Baffinland Iron Mines Corporation

MARINE MONITORING PLAN

BAF-PH1-830-P16-0046

Rev

FOR REVIEW PURPOSES ONLY

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1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

This Marine Monitoring Plan (MMP, the Plan) describes the approach by Baffinland Iron Mines Corporation (Baffinland) to monitor the potential effects of the Mary River Project on the marine biophysical environment. The Plan addresses the requirement that the Project (Nunavut Agreement, Section 12.5.5) does not unduly prejudice the integrity of the marine environment and marine wildlife in the Project area. The objectives of the MMP are to:

- Monitor compliance with monitoring requirements in the agreed terms and conditions set out in Project Certificate No. 005;
- Detect Project-related short and long-term effects of the marine environment;
- Evaluate the accuracy of impact predictions;
- Assess the effectiveness of mitigation measures; and
- Identify the need for additional mitigation measures to further avoid or reduce adverse environmental effects on the marine environment.

In accordance with standard EIA practice, monitoring programs are not mandatory for every Project effect pathway considered in the EIA. Monitoring programs are warranted in circumstances where the limitations in, or scientific certainty of, the impact predictions need to be verified (i.e., when an EIA practitioner's confidence in the significance determination is low or moderate), or where the effectiveness of mitigation requires confirmation (i.e. for non-standard mitigation or where new technology is being proposed) (CEAA, 2011). The nature of and need for follow-up monitoring is also informed by the sensitivity of the receptor to potential Project-related environmental effects that may be greater than predicted or where mitigation may be found to be ineffective.

In the case of the Mary River Project, Baffinland's practice is to undertake follow-up (post-EA) monitoring programs for any adverse residual effects of the project identified as significant, any adverse residual effects associated with low certainty/confidence, those associated with species of conservation concern (i.e., at risk species), and/or those considered as 'key issues' by local stakeholders and the general public.

For each measured variable, an impact (null) hypothesis has been developed stating that the predicted effect of Project operations will not exceed the maximum allowable effects level for that variable, and that all of the null hypotheses developed for the MMP are not shown to be rejected. In other words, the project does not have impacts on the marine environment beyond acceptable levels.

1.2 RELATIONSHIP TO OTHER MANAGEMENT PLANS

This Plan must be viewed in consideration with the Environmental Management and Monitoring Plans for the Project as listed and described in Table 1.1. The Document Reference Numbers in this table are currently under review and subject to change in future management plans.

Table 1.1 Relationship to Other Management Plans

Referenced Management Plan	Document Reference Number	Information Provided by Referenced Plan
Air Quality and Noise Abatement Management Plan (AQNAMP)	BAF-PH1-830-P16-0002	Provides guidance on management of air emissions from construction and operation activities, including dust deposition in the marine environment due to shiploading operations
Ballast Water Management Plan (BWMP)	BAF-PH1-830-P16-0050	Management measures to prevent / minimize adverse impacts to the marine environment from the introduction of non-native aquatic invasive species in vessel ballast water discharges
Emergency Response Plan (ERP)	BAF-PH1-840-P16-0002	Process for responding to emergencies
Environmental Protection Plan (EPP)	BAF-PH1-830-P16-0008	Provides relevant environmental protection measures
Metal and Diamond Mining Effluent Regulations Emergency Response Plan (MDMER ERP)	BAF-PH1-830-P16-0047	Discharge to Milne Port monitoring
Shipping and Marine Wildlife Management Plan (SMWMP)	BAF-PH1-830-P16-0024	Describes the means whereby Baffinland ships fuel and equipment to the site, and exports iron ore from the Milne Port Site. Describes the monitoring and mitigation measures, and adaptive management procedures to address concerns related to marine wildlife
Narwhal Adaptive Management Response Plan (NAMRP) - included in Appendices of SMWMP	BAF-PH1-830-P16-0024	Describes shipping mitigation measures and marine mammal monitoring programs.
Spill at Sea Response Plan (SSRP)	BAF-PH1-830-P16-0042	Actions and reporting requirements during a fuel spill from Baffinland shipping operations

1.3 Corporate Policies

Baffinland has two corporate policies that apply to environmental management:

- **Sustainable Development (SD) Policy -** identifies Baffinland's commitment internally and to the public to operate in a manner that is environmentally responsible, safe, fiscally responsible and respectful of the cultural values and legal rights of Inuit.
- **Health, Safety and Environment (HSE) Policy -** describes the company's commitment to achieve a safe, healthy and environmentally responsible workplace.

All employees and contractors must comply with the contents of both above mentioned policies, which are included in Appendix A.

1.4 Regulatory Requirements

This Plan outlines the Project's policies and procedures to ensure compliance with the relevant terms, conditions and regulations outlined in the following regulatory instruments and Inuit agreements:

- Commercial Lease - Q13C301 (Commercial Lease) with the Qikiqtani Inuit Association (QIA)
- Project Certificate No. 005 issued by the Nunavut Impact Review Board (NIRB)
- Fisheries Act Authorization
- Nunavut Water Board water licence

The terms and conditions relevant to the marine environment, with cross-reference to where the terms are addressed, are summarized in Appendix B.

There are several other acts, regulations, and laws that Baffinland must follow, the guidelines and requirements of which have been adopted where applicable in this MMP. Highlights of the various acts, regulations, land use plans and management guidance documents that are related to the management and protection of the marine environment are described below.

1.4.1 Applicable Legislation

1.4.1.1 *Fisheries Act*

The federal *Fisheries Act* (1985, amended 2019), administered by Fisheries and Oceans Canada (DFO), includes provisions for the protection of fish[1] and their habitats, and is the principal federal statute to manage Canadian fisheries. The following sections and regulations of the Act outline prohibitions that require Authorizations and that are applicable to the proposed Project:

- Section 34 prohibits any work, undertaking or activity (other than fishing) that results in the death of fish.
- Section 35 prohibits any work, undertaking or activity that results in the harmful alteration, disruption or destruction of fish habitat.
- Section 36 prohibits the deposit of deleterious substances into water frequented by fish or in any place under any conditions where the deleterious substance or any other deleterious substance that results from the deposit of the deleterious substance may enter any such water.
- The Marine Mammal Regulations (last amended November 2, 2018), pursuant to sections 8 and 43 and subsection 87(2) the Fisheries Act, prohibits:
    - under Section 7(1), the disturbance of marine mammals by any person except:
    - When carrying on a work, undertaking or activity that is authorized or permitted under the Fisheries Act;
    - When fishing for marine mammals under the authority of the Regulations;
    - In the manner set out in a licence issued under the Fishery (General) Regulations authorizing the licensee to fish for marine mammals for experimental, scientific, education or public display purposes; and
    - In the manner authorized under the Species at Risk Act

[1] Under the Fisheries Act, 'fish' is defined as shellfish, crustaceans, marine animals and any part of the life history of the animal, including eggs, sperm, spat, larvae and juvenile stages (Government of Canada, 1985).

- Under the Regulations Section 7(2), disturbance of a marine mammal is defined as 'to approach a marine mammal to, or to attempt to a) feed it, b) swim with it or interact with it, c) move it or entice or cause it to move from the immediate vicinity in which it is found, d) separate if from members of its group or go between it and a calf, e) trap it or its group between a vessel and the shore or between a vessel and one or more other vessels, or f) tag or mark it.
- Under the Regulations Sections 7(3) through 7(5), disturb also includes approaching a marine mammal with a vehicle in all Canadian fisheries waters within 100 metres, unless the vessel is in transit.

- The Metal and Diamond Mining Effluent Regulations (SOR/2002-222) enabled under the Fisheries Act prescribe deleterious substances, and authorize the deposit of effluent containing deleterious substances if it is within applicable maximum authorized concentrations, requires that final discharge points be identified, and outlines monitoring conditions.

1.4.1.2 Species at Risk Act

The federal *Species at Risk Act* (SARA, the Act) is federal legislation that "provides for the legal protection of wildlife species and the conservation of the biological diversity" (SARA website). Under Section 32 of the SARA, once a species is listed as extirpated, endangered or threatened on Schedule 1, individuals of those species are protected from "killing, harming, harassing, capturing, taking, possessing, collecting, buying, selling or trading" (Government of Canada, 2020). Section 33 of the Act prohibits against "damaging or destroying the residence of individuals of a species listed as extirpated, endangered, or threatened". Of the ten species of marine mammals that potentially occur in the Project area during the shipping season, polar bear are the only species protected under SARA, where they are listed as Special Concern in Schedule 1.

1.4.1.3 Nunavut Land Claims Agreement

The Nunavut Land Claims Agreement (NLCA) is a modern treaty that was signed in 1993 by representatives of the Government of Canada, Tunngavik Federation of Nunavut, and the government of the Northwest Territories (CIRNAC, 2020). The NLCA provides the Tunngavik Federation of Nunavut with aboriginal title to the Nunavut settlement area—a land area of approximately 350,000 square kilometres (Nunavut Tunngavik, 2019). The Tunngavik Federation of Nunavut also has ownership of waters and land-fast ice that fall within their area of traditional use. The NLCA consists of 42 chapters that focus on a range of aspects, such as: wildlife management; harvesting rights; lands, water and environmental management regimes; public sector employment and contracting; and heritage resources. Some of the identified rights of Indigenous Peoples include the right to harvest wildlife, the right to negotiate with industries for social and economic benefits from non-renewable resources, as well as the right to have equal representation of Inuit in decision-making processes related to resource management and land use (CIRNAC, 2020). The NLCA guarantees Inuit federal royalties from resource-extraction projects and allows for Inuit to self-govern. The goals of the NLCA are to provide Inuit with financial compensation and economic opportunities related to development; to provide clarity of land ownership and the use of land and resources; to provide harvesting rights; to provide the rights to participate in decision-making concerning the harvesting of wildlife; to encourage the cultural preservation of Inuit; and to encourage self-reliance (Nunavut Tunngavik, 2019). The Governmen of Nunavut Department of Environment (GNDoE) is the lead Government of Nunavut (GN) Agency in fulfilling Government obligations concerning wildlife in Nunavut. Section 5.2.1 (i) of the Nunavut Agreement states that the government retains the ultimate responsibility for wildlife management.

1.4.1.4 NUNAVUT *WILDLIFE ACT*

The Nunavut *Wildlife Act* (GN, 2005), and applicable regulations that came into effect in July 2015, is territorial legislation established for the management of wildlife and habitat in Nunavut, including the conservation, protection and recovery of species at risk. The *Nunavut Wildlife Act* applies to all terrestrial wildlife and their habitat. The GNDoE has a legislated mandate for the management of terrestrial species in Nunavut and is responsible for fulfilling the GN responsibilities under federal legislation, and national and international agreements and conventions. The relevant species related in this act related to the Project is the polar bear.

1.4.1.5 NUNAVUT PLANNING AND PROJECT ASSESSMENT ACT (NUPPAA)

The Nunavut Planning and Project Assessment Act (NuPPAA) is a federal statute that was implemented in 2014 and adds to the environmental impact assessment regime outlined in Articles 11 and 12 of the NLCA (Dylan and Thompson, 2020). The NuPPAA contains provisions that regulators must follow during the environmental assessment process, including the incorporation of Inuit Qaujimajatuqangit (IQ). NuPPA allows for a single-window entry point, which means that all proposed projects must be submitted to the Nunavut Planning Commission (NPC) for review prior to any development (CIRNAC, 2015). As per the NuPPAA, the NPC must then determine whether the proposed developments conform with Nunavut land use plans (CIRNAC, 2015). If the NPC determines that the project plans conform with the land use plans, then a commercial production lease is granted and the project can begin compiling the necessary data to develop an environmental impact statement (EIS) (Dylan and Thompson, 2020).

2.0 PLANNING

2.1 OBJECTIVES

The MMP is intended as a framework for monitoring for potential Project-related adverse effects on the marine environment and marine wildlife, and to identify the need for additional mitigation measures, if necessary. Based on predictions from the Project-specific Final Environmental Impact Statement (FEIS) (Refer to Volume 8: Marine Environment), terms and conditions of Project Certificate No. 005, and existing Project commitments, the primary objectives of the Plan (along with associated performance indicators) are listed in Table 2.1.

This MMP focuses on operational activities implemented as part of the Approved Project (ERP), including shipping activities (i.e., berthing, active transits in Regional Study Area, ballast water exchange) and port operational activities (i.e., ore stockpiling, ship loading, site discharges to the marine environment). This MMP does not address monitoring of construction activities at Milne Port on the basis that the Milne port construction phase is now complete.

