gradient beyond the ZOI which is not provided by the other transects given the shape of the Inlet. Data collected along this transect will be important in determining if the identified ZOI is accurate and will be important in delineating the spatial scale of Project effects. Additionally, the end point of the Coastal Transect is located in proximity to Reference Site 1, established in 2013, thereby maximizing the use of existing baseline data.

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There are four primary transects with sampling stations location along each transect (Figure 3.1):

1) West Transect (~1.5 km) — The West Transect extends from the ore dock and follows the 15 m contour in a westerly direction. The transect has five sampling stations (SW-1 to SW-5) at approximately 0 m, 250 m, 500 m, 1,000 m and 1,500 m.

2) East Transect (~1.5 km) — The East Transect extends from the ore dock and follows the 15 m contour in an easterly direction. The transect has five sampling stations (SE-1 to SE-5) at approximately 0 m, 250 m, 500 m, 1,000 m and 1,500 m.

3) Coastal Transect (~4 km) — The Coastal Transect extends from the terminus of the East Transect and follows the 15 m contour in a northeasterly direction, along the eastern shore. The transect has five sampling stations (SC-1 to SC-5) at approximately 0 m (identical to station 1,500 m of East Transect), 500 m, 1,000 m, 2,000 m and 4,000 m.

4) North Transect (~2km) — The North Transect extends from the Ore Dock in a northerly direction at increasing depths. The transect has five sampling stations (SN-1 to SN-5) at approximately 0 m, 250 m, 500 m, 1,000 m and 2,000 m.

The Coastal Transect extends to beyond the predicted Zone of Influence for the Project and as such includes sampling locations that are considered 'Control' sites outside of the influence of the Project.

### 3.4.2 Statistical Design

The radial pattern sampling design permits the capture of a gradient of key environmental variables (e.g., sediment quality) that could change over time and be linked to Project activities. The radial design allows for the comparison of changes in gradients over time for the key parameters and provides greater statistical power than comparing changes at individual stations. Combining the radial design with the analysis of the individual stations provides a substantial amount of information to feed back into the MEEMP to further refine the design and monitoring targets. An EWI for change in gradients or in individual stations is set at two standard deviations of the slope or mean, respectively (as per Environment Canada 2012).

The MEEMP design required evaluation of sample sizes necessary to meet the needs of statistical analyses. A power analysis (alpha=0.05, power=80%) for the iron concentration from the 2013 baseline data was used to determine the sample size required to detect changes within two standard deviations of the mean (as per Environmental Canada 2012). It was determined that a minimum of four samples was the preferred sample size for analysis. The results from each station will be compared to those of the previous year. A comparison of each subsequent year of data will add to the statistical power of the analysis. Furthermore, capturing a gradient with the dataset will reduce the minimum sample size requirements thereby increasing both the efficiency (i.e., effort and cost) and effectiveness (i.e., scientific confidence) of the MEEMP as the program progresses.

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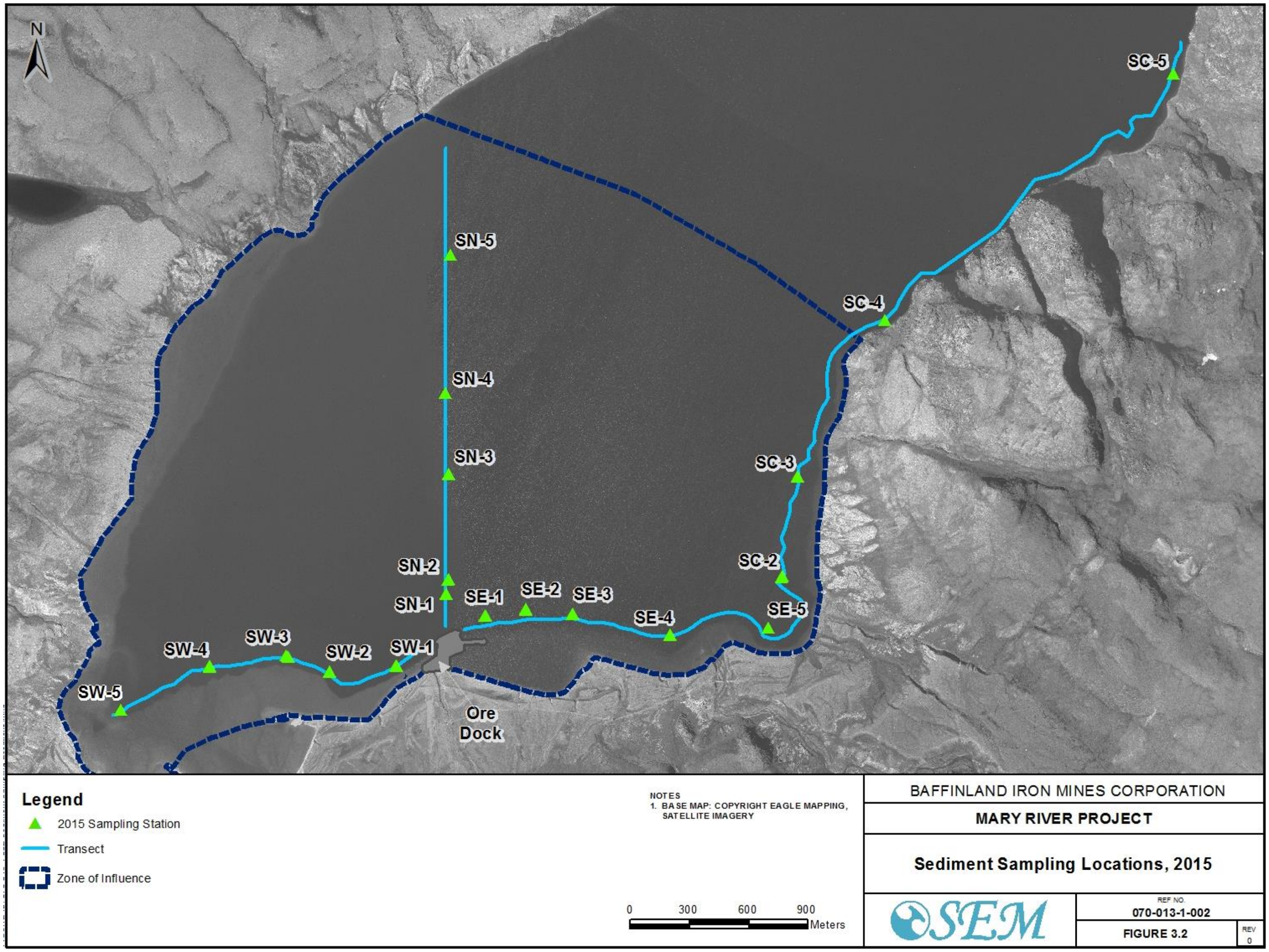


**Figure 3.1 Radial Gradient Study Design and Sediment Sampling Locations.**

Initially, linear regression analysis will be used to describe the dependence of one variable (the response variable) on one or more explanatory variables. A linear regression model is a 'line of best fit' that attempts to explain the dataset by reducing the distance between each data point and the regression line to the extent possible. The slope of a linear regression line, also known as the gradient, can be negative or positive and indicates the rate of change that can be expected in the response variable, based on the change in the explanatory variable(s). The R-squared value, which ranges from 0 to 1, provides a measure of the proportion of the variation in the dataset that is explained by the linear regression model.

Prior to Project operations, linear regression analyses was used to determine the baseline gradients of potential monitoring targets with respect to the distance from what will be the future contaminant point source (Milne ore dock and proximal site discharge location).

#### 3.4.2.1 Addressing High Levels of Variance

A common issue that will likely be encountered is a high level of variance of the monitoring target gradients as a function of distance from the point source or simply as a function of natural variability. There are several ways to address the issue to maintain practical use of the monitoring variables:

1) Increasing sample size;
2) Introducing other variable(s) that explain the variance; and
3) Using a more appropriate error structure (i.e., a non-normal error structure).

Increasing sample size can be an effective way to reduce variance, however, it often increases the time and cost of the MEEMP. Furthermore, an increased sample size does not always decrease variance. If a gradient is close to being significantly different from zero (i.e., p-value slightly higher than 0.05), an increase in sample size can be simulated in the regression analysis by increasing N and maintaining the variance. The sample size required to make the gradient significantly different from zero ($p<0.05$) can be calculated using this method, and the cost-benefit of incorporating this sampling effort (i.e., increased sample size) into the MEEMP can be evaluated.

The introduction of additional explanatory variables is another way to reduce variance. For example, introducing depth as a covariate would produce a depth-corrected gradient for a given environmental variable. Other explanatory variables might include organic carbon and/or particle size for the response variable iron concentration, or substrate class for the response variable benthic epifaunal abundance.

A different error structure can be useful when the variance is too large. A non-normal error structure gives less weight to high variance data, where variance increases with the mean, for example. This may resolve issues with high variance where the residuals are heterogeneous. This solution is likely to be very useful for benthic epifaunal abundance where a normal error structure will almost certainly be indefensible. The use of these alternative error structures can be difficult to explain and justify to regulatory authorities, and many commercially available statistical software packages do not accommodate applications of non-normal error structures.

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#### 3.4.2.2 Alternatives to Linear Regression Model

A variety of methods of analyzing data from multiple years will be explored to identify a method that is both informative and practical. This may include bivariate or multivariate models that assist in describing relationships that are not linear and increase the statistical power by reducing variance. It is possible that the analyses may provide insight into the addition of sampling sites above the current sample design. For example, evidence of an effect in close proximity to the point source with no effect at more distant stations may indicate the need to increase the number of near-field stations to provide greater spatial resolution of effects.

### 3.4.3 Benthic Habitat

#### 3.4.3.1 Review of Baseline Benthic Habitat and Epifauna

The collection of baseline benthic habitat data at Milne Inlet began in 2008 using drop-camera videography and continued in 2010, 2013 and 2014. Data collected included macrofloral assemblage, substrate classification and benthic epifauna.

Most of the sampling covered areas around the proposed Milne ore dock with efforts in 2013 aimed at characterizing an impact site around the ore dock as well as two reference sites at increasing distance from the Project's ZOI.

The Milne Port Area inshore habitats consisted of mixed fine/medium substrates in the upper subtidal and intertidal zone. The backshore was characterized mainly by fine sediment. Subtidal habitats contained primarily fine substrates (71%). There was a relatively abundant but low diversity of macroflora, dominated by brown algae (99.8%). Several macrofauna were observed with brittle star and sea star being the most abundant.

The reference site located at the closer distance to Milne Port was characterized by mixed medium/coarse substrate with scattered boulders and sections of fine sediment. The backshore was characterized by cliffs and rocky outcrops. Medium/fine substrates were the dominant substrate class, followed by fine substrates. There was a relatively abundant but low diversity of macroflora, dominated by brown algae (99.92%). A variety of macrofauna were observed in the underwater video with brittle star and various zooplankton being the most abundant.

#### 3.4.3.2 Benthic Epifauna and Benthic Habitat Study Design

Underwater videography will be used to record benthic habitat features including benthic epifaunal abundances, substrate classification and macroflora cover. Sampling will be conducted along each of the West Transect, East Transect, North Transect and Coastal Transect (Figure 3.1). Video recordings of each transect will be replicated, to the extent possible, to provide a pair of recordings for each of the four transects. The duplicate recording will help address sample variance related to attempting to replicate transects precisely between years.

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The video data will be analysed by an experienced technician to identify and quantify benthic epifauna and macroflora to the lowest possible taxonomic level. The video data will be analysed frame by frame to determine total epifauna abundance and the percent macroflora coverage. A gradient of two biological metrics, benthic epifaunal abundance and percent macrofloa coverage, will be established as a function of distance from the point source of contaminant using linear regression analysis or other methods suited to the data. A summary of the EEM level study design is presented in Table 3.4. Sampling requirements were estimated using a power analysis of the 2013 underwater video benthic epifauna results. These calculations indicated the video coverage proposed in the four transect design described above will be adequate to capture the natural variability of the system and provide a means of detecting changes over time. Linking observed benthic habitat changes, as indicated by the biological metrics, to Project activities will be the next step in monitoring. Project activities associated with potential changes to the marine benthic habitat have been described in Table 3.4.

### 3.4.4 Sediment Quality

#### 3.4.4.1 Review of Baseline Sediment Quality

The collection of sediment quality data began in 2008 and continued in 2010, 2013 and 2014. Samples from sediment grabs were analyzed for metals, hydrocarbons and particle size. Sampling was most intensive in 2013 and 2014 where the number of samples collected (>120 samples) were an order of magnitude greater than those of 2008 and 2010 (ten samples).

In 2008 and 2010, sediments in Milne Inlet were found to be dominated by either sand or sand and silt. Nutrient concentrations were low, generally comprising less than one percent of the total amount of sediment. Some hydrocarbons were detected within the port area, including: oil and grease; naphthalene; hydrocarbons C10-16 and C16-C34; and toluene. Naphthalene was the only PAH detected.

Throughout Milne Inlet, some metals (including cadmium and mercury) were present at concentrations below the analytical limits of detection. When detected, metal concentrations were higher in areas where the sediments had a higher proportion of fines. Sediment concentrations were consistently within the CCME guidelines for protection of marine aquatic life for arsenic, cadmium, chromium, copper, lead, zinc and PAHs.

In 2013, samples were mainly composed of sand and gravel. Silt and clay were also present in considerable amounts at depths >15 m. Organic carbon concentration was generally low but was moderate to high in finer sediment. No polycyclic aromatic hydrocarbons (PAHs) were detected and only low concentrations of modified total petroleum hydrocarbons (TPH) were detected in the possible lube oil fraction at a few locations.

Metals detected in 2013 include: aluminum, arsenic, barium, chromium, cobalt, copper, iron, lead, lithium, manganese, mercury, nickel, rubidium, strontium, thallium, uranium, vanadium and zinc. There were no exceedances of the CCME PAL guidelines.

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**Table 3.4 Summary of Benthic Epifauna and Habitat Study Design.**

| | | |
|---|---|---|
| Project Interaction | Activity | Propeller wash, site discharge, ballast water discharge, dust dispersion |
| | Environmental Effect/Issue | Alteration of benthic habitat and changes to epifaunal community |
| Hypothesis Formation | | Increase in temperature from ballast water discharge could reduce benthic productivity<br>Re-suspension of sediments and dust dispersion could alter benthic habitat. |
| Monitoring Target | | Benthic epifaunal community abundances<br>Macrofloral percent cover<br>Substrate Classification |
| Design Type | | Radial Gradient Design as a function of distance from Milne Port point source |
| Testable Hypotheses | | $H_0$ Benthic epifauna abundance gradient does not significantly change over time.<br>$H_A$ Benthic epifauna abundance gradient changes over time.<br>$H_0$ Macroflora cover and/or substrate classification do not explain changes to benthic epifauna abundances<br>$H_A$ Macroflora cover and/or substrate classification help to explain changes to benthic epifauna abundances |
| Sample Size Requirements | | Approximately 2–3 km per transect based on data collection of 1 frame/metre) |
| Sampling | Frequency | Annually, during the open water season; |
| | Location | Continuously along West, North, East, Coastal Transects |
| | Timing | August/September |
| Data Collection Methods | | Underwater videography |
| Sample Handling and Analysis | | Identification and enumeration of benthic epifauna<br>Classification of substrate type<br>identification of macroflora and determination of percent cover |
| Data Interpretation and Reporting | | Linear regression analysis of benthic epifauna abundances as a function of distance from Milne Port point source to establish gradient;<br>Use of macroflora and/or substrate data as additional explanatory variables (covariates) in the regression analysis |
| Triggering Levels | | A measured gradient within two standard deviations of the baseline or previous year, as applicable. |

#### 3.4.4.2 Sediment Quality Study Design

The sampling design is based on a radial pattern extending out from the Milne ore dock and sampling stations are established along four transects at increasing distance from the point source and as previously described. Descriptions of the four transects are presented in Section 3.4.1. A summary of the EEM level study design is presented in Table 3.5.