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

Table 2.1 Objectives and Performance Indicators

VEC / Sub-VECs (Key Indicators)	Objective	Performance Indicator(s)
Marine Water and Sediment Quality • Marine Water Quality • Marine Sediment Quality	Monitor for adverse environmental effects from shipping operations (prop wash, ballast water discharges[2]) and port operations (effluent discharge, dust dispersion and deposition from ore stockpiles and ship loading) on marine water and sediment quality at Milne Inlet. Identify mitigation for avoiding and/or minimizing adverse effects that exceed FEIS predictions.	Marine Water Quality • Metals, TSS, hydrocarbons, nutrients Marine Sediment Quality • Particle size, nutrients, metals, hydrocarbons

[2] Refer to Baffinland's Ballast Water Management Plan (BAF-PH1-830-P16-0050) for ballast water monitoring requirements and testing protocols

VEC / Sub-VECs (Key Indicators)	Objective	Performance Indicator(s)
Marine Habitat and Biota • Benthic Infauna • Substrate, Macroflora and Epifauna • Marine Fish Community • Marine Fish Health • Non-indigenous Species / Aquatic Invasive Species (NIS/AIS)	Monitor for adverse environmental effects from shipping operations (prop wash, ballast water discharges[3]) and port operations (effluent discharge, dust dispersion and deposition from ore stockpiles and ship loading) on marine habitat and biota at Milne Inlet. Identify mitigation for avoiding and/or minimizing adverse effects that exceed FEIS predictions.	Benthic Infauna • Density, taxa richness, Simpson's diversity and evenness indices Substrate, Macroflora and Epifauna • Relative abundance (% cover or density), Simpson's diversity and evenness indices Marine Fish Community • Total catch, relative abundance, catch-per-unit-effort (CPUE) Marine Fish Health • Tissue chemistry (metals) and body condition[4] NIS/AIS • Detection of NIS/AIS across multiple trophic groups (zooplankton, benthic infauna/epiflora/epifauna, fish)
Marine Mammals • Narwhal • Ringed Seal	Monitor for potential effects of ship traffic and ship noise on marine mammals in the Regional Study Area (RSA) (i.e., behavioural disturbance such as displacement, avoidance, change in abundance and/or distribution). Identify mitigation for avoiding and/or minimizing adverse effects that exceed FEIS predictions.	Narwhal • Change in stock abundance • Change in relative abundance and distribution • Change in group composition • Change in surface behaviour • Change in dive behaviour Ringed Seal • Change in regional density and/or distribution
Marine Mammals • Narwhal • Ringed Seal	Monitor for potential ship strikes on marine mammals in RSA.	• Occurrence of death or injury as a direct result of a ship strike

[3] Refer to Baffinland's Ballast Water Management Plan (BAF-PH1-830-P16-0050) for ballast water monitoring requirements and testing protocols

[4] Effect indicators for body condition include: Wrinkled rock-borer clam (*Hiatella arctica)*: whole animal wet weight, relative gonad size (gonad weight against body weight) if observable, whole-animal dry weight, dry shell or soft tissue weight related to shell length, and length frequency analysis; Fourhorn sculpin (*Myoxocephalus quadricornis*): size at age/length (i.e., body weight against age/length), relative gonad size (gonad weight against body weight), body weight relative to length (i.e., condition), relative liver weight (liver weight against body weight) and length frequency analysis.

VEC / Sub-VECs (Key Indicators)	Objective	Performance Indicator(s)
• Bowhead	Identify mitigation for avoiding and/or minimizing adverse effects that exceed FEIS predictions.	
TBD	Inuit objectives TBD	The development of Inuit indicators will be jointly developed by Baffinland and the QIA.

2.2 Consideration of Inuit Qaujimajatuqangit and Local Knowledge

Baffinland views Inuit Qaujimajatuqangit as central to the successful planning and operation of the Project. IQ is reflective of the Inuit knowledge transferred from generation to generation and captures knowledge of relationships and morality, core values and worldviews, as well as environmental knowledge. As identified in the Mary River Project Inuit Impact and Benefit Agreement (IIBA), IQ is beneficial for the Project and provides critical insights into the environmental, ecological, cultural and socioeconomic dimensions of the Project.

Given the importance of IQ, Baffinland developed an IQ Framework to guide its integration and use. The IQ Framework supports collaboration and decision-making throughout the life of the Project and is not limited to the approach or methods associated with an individual IQ study. The purpose of the IQ Framework is to identify procedures and provide guidance on the following;

- The processes through which IQ can be shared with Baffinland
- Schedule and timing for gathering and integration of IQ
- Roles and responsibilities of parties involved
- Processes and mechanisms through which IQ informs Project related decision-making

The IQ Framework also defines commonly used terms to support communication between parties and identifies the relationship between the IQ Framework and other management and monitoring plans, including the QIA's Inuit Stewardship Plan. For a greater understanding of the Projects general approach towards consideration of IQ, please refer to the IQ Framework.

In addition to the general pathways that IQ has and will inform this Plan, there are several initiatives with specific relevance to this Plan worth noting here:

- North Baffin Hunters and Trappers Organizations membership in the Marine Environment Working Group. Baffinland has agreed to resource the participation of 2 members of the MHTO and 1 member from each of the 4 remaining North Baffin HTO's in the Marine Environment Working Group, where marine monitoring programs and mitigation are discussed before being finalized and implemented.
- Project Certificate 005, Appendix B Commitments. Baffinland and QIA agreed to several commitments aimed at increasing the role of IQ in marine monitoring and mitigation. These include commitments by Baffinland to:

- resource Inuit-led monitoring, updated Early Warning Indicator, Inuit Objectives, Thresholds, Responses
- work with harvesters to gather samples, and observations on what they are experiencing and comparing to previous years with respect to narwhal body condition
- Jointly approve with the QIA the adaptive management components of this Plan that relate to narwhal and seal through a bilateral Adaptive Management Plan Working Group

2.3 Principles of Adaptive Management

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

Adaptive strategies are implemented when unanticipated adverse effects are observed, or if effects exceed identified thresholds. The management and mitigation of unanticipated adverse effects are most effective when collaboration between Baffinland, local stakeholders and regulators is employed. If effects to the atmospheric environment exceed identified thresholds, Baffinland will implement a corresponding response as contained within the Trigger Action Response Plan (TARP; Section 5), or a reasonable alternative.

2.3.1 Defining the Adaptive Management Process

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

Monitoring and responding to effects in the short-term is addressed in a Trigger Action Response Plan (TARP) described in Section 5.0. The TARP identifies the pre-defined actions to be taken should corresponding threshold levels be exceeded. A series of escalated actions to be implemented are detailed in Section 5. Longer term review of and response to monitoring data is addressed in an annual review of plan effectiveness in Section 6. The latter includes an annual comparison of Project effects against impact predictions made in the Final Environmental Impact Statement (FEIS; Baffinland, 2012) and addendum for the Early Revenue Phase (ERP; Baffinland, 2013).

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

Section 2.4 of the AMP identified implementation of pre-determined responses to thresholds described in the MMP does not require approval by the QIA. However, Baffinland will communicate response actions to QIA prior to implementation unless this is not possible due to the expediency required by the circumstance. Additionally, if a new response not previously considered is proposed by Baffinland, QIA approval will be sought.

2.3.2 Adaptive Management Checklist for Environmental Management

Table 2.2 presents an adaptive management checklist developed for the MMP, identifying how adaptive management has been incorporated into the current revision of the Plan.

Table 2.2 Adaptive Management in the MMP

Adaptive Management Phases	Components	Questions to Guide Decision-Making	Status of Management Plan (i.e., complete, in progress, undergoing revisions)
Plan	Objectives	Are objectives clear and key desired outcomes defined? Do they include Inuit objectives?	In Progress Interim Objectives are identified in Section 2.1.
	Indicators	Are performance indicators adequately identified? Do they include Inuit indicators?	In Progress Interim Performance indicators are identified in Section 2.1.
Plan	Identification of Thresholds	Are thresholds for specific responses identified (i.e., early warning triggers, action levels, quantitative metrics or qualitative descriptions)?	In Progress Interim Thresholds are identified in Section 5
	IQ Integration / Influence	Are mechanisms for IQ integration/influence identified?	In Progress Integration of IQ will be clarified in the next draft of the MMP through the MEWG, and later firmed up through inputs by the Inuit Committee
Implement and Monitor	Management Strategies and Responses	Are management strategies and response options clearly identified?	In Progress Baffinland management strategies for FEIS and regulatory requirements are described in applicable management plans
	Resourcing	Are all phases of the adaptive management cycle properly resourced (in accordance with Inuit Agreements) to be fully implemented?	In Progress Resourcing in accordance with Inuit Agreements will need to be discussed through the AMP Working Group, with annual work plans and budgets developed.
	Monitoring	Does the monitoring program provide the information needed to determine the effectiveness of management strategies and responses?	In Progress Draft list of monitoring programs and associated study designs are identified in Section 3.
	Timeline for implementation	Is the possibility that rapid response may be necessary, taken into account in the	In Progress The TARP (Section 5) has been developed for key Project activities and related monitoring plans, and includes the identification of low, moderate,

Adaptive Management Phases	Components	Questions to Guide Decision-Making	Status of Management Plan (i.e., complete, in progress, undergoing revisions)
		implementation plan/process?	and high action responses that correspond to low, moderate, and high-risk thresholds.
Evaluate and Learn	Review Data and Feedback	Is the process for reviewing and evaluating management effectiveness (based on monitoring data and feedback) articulated?	The review process for plan effectiveness is outlined in Section 6
	Additional Mitigation	Are mechanisms for determining the need for additional mitigation described?	In Progress Section 5 identifies actions to be undertaken according to various triggers. Need for additional mitigation is determined based on results of monitoring programs described in Section 5.
	Input of IQ Holders	Are opportunities identified for IQ holders to review results and provide input into adaptive management responses / mitigations?	In Progress To be discussed with Inuit Committee
Adjust	Unanticipated Adverse Effects or Issues	Is it apparent how unanticipated adverse effects or issues will be actioned and resolved?	In Progress Section 6 (Figure 6.1) describes the process for incorporating repeat non-compliance and unanticipated effects into future plan updates.
	Reporting	Are reporting mechanisms for new / revised strategies and response actions established?	In Progress Section 6 describes the process for reporting mechanisms for new / revised strategies.
	Scheduled Updates	Is the frequency of scheduled updates to the management plan identified?	A review of the plan is provided in Table 6.1.

2.3.3 Marine Monitoring Plan Updates

The MMP will be periodically updated (as required) based on changes in port or shipping operations, management reviews, incident investigations, regulatory changes and other Project-related changes. The MMP may also be updated as new methods or technologies become available and based on feedback from regulatory bodies and working groups (i.e., the MEWG).

2.4 Thresholds

Adaptive management includes short-term and longer-term review and response cycles (Section 2.3). Threshold-based adaptive management allows Baffinland's environment department to make ongoing adjustments to management approaches as new information on thresholds is gathered. Thresholds are defined as part of the Data Assessment and Response Framework (Section 5) that includes a Trigger Action Response Plan (TARP) with thresholds and pre-defined actions to be taken should threshold levels be exceeded. Thresholds may be informed by Inuit thresholds, effect predictions from the FEIS, or terms and conditions outlined in Project Certificate No. 005.

Thresholds outlined in the TARP (Section 5) are designed to guide short-term and long-term adaptive management strategies.

2.4.1 Inuit-Identified Thresholds

Inuit may identify thresholds that are applicable to the various monitoring programs presented in this Plan. In no instance will Inuit thresholds lead to non-compliance with regulatory objectives or requirements; Inuit requirements may be more sensitive to environmental change than regulatory requirements. The development of Inuit-identified thresholds is the joint responsibility of Baffinland and the QIA.

Inuit thresholds related to dust will be developed and proposed by the QIA through the Inuit Stewardship Plan. Once made available and agreed to, they will be included in this Plan as needed.

2.4.2 Effect Predictions

The effects predictions from the FEIS and addendums can be used for comparison to assess the extent to which Project impacts align with what was anticipated as described in Section 6.1 (Annual Review of Compliance and Unanticipated Effects). Baffinland may also identify the need for further adaptive management measures when unanticipated adverse effects or effects that exceed FEIS predictions occur.

2.5 Monitoring Framework

2.5.1 Monitoring Principles

The Monitoring Framework's objectives provide guidance for the development of specific Project monitoring principles:

- Compare Project effects against predictions made in the impact assessment;
- Monitor and evaluate the effectiveness of mitigation measures;
- Identify unanticipated adverse effects;
- Consult Inuit on their perspectives of Project effects and the effectiveness of mitigation measures to understand where alignment or gaps between scientific monitoring programs and IQ exist;
- Monitor to gather supplementary baseline data, if required; and
- Inform adaptive management measures.

2.5.2 Holistic and Robust Data Analysis

An underlying principle of the MMP is to provide data and analyses that are meaningful, informative, robust and useful for decision and adaptive management. Programs should be evaluated holistically (i.e., being interconnected and with reference to the whole) rather than distinctly and/or independently from one another. That said, individual programs may be completed per different frequencies and timelines during the life of the Project (i.e., not all

programs will need to be conducted on an annual basis throughout the life of the Project. Timing and frequency will depend on the nature of the data capture (i.e., some features may not exist in sufficient quantity to provide a robust evaluation of potential Project effects) and practicality (i.e., the effort required to collect sufficient data may be unreasonable when there is a very low likelihood for a Project effect and/or interaction). Refer to Tables 3.2 – 3.7 in Section 3.0 for monitoring program frequencies. Updates to the MMP will also consider regional monitoring efforts and/or research initiatives conducted by other agencies, universities, and institutes, and/or non-governmental organizations, etc., who have a jurisdictional interest and/or responsibilities for monitoring in the Project area (i.e., DFO), as appropriate.