Sediment will be analyzed for metals, hydrocarbons and particle size. The principle variables of interest with respect to the MEEMP are iron concentrations, particle size and hydrocarbon concentrations, since each of these may be linked to Project activities. Linear regression analysis will be used to establish baseline gradients of each sediment quality variable. When a transect does not follow a single depth contour (i.e., the North Transect), depth will be used as a second explanatory variable to provide a depth-corrected gradient for each variable.

Other explanatory variables might be included in future multiple linear regressions, such as organic carbon concentration or fines percent for the iron concentration response variable.

Sediment quality guidelines for marine environments exist for several metals and hydrocarbons. The CCME (1999; updated to 2015) has both Interim Sediment Quality Guidelines (ISQG) and Probable Effects (Table 3.6) and are reported as half of the CCME ISQG levels as an EWI. In cases where the CCME ISQG guideline falls below the reportable detection level (RDL), the RDL may be used as an EWI.

**Table 3.5 Summary of Sediment Quality Study Design.**

| | | |
|---|---|---|
| Project Interaction | Activity | Propeller wash, site discharge, dust deposition, shipping |
| | Environmental Effect/Issue | Benthic habitat alteration due to sediment re-distribution and contaminant accumulation |
| Hypothesis Formation | | Does particle size gradient change over time as a function of distance from the Milne Port point source?<br>Do metal concentration gradients change over time as a function of distance from the Milne Port point source?<br>Do hydrocarbon concentration gradients change over time as a function of distance from the Milne Port point source? |
| Monitoring Target | | Particle size — Fines %<br>Metal Concentrations — Iron<br>Hydrocarbon Concentrations |
| Design Type | | Radial gradient design |
| Sample Size Requirements | | Three replicates per station;<br>5 sampling stations on 4 transects |
| Sampling | Frequency | Annually during the open water season |
| | Location | SW-1, SW-2, SW-3, SW-4, SW-5<br>SN-1, SN-2, SN-3, SN-4, SN-5<br>SE-1, SE-2, SE-3, SE-4, SE-5<br>SC-1, SC-2, SC-3, SC-4, SC-5 |
| | Timing | Once per year during open water season |
| Data Collection Methods | | Petit Ponar grab or other suitable benthic grab |
| Sample Handling and Analysis | | Shipped in glass jars to laboratory;<br>Acid Extraction — ICPMS (metals);<br>GCMS (hydrocarbons);<br>Pipette and Sieve (particle size analysis). |

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**Table 3.5 Summary of Sediment Quality Study Design.**

| | | |
|---|---|---|
| Data Interpretation and Reporting | | Linear regression analysis as a function of distance from Milne Port. |
| Triggering Levels | | See Table 3.6 for triggering values related to CCME guidelines.<br>Changes in gradient greater than two standard deviations. |
| Testable Hypotheses | | $H_0$ Fines % gradient does not change over time as a function of distance from Milne Port.<br>$H_A$ Fines % gradient changes as a function of distance from Milne Port.<br>$H_0$ Iron concentration gradient does not change over time as a function of distance from Milne Port.<br>$H_A$ Iron concentration gradient changes as a function of distance from Milne Port.<br>$H_0$ Hydrocarbon concentration gradients do not change over time as a function of distance from Milne Port.<br>$H_A$ Hydrocarbon concentration gradients change as a function of distance from Milne Port. |
| Sample Size Requirements | | Three replicates per station;<br>5 sampling stations on 4 transects |
| Sampling | Frequency | Annually during the open water season |
| | Location | SW-1, SW-2, SW-3, SW-4, SW-5<br>SN-1, SN-2, SN-3, SN-4, SN-5<br>SE-1, SE-2, SE-3, SE-4, SE-5<br>SC-1, SC-2, SC-3, SC-4, SC-5 |
| | Timing | Once per year during open water season |
| Data Collection Methods | | Petit Ponar grab or other suitable benthic grab |
| Sample Handling and Analysis | | Shipped in glass jars to laboratory;<br>Acid Extraction – ICPMS (metals);<br>GCMS (hydrocarbons);<br>Pipette and Sieve (particle size analysis). |
| Data Interpretation and Reporting | | Linear regression analysis as a function of distance from Milne Port. |
| Triggering Levels | | See Table 3.6 for triggering values related to CCME guidelines.<br>Changes in gradient greater than two standard deviations. |

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**Table 3.6 Early Warning Indicators (Triggers) for Sediment Quality**

| Sediment Quality Variables | Units | RDL[1] | CCME-ISQG[2] | CCME-PEL[3] | Early Warning Indicator (Triggering Value)[4,] |
|---|---|---|---|---|---|
| **Metals** | | | | | |
| Extractable Arsenic (As) | $mg \cdot kg^{-1}$ | 2.0 | 7.24 | 41.6 | 3.62 |
| Extractable Cadmium (Cd) | $mg \cdot kg^{-1}$ | 0.30 | 0.7 | 4.2 | 0.35 |
| Extractable Chromium (Cr) | $mg \cdot kg^{-1}$ | 2.0 | 52.3 | 160 | 26.15 |
| Extractable Copper (Cu) | $mg \cdot kg^{-1}$ | 2.0 | 18.7 | 108 | 9.35 |
| Extractable Lead (Pb) | $mg \cdot kg^{-1}$ | 0.50 | 30.2 | 112 | 15.1 |
| Mercury (Hg) | $mg \cdot kg^{-1}$ | 0.017 | 0.13 | 0.7 | 0.065 |
| Extractable Zinc (Zn) | $mg \cdot kg^{-1}$ | 5.0 | 124 | 271 | 62 |
| **Hydrocarbons** | | | | | |
| Methylnaphthalene (2-) | $mg \cdot kg^{-1}$ | 0.010 | 0.0202 | 0.2010 | 0.0101 |
| Acenaphthene | $mg \cdot kg^{-1}$ | 0.010 | 0.00671 | 0.0889 | 0.003355 |
| Acenaphthylene | $mg \cdot kg^{-1}$ | 0.010 | 0.00587 | 0.1280 | 0.002935 |
| Anthracene | $mg \cdot kg^{-1}$ | 0.010 | 0.0469 | 0.2450 | 0.02345 |
| Benzo(a)anthracene | $mg \cdot kg^{-1}$ | 0.010 | 0.0748 | 0.6930 | 0.0374 |
| Benzo(a)pyrene | $mg \cdot kg^{-1}$ | 0.010 | 0.0888 | 0.7630 | 0.0444 |
| Chrysene | $mg \cdot kg^{-1}$ | 0.010 | 0.1080 | 0.8460 | 0.054 |
| Dibenz(a,h)anthracene | $mg \cdot kg^{-1}$ | 0.010 | 0.00622 | 0.1350 | 0.00311 |
| Fluoranthene | $mg \cdot kg^{-1}$ | 0.010 | 0.1130 | 1.4940 | 0.0565 |
| Fluorene | $mg \cdot kg^{-1}$ | 0.010 | 0.0212 | 0.1440 | 0.0106 |
| Naphthalene | $mg \cdot kg^{-1}$ | 0.010 | 0.0346 | 0.3910 | 0.0173 |
| Phenanthrene | $mg \cdot kg^{-1}$ | 0.010 | 0.0867 | 0.5440 | 0.04335 |
| Pyrene | $mg \cdot kg^{-1}$ | 0.010 | 0.1530 | 1.3980 | 0.0765 |

1 Reportable Detection Limit; RDLs vary as a function of concentration and/or volume as defined by the analytical laboratory. RDLs presented here are from sediment samples taken in Milne Inlet in 2014 (SEM, 2015a Draft)

2 Canadian Council of Ministers of the Environment — Interim Sediment Quality Guidelines

3 Canadian Council of Ministers of the Environment — Probable Effects Levels

4 Based on one half the CCME ISQG guideline values. Note: only values above the RDL are useful as triggering values

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Sediment will be analyzed for metals, hydrocarbons and particle size. The principle relevant variables are iron, particle size and hydrocarbon concentration since these may be linked to Project activities. Linear regression analysis will be used to establish baseline gradients of each sediment quality variable. For the North transect (which does not follow a single depth contour) depth will be used as a second explanatory variable to provide a depth-corrected gradient. Other explanatory variables might be included in future multiple linear regressions, such as organic carbon concentration or fines percent for the iron concentration variable.

Sediment quality guidelines exist for several metals and hydrocarbons in the marine environment. The CCME (1999; updated to 2015) has Interim Sediment Quality Guidelines (ISQG) and Probable Effects Levels (PEL). Sediment quality triggering levels are reported in Table 3.6 and are reported as half of the CCME ISQG levels as an EWI. In cases where the CCME ISQG guideline falls below the reportable detection level (RDL), the RDL is used as the EWI.

### 3.4.5 Water Quality

#### 3.4.5.1 Review of Baseline Water Quality

The collection of water quality data took place in 2008 and 2010, with the majority of sampling taking place during the open water season. One third of the data collected were under-ice samples. Water samples were analyzed for nutrients, water clarity, salinity, temperature and pH and results are presented in the Mary River FEIS (Baffinland 2012).

The surface waters of Milne Inlet were near neutral (pH: 7.33 to 7.98), brackish (23 psu to 30 psu), hard (total hardness: 1,620 $mg \cdot L^{-1}$ to 5,990 $mg \cdot L^{-1}$) and clear (turbidity: 0.3 NTU to 0.6 NTU) with moderate amounts of nutrients (0.3 to 3.1 $mg \cdot L^{-1}$ and 0.011 to 0.54 $mg \cdot L^{-1}$ for total nitrogen [TN] and total phosphorus [TP], respectively). Nutrient concentrations measured during the open-water season tended to be higher in deep waters than at the surface.

The predominant elements (major ions and metals) in water samples collected from Milne Inlet were those that typically dominate marine waters (chloride, sodium, sulphate and magnesium). Total and dissolved metal concentrations were mostly similar, illustrating that metals were present in the water column in the dissolved form and were not typically associated with particulates. Several metals (including arsenic, cadmium, iron and mercury) were generally below the analytical limits of detection; however, concentrations of most metals detected in samples from Milne Inlet were higher at depth than they were near the surface, particularly during the open-water season.

#### 3.4.5.2 Water Quality Study Design

After completion of the ore dock construction and prior to shipping operations, a radial gradient sampling design has been established. Sampling will be completed at three stations at increasing distances (250 m) from Milne Port along each of three transects originating at the port site water discharge location (Figure 3.2). The location of the transect sampling stations has followed the overall

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radial gradient design, the extent of these transects is shorter than previously described overall MEEMP design, as potential water quality effects are expected to be only detectable in close proximity to the point source. At the end of each transect, conductivity/temperature/depth profiles will be collected to determine if the water column is stratified. Water samples will be collected at the surface and just above bottom, and if CTD cast determine the water column is well stratified, an additional sample will be collected mid-water column, in association with any detected thermocline and/or halocline. Water quality measurements will include salinity, temperature, total suspended solids (TSS) and nutrient, metal and hydrocarbon concentrations. The CCME (1999; updated to 2015) has issued guidelines for TSS, turbidity and salinity, but the guidelines refer to a departure from background conditions. Water quality sampling in 2015 was intended to fill gaps in baseline information and provide background conditions for salinity, turbidity and TSS against which to measure potential future changes attributable to Project activities. Sampling in 2015 will also evaluate the adequacy of the study design in terms of length and orientation of transects. There are no CCME guidelines issued for temperature, therefore a EWI, or trigger, of $\geq$1˚C has been selected. Surveillance level monitoring will begin in 2016, and a summary of the design is presented in Table 3.7.

Water quality variables will be expressed as gradients as a function of distance from the point source of contaminants/perturbations.

Measurements will be taken in 2015 following the completion of the construction of the ore dock at Milne Port and in advance of operational shipping of ore. An expansion of sampling efforts could be triggered by detection of significant changes in parameters during surveillance monitoring and/or increases in metals and hydrocarbons in sediments. Expansion of water quality monitoring both temporally (increased frequency) and spatially may then be considered.

Water quality guidelines for marine environments exist for pH, nitrate, arsenic, cadmium, chromium and mercury (Table 3.8). The CCME (1999; updated to 2015) also issued guidelines for total suspended solids (TSS), turbidity and salinity, however guidelines refer to a 'departure from background conditions'. Recommended water quality triggering levels are provided in Table 3.8 and are reported as half of the CCME guidelines as an EWI. In cases where the CCME guideline falls below the RDL, the RDL may be substituted as the EWI.

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**Figure 3.2 Water Quality Sampling Sites.**

**Table 3.7 Summary of Marine Water Quality Monitoring Study Design.**

| | | |
|---|---|---|
| Project Interaction | Phenomena | Ballast water discharge, site discharge, dust deposition |
| | Environmental Effect/Issue | Increase in water temperature and salinity, changes to nutrient concentrations, increases in TSS, metals and hydrocarbon concentrations |
| Hypothesis Formation | | Does water temperature and salinity increase as a result of ballast water discharge?<br>Does nutrient concentration change due to dilution from ballast water discharge (decrease) or due to site discharge (increase)?<br>Do TSS, metal and hydrocarbon concentrations increase as a result of dust deposition and site discharge? |
| Monitoring Target | | Water temperature<br>Salinity<br>Nutrient concentrations<br>TSS, metal concentrations, hydrocarbon concentrations |
| Design Type | | Selected stations along a radial gradient design, three transects |
| Testable Hypotheses | | $H_0$ Water temperature does not increase $\geq$1˚C due to ballast water discharge.<br>$H_A$ Water temperature does increase $\geq$1˚C due to ballast water discharge.<br>$H_0$ Water salinity does not increase due to ballast water discharge.<br>$H_A$ Water salinity does increase due to ballast water discharge.<br>$H_0$ Nutrient concentration gradients do not change over time.<br>$H_A$ Nutrient concentration gradients do change over time.<br>$H_0$ Metal concentration gradients do not change over time.<br>$H_A$ Metal concentration gradients do change over time.<br>$H_0$ Hydrocarbon concentration gradients do not change over time.<br>$H_A$ Hydrocarbon concentration gradients do change over time. |
| Timing | | Bi-weekly during open water period (n=6 per year) |
| Data Collection Methods | | Niskin bottle |
| Sample Handling and Analysis | | Preserved as necessary and shipped to lab for analysis;<br>Analyses to be completed by qualified laboratory (Canadian Association for Laboratory Accreditation Inc. certification).<br>Appropriate QA/QC standards implemented in the field and laboratory |
| Data Interpretation and Reporting | | Determine if variables are above detection.<br>Compare to CCME guidelines, where applicable.<br>Compare gradient of nutrient, metal and hydrocarbon concentrations over time to determine existence of Project-related change. |
| Triggering Levels | | See Table 3.8 for triggering values related to CCME guidelines.<br>Changes in concentration gradient greater than two standard deviations.<br>Changes in temperature $\geq$1˚C. |

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**Table 3.8 Early Warning Indicators (Triggers) for Water Quality.**

| Water Quality Variable | Units | RDL[1] | CCME[2] | Early Warning Indicator (Triggering Value)[3] |
|---|---|---|---|---|
| pH | - | N/A | 7.0–8.74 | - |
| Turbidity | NTU | 0.1 | - | - |
| Conductivity | $\mu S \cdot cm^{-1}$ | 1 | - | - |
| Total Suspended Solids | $mg \cdot L^{-1}$ | 1 | 5-255 | - |
| Nitrate | $mg \cdot L^{-1}$ | 0.05 | 200–1,500 | 100–750 |
| Nitrite | $mg \cdot L^{-1}$ | 0.01 | N/A | - |
| Ammonia | $mg \cdot L^{-1}$ | 0.05 | N/A | - |
| Total Phosphorus | $mg \cdot L^{-1}$ | 10 | N/A | - |
| Arsenic | $mg \cdot L^{-1}$ | 0.1 | 0.0125 | 0.0063 |
| Cadmium | $mg \cdot L^{-1}$ | 0.03 | 0.00012 | 0.00006 |
| Chromium | $mg \cdot L^{-1}$ | 0.1 | 0.0015 | 0.00075 |
| Mercury | $mg \cdot L^{-1}$ | 0.000013 | 0.000016 | 0.000008 |

1 Reportable Detection Limit; RDLs vary as a function of concentration and/or volume as defined by the analytical laboratory. RDLs presented here are from water samples taken in Milne Inlet in 2014 (SEM 2014)

2 Canadian Council of Ministers of the Environment Guidelines for the Protection of Aquatic Life

3 Values are based on one half CCME Guideline values. Note: only values above the RDL are useful as triggering values.

4. The pH of marine and estuarine waters should fall within the range of 7.0 – 8.7 units unless it can be demonstrated that such a pH is a results of natural processes. Within this range, pH should not vary by more than 0.2 pH units from the natural pH expected at that time. Where pH is naturally outside this range, human activities should not cause pH to change by more than 0.2 pH units from the natural pH expected at that time, and any change should tend towards the recommended range.