3.0 COMPONENT STUDIES

The marine monitoring programs currently implemented by Baffinland as part of the MMP are focused on impact pathways defined in the Environmental Impact Assessment (Baffinland 2012; 2013) as Level 2 interactions[5], and predicted to result in residual effects following implementation of the proposed mitigation measures. These include:

- Potential changes in marine water and sediment quality due to shipping operations (i.e., propeller wash) and port operations (i.e., site discharges, ore dust dispersion and deposition);
- Potential loss or alteration of habitat due to shipping operations (i.e., propeller wash) and port operations (i.e., site discharges, ore dust dispersion and deposition);
- Potential introduction of NIS/AIS from ship ballast water releases and hull biofouling;
- Potential ship strikes on marine mammals;
- Potential behavioural disturbance from ship traffic and ship noise; and
- Potential ice entrapment from icebreaking operations during the fall shoulder season.

The MMP focuses on targeted valued ecosystem components (VECs) and their key indicators (KIs) via ongoing data collection and monitoring. Select KIs were identified in the Marine Environmental Impact Assessment (Volume 8 of the FEIS based on criteria outlined in Volume 2 {Impact Assessment Methodology} (Baffinland, 2012). KIs that were identified for follow-up monitoring were selected based on impact prediction confidence ratings, practicality of monitoring, and predicted effectiveness of the proposed mitigation measures (Baffinland, 2012, 2013). Not all the KIs identified in the Impact Assessment were selected as KIs for monitoring, although specific mitigation measures for those KIs are included in the Shipping and Marine Widlife Management Plan (SMWMP) (Baffinland, 2019). In some instances, where residual Project impacts to a KI were assessed as low, and the confidence (i.e., certainty) level in the Impact Assessment prediction was moderate to high (Baffinland 2012, 2013, 2018), follow-up monitoring was not deemed necessary.

Within the Marine Environment RSA, marine water and sediment quality could be affected by Project construction, operation and closure activities. Overall those potential effects were predicted to be not significant with a moderate level of confidence (Baffinland, 2012, 2013). With effective implementation of mitigation, potential Project effects on marine water and sediment quality are expected to be limited; however, monitoring is proposed throughout the construction, operation and closure periods of the Project.

Within the Marine Environment RSA, marine fish habitat and biota may be affected by Project construction, operation and closure activities. With effective implementation of mitigation and offset measures, potential Project effects on marine fish habitat and biota were predicted to be not significant with a moderate to high level of confidence (Baffinland, 2012, 2013).

Although the potential introduction of NIS/AIS to the marine environment is unlikely, monitoring programs have been developed and implemented to detect the potential presence of NIS/AIS in the Project area.

Within the Marine Mammal RSA, the Project was predicted to have the potential to affect the abundance, distribution and behaviour of marine mammals (Baffinland, 2012, 2013). To assess Project impacts on marine mammals, the following KIs were selected: narwhal, beluga, bowhead, ringed seal, walrus and polar bear. The

[5] Level 2 interactions are defined as key issues that are of substantial public interest and/or identified as potentially high environmental importance or consequence (Baffinland, 2012).

assessment determined with a high level of confidence that potential Project effects on most of these species would be low or negligible. One exception to this was for acoustic impacts on narwhal (potential disturbance and acoustic masking effects) from Project shipping in which potential Project effects were expected to be limited but the assessment confidence was low (Baffinland, 2013) due to uncertainties in the anticipated degree of behavioural response by marine mammals to shipping effects in the RSA. Therefore, the current monitoring programs have been developed to evaluate the potential effects of shipping on the abundance, distribution and behaviour of narwhal in the RSA. Acoustic monitoring studies have also been designed and implemented to assess for potential behavioural disturbance and auditory masking effects of shipping on all marine mammal KIs considered in the assessment.

Table 3.1 summarizes the program frequency (past and future/projected frequency) for each marine-based monitoring program dating back to baseline collection. This includes a proposed frequency for each monitoring program moving forward, based on monitoring results to date. The marine mammal monitoring programs are more prone to alterations in frequency based on logistics & resources, previous years monitoring results, and community and working group feedback, and as such a suggested frequency for the years 2024-2026 have not been assigned, The Data Assessment and Response Framework (Section 5.0) then defines thresholds, as well as the assessment and decision-making framework (Trigger-Action Response Plan; Section 5.2) in response to potential Project-related effects.

3.1 Marine Water Quality

3.1.1 Effect Pathways

Potential Project-related changes to marine water quality may result from the following Project-related effect pathways:

- Treated effluent and site drainage discharges at Milne Port (downstream of Milne Port camp and maintenance shops, fuel depots and tank farms, wastewater treatment facility and ore stockpiles).

3.1.2 Indicators and Thresholds

Indicators for marine water quality include metals, total suspended solids (TSS), hydrocarbons, and nutrients. Measurements of these parameters are compared to the Canadian Council of Ministers of the Environment [CCME] water quality guidelines (WQG) for the protection of aquatic life in marine environments (CCME, 2022), for parameters that have available WQG (i.e., pH, nitrate, arsenic, cadmium, chromium and mercury). For parameters that do not have applicable WQG (e.g., iron, TSS, turbidity and salinity), results are assessed relative to previous years and/or refer to a departure from background conditions. Marine water quality results measured in 2015 are used as the baseline condition. Table 5.1 provides a summary of the indicators and thresholds used for the marine water quality sampling program at Milne Port.

3.1.3 Monitoring Program

The marine water quality sampling program is designed to monitor potential changes in receiving environment water quality at two marine discharge points (MP-05 and MP-06) associated with site drainage (i.e., run-off), treated effluent discharge and settlement pond discharge from the iron ore stockpiles at Milne Port. Four sampling stations are monitored at each discharge point – one nearshore station located directly downstream of the discharge point downstream, and three offshore stations located at increasing distances (250 m) from the discharge point along each of three transects (extending northwest, north, and northeast of the discharge point) – for a total of eight

sampling stations (Figure 3.1). Multiple sampling events occur over the peak open-water season corresponding with late July to August (with sampling typically occurring weekly).

Table 3.1: Program Frequency for Marine Monitoring Programs For Early Revenue Phase (ERP)

VEC		Program	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Marine Water & Sediment Quality	MEEMP	Marine Water Quality																					
		Marine Sediment Quality																R	R		R	R	
Marine Habitat and Biota		Benthic Infauna																R	R		R	R	
		Macroflora & Epifauna			TV		TV			TV	TV	TV	TV	TV	BT	BT	Q-R	Q-D	Q-D	Q-D			
		Fish Community																					
		Fish Health																					
		NIS/AIS																					
Marine Mammals		Shore-based Monitoring Program																			TBD		
		Marine Mammal Aerial Surveys											**								TBD		
		Ringed Seal Aerial Surveys																			TBD		
		Narwhal Tagging Program																			TBD		
		Ship-based Observer Program															*	*	*		TBD		
		Acoustic Monitoring Program																			TBD		

NOTE: GREEN CELLS REPRESENT BASELINE MONITORING. BLUE CELLS REPRESENT COMPLETED PROJECT EFFECTS MONITORING. ORANGE CELLS REPRESENT PROPOSED FUTURE MONITORING.

R= reduced sampling year. *=program did not occur due to ice conditions, earlier than anticipated closure of season or COVID restrictions. ** = Golder analyzed aerial survey data collected by DFO in 2016 to generate an abundance estimate for Eclipse Sound narwhal summer stock.TV= towed video biophysical transect. BT = belt transect surveyed by ROV. Q-R = permanent quadrat samples surveyed by ROV video survey. Q-D = permanent quadrat samples surveyed by divers.

Figure 3.1 Sampling Stations for Marine Water Quality– 2023 Marine Monitoring Plan (MMP)

The extent of the transects is shorter than the sediment quality radial gradient design, as potential water quality effects are expected to be only detectable in close proximity to the point source. Sampling events aim to target active discharge periods in the marine environment, as possible. The following sections discuss the monitoring programs for each of the key indicators carried forward in the MMP.

Water samples are collected from approximately 0.5 to 1 m below the surface at each station using a 5.0 L Niskin sampler deployed from a field vessel. The sampler is washed with laboratory-grade detergent and then rinsed with site-water prior to sample collection at each station. Samples are preserved in the field according to laboratory instructions and kept refrigerated until they are shipped (within 48 h of sample collection) on ice in coolers to ALS Canada Ltd. (ALS), a Canadian Association for Laboratory Accreditation Inc. (CALA) accredited analytical laboratory.

Table 3.2 provides a summary of the sampling design for the marine water quality sampling program.

Table 3.2 Study Design For Marine Water Quality

Indicator	Marine Water Quality
Monitoring Category	Compliance Monitoring
Design Type	Sampling stations along a radial gradient design, three transects per discharge location, two discharge locations
Measurable Parameter	Changes in the following water quality parameters: TSS, metals, hydrocarbons and nutrients
Key Project Interactions	Potential changes in water quality due to increased ore dust deposition and site discharges in the marine environment.
Objective	Project will not result in significant changes to marine water quality
Timing	Weekly sampling during open-water period (late July/August)
Data Collection Method	Niskin bottle or equivalent
Sample Handling and Analysis	Preserved as necessary and shipped to lab for analysis. Analyses to be completed by qualified laboratory (Canadian Association for Laboratory Accreditation Inc. certification). Appropriate QA/QC standards implemented in the field and laboratory
Data Interpretation and Reporting	Compare to CCME guidelines, where applicable. Where guidelines do not exist, compare to previous years and/or refer to a departure from background conditions to determine existence of Project-related change.
Thresholds (Triggering Levels)	Refer to Trigger-Action Response Plan (Section 5.2)
Status	Active/Ongoing
Agency/Partner Participation	None required

3.1.4 Program Modifications

The following is a summary of modifications made to the program since program implementation:

In 2020, Baffinland integrated marine-based monitoring at the second effluent discharge location known as MP-06. Consistent with the study design used to monitor receiving environment water quality downstream of the primary site discharge (MP-05), four additional water quality stations downstream from MP-06 started being monitored in 2020 (Source-2, WNE-2, North-2 and ENE-2). Prior to 2020, marine water quality monitoring was limited to the MP-05 discharge location.

3.2 Marine Sediment Quality

3.2.1 Pathways

Project-induced changes to marine sediment quality could result from the following interactions:

- Site drainage discharges at Milne Port (downstream of camp and maintenance shops, fuel depots and tank farms, wastewater treatment facility and ore stockpiles);
- Fuel and lubricant residues from shipping and berthing operations at Milne Port;
- Ore dust dispersion and deposition from stockpiles and during ore loading at the ore dock;
- Propeller wash from Project vessels; and
- Ore dock construction activities.

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 may 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 redistribution of fines due to propeller wash), and hydrocarbon concentrations (discharge to marine environment of treated waste water and site run-off, and fuel and lubricant residues from shipping activity).

3.2.2 Indicators and Thresholds

Indicators for marine sediment quality include particle size distribution, organic and inorganic carbon, total petroleum hydrocarbons, volatile organic compounds, polycyclic aromatic hydrocarbons, and trace metals. It should be noted that marine sediments at Milne Port are characterized by high natural background concentrations of select metals, such as aluminium, iron and arsenic such that distinction of Project effects from natural variation requires careful consideration in the study design.

Concentrations of metals and hydrocarbons are compared to CCME Interim Sediment Quality Guidelines (ISQGs) and Probable Effect Level (PELs) for the protection of aquatic life in the marine environment (CCME, 2022). To provide a screening value to inform the sediment evaluation, in the absence of a CCME guideline, metals and hydrocarbons are compared to British Columbia Working Sediment Quality Guidelines (WSQG) (BC MOE, 2021), and the National Oceanic and Atmospheric Administration (NOAA) sediment benchmarks (Buchman, 2008), based on feedback received from the MEWG. As there is no marine sediment quality guideline for iron in Canada, sediment data for iron and fine sediments are evaluated spatially and temporally along the transects using general linear modeling.

The statistical approach is based on repeated measures (RM) distance regression analyses, with each station re-sampled over time. Table 5.1 provides a summary of the indicators and thresholds used for the marine sediment quality sampling program at Milne Port.

3.2.3 Monitoring Approach

Sampling for marine sediment quality is based on a radial gradient (RG) design, as recommended by Environment Canada (2012) and Ellis and Schneider (1997). The current design involves four transects extending out from the Ore Dock, which represents a potential point source for contaminants (e.g., for ore dust deposition, fuel spills, effluent discharge, and site runoff) and physical changes as a result of Project activities (e.g., sediment re-suspension and transportation). The radial pattern is designed to detect potential Project-related changes along the transects, two alongshore (i.e., East, West) and two offshore (i.e., Northeast and Northwest) with increasing distance from the point source. Fifteen stations are sampled per transect, and these are co-located with benthic infauna stations to allow for evaluation of exposure data (sediment quality) in relation to biological variables (benthic infauna community characteristics). The two Coastal Transects (East and West) and the two Northern Offshore Transects (Northwest and Northeast) are depicted in Figure 3.2, and are described below.