5. Short term — not to exceed 25 mg/L over baseline levels, Long term – not to exceed 5 mg/L over baseline levels (CCME 1999, updated to 2015)

### 3.4.6 Finfish Species

#### 3.4.6.1 Review of Baseline Data

Fish sampling began in 2010 and continued in 2013 and 2014. In 2010 and 2013, measurements such as length, weight, sex, age and stomach contents were taken for fish catches. In 2014, destructive sampling was not conducted, therefore only length and weight were recorded. In 2014, a mark-recapture program was attempted to get an estimate of the population size of the various sculpin species. Total fish catch for baseline studies is presented in Table 3.9.

**Table 3.9 Total Fish Catch Comparison, 2010, 2013 and 2014.**

| Species | 2010 | 2013 | 2014 |
|---|---|---|---|
| Arctic char | 11 | 6 | 3 |
| Arctic sculpin | 0 | 0 | 4 |
| Shorthorn sculpin | 50 | 4 | 9 |
| Fourhorn sculpin | 7 | 3 | 39 |
| Arctic staghorn sculpin | 3 | 0 | 0 |
| Longhorn sculpin | 0 | 2 | 4 |
| Arctic hookear sculpin | 0 | 0 | 5 |
| Greenland cod | 4 | 0 | 1 |
| Common lumpfish | 0 | 0 | 1 |
| Fish doctor | 0 | 1 | 0 |
| Fourline snakeblenny | 0 | 0 | 1 |
| **Total** | **75** | **16** | **67** |

#### 3.4.6.2 Sculpin Species

The resident population of a fish species must be large enough to support lethal sampling of fish at the required sample size for tissue analysis in an EEM program. Therefore, to utilize sculpin body burden for an ongoing monitoring program, a population estimate was required to determine if the sampling requirement was sustainable without affecting the resident population. In 2014, a mark-recapture study to estimate the sculpin populations was conducted in the vicinity of Milne Port. No recaptures were obtained in 2014 hence no estimation of population size was possible. The fact that no recaptures were obtained in 2014, despite considerable fishing effort, could indicate a large population size however the low CPUE in both 2013 and 2014 suggested very small populations. The lack of recaptures was indicative of the large survey area, short times between surveys, the small home ranges of sculpin and fishing methods used (primarily non-lethal sampling techniques). It has been concluded that the sculpin populations in the vicinity of Milne Port, representing six different species, are not large enough to sustain a dedicated EEM program requiring lethal sampling. Sampling in 2015 included mark-recapture methods to again attempt to determine the relative size of the sculpin population in association with the Milne Port. Results of this effort are currently underway and will be used to update then document when available.

Sculpin species morphometrics (length, weight, age) will be measured for all sculpin catches while determination of sex, stomach contents and body burden analysis will be monitored on incidental mortalities during routine fish sampling (as described above in Section 3.2.5). Contaminant levels will be compared to baseline levels and guidelines set by Health Canada (2012; mercury, 0.5 mg·kg$^{-1}$). A summary of the surveillance level study design is presented in Table 3.10.

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**Table 3.10 Summary of Sculpin Study Design.**

| | | |
|---|---|---|
| Project Interaction | Phenomena | Propeller wash, site discharge, dust deposition |
| | Environmental Effect/Issue | Reduction in fish health condition and/or population dynamics due to habitat alteration and/or contaminant dispersion. |
| Hypothesis Formation | | Does sculpin health deteriorate as a result of habitat alteration from propeller wash, ballast water discharge, site discharge or dust deposition?<br>Does sculpin population decrease as a result of habitat alteration from propeller wash, ballast water discharge, site discharge or dust deposition? |
| Monitoring Target | | Sculpin CPUE (by species) as indicator of abundance<br>Sculpin condition factors (e.g., length, weight, external condition, external determination of sex and age, stomach contents if possible)<br>Sculpin tissue analysis (metals, contaminants) from incidental mortalities |
| Design Type | | Near shore sampling around Milne Inlet |
| Testable Hypotheses | | $H_0$ Sculpin health is reduced as a result of Project activities.<br>$H_A$ Sculpin health is not reduced as a result of Project activities.<br>$H_0$ Sculpin population size does not decrease as a result of Project activities.<br>$H_A$ Sculpin population size decreases as a result of Project activities. |
| Sample Size Requirements | | Not applicable |
| Sampling | Frequency | During the open water season |
| | Location | Sampling stations along the western and eastern shores of Milne Inlet, and near the Milne Port ore dock. |
| | Timing | August/September |
| Data Collection Methods | | Fukui traps and/or gill nets |

#### 3.4.6.3 Arctic Char

Arctic char in Milne Inlet are anadromous and spend limited time in the marine environment and are therefore only present near the Milne Port for a short period of time with limited exposure to Project activities. The timing of migration to, and within, the marine environment can vary considerably on a yearly basis depending on local weather patterns, timing of the spring freshet, and oceanographic conditions. The lack of char producing rivers in the vicinity of Milne Port further reduces the likelihood of capturing a significant number of fish at this location. The short and variable residency time of Arctic char in the vicinity of the Milne Port, would indicate that a full population assessment and body burden analysis

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would not be statistically robust. Arctic char morphometrics (length, weight, age, sex, stomach contents) will therefore be non-destructively measured for all catches and sex, stomach contents, and body burden analysis will be monitored on incidental mortalities during routine fish sampling (as described above in Section 3.2.6). Contaminant levels will be compared to baseline levels and guidelines set by Health Canada (2012; mercury, 0.5 mg·kg$^{-1}$). A summary of the surveillance level study design is presented in Table 3.11.

**Table 3.11 Summary of Arctic Char Study Design.**

| | | |
|---|---|---|
| Project Interaction | Phenomena | Propeller wash, ballast water discharge, site discharge, dust deposition |
| | Environmental Effect/Issue | Reduction in fish health condition and/or population size due to habitat alteration and/or contaminant dispersion. |
| Hypothesis Formation | | Does arctic char health deteriorate as a result of habitat alteration from propeller wash, ballast water discharge, site discharge or dust deposition?<br>Does arctic char population decrease as a result of habitat alteration from propeller wash, ballast water discharge, site discharge or dust deposition? |
| Monitoring Target | | Arctic Char CPUE as indicator of abundance<br>Arctic Char condition factors (e.g., length, weight, external condition, external determination of sex and age, if possible)<br>Arctic Char tissue analysis (metals, contaminants) from incidental mortalities |
| Design Type | | Near shore sampling around Milne Inlet |
| Testable Hypotheses | | $H_0$ Arctic char health is reduced as a result of Project activities.<br>$H_A$ Arctic char health is not reduced as a result of Project activities.<br>$H_0$ Arctic char population size does not decrease as a result of Project activities.<br>$H_A$ Arctic char population size decreases as a result of Project activities. |
| Sample Size Requirements | | Not applicable |
| Sampling | Frequency | During the open water season |
| | Location | Sampling stations along the western and eastern shores of Milne Inlet, and near the Milne Port ore dock. |
| | Timing | August/September |
| Data Collection Methods | | Gill nets |
| Sample Handling and Analysis | | Photograph catch (if necessary) to confirm identification, measure length and weight of each fish, collect tissue sample from incidental mortalities |

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### 3.4.7 Aquatic Invasive Species

#### 3.4.7.1 Review of Baseline Data

Collection of baseline information on aquatic marine species in the vicinity of Milne Port has been ongoing with data collection beginning in 2008 and continuing in 2010, 2013 (SEM 2014a) and 2014 (2015a). A comprehensive review and gap analysis was completed of baseline monitoring to 2013 (SEM 2014b) prior to completing final baseline studies in 2014. Studies to date have involved the collection of species inventories for zooplankton, benthic infauna and epifauna, finfish and macroflora. Artificial substrates (settlement baskets) were deployed in 2014 in order to include encrusting epifauna in the species inventory. These substrates will be retrieved after sufficient time for colonization (minimum one year) and processed to identify epifauna and algae species associated with hard substrates. A compilation of species inventories for all work completed to 2014 at Milne Port is in preparation (SEM 2015b, in prep.).

#### 3.4.7.2 Study Design for Aquatic Invasive Species

AIS monitoring will be a simple Before/After experimental design, focussing on areas with highest potential for marine invasions, notably the Milne Port infrastructure. Monitoring will include studies at the surveillance level and the threshold would be detection of a single occurrence of a non-indigenous species. The purpose is to detect, as an early warning indicator, the invasion of non-native flora and fauna such that a response (e.g., increase scope of monitoring, surveys to determine if the AIS have become established, increase or alteration in mitigation activity [ballast water treatment], implementation of eradication measures [if feasible] can be initiated). Monitoring will include aquatic flora and fauna at a variety of trophic levels including finfish, zooplankton, benthic infauna, epifauna (including encrusting epifauna), and macroflora. Initially all monitoring components will be assessed annually with the frequency of sampling determined through discussion with regulators. This may, in part, be determined by the results of other monitoring programs (i.e., the monitoring of AIS in ballast water).

The monitoring design was developed in consideration of the Canadian Aquatic Invasive Species Network (CAISN II) Arctic Sampling Program sampling protocols (Howland *et al*. 2013) as well as aquatic invasive species monitoring programs and protocols in use in other jurisdictions, specifically Australia's Surveys for Introduced Marine Pests (Hewitt and Martin 2001), the National Atmospheric and Oceanographic Administration (NOAA) Port Surveys for Invasive Species in the USA (Power *et al*. 2006), and the Helsinki Commission (HELCOM) ALIENS 2 Program in the Baltic Sea (Helsinki Commission 2013). The CAISN II Arctic Sampling Program had prepared a species inventory for four Arctic Canadian ports (Churchill, Iqaluit, Deception Bay and Steensby Inlet) and Fisheries and Oceans Canada (DFO) had suggested that these protocols be used to guide the development of existing species inventories and future monitoring at Milne Port.

The various study components to be addressed in the AIS EEM program are identified in Table 3.12. As with the CAISN II program and other AIS programs globally, the focus is on fauna and lower trophic levels. Fish have been included as part of the AIS monitoring, only because fish sampling will be completed as part of the overall MEEMP and the fishing methods are applicable to the collection of mobile epifauna. A generalized location map showing locations for collection of samples for the various AIS EEM components is provided in Figure 3.3. These locations were used to complete additional AIS baseline data in 2014. Locations for future AIS EEM sample collections may be modified slightly, if required, in consideration of any disturbances of 2014 locations during construction.

**Table 3.12 Recommended Study Components for a Marine Aquatic Invasive Species Environmental Effects Monitoring Program.**

| Component | Spatial Extent | Sampling Approach |
|---|---|---|
| Zooplankton | Sampling from deep water at port location | Zooplankton tows during open water and under ice |
| Benthic Infauna | Sampling from four depth strata/habitats | Grab samples or quadrats from soft sediments |
| Epifauna | Sampling from four depth strata/habitats | Data collected from baited Fukui traps and underwater video |
| Encrusting Epifauna | Sampling from project infrastructure and artificial substrates | Scrapings from project's infrastructure and deployed artificial substrates |
| Fish | Sampling from four depth strata/habitats | Sampling from Fukui traps and tended gill net sets |

DFO, under the CAISN II Program and with support from the National Science and Engineering Research Council (NSERC), is exploring the development of novel methods for the detection of AIS including the use of DNA barcoding (Briski *et al*. 2011) or the application of rapid assessment techniques (e.g., Minchin 2007), which could potentially involve the participation of local communities in AIS monitoring. Should any of these novel approaches become 'operational' in the context of accepted EEM practices, consideration will be given to integrating these methods into the AIS component of the MEEMP.