- East and West Transects: arranged along the 15 metre (m) depth contour to minimize the confounding influence of water depth on sediment and associated biota. The 15 m depth contour is considered to be unaffected by winter ice scour and has been associated with relatively higher species counts and increased species diversity for both marine flora and fauna (SEM, 2015). The East and West Transects extend approximately 1,500 m to the east and the west of the ore dock, respectively.
- Northwest and Northeast Transects: extend directly offshore from the existing ore dock out to a distance of 2,000 m, corresponding with water depths of approximately 100 m and 120 m, respectively. These transects include both distance and depth gradients for consideration in the analysis, such that both distance and depth along a transect represent potential confounding factors in the evaluation of potential effects on sediment quality from the Project.

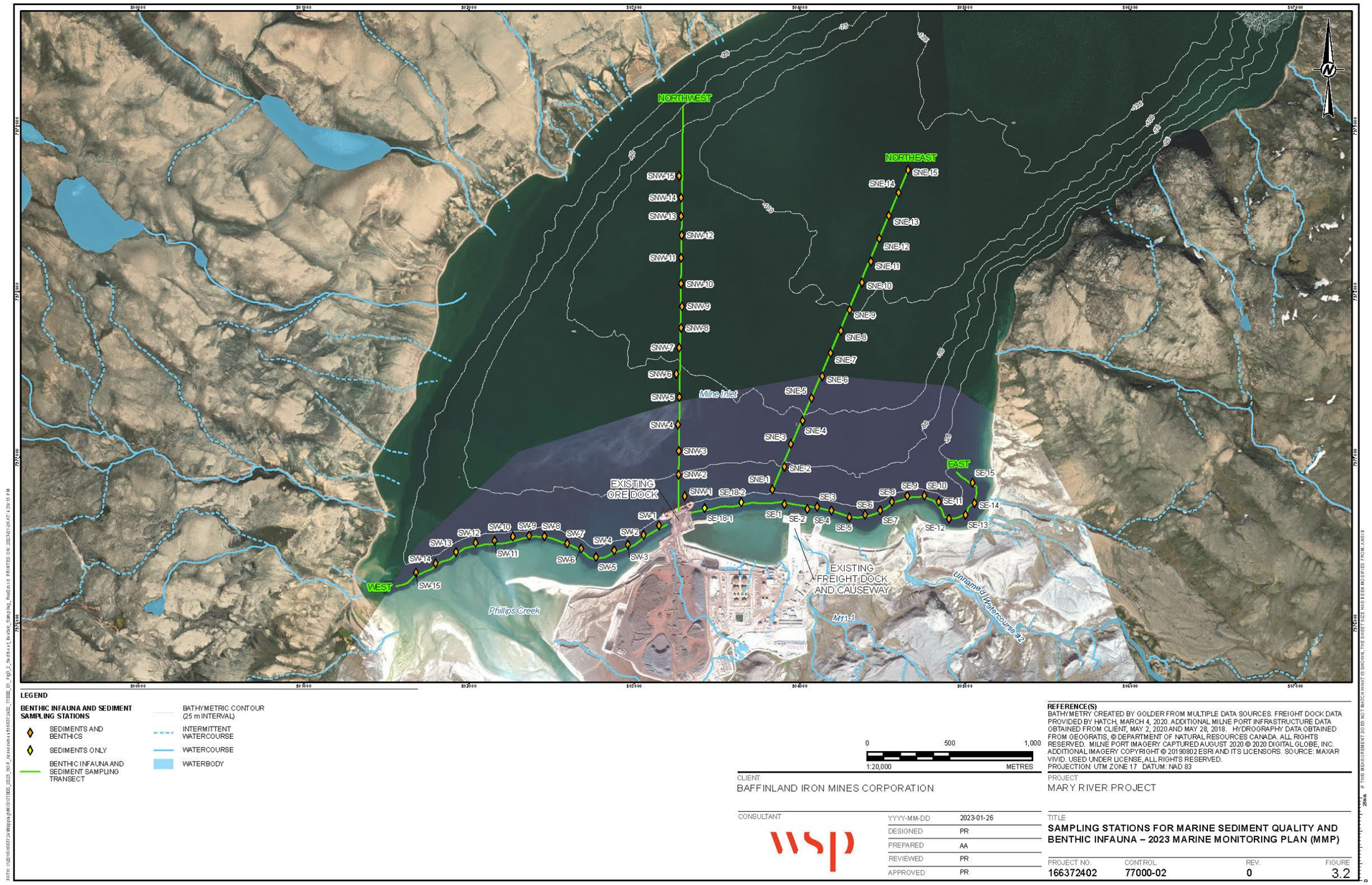
Sampling takes place over the open-water season between late July and early September. Sediment samples are collected using a standard Van Veen grab sampler (area of 0.1 m^2). Samples are decanted and homogenized in the field and transferred to clean, laboratory supplied sampling containers and sent to ALS Canada Ltd. (ALS) for laboratory analysis.

3.2.4 Program Modifications

Following is a summary of modifications made to the program since program implementation:

- In 2018, the number of sediment samples analyzed for hydrocarbon concentrations was reduced from three samples to one sample per station, as hydrocarbon concentrations were shown to be below detection limits (DL) in all samples collected since the start of monitoring (2015-2019).
- In 2019, a fifth transect (Northeast Transect) was added to the sampling design based on recommendations from the MEWG. The new transect ran from a point between the Ore Dock and the Freight Dock extending in a Northeast direction up to a distance offshore of approximately 2,100 m, corresponding to a water depth of approximately 120 m.

- In 2019, Baffinland increased the number of sediment sampling stations to accommodate a more statistically robust study design. Sampling effort increased from 5 stations/transect to 15 stations/transect to improve statistical power and the ability to detect Project-related effects. This change was based on results of a power analysis (Golder, 2020a) undertaken at the request of the MEWG.



LEGEND

BENTHIC INFAUNA AND SEDIMENT SAMPLING STATIONS

- SEDIMENTS AND BENTHICS
- SEDIMENTS ONLY
- BENTHIC INFAUNA AND SEDIMENT SAMPLING TRANSECT
- BATHYMETRIC CONTOUR (25 m INTERVAL)
- INTERMITTENT WATERCOURSE
- WATERCOURSE
- WATERBODY

0 500 1,000
1:20,000 METRES

REFERENCE(S)
BATHYMETRY CREATED BY GOLDER FROM MULTIPLE DATA SOURCES. FREIGHT DOCK DATA PROVIDED BY HATCH, MARCH 4, 2020. ADDITIONAL MILNE PORT INFRASTRUCTURE DATA OBTAINED FROM CLIENT, MAY 2, 2020 AND MAY 28, 2018. HYDROGRAPHY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. MILNE PORT IMAGERY CAPTURED AUGUST 2020 © 2020 DIGITALGLOBE, INC. ADDITIONAL IMAGERY COPYRIGHT © 20190802 ESRI AND ITS LICENSORS. SOURCE: MAXAR VIVID. USED UNDER LICENSE, ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

PROJECT
MARY RIVER PROJECT

CONSULTANT
wsp

YYYY-MM-DD	2023-01-26
DESIGNED	PR
PREPARED	AA
REVIEWED	PR
APPROVED	PR

TITLE
SAMPLING STATIONS FOR MARINE SEDIMENT QUALITY AND BENTHIC INFAUNA – 2023 MARINE MONITORING PLAN (MMP)

PROJECT NO.	CONTROL	REV.	FIGURE
166372402	77000-02	0	3.2

Figure 3.2 Sampling Stations for Marine Sediment Quality and Benthic Infauna – 2023 Marine Monitoring Plan (MMP)

- In 2020, the Coastal Transect was removed from the marine sediment sampling design. This transect extended from the eastern terminus of the East Transect northward along the 15 m depth contour for approximately 4,250 m. As this transect extended outside the predicted zone of influence for the Project; stations along this transect were more similar to control/reference stations which are not required in a radial gradient study design. The Coastal Transect was considered redundant and did not add significant value towards the identification of Project-related effects, thus it was removed from the study design in 2020 with the approval of the MEWG on 25 June, 2020.
- The 2020 sediment sampling program was the first year that all 15 stations along each of the four transects (East, West, Northwest and Northeast) were sampled as intended for the gradient sampling design.
- In 2020, sediment samples were consistently collected at each station using a Van Veen grab rather than either a standard Ponar or Van Veen grab as was done in 2019.
- In 2021, the temporal frequency of the marine sediment program was scaled back from annual monitoring to monitoring once every three years, on the basis that marine sediment results up to 2020 did not demonstrate any evidence of Project impacts.
- The original power analysis appended to the 2019 MEEMP Report (Golder, 2020a) was based on a data simulation using residual bootstrapping – the target sample size of 60 stations was set based on results of these analyses. However, follow-up power analyses were completed using the 2019 and 2020 sediment results from the field, which confirmed there was sufficient statistical power (i.e., >80%) for both sediment variables (percent fines and iron content) even in 2019 where only 44 of the planned 60 stations were sampled. This demonstrates that the monitoring program was functioning as intended (i.e., able to detect change). The revised 2020 power analyses were appended to the 2021 MEEMP Report (Appendix E of Chapter 2 – Sediment Quality in Golder, 2022a).

Table 3.3 provides a summary of the sampling design for the marine sediment quality sampling program.

Table 3.3 Study Design For Marine Sediment Quality

Indicator	Marine Sediment Quality
Monitoring Category	EEM
Design Type	Radial gradient design (4 transects, 15 stations per transect)
Measurable Parameter	Changes in the following sediment quality parameters: particle size distribution, organic and inorganic carbon, total petroleum hydrocarbons, volatile organic compounds, polycyclic aromatic hydrocarbons, and trace metals
Key Project Interactions	Potential changes in sediment chemistry and particle size due to propeller wash, fuel spills, increased ore dust deposition and site discharges in the marine environment.
Objective	Project will not result in significant changes to marine sediment quality
Timing	Once per year during the open-water season
Data Collection Method	Van Veen sediment grab or equivalent
Sample Handling and Analysis	Preserved as necessary and shipped to lab for analysis. Analyses to be completed by qualified laboratory (Canadian Association for Laboratory Accreditation Inc. certification). Appropriate QA/QC standards implemented in the field and laboratory

Data Interpretation and Reporting	Compare to CCME guidelines, where applicable. Where guidelines do not exist, compare to previous years and/or refer to a departure from background conditions to determine existence of Project-related change. Linear regression analysis as a function of distance from Milne Port.
Thresholds (Triggering Levels)	Refer to Trigger-Action Response Plan (Section 5.2) for triggering values related to CCME guidelines and/or background conditions
Status	Active/Ongoing
Agency/Partner Participation	None required

3.3 Benthic Infauna

3.3.1 Effect Pathways

- Project-induced changes to marine benthic infauna could result from the following Project-effect pathways:
- Loss of habitat from propeller wash;
- Alteration of habitat due to potential changes in marine water and sediment quality (due to treated effluent and settlement pond discharge, site drainage (run-off), ore dust deposition and fuel spills); and
- NIS/AIS introductions.
- Benthic infauna represents a biological indicator of environmental change in the marine environment and a potential pathway for contaminants to enter and/or affect the marine food web at higher trophic levels (i.e., fish and marine mammals).

3.3.2 Indicators and Thresholds

For benthic infauna, four endpoints are adopted as effect indicators: total density, taxa richness, and Simpson's diversity and evenness indices. These indicators are calculated from data collected as part of a radial gradient design and analyzed statistically to evaluate Project-related effects within the Milne Inlet study area both spatially and temporally.

3.3.3 Monitoring Approach

The benthic infaunal monitoring program follows the same RG design as described for marine sediment quality in Section 3.2 above. Benthic infaunal samples are collected from 15 sampling stations (in tandem with marine sediment sampling) along each of four transects, with sampling stations established at increasing distance from the ore dock infrastructure (Figure 3.2).

Samples are collected as composites of three individual grabs from each station using a standard Van Veen sampler with a surface area of 0.1 m². Each of the three individual grab samples are split using a field splitter constructed specifically for the purpose of this program due to the large volume of the Van Veen sampler. The composite material is gently rinsed with filtered seawater through a 1-cm mesh sieve to initially remove larger organisms; samples are either retained as whole samples, or further split into ½ or ¼, such that a reasonable volume would be submitted to the taxonomy laboratory. Large debris, such as gravel and cobble, are checked for encrusting fauna and included in the sample jar if observed. The 1-cm mesh sieved composited material is then further split in half, totalling a ¼ field

split, which is then transferred to an aluminium sieving table and gently rinsed through a 0.5-mm mesh sieve with filtered seawater. Remaining material on the sieve is placed in pre-labelled 1-L wide-mouth high-density polyethylene (HDPE) sample jars and preserved in a 10% buffered formalin solution. The containers are then sealed and inverted several times to promote homogenization with the formalin. Containers are then labeled internally and externally with water-resistant labels and sent to Biologica Environmental Services Ltd. (Biologica) for sorting and taxonomic identification.

Table 3.4 provides a summary of the sampling design for benthic infauna.

Table 3.4 Study Design For Benthic Infauna

Indicator	Benthic Infauna
Monitoring Category	EEM
Design Type	Radial gradient design (4 transects, 15 stations per transect)
Measurable Parameter	Changes in the following parameters: abundance / density, richness, diversity
Key Project Interactions	Potential changes in benthic infauna community metrics (density, richness, Simpson's diversity and evenness indices) due to propeller wash, fuel spills, increased ore dust deposition and site discharges in the marine environment.
Objective	Project will not result in significant changes to benthic infauna community metrics
Timing	Once per year during the open-water season
Data Collection Method	Van Veen sediment grab or equivalent
Sample Handling and Analysis	Preserved as necessary and shipped to lab for analysis. Analyses to be completed by qualified laboratory (Canadian Association for Laboratory Accreditation Inc. certification). Appropriate QA/QC standards implemented in the field and laboratory
Data Interpretation and Reporting	Statistical comparison to previous years and/or refer to a departure from background conditions to determine existence of Project-related change. Linear regression analysis as a function of distance from Milne Port.
Thresholds (Triggering Levels)	Refer to Trigger-Action Response Plan (Section 5.2) for triggering values
Status	Active/Ongoing
Agency/Partner Participation	None required

3.3.4 Program Modifications

Following is a summary of modifications made to the program since program implementation:

- In 2019, a fifth transect (Northeast Transect) was added to the benthic infauna sampling design based on recommendations from the MEWG. The new transect ran from a point between the Ore Dock and the

Freight Dock extending in a Northeast direction up to a distance offshore of approximately 2,100 m, corresponding to a water depth of approximately 120 m.

- In 2019, Baffinland increased the number of benthic infauna stations to accommodate a more statistically robust study design. Sampling effort increased from 5 stations per transect to 15 stations per transect to improve statistical power and the ability to detect Project-related effects. This change was based on results of a power analysis (Golder, 2020a) undertaken at the request of the MEWG.
- In 2020, the Coastal Transect was removed from the marine sediment sampling design. This transect extended from the eastern terminus of the East Transect northward along the 15 m depth contour for approximately 4,250 m. As this transect extended outside the predicted zone of influence for the Project; stations along this transect were more similar to control/reference stations which are not required in a radial gradient study design. The Coastal Transect was considered redundant and did not add significant value towards the identification of Project-related effects, thus it was removed from the study design in 2020 with the approval of the MEWG on 25 June, 2020.
- The 2020 benthic infaunal sampling program was the first year that all 15 stations along each of the four transects (East, West, Northwest and Northeast) were sampled as intended for the gradient sampling design.
- Starting in 2020, benthic infauna samples have been collected at each station using exclusively a Van Veen grab rather than either a standard Ponar or Van Veen grab as was done in previous years.
- In 2021, the temporal frequency of the benthic infauna program was scaled back from annual monitoring to monitoring once every three years, on the basis that benthic infaunal results up to 2020 did not demonstrate any evidence of Project impacts. The next scheduled sampling program for benthic infauna is planned for summer of 2023.
- The original power analysis appended to the 2019 MEEMP Report (Golder, 2020a) was based on a data simulation using residual bootstrapping – the target sample size of 60 stations was set based on results of these analyses. However, follow-up power analyses were completed using the 2019 and 2020 benthic infauna results from the field, which confirmed there was sufficient statistical power (i.e., >80%) for all four benthic community variables (density, richness, Simpson's Diversity Index (SDI), and Simpson's Evenness Index (SEI)) even in 2019 when only 32 of the planned 60 stations were sampled. This demonstrates that the monitoring program was functioning as intended (i.e., able to detect change). The revised 2020 power analyses were appended to the 2021 MEEMP Report (Appendix E of Chapter 2 – Sediment Quality in Golder, 2022a).

3.4 Benthic Substrate, Macroflora and Epifauna

3.4.1 Effect Pathways

Project-induced changes to benthic macroflora and epifauna could result from the following Project-effect pathways:

- Loss of habitat from propeller wash;
- Alteration of habitat due to potential changes in marine water and sediment quality (due to treated effluent and settlement pond discharge, site drainage (run-off), ore dust deposition and fuel spills); and
- NIS/AIS introductions.

Benthic macroflora and epifauna represent biological indicators of environmental change in the marine environment and a potential pathway for contaminants to enter and/or affect the marine food web at higher trophic levels (i.e., fish and marine mammals).

3.4.2 Indicators and Thresholds

Effect indicators for substrate, macroflora and epifauna include relative abundance (i.e., density for motile epifauna and % cover for sessile epifauna and macroflora), taxa richness (number of taxa present), and Simpson's diversity and evenness indices. These indicators are calculated from data collected in both reference and impact areas and analyzed statistically.

3.4.3 Monitoring Approach

Biophysical surveys of permanent, steel quadrats are conducted using SCUBA divers and/or a Remote Operated Vehicle (ROV). A total of 26 square steel quadrats (each with a survey area of 0.44-0.64 m^2) were installed on the sea bottom at depths between 5 m and 16 m Chart Datum in the Milne Port region in 2020-2022— 13 in the Project exposure area and 13 in a reference area (Figure 3.3). Divers record the following data: substrate type (particle size categories, quantified by percent cover); macroalgae (identified to lowest practical level, quantified via percent cover), sessile invertebrates (identified to lowest practical level, quantified via percent cover); motile invertebrates and fish (identified to lowest practical level and enumerated. Representative photographs are taken, as needed, to show biological features and aid in taxonomic identification. Divers also collect specimens, when necessary, to improve the resolution of taxonomic identification. In addition, a set of five plastic settlement plates and four settlement baskets are attached on a line to each quadrat, lifted into the water column by a float, to be used as settlement substrate for encrusting epifauna and epiflora. One settlement plate and one settlement basket are retrieved annually from each quadrat after a soak time of one year. Starting in 2023, one settlement plate and one settlement plate per quadrat will be retrieved annually after a soak time of three years. Samples are sent to an accredited laboratory (i.e., Biologica) for taxonomic identification.

Table 3.5 provides a summary of the sampling design for benthic substrate, macroflora and epifauna.

Table 3.5 Study Design For Benthic Substrate, Macroflora And Epifauna

Indicator	Benthic Substrate, Macroflora and Epifauna
Monitoring Category	EEM
Design Type	Before-After/Control-Impact (BACI)
Measurable Parameter	Changes in the following parameters: relative abundance (i.e., density for motile epifauna and % cover for sessile epifauna and macroflora), taxa richness (number of taxa present), and Simpson's diversity and evenness indices
Key Project Interactions	Potential changes in benthic macroflora and epifauna community metrics due to propeller wash, fuel spills, increased ore dust deposition and site discharges in the marine environment.
Objective	Project will not result in significant changes to benthic macroflora or epifauna
Timing	Once per year during the open-water season

Data Collection Method	Diver-based quadrat surveys
Sample Handling and Analysis	Permanent photographic record of quadrats. Data transcribed to database Appropriate QA/QC standards implemented in the field and database checks.
Data Interpretation and Reporting	Analysis of variance (ANOVA) and/or analysis of covariance (ANCOVA).
Thresholds (Triggering Levels)	To be developed in consultation with the MEWG
Status	Active/Ongoing
Agency/Partner Participation	None required

3.4.4 Program Modifications

Following is a summary of modifications made to the program since program implementation:

- The collection of baseline data for benthic macroflora and epifauna in 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.
- In 2015-2017, towed video surveys were used to characterize substrate, macrofloral assemblages and benthic epifauna along established nearshore transects at Milne Port.
- In 2018, the towed video transect surveys were discontinued due to low taxonomic resolution and poor ability to annually replicate the transect survey locations. This method was replaced with belt transect surveys using ROV-based video data collection which was implemented in 2018 and 2019.
- In 2019, the belt transect surveys were discontinued due to loss of multiple belt transects throughout the winter (likely to ice scour). This method was replaced with permanent steel quadrat surveys using ROV and/or diver-based data collection, which has been implemented annually since 2020 and has greatly improved data resolution and taxonomic identification.

3.5 Marine Fish Community

3.5.1 Effect Pathways

Project-induced changes to the marine fish community could result from the following potential Project effect pathways:

- Treated effluent and site drainage discharges at Milne Port (downstream of camp and maintenance shops, fuel depots and tank farms, wastewater treatment facility and ore stockpiles);
- Ore dust dispersion and deposition from stockpiles and during ore loading at the ore dock;
- Loss of habitat from propellor wash;
- Alteration of habitat due to potential changes in marine water and sediment quality (due to treated effluent and settlement pond discharge, site drainage (run-off), ore dust deposition and fuel spills); and
- NIS/AIS introductions.

3.5.2 INDICATORS AND THRESHOLDS

A number of indicators are measured for this component, including total catch, relative abundance, and catch per unit effort (CPUE). A statistical analysis of these indicators is undertaken for select standardized sampling methods including gill net, angling and hoop net sampling. Other fish sampling methods employed in this program are subject to a qualitative analysis, rather than statistical.

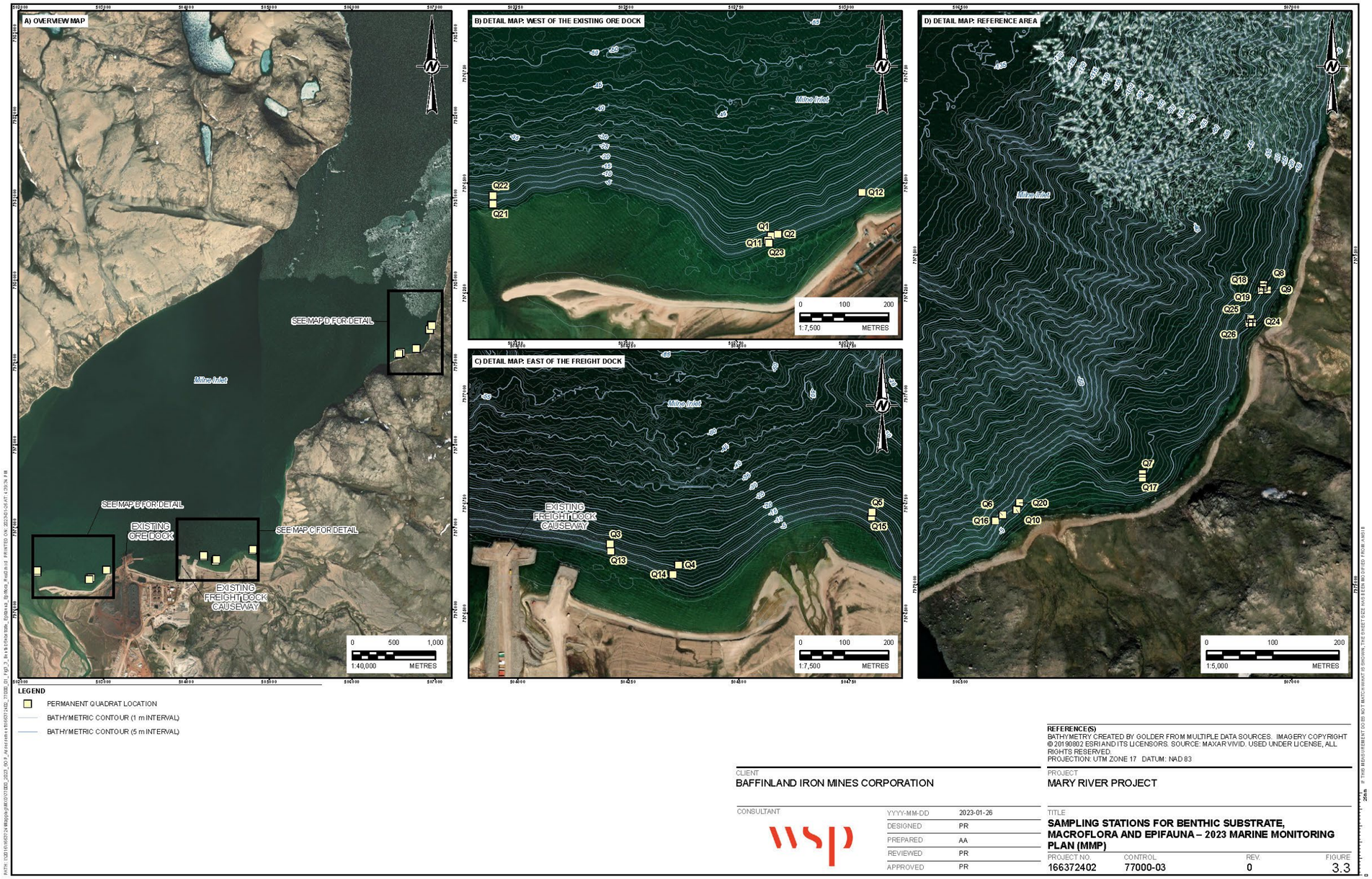


Figure 3.3 Sampling Stations for Benthic Substrate, Epifauna and Epiflora – 2023 Marine Monitoring Plan (MMP)

3.5.3 MONITORING APPROACH

In accordance with relevant permits and licenses (DFO License to Fish for Scientific Purposes, Nunavut Research Institute {NRI} Scientific License, and Canadian Council of Animal Care {CCAC} Animal Use Protocol Permit), fish sampling is conducted in the Milne Port area using both active (angling, gill netting, beach seine, trawling) and passive (hoop nets) capture methods to characterize the local fish community. Fish sampling locations are shown in Figure 3.4.