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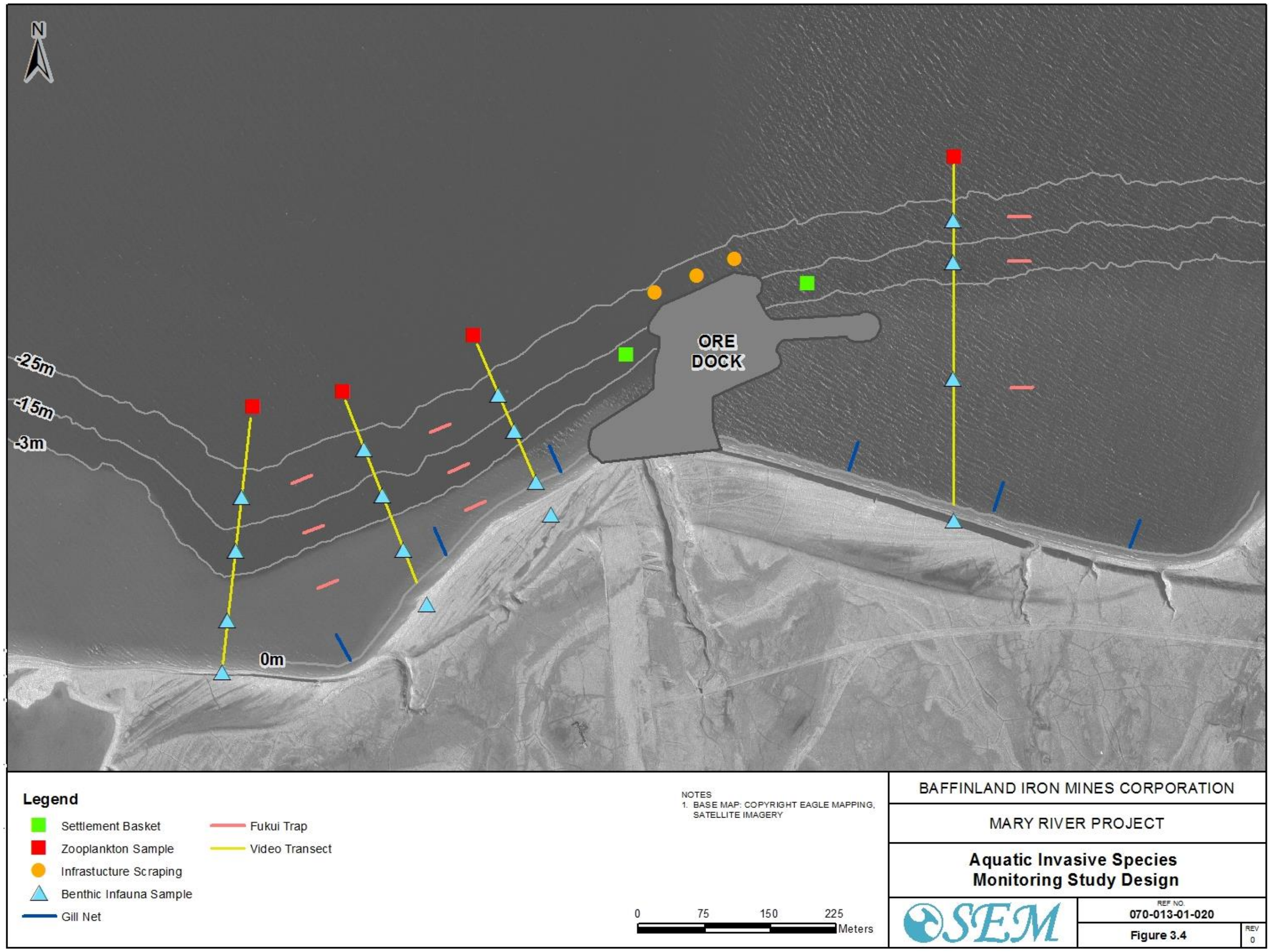


**Figure 3.3 Aquatic Invasive Species Monitoring Study Design.**

#### 3.4.7.3 EEM Components

***Zooplankton*** — The objective of this component of the AIS monitoring is to conduct annual monitoring at a surveillance level to detect a single occurrence of a non-indigenous zooplankton species. Should an invasive zooplankton species be detected, EEM could be adjusted for example to determine the distribution of the invader (e.g., increased spatial extent of monitoring) and if the invader is affecting the existing zooplankton populations (e.g., data analyses using community indices).

Zooplankton will be collected during the open water period (July to September) by vertical tows with an 80 µm mesh plankton net and oblique tows using a 250 µm mesh plankton net at a deep water location (>25 m depth) at the end of each of four transects in the vicinity of the Milne ore dock (Figure 3.3). Oblique tows will be collected by trailing the plankton net behind the sampling platform in a figure eight fashion for a defined period of time, in the vicinity of the vertical tow location. Zooplankton collections will also be made under the ice in June with vertical tows at the same location as open water tows with an 80 µm mesh plankton net. All taxa will be identified to the lowest practical taxonomic level (LPL) by qualified taxonomists and a reference collection of all identified taxa will be made and updated annually. Note that experience during baseline data collection has determined that not all zooplankton can be identified to species and this is a potential constraint on the AIS monitoring.

The faunal list from each monitoring survey will be cross checked against the baseline species inventory compiled during baseline surveys. Samples will also be screened for the presence of non-native ichthyoplankton.

***Benthic Infauna*** — As above, EEM monitoring of benthic infauna will be at a surveillance level to detect a single occurrence of a non-indigenous benthic species. Should an invader be detected, the EEM program could be adjusted as described above.

Benthic infauna samples will be collected from soft sediments in the vicinity of the Milne Port using grab samplers. Replicates (n=5) will be collected from each of four habitat/depth strata; inter-tidal zone, 0–3 m, 3–15 m and 15–25 m (Figure 3.3). The requirement for replication is not an explicit requirement for AIS monitoring, as the focus is on early detection of a single AIS, however replication will increase the sample size and will improve chances for AIS detection. Should an AIS be detected, data analyses using community indices, as permitted by sample replication, will assist in determining effects of an AIS on the indigenous benthic community. All taxa will be identified to the lowest practical taxonomic level (LPL) by qualified taxonomists. A reference collection of all identified taxa will be made and updated annually. As with zooplankton, not all benthic infauna can be identified to species and this is a potential constraint on the AIS EEM.

The faunal list from each monitoring survey (annual) will be cross checked against the list compiled during baseline surveys.

***Epifauna*** — EEM monitoring of benthic epifauna will be at a surveillance level to detect a single occurrence of a non-indigenous epifaunal species. Should an invader be detected, the EEM program could

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be adjusted and/or expanded. If a suspected invader is identified during EEM, increased surveying and sampling effort to capture and confirm identification of the suspected benthic epifauna invader would be undertaken.

Epifauna will be monitored through the use of baited Fukui traps, which will capture the mobile epifauna, and underwater video, which will document the larger and possibly less mobile taxa. This monitoring component is also being used to assess the effects of other project operations, specifically the effects of sediment redistribution and/or deposition and accumulation of contaminants in sediments. The metric used in those EEM components will be total abundance of epifauna, using the underwater video data only.

Baited Fukui traps will be set in the four habitat/depth strata identified above (Figure 3.3). All epifauna captured will be identified to species in the field, and if identification is not possible, detailed photographs will be collected or the specimen will be sacrificed for subsequent taxonomic identification.

Underwater video data will be collected along transects in three of the four habitat/depth strata identified above. Similar shoreline transects will be walked in the inter-tidal habitats at low tide, as an extension of the underwater transects. In the shoreline surveys, all taxa will be field identified, photographed, and/or sacrificed as above. In the video data, all taxa will be identified to the lowest practical taxonomic level (LPL) by a qualified technician. Experience has indicated that it may not be possible to identify all taxa to species from the video footage which is a potential constraint on AIS monitoring. As specimens are collected for taxonomic identification and more exposure to the native epifauna community occurs, it is expected more of the epifauna will be identified to species.

The faunal list from each monitoring survey will be cross checked against the list compiled during baseline surveys.

***Encrusting Epifauna*** — EEM monitoring of encrusting epifauna will be at a surveillance level to detect a single occurrence of a non-indigenous epifaunal species. Should an invader be detected, the EEM program could be adjusted and/or expanded to determine the distribution of the invader by sampling other hard substrates over a larger spatial area (e.g., navigation buoys). The baseline species inventory for this component was initiated in 2014.

Encrusting epifauna will be monitored through the collection of samples by physical removal (scraping) from the port infrastructure including different types of hard surfaces (metal, concrete, wood, rock, rope, chains, etc.). Samples will be collected from exposed surfaces in the intertidal areas at low tide. Samples in the 0–3 m strata may be collected using a custom designed scraping net (see Power *et al*. 2006) or through the deployment of settlement baskets or plates. Sample collection from the deeper strata (5–15 m and 15–25 m) will be from the deployment of settlement baskets.

The length of time that settlement baskets are to be deployed will be determined initially by evaluating cumulative species curves for each depth/habitat strata. As the settlement baskets are left in place for

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longer periods of time, additional colonizing species will decrease until an asymptote is approached. This will then provide guidance as to the length of time for deployment for refinement of the EEM protocol.

All taxa will be identified to the lowest practical taxonomic level (LPL) by qualified taxonomists and a reference collection of all identified taxa will be made and updated annually.

The faunal list from each monitoring survey will be cross checked against a compiled list developed during the initial EEM surveys. It is recognized that, owing to the harsh northern environments, colonization of project infrastructure and settlement baskets may take some time, extending into project operations, which could compromise characterization of a true baseline for encrusting epifauna.

***Fish*** — Fish fauna monitoring will be conducted at a surveillance level to detect a single occurrence of a non-indigenous fish species. Monitoring will be completed primarily in relation to adults or large juvenile fish using conventional sampling methods. Should an invasive fish species be detected, EEM could be adjusted to determine the distribution of the invader (e.g., increased spatial and potentially temporal extent of monitoring) and if the invader has become established (i.e., the presence of an adult specimen would likely indicate successful survival, growth and potentially reproduction).

Fish will be collected in the vicinity of the Milne Port using baited Fukui traps and tended gill net sets. This monitoring component will also be used to assess several environment effects monitoring objectives (e.g., bioaccumulation of contaminants in fish flesh) in addition to monitoring for the invasion of non-indigenous fish fauna. Traps and gill nets will be set in each of four habitat/depth strata; inter-tidal zone, 0–3 m, 3–15 m and 15–25 m (Figure 3.3). The use of gill nets will likely be constrained by conditions placed on experimental licenses issued by DFO (i.e., to minimize mortalities during sampling).

In addition to nets and traps, zooplankton samples will be screened for the presence of ichthyoplankton (eggs and larvae) and any unidentifiable specimens will be retained for identification by taxonomic experts.

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# 4 MARINE MAMMAL EFFECTS MONITORING (MEEMP — MAMMALS)

This is the third revision of the Marine Mammal Effects Monitoring Plan for shipping activities associated with the Mary River Project (see LGL 2014). Specific marine mammal study designs have been modified based on recent field analyses and results. Flexibility in the EEM approach is necessary to account for the complexity of the Project- marine mammal interactions.

## 4.1 QUESTIONS FOR HYPOTHESIS FORMULATION

Several questions arose during the preparation and review of the EIS and Addendum (ERP), as well as during the issuance of the NIRB Project Certificate (No. 005). These served to formulate hypotheses needed to guide development of the EEM program. The following were considered:

1) Will marine mammal distribution and abundance change as a result of Baffinland shipping activity along the northern shipping route during the open-water season?
    a) What is the spatial-temporal distribution of marine mammals in the absence of shipping?
    b) How far away from the ship will marine mammals avoid it?
    c) What is the duration of avoidance for a single ship passage?
    d) What received sound levels from ore carriers result in marine mammal avoidance? Or do mammals respond to the approaching vessel rather than just the received noise levels.
    e) Will marine mammals habituate to frequent and regular ship passages?
    f) If yes to (e), how long will it take marine mammals to habituate?
    g) What natural factors influence narwhal distribution and abundance, independent of shipping?
2) Will narwhal behaviour change during and after a project vessel passage?
    a) What is narwhal behaviour in Milne Inlet before Project shipping?
    b) Does relative abundance and distribution of narwhals change during and after a ship passage?
    c) Is narwhal group composition affected?
    d) Does narwhal behaviour change during and after a ship passage?
    e) How does subsistence hunting affect narwhal behaviour?
    f) Do the number and characteristics of narwhal calls change in the presence of shipping?
3) What are short-term, long-term, and cumulative effects of shipping and underwater noise on marine mammals?

## 4.2 MARINE MAMMAL EEM CANDIDATE STUDIES SELECTION

A series of monitoring studies have been developed to address potential Project shipping effects on marine mammals during the ERP. The monitoring studies are designed to complement each other and to allow effects monitoring at both a regional and local scale. Results will be integrated to provide a more complete understanding of marine mammal response to Baffinland shipping activities during the ERP (see Section 4.3.8). A summary of the monitoring studies is provided in Table 4.1. These studies were primarily selected because of low levels of certainty with effects predictions and because of NIRB Project Certificate requirements.

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**Table 4.1 Summary of EEM – Mammal Studies According to Current Program Level**

| VEC (Key Indicator) | Type | Description |
|---|---|---|
| All marine mammals | Surveillance | Ship-based observers on some Baffinland vessels |
| Narwhals and bowhead whales | EEM | Shore-based monitoring of narwhals from Bruce Head, Milne Inlet before, during and after ship transits. |
| | EEM | Regional-level aerial surveys of Pond Inlet, Eclipse Sound, Milne Inlet, Navy Board Inlet, and Koluktoo Bay |
| | EEM | Acoustic recordings of ambient noise levels, shipping sounds, and marine mammal calls. |
| Narwhals | EEM | Local-level aerial photographic surveys of narwhals in northern Milne Inlet and Tremblay Sound before, during and after ship transits. |

## 4.3 EEM STUDY SCHEDULE

A nominal schedule for the MEEMP-Marine Mammals will be developed following the completion of data analyses for the 2015 field season. A schedule will be presented by year, through to 2025. To date, monitoring programs (with the exception of the acoustic study) have been conducted annually for three years. Subsequent to establishment of a firm baseline, and development of statistically valid null hypotheses, a less frequent sampling schedule will be employed. Programs at a research level are for defined periods of time with continuation of monitoring at a higher level (surveillance or EEM) to be determined based on the research study results. Programs to be conducted at a surveillance level will be subject to changes in response to any observed effects that could trigger an expanded monitoring program (both spatially and temporally).

## 4.4 EEM STUDY DESIGN AND DESCRIPTIONS

### 4.4.1 Rationale and Background

The MEEMP is designed to investigate the responses of marine mammals to shipping through Eclipse Sound, Milne Inlet, Pond Inlet, and Koluktoo Bay during the open-water season. The numbers and species of marine mammals that occur in the vicinity of Baffinland's northern shipping route vary with date and environmental conditions and different species of marine mammals rely on different resources while in the vicinity of northern shipping route. The monitoring studies need to be able to address the possibility of habituation by the animals. It is known that mammals react differently to ships (and other anthropogenic activities) depending on their previous level of experience with shipping and their activities during exposure (Ellison *et al*. 2012).

One of the MEEMP's objectives is to gain an understanding of the natural variability of marine mammal distribution, abundance and behaviour along the northern shipping route. The design of the monitoring program is premised on (and designed to test) the expectation that, while some avoidance behaviour of shipping will occur, it is likely that animals will have minimal response to and will habituate to the slow moving, regular pattern of shipping traffic associated with the Project.

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The main null hypotheses to be tested during the study are:

> *$H_o$: Marine mammal distribution and relative abundance does not change in the presence of open-water shipping.*
>
> *$H_o$: Marine mammal behaviour does not change in the presence of open-water shipping.*

Associated hypotheses related to the length of time that any distributional or behavioural responses persist will be addressed to determine whether habituation occurs over time. Specific hypotheses are provided in each EEM study below.

The NIRB Project Certificate includes requirements (Condition #106 and #123) that Baffinland employ ship-based observers to monitor interactions with marine mammals and seabirds with Project shipping activities. It was also important that Baffinland provide the opportunity for local stakeholders to be involved in these marine mammal monitoring activities (Condition #126).

### 4.4.2 Study Area and Key Species

The overall study area includes Koluktoo Bay, Milne Inlet, Eclipse Sound, Pond Inlet, Navy Board Inlet, and Tremblay Sound. The monitoring effort and schedule in each of these areas varies and is outlined below for each EEM study. A map of the overall study area is provided (Figure 4.1) to put the MEEMP in a regional context.

Narwhals are the primary species of interest in the Eclipse Sound – Milne Inlet area because they are present in large numbers during the open-water season when shipping occurs and because it is a major resource used by local hunters. The other regularly occurring cetacean species (albeit in much reduced numbers) that will be studied (if possible) is the bowhead whale. There will be small numbers of belugas and killer whales in the area on occasion but their numbers are too small to form the basis for a quantitative effects study. Information on pinnipeds (ringed seal, bearded seal, walrus, and harp seal) and polar bears will also be recorded but they are not a focus of MEEMP.

Monitoring efforts for the ERP are focused on the open-water period when Baffinland shipping will occur. The open-water season is tentatively defined as the period from break-up of the landfast ice in Milne Inlet in mid to late July to sometime in late October or early November when ships can last operate within Eclipse Sound, Milne Inlet and Pond Inlet without icebreaker support.

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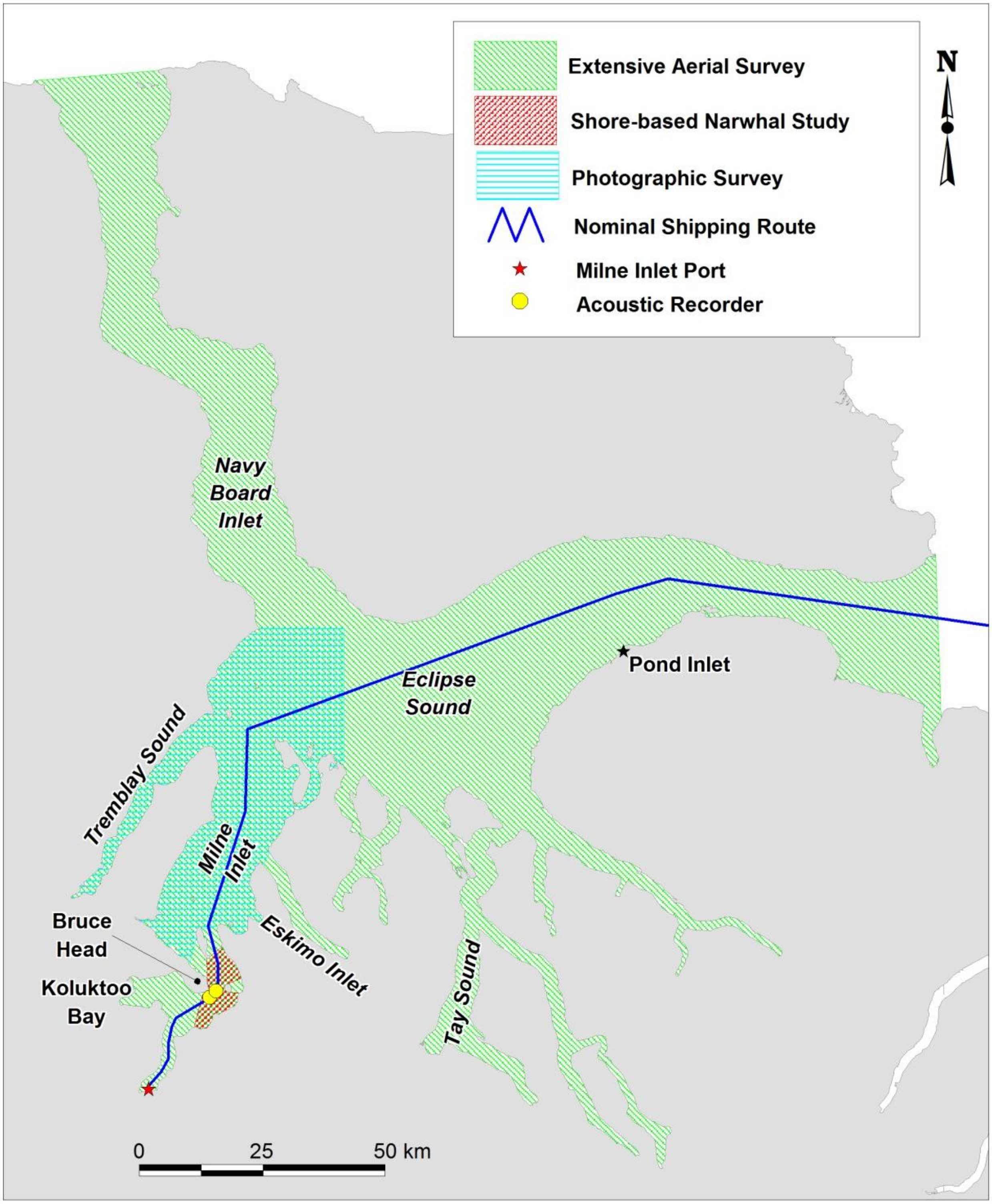


**Figure 4.1 Study Areas for Marine Mammal and Acoustic Monitoring Studies.**

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### 4.4.3 Statistical Approach

#### 4.4.3.1 Rationale for Sampling Approaches

The primary objective of marine mammal monitoring is to test for and quantify effects from Baffinland shipping activity on narwhal distribution, relative abundance, and behaviour. The monitoring studies required various sampling and modelling approaches due to the differing spatial-temporal scales of the responses being tested. Three sampling approaches are summarized below along with their advantages and disadvantages. Taken together, all three complement each other to form a synergistic effects monitoring program for narwhals and Project shipping activity during the ERP.

***Extensive Aerial Surveys*** — At the largest spatial scale, annual variation in the general distribution of narwhals across the Eclipse Sound complex (i.e., Pond Inlet, Eclipse Sound, Milne Inlet, Koluktoo Bay, Tremblay Sound, Navy Board Inlet, smaller fjords) throughout a typical open-water season had to be understood to anticipate when and where narwhals will likely occur in relation to vessel transits along the northern shipping route. This knowledge was gained from expanded aerial surveys of the entire study area spread over the open-water season for multiple years (see Elliott et al. 2015; Thomas et al. 2015). Though some season-area combinations were missed due to logistical limitations, the extensive aerial surveys conducted in 2007, 2008, and 2013–2015 provide the data necessary to describe the general seasonal pattern in distribution and the annual variation therein. While this sampling regime is adequate to detect large-scale movements of narwhals from a given area-time period combination that deviates from baseline, more acute and less severe narwhal responses to shipping require greater sampling resolution.

***Photographic Aerial Surveys*** — In 2015, directed aerial surveys were conducted over Milne Inlet and Tremblay Sound before, during, and after vessels passed through northern Milne Inlet. These surveys collected high-resolution photographs that will be analyzed after the field season. From these images, the number, exact location, and direction of travel for narwhal groups will be determined. Thus, this sampling effort provides the greatest spatial resolution of narwhal density and behaviour (albeit only one aspect of behaviour) in relation to shipping events. The disadvantage of this approach is the restricted amount of flying time, which limited observation of shipping events co-occurring with substantial narwhal presence in the study area. Moreover, in 2015, the surveys were never performed in the complete absence of a shipping event (particularly given that ships were anchored within the Study Area at Ragged Island). Nevertheless, sufficient data were obtained to test for shipping effects on narwhals (the nominal modelling approach is outlined below).

***Shore-based Study*** — The shore-based study (2013–2015) from Bruce Head, Milne Inlet provides more continuous data on narwhal abundance and behaviour both on days without shipping events and also on days before, during, and after a shipping event. These data afford greater temporal resolution than the two approaches mentioned above, but spatial resolution for the shore-based survey is restricted to a smaller geographic area (described below).

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#### 4.4.3.2 Experimental Design and Model Specifications

***Defining Narwhal Response Variables*** — For all three survey types, several response variables were used to index the distribution and abundance of narwhals. The extensive aerial surveys enumerated narwhals for each 2-min sample along the transect lines, while the photographic survey and shore-based study provided the same information for each photograph and spatial stratum, respectively. Both the number of narwhal sightings and the group size for each sighting was recorded for each sampling unit. Both number of sightings and total number of narwhals can be modelled with a negative binomial distribution that accounts for over-dispersion in the data.

For the photographic survey, two other types of responses are available. First, the perpendicular distance from the vessel's ultimate track line can be recorded for each group sighted, and can be considered a response in itself. Evidence for vessel effects on narwhals (i.e., an avoidance response) would be indicated if this distance increases as a vessel comes closer. This response has the advantage of removing all zero observations, and can likely be modelled as a log-normal distribution. Second, the headings for each narwhal group sighted within a photograph can be summarized and binned into four categories: (1) parallel to the vessel track line and headed toward the vessel, (2) parallel and headed away from the vessel, (3) perpendicular and headed toward the track line, and (4) perpendicular and headed away. These data would form a multinomial response for each photograph that could be tested against the vessel's approach.

Finally, for the shore-based study the number of narwhals in each spatial substratum across the study area could be considered a multinomial response as well. There are 26 possible substrata, but some may be pooled together during analyses. An effect on narwhals would be evidenced if their distribution pattern shifts during vessel transits.

***Quantifying Vessel Transits*** — Important metrics describing a vessel transit will include (1) whether a vessel is approaching or leaving with respect to a sampling unit, (2) the vessel's bearing in relation to the sampling unit, and (3) the line-of-sight distance between the vessel and the sampling unit. Metrics 2 and 3 can be combined into polar coordinates (Polar X and Polar Y). The axis of each sample's "pole" will always be placed perpendicular to the track line. The interaction of this coordinate with the categorical variable vessel "Approaching/Leaving" will be incorporated into the analyses.

When testing the sightings, number and presence/absence responses, each sampling unit's distance from the vessel track line will be interacted with Polar X. If the vessel transit is having an effect, these responses should increase in samples further from, and decrease in samples closer to, the track line as Polar X becomes smaller (i.e., the ship approaches closer).

***Modifying the Before-After-Control-Impact Design*** — The photographic surveys and shore-based study were designed to test for acute responses by narwhals to shipping events. The most powerful experimental design used to assess environmental effects is the before-after-control-impact (BACI) design. The heterogeneous habitat in the study area and the ecology of narwhals precludes the selection

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of a suitable "control" or reference site. However, a before-after-control-gradient (BAG) design can be applied (Ellis and Schneider 1997). Under the BAG design, the terms in a statistical model that characterize the disturbance are continuous instead of categorical. The term designating control versus impact becomes the continuous variable, and the variable "time since vessel presence" gets interacted with the binary term designating before versus after. Depending on feasibility of this approach, refinements will be made.

***Accounting for Extraneous Variables*** — Extraneous variables are defined as those forces that partially confound the levels of the factor of interest. For example, visibility would be an extraneous variable if it happened to be poor during most of the shipping activity, but good in absence of shipping. Other variables are not confounding, but merely add variability to responses, and therefore lower the power to detect effects from the factor of interest. Analyses of the effects of shipping on narwhals are complicated by such variables including other anthropogenic factors such as hunting.

Available environmental covariates will be entered into the models for these surveys to account for as much natural variation in narwhal responses as possible. However, a key confounding factor in attempting to determine the effects of vessel transits on narwhals is the frequent occurrence of narwhal hunting at the base of Bruce Head and in surrounding areas. At present it is difficult to account for hunting activity because shore-based and aerial observers can only record hunting activity when they are surveying; in other words, there is much time when this information is unavailable. Community-based monitoring may contribute to quantifying hunting activity.

### 4.4.4 Ship-based Observers

#### 4.4.4.1 Overall Approach

The Project commenced in 2013 with the transport of fuel and supplies by vessels transiting between Quebec City and Milne Inlet and concurrently, the Ship-based Observer Program was initiated as a pilot study (SEM 2013). In 2014 and 2015, the Ship-based Observer Program was continued during construction activities in Milne Port (SEM 2015c). Fuel tanker and sealift vessel traffic in and out of Milne Port provided the opportunity to conduct ship-based observations between Pond Inlet and Milne Port. Ship-based observers surveyed the shipping route embarking at Pond Inlet and disembarking at Milne Port. Future ship-based observer monitoring will include observers being placed on Baffinland ore carriers during Project operation.

#### 4.4.4.2 Study Design

Marine mammal surveys will be completed during daylight hours with scheduled breaks to avoid observer fatigue. Observers will continually scan a 180° viewing area (from port to starboard side, out to the horizon) for the presence or sighting cues of marine mammals (dorsal fins, blows, breaching). Observers will use 7 x 50 range finder binoculars to determine mammal species and distance from the vessel, once a sighting is confirmed. An "Incidental Marine Mammal Sighting Form" will be completed for each

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confirmed sighting. Ledwell (2003) and Reeves *et al*. (1992) will be used as reference material for marine mammal identification.

The survey method for seabird surveys is the Partial Tasker, Method 1 (SEM 2015c), which provides data fundamental for seabird survey designs, and is considered effective for the experience levels of the observers. During each seabird survey, all birds within a 300 m transect of the observer's viewing area will be identified to the species level where possible, counted and recorded as either flying or on the water. Birds observed outside of the transect will be counted but recorded as outside the survey transect. Birds initially sighted by eye will be observed with 7 x 50 binoculars to allow for species identification as required. Each survey will be conducted for 20 minutes in duration; ten minutes with a 90° scanning area from the bow to starboard side, followed by another ten minutes with a 90° scanning area from the bow to port side (for a total of 180°). All surveys will be conducted from the bridge of the vessel.

### 4.4.5 Shore-based Study of Narwhals

#### 4.4.5.1 Overall Approach

The shore-based monitoring of narwhals began in 2013 and this first year was considered a pilot study. A pilot approach was taken to allow potential logistical issues and data collection protocols to be refined prior to increases in shipping activities associated with the ERP. In 2013, the study team consisted of three marine biologists and three Pond Inlet residents. Narwhal distribution and relative abundance data as well as focal group composition behaviour data were collected from August 6–26, 2013. The shore-based study continued in 2014 and 2015 and each year's approach and study design was improved based on lessons learned the previous year. A notable change was that the study team size and the study period were doubled after 2013 to increase the amount of data collected.

The study is currently designed to collect three primary types of narwhal data (relative abundance and distribution, group composition, and behaviour). Data were collected from a shore-based location on Bruce Head (N 72°4'17.76", W 80°32'35.52") at an elevation of ~215 m above mean sea level (Figure 4.2). Ship track logs for large vessels were compiled from various sources and integrated into a single database. Environmental and other anthropogenic activity data (including local hunting activity) were collected to investigate and to account for, additional sources of variability in narwhal relative abundance, distribution, and behaviour. As well, data were collected to sample the full 24-hour period to account for potential daily variation in narwhal numbers. Baseline data collected in the absence of large vessels are valuable and necessary for the investigation of narwhal response to any type of disturbance.

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**Figure 4.2 The Observation Platform at Bruce Head, 2014.**

#### 4.4.5.2 Study Design

Visual observations by biologists and trained local observers (from Pond Inlet) were used to document narwhal response to Baffinland vessels in waters near Bruce Head, Milne Inlet. A summary of the Study Design is provided in Table 4.2. As noted above, three primary types of narwhal data were the focus of this study: (1) relative abundance and distribution, (2) group composition, and (3) behavioural data. An overview of the methods and hypotheses associated with each type of data are provided below. Detailed methods for the 2014 study are provided in Smith *et al*. (2015). Based on results to date (primarily 2013 and 2014; see Thomas *et al*. 2014 and Smith *et al*. 2015), key issues that will have to be addressed include the natural variation of narwhal distribution/abundance as well as behaviour, and the effects of narwhal hunting in the Bruce Head study area.