Standardized monofilament floating gill nets are used to sample shallow (i.e., up to 15 m deep) subtidal areas for characterization of pelagic fish communities present in the Milne Port area. Each gill net consists of six panels with each panel measuring 15.2 m in length and 2.4 m in width, with mesh sizes of each panel of 2.5 cm, 3.8 cm, 5.1 cm, 6.4 cm, 7.6 cm and 10.2 cm. The gill nets are deployed in a shore-perpendicular orientation (smallest mesh size closest to shore) and are either suspended just below the water surface or weighted to run along the seabed. Nets are then checked at least every two hours for fish presence over the duration of deployment.

Angling (i.e., jigging and trolling) is conducted to characterize bottom and demersal fish communities in Milne Port. Jigging is conducted from a stationary position with two to five rods and lines deployed from the field vessel. Hooks or spoon lures (flashers) are allowed to hit the bottom, then flicked upward to attract bottom fish. Trolling occurs along a pre-determined depth contour where lines with flashers are cast over the side of the field vessel and spooled in towards the field vessel at a known depth to attract pelagic fish. Sampling start and end positions are recorded using a Garmin GPS and logged in a field notebook.

Beach seines are used to sample fish in nearshore habitat at Milne Port. Sampling is conducted using a 1.2 m x 10 m seine net with a 10 mm mesh size. Sampling areas are typically in the range of 400 m^2 to 800 m^2 and occur at shoreline locations with an average depth of 1 m. Sampling locations are recorded using a Garmin GPS and logged in a field notebook.

Hoop nets are also used to sample demersal fish in both shallow and deep nearshore areas. Sampling is conducted using a 5 m two-chamber hoop net with 25 mm mesh. Shallow (i.e., shore-based) nets are set in subtidal areas during low tide with the wing panels running from a minimum water depth of 0.2 m to a maximum depth of 1.5 m. Nets are checked daily during low tide. Nets oriented to the west and east are placed so the 1.0 m diameter mouth is perpendicular to shore and the 10 m wing panels are in a wide V-shape extending outward from the opening – targeting fish moving through the subtidal. Nets oriented to the north and south are placed to the mouth is parallel to shore, either facing shore (south) or open water (north), targeting fish moving in and out of freshwater. Deep deployments are set with both ends of the hoop net left open to allow fish to swim into the trap and weighted on both ends to lay flat on the seabed, targeting demersal species. Sampling locations are recorded using a Garmin GPS and logged in a field notebook.

Table 3.6 provides a summary of the sampling design for marine fish community.

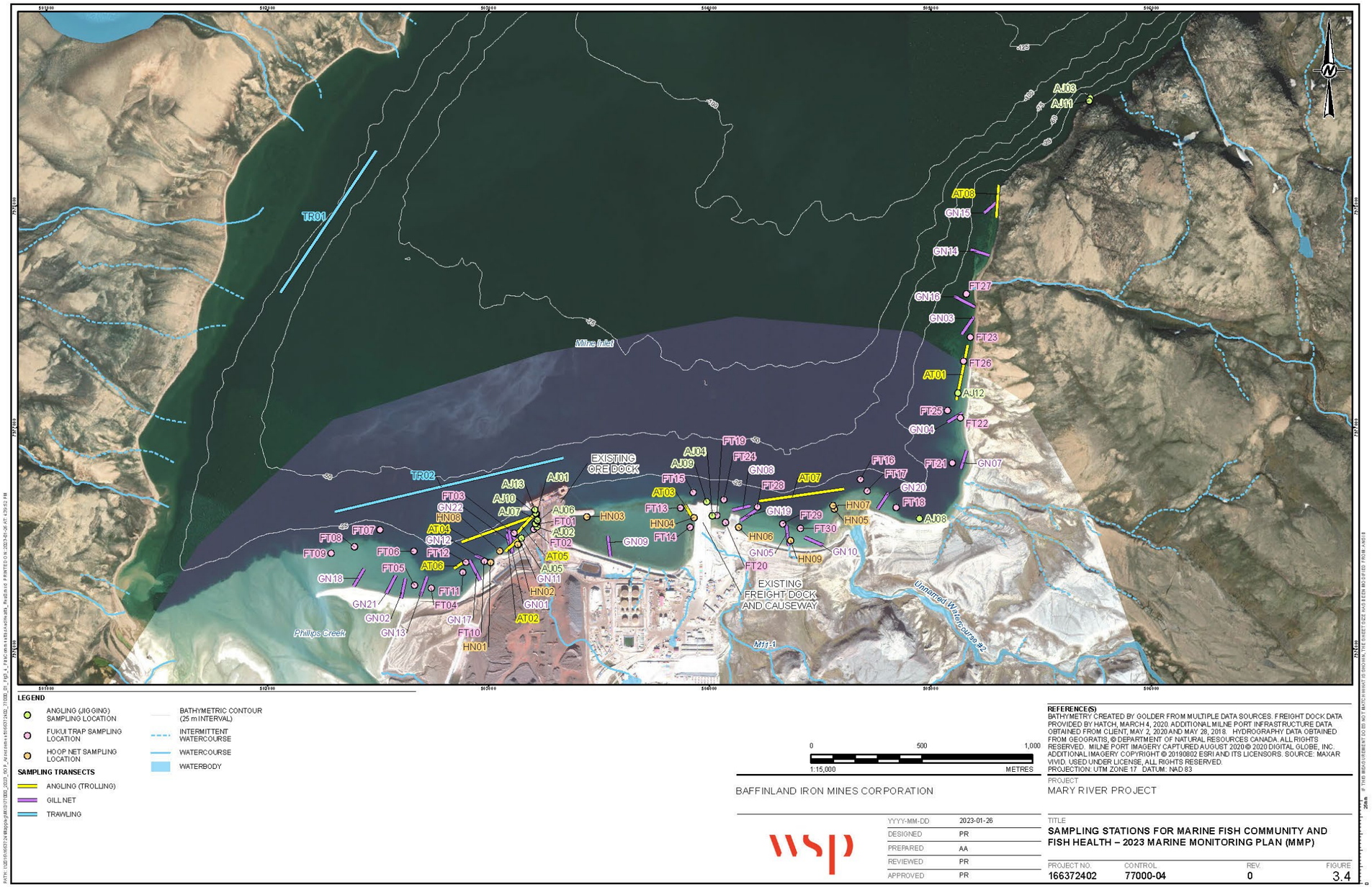


Figure 3.4 Sampling Stations for Marine Fish Communities and Fish Health – 2023 Marine Monitoring Plan (MMP)

Table 3.6 Study Design For Marine Fish Community

Indicator	Marine Fish Community
Monitoring Category	EEM / Surveillance Monitoring
Design Type	Nearshore sampling in Milne Inlet (various sampling methods)
Measurable Parameter	Changes in the following fish community parameters: total catch, relative abundance, CPUE
Key Project Interactions	Potential changes in fish community due to propeller wash, fuel spills, increased ore dust deposition and site discharges in the marine environment.
Objective	Project will not result in significant changes to the marine fish community
Timing	Once per year during the open-water season (July to September)
Data Collection Method	Systematic methods include angling, gill net and hoop net. Other fish sampling methods (beach seine and trawl) are used for qualitative assessment of fish community.
Sample Handling and Analysis	Photographic record (if necessary) to confirm identification, measure length and weight of each fish, collect tissue sample from incidental mortalities Appropriate QA/QC standards implemented in the field
Data Interpretation and Reporting	Compare to previous years and/or refer to a departure from background conditions to determine existence of Project-related change.
Thresholds (Triggering Levels)	To be developed in consultation with the MEWG
Status	Active/Ongoing
Agency/Partner Participation	None required

3.5.4 Program Modifications

Following is a summary of modifications made to the program since program implementation:

- In 2017, angling (jig and troll methods) was added to the marine fish monitoring program. Prior to 2017, fish sampling was limited to gill nets and Fukui traps.
- In 2018, seine net sampling was added to the marine fish monitoring program. This method was discontinued in 2021 due to low fish yields.
- In 2019, hoop net sampling was added to the marine fish monitoring program as a trial to potentially replace Fukui trap sampling which traditionally yielded low fish returns. Both Fukui trap and hoop net methods were simultaneously employed in 2019-2022 to meet commitments to MEWG of continuing to sample at previous locations for a minimum of three years to facilitate comparison of old and new methods / results. Results demonstrated that hoop nets yielded better fish returns and therefore Fukui net sampling is planned to be discontinued starting in 2023.
- In 2020, trawl net sampling was added to the marine fish monitoring program as a trial to determine the capture efficiency of that method within Milne Port.

- In 2021, longline sampling was added to the marine fish monitoring program as a trial to determine the capture efficiency of that method within Milne Port. This method was discontinued in 2022 given 2021 results, which yielded zero fish catch.
- Starting in 2021, standardized sampling was initiated for four fish sampling methods (angling, gill net, hoop net and Fukui trap) to allow for a statistical comparison of fish community metrics across years, based on MEWG recommendations. As part of this modification, CPUE calculations were revised for three fish sampling methods (angling, gill net, and Fukui trap) to better account for field variability. Previous to 2021, CPUE was assessed as number of fish per hour of effort (no. of fish/h of effort). For the 2021 program CPUE metrics accounted for the number of rods used during angling (fish/h/rod), the length of the gill net adjusted to 100 m (fish/h/100 m net), and the number of Fukui traps used in a cluster (fish/h/trap). Data from 2020 were also re-calculated with the modified CPUE calculations and compared against 2021 results. CPUE data from sampling prior to 2020 were not based on standardized sampling and are therefore not included in the statistical analyses.

3.6 Marine Fish Health

3.6.1 Effect Pathways

Project-induced changes to fish health and tissue chemistry could result from the following potential Project effect pathways:

- Treated effluent and site drainage discharges at Milne Port (downstream of camp and maintenance shops, fuel depots and tank farms, wastewater treatment facility and ore stockpiles); and
- Ore dust dispersion and deposition from stockpiles and during ore loading at the ore dock.

3.6.2 Indicators and Thresholds

For fish health, Fourhorn Sculpin and *H. arctica* have been selected as sentinel species and are monitored for the following indicators: measures of energy use (i.e., growth, reproduction), energy storage (i.e., condition) and survival, in addition to supporting endpoints (as appropriate for each species) such as length, body weight, external condition, internal condition, organ weights, stomach fullness, parasite presence/absence, sex, life stage and state-of-maturity.

For fish tissue chemistry, concentrations of total metals[6] and polycyclic aromatic hydrocarbons (PAH) are measured for three species (i.e., Arctic Char, Fourhorn Sculpin, and *H. arctica*) and compared to data from previous years, where possible. Historic data available for comparison varies for each species, with data extending back for Arctic char intermittently to 2010, and *H. arctica* and Fourhorn Sculpin to 2018. In addition, tissue concentrations of mercury and selenium for Arctic Char, Fourhorn Sculpin and *H. arctica* are compared to applicable tissue quality guidelines; specifically, mercury concentrations are compared to Health Canada's Maximum Levels for Chemical Contaminants in Foods mercury consumption guideline of 0.5 mg/kg ww (Health Canada, 2015) while selenium concentrations are compared to the British Columbia Ministry of Environment (BC MOE) fish tissue guidelines of 4 mg/kg dry weight (dw; BC MOE, 2014).

[6] Includes metals, metalloids, and non-metals. Metals are broadly defined as elements which are good conductors of electricity and heat, which form cations by loss of electrons, and which yield basic oxides and hydroxides (Wood et al., 2012). Metalloids share some but not all properties of metals, while non-metals mostly lack characteristics of metals.

3.6.3 MONITORING APPROACH

Fish community sampling is conducted at various locations in Milne Inlet, near the port; capture methods are described in Section 3.5 above. All external and internal assessments described below follow standardized procedures consistent with MDMER Environmental Effects Monitoring (EEM) program requirements (Environment Canada, 2012).

Forty Fourhorn Sculpin are retained for fish health sampling to meet target sample sizes of 20 adult males and 20 adult females. All other fish are released alive back into Milne Inlet. Incidental mortalities of Arctic Char are also retained for analysis of age and stomach contents. *H. arctica* specimens are collected opportunistically from benthic infauna samples (collection methods described in Section 3.3 above), with a subsample of 40 individuals retained for fish health and tissue chemistry sampling. In samples where *H. arctica* numbers are high, a maximum of five individuals are selected. Specimens are selected for processing if the shell is greater than 1.5 cm in length, is intact, and has no indications of damage to the umbo or hinge area.

Fourhorn Sculpin retained for fish health sampling are lethally processed by a concussive blow to the head followed by cervical dislocation (i.e., cutting the spinal cord behind the head). Total lengths (± 0.01 mm) and total body weights (± 0.001 g) of the fish are documented, external observations of fish features (i.e., body form, eyes, skin, thymus, opercula, gills, pseudobranchs, fins, vent, and parasites) are recorded, and abnormal features (e.g., wounds, tumours, parasites, fin fraying, gill parasites, or lesions) are described in detail and photographed. The condition of the internal organs (e.g., liver, spleen, gall bladder, and kidneys) are assessed immediately after opening the body cavity and documented. Liver weight and percent mesenteric fat are recorded. The gonads of each fish are removed, weighed (± 0.001 g), and photographed before assigning sex and maturity stage. Parasite presence and predominance are recorded, and parasite weight is documented if large parasites (e.g., tapeworms) are observed in the body cavity.