**Table 4.2 Summary of Shore-based Narwhal Study Design.**

| | | |
|---|---|---|
| Project Interaction | Project Activity | Shipping |
| | Environmental Effect | Narwhal avoidance of shipping; changes in narwhal behaviour related to shipping |
| Hypothesis Formation | | Will narwhal distribution and relative abundance change as a result of Baffinland shipping activity? Will narwhal behaviour change during and after a vessel transit?<br>If changes in distribution and relative abundance occur, how long will they last? Will the duration of an effect decrease as narwhals possibly habituate to regular and repeated vessel traffic? |
| Monitoring Target | | Narwhal distribution and relative abundance<br>Narwhal group composition<br>Narwhal behaviour |
| Design Type | | Before-after-control-gradient (BAG) |
| Testable Hypotheses | | $H1_0$: Narwhal distribution and relative abundance does not significantly change in response to a large vessel transit.<br>$H1_A$: Narwhals move away from a vessel and narwhal numbers decrease in response to a large vessel transit.<br>$H2_0$: Narwhal group characteristics do not significantly change in the presence of a vessel.<br>$H2_A$: Narwhal group characteristics do significantly change in the presence of a vessel.<br>$H3_0$: Narwhal behaviour does not significantly change in the presence of a vessel.<br>$H3_A$: Narwhal behaviour does significantly change in the presence of a vessel.<br>$H4_0$: Narwhals do not habituate to large vessel shipping.<br>$H4_A$: Narwhals habituate to large vessel shipping. |
| Sample Size Requirements | | To be determined. |
| "Sampling" | Frequency | Annually, during the open water season; minimum of three years |
| | Location | Southern Milne Inlet, adjacent to Bruce Head |
| | Timing | August/early September |
| Data Collection Methods | | Visual observations using scan sampling, abundance counts, and group follows. |
| Analyses Approach | | Generalized linear mixed model (GLMM) |
| Data Interpretation and Reporting | | GLMM of relative abundance and distribution data that can account for influences of natural environmental factors and other sources of anthropogenic activity. To date, behaviour and group composition data have been examined with univariate statistical tests but will potentially be examined via modelling. |

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#### 4.4.5.3 Relative Abundance and Distribution Data

Relative abundance and distribution (RAD) data have been collected before, during and after a large vessel entered the Stratified Study Area (SSA; Figure 4.3) as well as during periods when no vessels are in the area. Group size, direction of travel and substratum were recorded for each narwhal sighting. During each count of the nine strata (A to I, see Figure 4.3) observers recorded environmental conditions within each substratum (e.g., A1, A2, etc.) and the type and location of any anthropogenic activity that occurred within the SSA.

The key hypothesis is whether large vessel presence affected narwhal abundance in the SSA. More specifically:

> *$H1_{0:}$ Narwhal distribution and relative abundance does not significantly change in response to a large vessel transit.*
>
> *$H1_{A:}$ Narwhals move away from a vessel and narwhal numbers decrease in response to a large vessel transit.*

To statistically test the above hypothesis, narwhal count data have been modelled using a generalized linear mixed model (GLMM), with a discrete probability distribution to calculate the likelihood of observing the counts that were recorded. The "mixed" terminology of the GLMM indicates that the model incorporates some predictors as "fixed" terms and some as "random" terms. Fixed terms are used mostly when the researcher is interested in how the mean response differs across only those levels of the factor, whereas random terms are used when the only interest is removing variation due to a factor and generalizing the results across all of its possible levels. In the GLMM used for narwhal count data, vessel presence has been modelled as a fixed term. Environmental covariates were entered into the model to account for natural variation in narwhal count data. As briefly noted above, a key confounding factor in attempting to determine the effects of large vessel transits on narwhals is the frequent occurrence of narwhal hunting at the base of Bruce Head and in surrounding areas.

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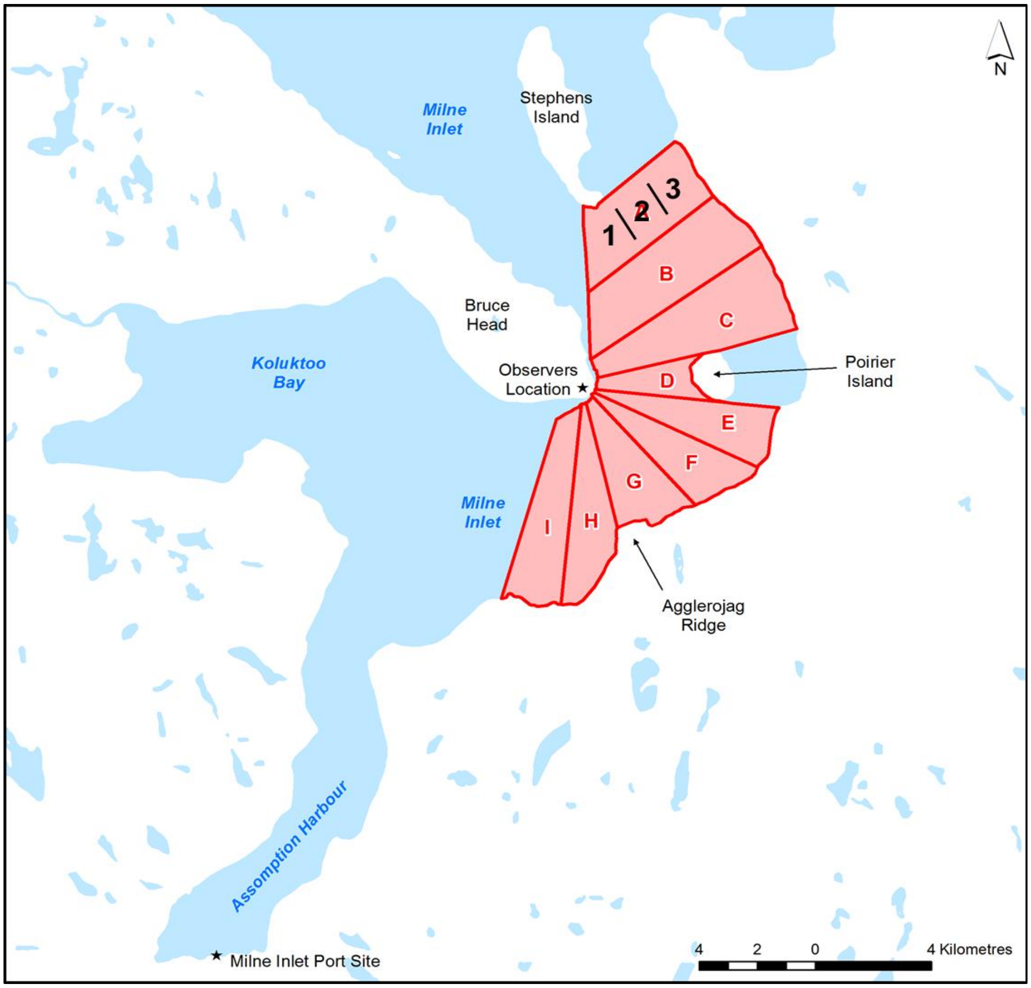


**Figure 4.3 The Stratified Study Area (SSA) for Shore-based Observations of Narwhal Relative Abundance and Distribution at Bruce Head.**

#### 4.4.5.4 Group Composition

Group composition data have been collected on narwhals that swim through the Behavioural Study Area (BSA; Figure 4.4) and pass within ~1,000 m of shore. Group composition data were collected by a team of three observers employing survey and scan sampling protocols (Mann 1999). Photographs were taken when possible and examined later to verify or augment data recorded in the field. Data that have been collected includes group size, number of narwhals with tusks, age category, spread, formation, direction of travel, speed of travel, and distance from shore. These data were used to test the following hypothesis regarding group composition:

*$H2_{0:}$ Narwhal group characteristics do not significantly change in the presence of a vessel.*

*$H2_{A:}$ Narwhal group characteristics do significantly change in the presence of a vessel.*

Group characteristics (i.e., group spread, formation, swim speed and distance from shore) in the presence and absence of shipping were tested with parametric tests (Pearson's Chi-squared statistic) when sample sizes permit, otherwise non-parametric tests like the Mann-Whitney *U* test were used. These analyses have to take into account that groups with different compositions (e.g., presence vs. absence of calves) may respond differently to vessel presence. It is possible that different statistical approaches will be taken to account for factors other than shipping that might affect group composition.

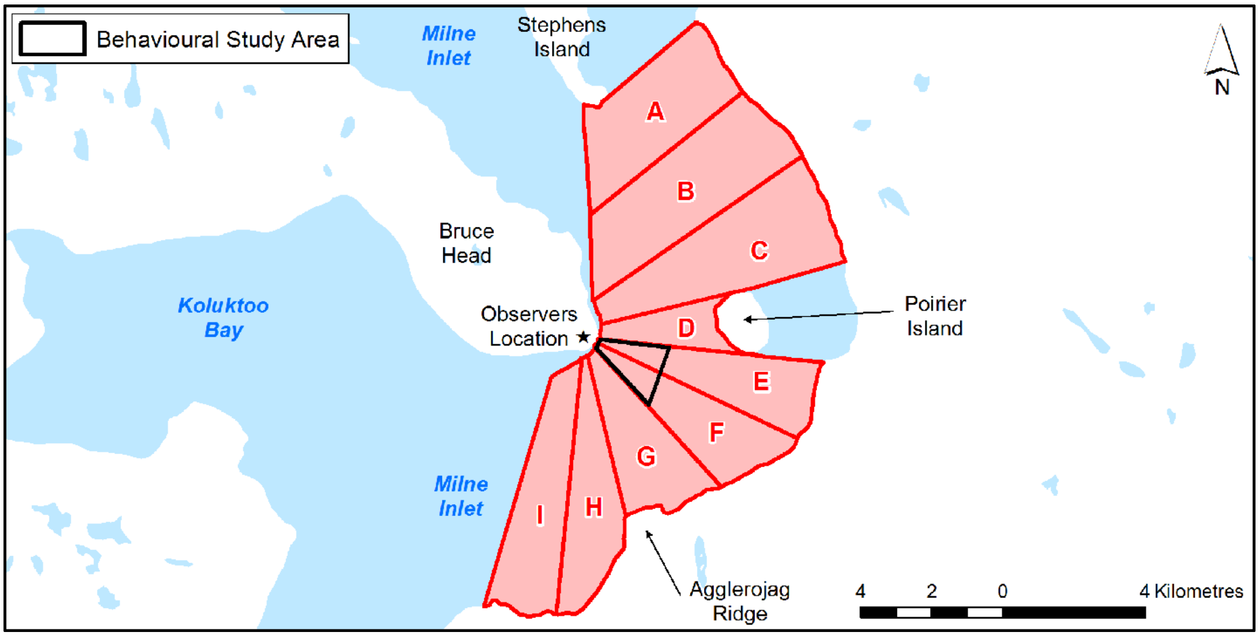


**Figure 4.4 Approximate Boundaries of the Behavioural Study Area (BSA) for the Shore-based Narwhal Study at Bruce Head.**

#### 4.4.5.5 Behavioural Data

Behavioural observations have been made on narwhals in the BSA (Figure 4.4). Data were collected by a team of three observers employing a modified group-follow and predominant group activity sampling protocols (Mann 1999). Group-follow is defined as monitoring a group of animals for >30 min; predominant group-activity is defined based on the assessment of the activity engaged in by >50% of group (Mann 1999). Beside primary and secondary behaviour types, group size, group composition, group spread and group formation were recorded. The key hypothesis is whether vessel presence affected narwhal behaviour in the BSA. More specifically:

*$H3_{0:}$ Narwhal behaviour does not significantly change in the presence of a vessel.*

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*$H3_{A:}$ Narwhal behaviour does significantly change in the presence of a vessel.*

Several behavioural parameters were examined in the presence and absence of vessels including trackline metrics and behaviour types.

### 4.4.6 Aerial Surveys

#### 4.4.6.1 Review of Baseline Data

Systematic aerial surveys of marine mammals in the study area occurred in 2007 and 2008; these data were used in support of the FEIS and its Addendum (Appendix 8A-2 in Volume 8 of the FEIS). During the open-water seasons of 2013 and 2014, baseline data were specifically collected in support of the marine mammal monitoring program (Elliott *et al.* 2015; Thomas *et al.* 2015). The 2013 and 2014 aerial surveys were not designed to systematically determine short-term and localized effects of shipping on cetacean distribution and abundance. The survey design has been modified in 2015 when the frequency of shipping for the ERP will increase substantially relative to 2013 and 2014). A summary of survey effort during 2013 and 2014 is provided in Table 4.3. The aerial survey crew consisted of biologists from LGL and local observers from Pond Inlet.

During all aerial surveys, narwhals were by far the most frequently encountered marine mammal. Narwhal numbers and distribution vary greatly from day-to-day, within a season, and amongst years (see Elliott *et al.* 2015 and Thomas *et al.* 2015). A general trend observed during the surveys was that narwhal densities peaked from mid-August to early September. Densities typically decreased by mid-September. By late September, narwhals had moved out of Milne Inlet, Koluktoo Bay and Tremblay Sound. As the open-water season progressed, narwhals were more frequently observed in Eclipse Sound, and in mid-October narwhals were observed in Pond Inlet. As ice cover becomes extensive, narwhals appear to leave the Eclipse Sound complex and start moving toward their wintering areas. Narwhals were seldom observed in Navy Board Inlet despite substantial survey effort in this area, particularly in 2014. It has become quite clear that the natural variation in narwhal abundance and distribution in the study area and along the shipping route has to be accounted for when attempting to determine the effects of shipping. A power analysis was conducted based on the 2014 dataset to offer insight into EEM design — see below for a summary of the findings and Appendix A for details.

**Table 4.3 Summary of Aerial Survey Effort (Baseline Data) for Marine Mammals in the Study Area in Support of ERP Monitoring.**

| Date | Survey Period | Geographic Strata Surveyed | Linear Distance Surveyed (km) |
|---|---|---|---|
| 1–4 August, 2014 | Early August | MIS, MIN, KB, TS, ESW, ESE, NBI, PI fjords | 2,113.9 |
| 14–17 August, 2014 | Mid August | MIS, MIN, KB, TS, ESW, ESE, NBI, PI fjords | 2,208.8 |
| 30 August – 2 September, 2014 | Late August | MIS, MIN, KB, TS, ESW, ESE, NBI, PI fjords | 2,092.9 |

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**Table 4.3 Summary of Aerial Survey Effort (Baseline Data) for Marine Mammals in the Study Area in Support of ERP Monitoring.**

| Date | Survey Period | Geographic Strata Surveyed | Linear Distance Surveyed (km) |
|---|---|---|---|
| 14–17 September, 2014 | Mid September | MIS, MIN, KB, TS, ESW, ESE, NBI, PI fjords | 2,264.2 |
| 29 September – 2 October, 2014 | Late September | MIS, MIN, KB, TS, ESW, ESE, NBI, PI fjords | 2,160.4 |
| 17–22 October, 2014 | Mid October | MIS, MIN, KB, TS, ESW, ESE, NBI, PI fjords | 1,775.0 |
| **Total In 2014** | | | **12,615.12** |
| 31 August – 1 September, 2013 | Late August | MIS, MIN KB, TS ESW, NBI | 1,047.3 |
| 14–15 September, 2013 | Mid September | MIS, MIN KB, TS ESW, NBI | 1,059.6 |
| 29–30 September, 2013 | Late September | MIS, MIN, KB, TS, ESW, ESE, NBI | 1,510.0 |
| 14, 16–18 October, 2013 | Mid October | MIS, MIN, KB, TS, ESW, ESE, NBI, PI | 1,528.3 |
| **Total in 2013** | | | **5,145.5** |

Note: MIS=Milne Inlet South, MIN=Milne Inlet North, KB=Koluktoo Bay, TS=Tremblay Sound, ESW=Eclipse Sound West, ESE=Eclipse Sound East, NBI=Navy Board Inlet, PI=Pond Inlet.

#### 4.4.6.2 Study Design

The aerial survey study design includes a two-pronged approach as noted in Section 4.3.3.1; an extensive survey (Figure 4.5A) similar to that surveyed during baseline data collection in 2013 and 2014 (and 2007 to 2008) and a photographic survey (Figure 4.5B) in northern Milne Inlet and Tremblay Sound that will focus on times before, during and after vessel passages. This two-pronged approach will allow for detection of "large-scale" as well as "finer-scale" changes in narwhal distribution and abundance. Further details are provided below and in Table 4.4.

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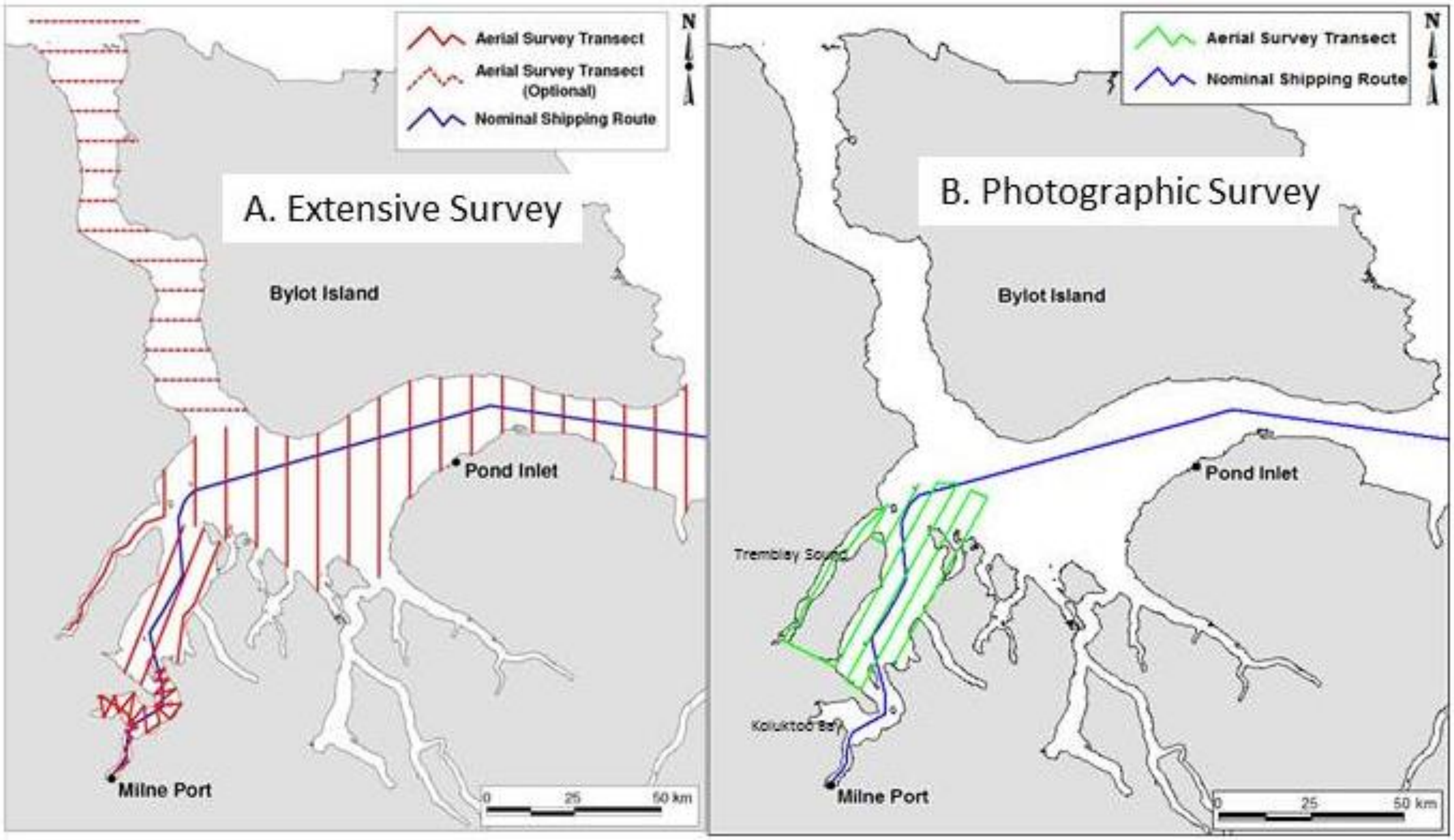


**Figure 4.5 Marine Mammal Aerial Survey Transects for the (A) Extensive Surveys and (B) Photographic Surveys in 2015.**

**Table 4.4 Summary of Aerial Survey Study Design.**

| | | |
|---|---|---|
| Project Interaction | Project Activity | Shipping |
| | Environmental Effect | Narwhal avoidance of shipping |
| Hypothesis Formation | | Will narwhal distribution and relative abundance change as a result of Baffinland shipping activity?<br>If changes in distribution and relative abundance occur, how long will they last? Will the duration of an effect decrease as narwhals possibly habituate to regular and repeated vessel traffic? How far away from the ship will narwhals exhibit avoidance? |
| Monitoring Target | | Narwhal distribution and relative abundance<br>Narwhal distribution/abundance relative to ship track and time since vessel transit |
| Design Type | | Baseline, Before-after-control-gradient (BAG) |
| Testable Hypotheses | | $H1_0$: Narwhal regional distribution and relative abundance does not significantly change in response to a large vessel transit.<br>$H1_A$: Narwhals move away from a vessel and narwhal numbers decrease in response to a large vessel transit.<br>$H2_0$: Narwhals do not habituate to large vessel shipping.<br>$H2_A$: Narwhals habituate to large vessel shipping. |
| Sample Size Requirements | | To be determined. |
| "Sampling" | Frequency | Have been conducted annually since 2013, during the open water season. Future frequency to be determined. |
| | Location | Pond Inlet, Eclipse Sound, Milne Inlet, Koluktoo Bay, Navy Board Inlet, Tremblay Sound and smaller fjords (baseline only). |
| | Timing | August, September, and October (some years) |
| Data Collection Methods | | Line-transect survey methodology<br>Photographic survey of transects flown at 2,500 ft |
| Analyses Approach | | Generalized linear mixed model (GLMM) |
| Data Interpretation and Reporting | | GLMM of relative abundance and distribution data that can account for influences of natural environmental factors and other anthropogenic activities (e.g., hunting). |

***Extensive Aerial Surveys*** — Aerial survey data along and adjacent to the northern shipping route acquired in 2007, 2008, 2013 and 2014 provide a series of "baseline" data for monitoring of shipping effects on narwhals during the operational years of the ERP and beyond. Marine mammal data have been collected along an extensive survey grid (Figure 4.5A) to document potential large changes in narwhal spatial-temporal distribution in response to shipping activity. Also, Baffinland is specifically required to monitor Eclipse Sound, Pond Inlet, and Milne Inlet (see Project Certificate No. 109). Power analysis results indicate that previously collected data along the extensive aerial grid and the approach has sufficient statistical power to detect large scale changes in narwhal distribution and abundance (Raborn 2015). However,

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detecting smaller scale changes using the extensive survey grid approach is unlikely given the large natural variation in narwhal distribution and abundance (see Section 4.3.3.1). In 2015, an extensive grid was surveyed during each of four survey periods, i.e., every two weeks (early August, mid-August, late August, mid-September) similar to that flown in 2014 (Figure 4.5A). Navy Board Inlet was not surveyed in 2015. However, the aerial crew was prepared to survey Navy Board Inlet (and potentially other areas) in the event that large scale changes in narwhal distribution and abundance were detected during photographic surveys of northern Milne Inlet and Tremblay Sound.

***Photographic Surveys*** — Photographic surveys of northern Milne Inlet and Tremblay Sound (see Figure 4.5B) were conducted periodically over ~30 days during the peak period narwhals occur in these key summering areas and when the majority of Baffinland vessel transits were expected during 2015. Koluktoo Bay was not surveyed photographically to minimize the chance of affecting narwhals in the shore-based study area. Photographic surveys were "centered" around Baffinland vessel (primarily ore carrier) transits in Milne Inlet to the extent possible— i.e., aerial surveys occurred before, during, and after a vessel passage. This approach will allow determination of whether there are movements of narwhals in a substantial portion of their primary summering habitat in response to repeated ship traffic. An assessment at this spatial-temporal scale is particularly important during the first operational years of the ERP. By documenting narwhal relative abundance and distribution in relation to a vessel track before, during and after a transit, it is possible to approximate the extent of potential avoidance, the area(s) where narwhals may move to avoid a ship transit, and approximately how long narwhals avoid an area around a vessel.

### 4.4.7 Acoustic Monitoring

#### 4.4.7.1 Overall Approach

The use of underwater acoustic recorders provides an important means to monitor marine mammals during periods when visual observations are not possible (due to poor weather/darkness and/or personnel scheduling) and when animals are not at the surface to be seen. Additionally, acoustic monitoring provides information to assist in verification of effects predictions regarding marine mammal response to shipping noise. In 2014, Greeneridge Sciences Inc. implemented a pilot study on passive acoustic monitoring of narwhals and vessels in Milne Inlet (Kim and Conrad 2015). The objectives of the pilot study were to characterize the local soundscape in terms of baseline noise levels, shipping sounds, and marine mammal calls.

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During the pilot study, two autonomous underwater acoustics recorders (ASARs) were deployed adjacent to Bruce Head in Milne Inlet (Figure 4.6). One recorder was deployed along the Milne Inlet shipping corridor with the primary goal of measuring vessel sounds. The second recorder, whose primary goal was to measure marine mammal sounds, was deployed 1.2 km offshore of Bruce Head. The ASARs operated on a 100% duty cycle from deployment on 30 July until retrieval on 26 September, 2014.

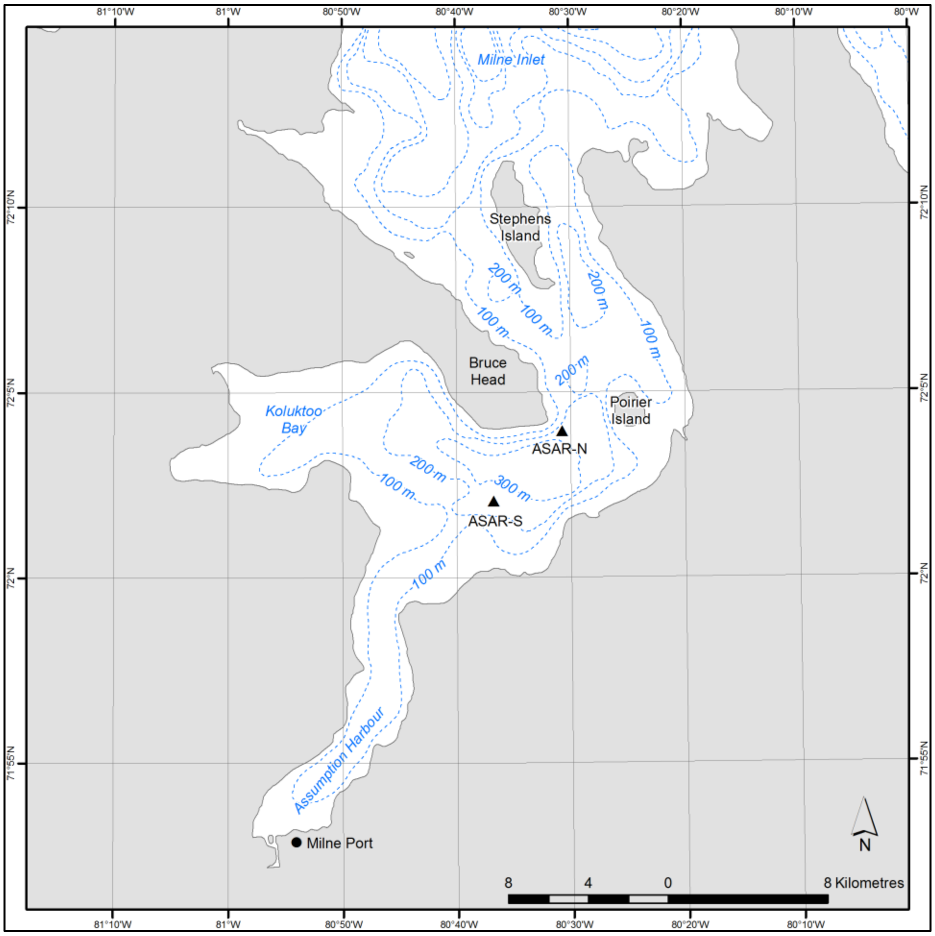


**Figure 4.6 Locations of Acoustic Recorders (ASARs) Deployed Near Bruce Head in 2014.**

The 2014 pilot study presented interesting findings regarding ship sounds and marine mammal calls but larger sample sizes are required to assess effects of shipping on narwhals. Increased shipping along the northern shipping route during the 2015 open-water season provided an opportunity to assess the effects of repeated large ore carrier transits on narwhals.

#### 4.4.7.2 Study Design

In 2015, two ASARs were deployed near Bruce Head as was done during the 2014 pilot study. One ASAR was deployed in the nominal shipping channel and the other closer to Bruce Head. Acoustic data were collected to overlap with the timing of the shore-based narwhal study and the aerial surveys, i.e., early

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August to mid-September (in 2015). The ASARs were configured to sample at a rate of 48,000 samples/s (48 kHz) per hydrophone, creating sound records spanning the frequency band from 2 to 24,000 Hz. Thus, each of the two recorders were capable of detecting low-frequency shipping sounds, whose energy resides primarily below 500 Hz, and marine mammal vocalizations at low to moderately high frequencies, for example, narwhal socialization whistles and some components of their pulsed calls.

Acoustic data is being analysed for ambient noise levels, shipping sounds, other anthropogenic sound sources and marine mammal calls. Narwhal call characteristics (type, frequency) will be examined in the presence and absence of large ships as well as in the presence of hunting activity. The presence and frequency of narwhal calls during periods with shipping and without shipping will also be examined. Acoustic data will also play a key role in the integration of the three marine mammal monitoring components (see Section 4.3.8). A summary of the acoustic EEM study design is presented in Table 4.5.

#### 4.4.7.3 Integration of Narwhal Monitoring Studies

Baffinland has been periodically conducting narwhal studies in the Milne Inlet and Eclipse Sound area since 2007. Prior to this, LGL (Baffinland's marine mammal consultant) undertook some of the first narwhal (and beluga whale) studies in the Eclipse Sound complex and Lancaster Sound. A consistent finding in all studies is the large degree of natural variation in narwhal distribution and abundance. Large numbers of narwhals seemingly regularly move from one area to another in very short periods of time. This has been documented as 'herding' events during the shore-based study at Bruce Head (see Smith *et al*. 2015) and extreme variation in narwhal numbers during back-to-back aerial survey replicates of the same area (Elliott *et al*. 2015; Thomas *et al.* 2015). This presumably natural variation in narwhal distribution and abundance makes it virtually impossible to use a single study in real-time to determine whether adaptive management procedures for Baffinland shipping should be implemented. We cannot, in real time, readily attribute changes (i.e., cause and effect relationship), even seemingly obvious changes, in narwhal distribution and abundance to the passage of a large vessel(s). A further complexity is the frequent marine mammal (primarily narwhal) hunting that occurs from the base of Bruce Head and in the nearshore waters of northern Milne Inlet during the open-water season. Results from all marine mammal monitoring studies need to be considered in an integrated fashion each year and reviewed to determine whether shipping effects on narwhals necessitate adaptive management activities and if so, what level of response is warranted.