Stomachs and ageing structures (i.e., otoliths) are collected from Fourhorn Sculpin and incidental mortalities of Arctic Char. Sagittal otoliths are extracted as the primary aging structure and sent to North/South Consultants Inc. for aging analysis. Stomach fullness is recorded and the stomachs are removed and sent to Biologica for enumeration and taxonomic identification of stomach contents. For Fourhorn Sculpin and Arctic Char, one muscle sample (> 10 g) without skin is collected from the left dorsal side of each fish for metals analysis. A second muscle sample (> 10 g) without skin is collected from the right dorsal side of each fish for PAH analysis. *H. arctica* specimens are measured along the largest axis (± 1 mm) and weighed (± 0.001 g), and sent to Biologica for processing (i.e., lengths, wet and dry weights, aging analysis). All tissue chemistry samples are sent to Bureau Veritas Laboratories for analysis. Percent moisture content and metals concentrations for fish and *H. arctica* are measured in milligrams per kilogram (mg/kg) wet weight (ww) using collision reaction cell inductively coupled plasma mass spectrometry (CRC ICPMS) while concentrations of PAH are measured in mg/kg by gas chromatography mass spectrometry.

Table 3.7 provides a summary of the sampling design for marine fish health.

Table 3.7 Study Design For Marine Fish Health

Indicator	Marine Fish Health
Monitoring Category	EEM
Design Type	Nearshore sampling in Milne Inlet (various sampling methods)
Measurable Parameter	Changes in PAH and metal concentrations in fish tissue, changes in body condition metrics
Key Project Interactions	Potential changes in fish health due to fuel spills, increased ore dust deposition and site discharges in the marine environment.
Objective	Project will not result in significant changes to marine fish health
Timing	Once per year during the open-water season (July to September)
Data Collection Method	Angling, gill net, hoop net, beach seine and trawl methods
Sample Handling and Analysis	Photographic record (if necessary) to confirm identification, measure length and weight of each fish, collect tissue sample from incidental and targeted mortalities Appropriate QA/QC standards implemented in the field and laboratory
Data Interpretation and Reporting	Compare to applicable tissue quality guidelines, previous years' results, and baseline conditions (where applicable).
Thresholds (Triggering Levels)	Refer to Trigger-Action Response Plan (Section 5.2) for proposed triggering values
Status	Active/Ongoing
Agency/Partner Participation	None required

3.6.4 Program Modifications

Following is a summary of modifications made to the program since program implementation:

- In 2018, *Hiatella arctia* was added as an indicator species for the marine fish health program. Prior to this year, the fish health program had been limited to Artic char and sculpin.
- In 2021 and 2022, exploratory fishing effort was conducted at the outflow of the Tugaat River, approximately 28 km northeast of Milne Port and (in 2021 only) in Koluktoo Bay, approximately 22 km north of Milne Port. Both locations were identified as having similar characteristics to Milne Port in terms of fish habitat, and were therefore thought to represent potentially suitable reference area for the MEEMP fish health sampling program. However, sampling completed in both locations in 2020 and 2021 yielded low yields of both indicator species, at levels unlikely to support a fish health program. Baffinland will work with the MEWG on how to address this issue prior to the 2023 field season. Either a new reference location will need to be identified in the Milne Inlet region, or one or more new indicator species should be explored to support the fish health program (targeting species that are available in sufficient quantities to support a repeatable fish health sampling program in both study site and reference site locations).

3.7 NIS/AIS

3.7.1 Pathways

Project-mediated introductions of NIS/AIS could result from the following pathways:

- Ballast water discharges
- Biofouling of ship hulls

3.7.2 Indicators and Thresholds

The NIS/AIS monitoring program is designed as a surveillance survey and therefore does not use traditional indicators and thresholds. Detection of a single NIS/AIS will initiate a response protocol aimed to assess the risk and determine the appropriate course of action. Ultimately, species are either determined to be no, low, or high risk. High and low risk species are placed on a "Watchlist" and subject to heightened monitoring efforts; if a project-related introduction can be verified, high risk species will be placed on a "Trigger List", where rapid response plans and potential intervention measures would be developed and implemented. Baffinland will follow the most updated version of the National Framework for the Development of Response Plans for Aquatic Invasive Species (Fisheries and Oceans, 2020) in the event an AIS becomes introduced via Project activities.

3.7.3 Monitoring Approach

Given the general paucity of information (including potential occurrence) on NIS/AIS in marine arctic systems, Baffinland has committed to monitoring for the presence of NIS/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 updated during subsequent monitoring undertaken from 2014 to 2022; this growing taxonomic inventory, along with both global and domestic NIS/AIS databases, are used to screen all species documented across all monitoring components. A project-specific flow chart has been developed to assist in evaluating species risk (Figure 3.5); as above, should an NIS/AIS be confirmed to have been introduced through Project activities, Baffinland will follow the most updated version of the National Framework for the Development of Response Plans for Aquatic Invasive Species (Locke et al. 2010).

NIS/AIS monitoring involves a combination of dedicated surveys (i.e., for zooplankton and ship hulls, described below) as well as screening all specimens caught during surveys for all the various MEEMP components (methods described in Sections 3.3 for benthic infauna, 3.4 for macroflora and epifaunal invertebrates, and 3.5 for fish); thus, NIS/AIS monitoring involves data collection across multiple trophic levels – marine vegetation, zooplankton, benthic invertebrates, and fish. Where required, samples are sent for independent verification by external experts and/or for DNA analysis. Sampling locations for the NIS/AIS program are shown in Figure 3.6.

Zooplankton samples are collected from both Milne Port and Ragged Island using a combination of vertical and horizontal oblique tows. Vertical hauls are conducted by lowering a 0.3 m diameter (64 µm mesh size) plankton net to 1 to 3 m above the bottom and then raising the net by hand to the surface at a rate of approximately 1 m/s (visually estimated). Three replicate hauls are conducted at each station and combined into a single composite sample. Horizontal oblique tows are conducted by towing a 0.5 m diameter net (250 µm mesh size) at a speed of approximately 2.5 knots in sinusoidal fashion by means of regular transitions in tow speed (1-minute towing, 1-minute idling), which allows the weighted net to periodically sink and rise during active sampling. This helps to avoid sampling only in the upper few metres of the water column and ensures a more representative sample of

zooplankton in the water column. All zooplankton samples are preserved in 5% formalin and submitted to Biologica for taxonomic identification.

Monitoring of hull biofouling has consisted of underwater video surveys of the hulls of randomly selected ore carriers berthed at the ore dock using an ROV-based underwater video system. Surveys were conducted along a series of

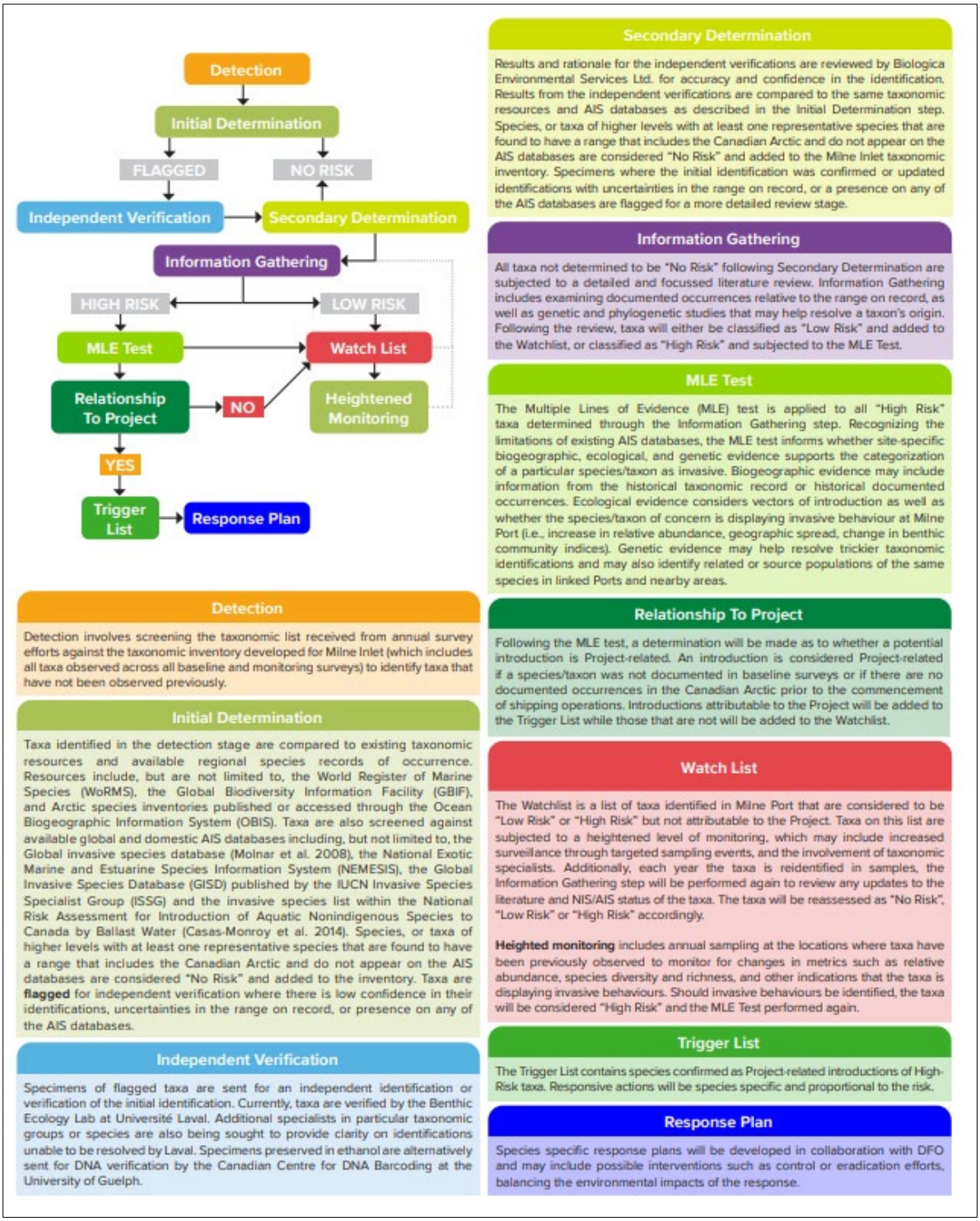


Figure 3.5 Flow Chart Describing Taxa Review For Flagging Species As Low Or High Risk

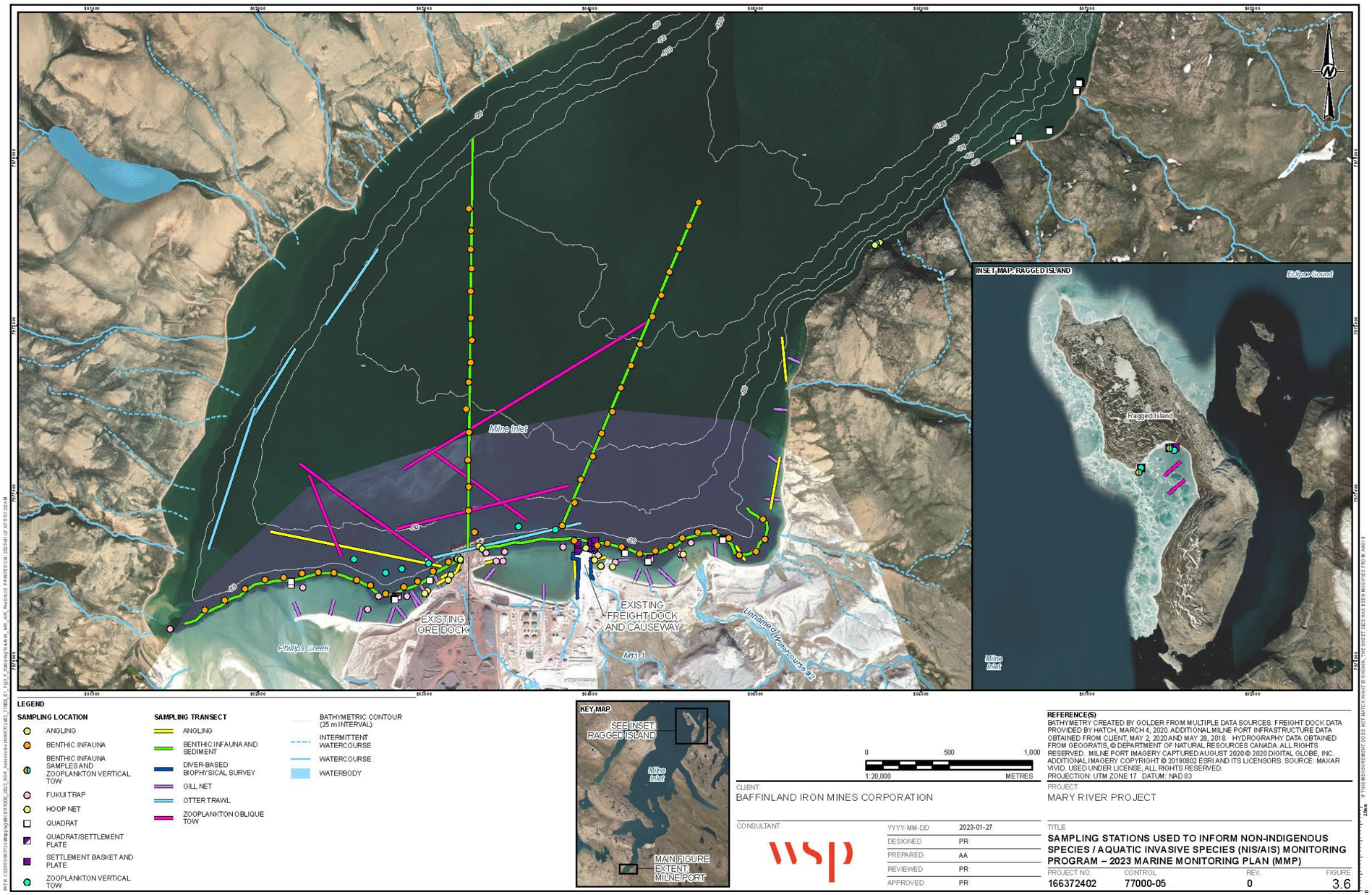


Figure 3.6 Sampling Stations Used to Inform Non-Indigenous Species / Aquatic Invasive Species (NIS/AIS) Monitoring Program – 2023 Marine Monitoring Plan (MMP)

horizontal transects along the hulls of the ore carriers, interspaced to cover a representative range of depths of the submerged hulls, and focused on niche areas of the hull where biofouling is most likely to occur (e.g., chain lockers, bulbous bow and stem, sea-chain grating, stern tube, rope guard, propeller nose cone and blades, rudder side, bottom, leading and trailing edges). This component of NIS/AIS monitoring was last conducted in 2020 as making conclusive species identifications via video footage proved challenging. Baffinland is currently working with Fisheries and Oceans Canada (DFO) to identify alternative methods for carrying out hull surveys.