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**Table 4.5 Summary of Acoustic Study Design.**

| | | |
|---|---|---|
| Project Interaction | Project Activity | Shipping |
| | Environmental Effect | Narwhal avoidance of shipping<br>Change in narwhal vocalizations |
| Hypothesis Formation | | Does presence/absence of narwhal calls change relative to ship transits? Does narwhal call type and frequency of calls change relative to ship transits? What received sound levels (if any) from ore carriers result in marine mammal avoidance? Will the duration of an effect decrease as narwhals possibly habituate to regular and repeated vessel traffic? |
| Monitoring Target | | Ambient noise levels<br>Shipping sounds<br>Narwhal calls<br>Other marine mammal calls |
| Design Type | | Baseline<br>Before, During and After Impact |
| Testable Hypotheses | | $H1_0$: Presence of narwhal calls does not significantly change relative to a large vessel transit.<br>$H1_A$: Presence of narwhal calls does significantly change relative to a large vessel transit.<br>$H2_0$: Narwhal call types and frequency of calls do not significantly change in response to large vessel transits.<br>$H2_A$: Narwhal call types and frequency of calls do significantly change in response to large vessel transits. |
| Sample Size Requirements | | To be determined |
| "Sampling" | Frequency | Annually, during the open water season since 2014. Future frequency to be determined. |
| | Location | Milne Inlet near Bruce Head |
| | Timing | August and September |
| Data Collection Methods | | Deployment of 2 acoustic recorders near Bruce Head. Sampling rate of 48 kHz |
| Analyses | | Ship source levels<br>Ambient noise levels<br>Narwhal call types, frequency of calls |
| Data Interpretation and Reporting | | Comparisons of number of narwhal calls relative to ship transits as well as changes in call types |

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# 5 ASSESSMENT OF EEM RESULTS AND MANAGEMENT RESPONSE

Data collected in each of the monitoring studies of the MEEMP are evaluated systematically to determine the existence of a Project-induced change and, if necessary, to determine the appropriate management response (see Figure 2.1). The framework for data assessment and management response will be implemented as illustrated in Figure 5.1. The steps are described below.

**Step 1 — Evaluating Data and Detecting Change** — For all studies, QA/QC is carried out on the monitoring data. Statistical analyses are carried out on the collected data either to test the null hypothesis (if applicable), or to compare with baseline values or regulatory guidelines. The outcome is a determination whether a change has occurred. If no change has been detected, no further action is required. If a null hypothesis is rejected, or measurable change is observed, then the data will be assessed further under Step 2. For all monitoring programs, Step 1 would occur on an annual cycle.

**Step 2 — Determining if Change is Project-related** — Step 2 involves determining if the detected change can be linked to Project activities or other factors.

Project activities that have the potential to cause the observed change will be reviewed to determine the likely source of disturbance. In the case of marine ecology, this could include: rates and regimes of discharge to the marine environment, loading activities and dust deposition and ballast water discharge at Milne Ore Dock. Any evidence of natural causes (e.g., changes in discharge from Phillips Creek) and the influence of natural events (e.g., oceanographic and meteorological patterns) would also be investigated. In the case of marine mammals, this could involve, for example, a more detailed investigation into marine mammal hunting activities.

Where the effects predictions indicate a zone of influence from Project activities, the sampling gradient will serve to examine the spatial extent and pattern of observed change. A comparison to sampling sites outside the ZOI will be useful in evaluating the data at this step.

If the identified changes are not linked to the Project, management response would consist of documentation of the analyses and sharing the results.

**Step 3 — Determining the Level of Response —** Step 3 follows a conclusion in Step 2 that the identified changes are in likely Project-induced. In this step, the required level of management response is determined.

A **low level response** for marine ecosystems is initiated when the triggering level is approached. The triggering level is different for each monitoring program and could be half the guideline value, the guideline value itself, or some assigned change with respect to baseline (e.g., within two standard deviations from baseline).

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A **low level response** for marine mammals is initiated when only one null hypothesis from the effects monitoring studies has been rejected. The potential exception is the extensive aerial survey study where rejection of the null hypothesis would lead to a moderate level response.

The low level response might include:

- Identifying the source and location of the observed change (a higher level of detail to what was conducted in Step 2);
- Identifying specific sampling stations that will help monitor the observed change in subsequent years;
- having external reviewers examine the technical soundness of the statistical test;
- examining need for and specific requirements of increased monitoring based on findings of the marine mammal integration report; and
- further evaluation of data to determine next steps.

A **moderate level response** is initiated when the triggering level is exceeded and it has been concluded that the exceedance is likely due to the Project. A **moderate level response** is undertaken for marine mammals when two or more null hypotheses have been rejected and/or the extensive aerial survey null hypothesis has been rejected. The effects of shipping on marine mammals (i.e., narwhals) have to be causally-linked to the Project.

In addition to the actions indicated for a low level response, the moderate level response would include:

- determining if management or mitigation is required based on trend analysis and/or an evaluation of the potential pathways of effect;
- developing a high level response 'trigger' with input from MEWG and other stakeholders
- conducting a risk assessment which considers other monitoring results in combination with the monitoring target where the observed change occurred;
- evaluating the need for increased monitoring or additional monitoring; and
- identifying next steps based on points above.

A **high level response** would be initiated if the response trigger is exceeded. Overall effects on the ecosystem and next steps should be discussed with regulatory agencies, and actions to be taken might include:

- implementing mitigation measures while monitoring to assess their effectiveness; and
- implementing increased monitoring to define the magnitude and/or spatial extent of the effects.

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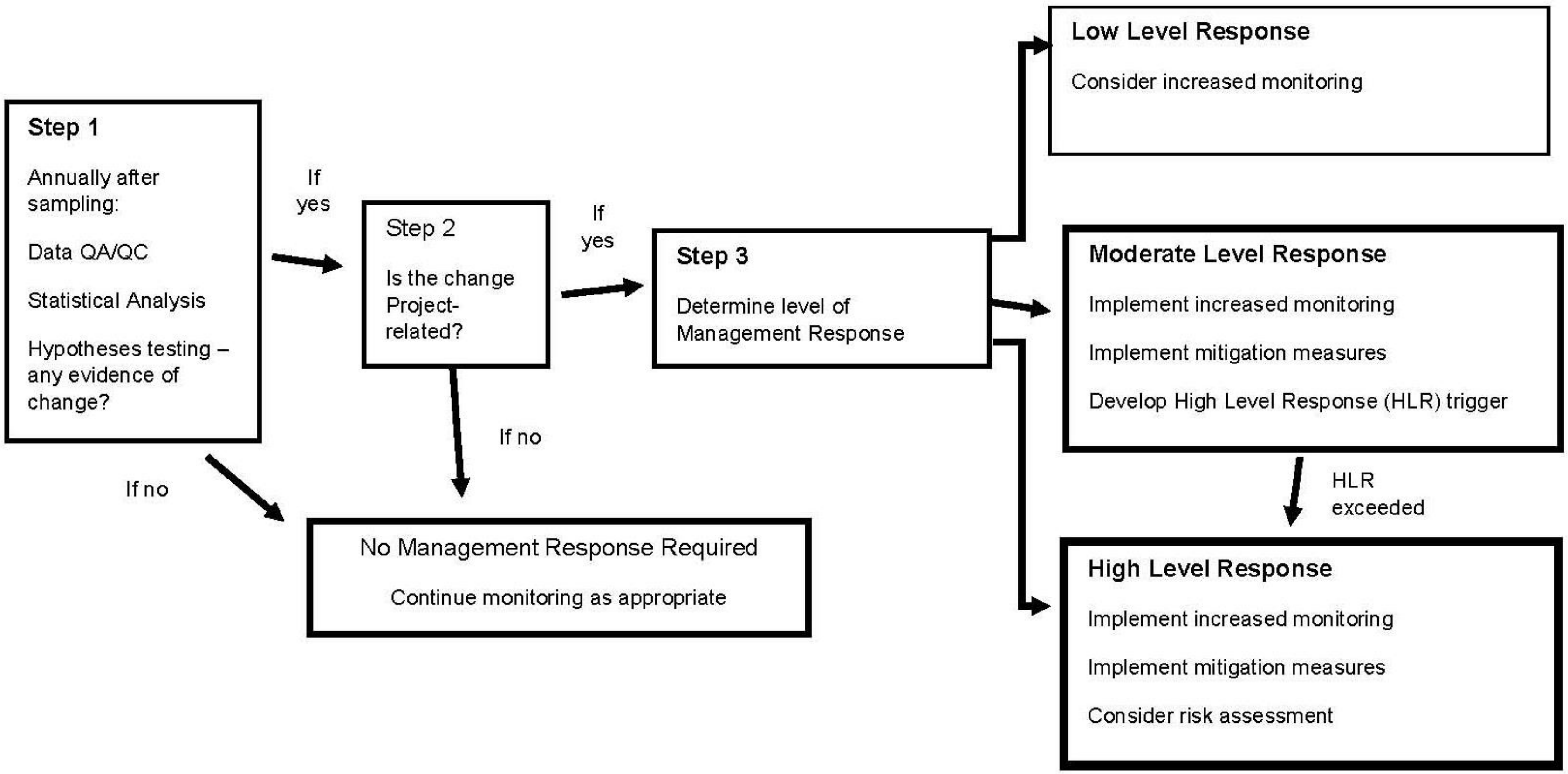


**Figure 5.1 Framework for Assessment and Response for Marine Environmental Effects Monitoring.**

## 5.1 FRAMEWORK FOR EVALUATION OF EFFECTS

A risk-based approach to integrating the results of the component monitoring programs will be undertaken, drawing from the approach applied at the Meadowbank Mine to the extent possible (Azimuth 2010). Monitoring results will be evaluated using the following risk-oriented criteria:

- Magnitude — the degree to which an indicator approaches or exceeds the established benchmark (or other guideline, if different than the benchmark);
- Extent — the scale at which the change or exceedance occurs;
- Causation — the strength of evidence for a Project-related cause;
- Reversibility — the likelihood that the effect may be reversed over time; and
- Uncertainty — the confidence or lack thereof in the findings regarding the above criteria.

The above criteria will be applied to each indicator or species for each study program as appropriate. Results can be summarized using the nominal rating system presented in Table 5.1, with particular emphasis given to Causation.

Once data are summarized for each component program, key findings from each program will be evaluated together in the MEEMP so that issues can be identified and response actions developed. This evaluation will be based on the response framework presented in Figure 5.1.

Management actions will also be implemented as identified in Figure 5.1. For marine ecology, in the instance of detecting change among multiple monitoring targets or species, action will be implemented according to the highest action level of any of the components detecting change and/or exceedance of benchmarks.

Mitigation measures can be applied at any time that a change is detected or statistically significant result occurs. It is not necessary to wait until a benchmark is exceeded. In the case of marine ecology, exceedance of a benchmark triggers a moderate action response. Moderate Action Responses may include mitigation measures that are easily implemented at low-cost and in a short time-frame. Such mitigation measures may already be identified as contingency or adaptive management measures within various management plans for the Project.

Key agency and community stakeholders can be consulted in the development of High Action Responses. High Action Responses are those mitigation measures that tend to take longer to implement, at higher cost and may have their own potential effects to be considered.

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**Table 5.1 Rating Criteria for the Evaluation of Effects.**

| Criteria | Classification | |
|---|---|---|
| Magnitude — The degree of change; specific to the Indicator/VEC and the impact | Level I | Change to the Indicator is not distinguishable from natural variation and is well below EWI |
| | Level II | Change to the Indicator is clearly distinguishable and approaching EWI |
| | Level III | Change to the Indicator is clearly distinguishable and exceeds the EWI |
| Extent — The physical extent of the effect, relative to study area boundaries | Level I | Isolated occurrence or very small area |
| | Level II | Moderately sized area affected, such as a portion of the ZOI |
| | Level III | The entire ZOI is likely to be affected |
| Causation — The strength of evidence that the effect is Project-related | Level I | No evidence that effect is Project-related |
| | Level II | Some likelihood that the effect is Project-related |
| | Level III | Very likely to be Project-related |
| Reversibility — The likelihood of the Indicator/VEC to recover from the effect | Level I | Fully reversible in less than 10 years |
| | Level II | Reversible over a long period of time (i.e., decades) |
| | Level III | Largely irreversible for at least several decades |
| Certainty — Degree of certainty or uncertainty in the findings of the monitoring data | High | High certainty in findings based on monitoring data |
| | Medium | Moderate certainty in findings based on monitoring data |
| | Low | Limited or conflicting monitoring data, resulting in a low certainty |

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# 6 QUALITY ASSURANCE AND QUALITY CONTROL

QA/QC steps will be in place to ensure that high quality and representative data are obtained in a manner that is scientifically defensible, repeatable and well documented. QA/QC will ensure that rigorous standard methods and protocols are used for the collection of all environmental data/samples. QA/QC begins at the project management level through organization and planning, and is assured by the monitoring of external and internal quality control measures (some of which are listed below). An essential component of QA/QC for the MEEMP is the review of all monitoring procedures/protocols by MEWG members. The MEWG meets twice each year to review the adequacy of the monitoring approach and the findings provided in monitoring technical reports. The following lists summarize the QA/QC procedures and practices to be followed:

- Internal Quality Control:
  - Staffing the project with experienced and properly trained individuals;
  - Checking field data for errors;
  - Ensuring that representative, meaningful data are collected through planning and efficient research;
  - Recording detailed field notes to verify completeness and accuracy of the recorded data;
  - Following standard operating procedures for sample collection, preservation, and documentation;
  - Calibrating and maintaining all field equipment; and
  - Collecting blind duplicates for submission to the laboratory (when appropriate).

- External Quality Control:
  - Employing fully accredited analytical laboratories for the analysis of all samples;
  - Determining analytical precision and accuracy through the interpretation of the analysis reports for the blind duplicate samples;
  - Engaging expert review of statistical analysis approach/methods; and
  - MEWG to review monitoring approach and technical reports.

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# 7 REPORTING

The MEEMP monitoring results will be presented annually and reports will be delivered to NIRB on a schedule as agreed with Baffinland. It is anticipated that two types of reports will be prepared: (1) a higher level integration report that summarizes all monitoring activities and any management recommendations; and (2) detailed technical reports for each of the MEEMP components. The higher level report will provide a compilation, assessment and interpretation of findings across monitoring programs, and present an issue-specific evaluation of effects.

Recommendations will be provided in regard to revisions to study designs or management response actions for each key issue. The MEEMP itself will be updated periodically, as required and determined in conjunction with the MEWG. Updates to the MEEMP may consist of modifications to study designs, or termination of shorter-term targeted studies accompanied by adequate rationale, or implementation of EEM level programs to elucidate results in cases where surveillance level study results warrant.

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