3.8 Marine Mammals

3.8.1 Effect Pathways

Project-induced changes to marine mammals could result from the following Project effect pathways:

- Potential ship strikes on marine mammals;
- Potential acoustic impacts on marine mammals (i.e., disturbance or acoustic masking) due to ship noise;
- Potential changes in narwhal behaviour due to ship traffic and ship noise;
- Potential changes in narwhal abundance and distribution due to ship traffic and ship noise;
- Potential ice entrapment of narwhal due to icebreaking during the fall shoulder season; and
- Potential change in ringed seal density due to ship traffic and ship noise.

3.8.2 Indicators and Thresholds

Indicators selected for narwhal include change in stock abundance (for both putative Eclipse Sound and Admiralty Inlet summer stocks), change in relative abundance and/or distribution, change in group composition (e.g., change in the proportion of immature narwhal relative to the observed population), change in surface behaviour, change in dive behaviour, and ship strike occurrence. Indicators selected for ringed seal include change in seal density in the RSA, and ship strike occurrence. Indicators selected for bowhead include ship strike occurrence. Table 5.2 provides a detailed summary of the indicators and thresholds used for the marine mammal monitoring programs in support of the ERP.

3.8.3 Monitoring Approach

A series of monitoring programs and research studies have been developed to address potential Project shipping effects on marine mammals in support of the ERP. The monitoring studies are designed to complement each other and to allow effects monitoring at both a regional and local scale. Results are commonly integrated to provide a more complete understanding of marine mammal responses to Baffinland shipping activities during the ERP. A summary of the monitoring studies is provided in Table 3.7.

Table 3.8 Summary of Marine Mammal Monitoring Programs

Marine Mammal VEC Key Indicator	Program Name	Monitoring Category	Description
All marine mammals	Ship-based Observer Program	Surveillance	Vessel-based monitoring program used to assess ship strike occurrence and changes in relative abundance and behaviour.
	Acoustic Monitoring Program	Surveillance / Compliance monitoring / EEM	Deployment of automated acoustic recorders to characterize ambient noise and ship noise relevant to established marine mammal acoustic disturbance criteria and relevant to species-specific hearing abilities to determine the level of acoustic masking (i.e., Listening Range Reduction) that marine mammals in the receiving environment may experience.
Narwhal	Marine Mammal Aerial Survey Program	Surveillance / EEM	Systematic aerial-based abundance surveys to assess regional-level changes in narwhal abundance and distribution in RSA (Eclipse Sound summer stock) and adjacent Admiralty Inlet summer stock area. Targeted low altitude surveys area also undertaken to assess changes in the proportion of immature narwhal relative to adult population.
	Bruce Head Shore-based Monitoring Program	EEM / Research (narwhal behavioural response study)	Systematic shore-based monitoring (visual observer and drone-based surveys) to assess local-level changes in narwhal relative abundance, distribution, group composition and behaviour in direct response to ship traffic.
	Narwhal Tagging Program	EEM / Research (narwhal behavioural response study)	Deployment of high-resolution location (satellite-based) and dive tags on narwhal to determine their behavioural responses (surface and dive behaviour response variables) to Project and non-Project ships transiting in the RSA
Ringed Seal	Ringed Seal Aerial Survey Program	Surveillance / EEM	Systematic aerial-based and thermal imagery surveys during late spring to assess regional-level changes in ringed seal density and distribution in RSA.

The primary objective of the marine mammal monitoring programs is to gain an understanding of the natural variability of marine mammal abundance, distribution, and behaviour along the northern shipping route in the RSA. The design of the monitoring programs 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. Effects are anticipated to be limited to temporary, localized avoidance responses at close distances to the ship with animals returning to their normal behaviour shortly after the exposure event. Hypotheses related to the length of time that behavioural

responses persist have been developed to determine whether narwhal are demonstrating any evidence of large-scale avoidance behaviour in direct response to shipping (i.e., effects that extend beyond localized, temporary avoidance responses). Details on the study design for each of the marine mammal monitoring program is presented below.

3.8.4 Marine Mammals - General

3.8.4.1 SBO Program

Baffinland's Ship-based Observer (SBO) Program has been designed to address the following impact pathways:

- Potential ship strikes on marine mammals;
- Potential changes in relative abundance and distribution of marine mammals due to exposure to ship traffic and ship noise; and
- Potential behavioural disturbance of marine mammals due to exposure to ship traffic and ship noise.

The SBO Program also addresses requirements outlined in Project Certificate No. 005 (Condition #106 and #123) in that Baffinland employ ship-based observers (SBO) to monitor interactions with marine mammals and seabirds with Project shipping activities.

Program Background

Baffinland first initiated the SBO Program in 2013 (SEM 2014) prior to development of the Project, concurrent with initial ship transport of fuel and supplies to Milne Port using vessels transiting between Quebec City and Milne Inlet. During the construction phase of the Project in 2014 and 2015, the SBO Program was implemented onboard fuel tanker and sealift vessels transiting along the Northern Shipping Route. Survey effort in 2014 and 2015 was limited to three one-way ship transits per season, with nine hours of survey effort completed in each year. In 2016, Baffinland suspended the SBO Program due to safety concerns associated with the MWOs boarding the vessel at-sea. In 2018, the SBO Program was re-initiated onboard the MSV Botnica, an icebreaker retained by Baffinland to conduct ore carrier escort services in the RSA during the shipping shoulder seasons. Data collection methods and monitoring protocols were revised in 2018 and 2019 to better address the relevant terms and objectives of the Project Certificate, based on recommendations provided by the MEWG. The SBO Program was not implemented in 2020 and 2021 due to COVID-19 restrictions. An SBO Program in 2022 was planned for the fall shoulder season onboard the MSV Botnica iceabreaker, but was not executed due to early closure of the shipping season due to ice conditions in the RSA. The SBO Program is next scheduled to occur over a 15-day survey period during the 2023 late shoulder season (starting mid-October) onboard the survey platform MSV *Botnica*.

Study Design

The primary objective of the SBO Program is to monitor for potential ship strikes on marine mammals and seabirds in the RSA. The secondary objective of the SBO Program is to collect observational data on the presence, relative abundance and distribution of marine mammals and seabirds within the boundaries of the RSA relative to Project vessel operations.

Marine mammal sightings and environmental data are systematically collected by ship-based observers (SBOs) from the enclosed bridge of the ship corresponding with the highest accessible point on the vessel. The SBOs perform daily scheduled rotational watches covering the majority of the day when light conditions allow for adequate animal detection. Watches are discontinued when visibility is poor due to weather or low light. Surveying is performed with the naked eye and using 10x42 and 7x50 reticle binoculars. The focus of the surveys is forward of the vessel, with SBOs visually surveying from 240° to 120° relative to the centre or track line of the vessel (0°). At the beginning of each watch period, a Global Positioning System (GPS) track file is initiated to record the path and speed of the survey vessel and to record sighting locations.

Marine mammal sightings data recorded by the SBOs includes the time and location of the sighting, species identification, numbers of animals, group composition, and behaviour (as possible). For each sighting record, the SBOs record the initial observed distance from vessel, the minimum distance from vessel (i.e., closest distance to the ship referred to as the 'closest point of approach', or CPA), bearing from vessel, and direction of movement. In addition to marine mammal sightings, the SBOs also record environmental conditions on their active watch (including information on ice cover, sea conditions, glare, visibility, weather), as well as information on other vessels or anthropogenic activities (e.g., hunting) on the water. In addition to marine mammal watch periods, the SBO team performs dedicated seabird surveys throughout the daily watch schedule. The dedicated seabird surveys are conducted in accordance with the Canadian Wildlife Service (CWS) Eastern Canadian Seabirds At Sea (ECSAS) protocol (CWS 2012). All sightings' data are entered into a computer database. Database entries undergo daily quality assurance and quality control procedures.

Data Analysis

Observational effort is calculated relative to survey distance in linear kilometers using trackline GPS data extracting segments of effort using start and end times recorded during each MWO shift. The same start and end times are used to determine temporal survey effort. All data analyses are completed based on spatial survey effort (km) and not temporal effort.

Animal detection rates are calculated and expressed as sightings per unit effort (SPUE; number of sightings/km) and number of animals/km (used as a proxy for relative abundance). Sightings are therefore expressed relative to spatial observational effort. Detection rates are analyzed in relation to environmental conditions as this influences detectability of marine mammals. For all analyses, pinnipeds observed hauled-out on ice are considered separately from pinnipeds observed in-water due to the differences in animal detectability between the two environments (i.e., pinnipeds are more easily detected on ice than in-water).

3.8.4.2 Acoustic Monitoring Program

Baffinland's Acoustic Monitoring Program has been designed to address the following impact pathway:

- Potential behavioural disturbance and acoustic masking effects in marine mammals due to exposure to ship traffic and ship noise.

The monitoring design was developed to verify predictions made in the FEIS (Baffinland 2012, 2013) that narwhal are expected to exhibit temporary and localized avoidance behaviour when encountering Project vessels along the shipping route. The Acoustic Monitoring Program also aims specifically to address the following terms and conditions outlined in Project Certificate No. 005:

- Condition No. 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".
- Condition No. 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".
- Condition No. 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 provided 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 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 results of vessel noise. Thus, shall include, but not be limited to:
    1. 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.)
    2. Vessel transit planning, for all seasons
    3. 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."

Program Background

Baffinland first initiated the Acoustic Monitoring Program in 2014 (Kim and Conrad 2015) during the construction phase of Milne Port, when Project-related shipping was limited to a small number of fuel tanker and sealift vessel transits along the Northern Shipping Route. Since iron ore shipping operations commenced in 2015, Baffinland implemented acoustic monitoring over six separate shipping seasons (Table 3-1) including several overwinter deployments to record icebreaker operations during the spring and fall shoulder season. The Acoustic Monitoring Program is next scheduled to occur during the 2023 open-water season when two acoustic recorders will be deployed along the shipping corridor to measure noise generated by Capesize ore carriers (not previously measured in the RSA). Recordings will be made using JASCO AMAR-G4 recorders programmed to record continuously at 128 kHz for an estimated period of 86 days.

Study Design

Acoustic recorders are deployed at representative locations along the shipping corridor in the RSA during the open-water season. The recorders are programmed to record continuously (or alternatively on a pre-established duty cycle) at a sample rate of 128 kHz sampling rate (or alternatively on a pre-established duty cycle of 14 minutes at 64 kHz and 1 minute at 512 kHz), over an extended deployment period lasting up to several months. Following recovery of the acoustic recorders, the acoustic data are downloaded from the recorders and processed by experienced acousticians. Acoustic analyses performed on the acoustic data include:

- a detailed description of the measured ambient noise levels in the RSA
- quantification of the contribution of vessel noise to the acoustic environment in the RSA;
- a comparison of the measured (in-situ) sound levels to modelled sound levels as assessed in the FEIS (Baffinland 2012, 2013);
- identification of the vocal presence of marine mammal species ifn the RSA through call detection;
- an evaluation of shipping noise levels in relation to established marine mammal acoustic thresholds for injury and onset of disturbance;
- an estimate of the extent of listening range reduction (LRR) associated with Project vessel transits in the RSA relative to ambient noise levels as an indicator of the potential for acoustic masking.

Data Analysis

The underwater sound conditions in the RSA are characterized to allow for comparisons between recording stations, and over time, in relation to external factors that influence underwater sound levels such as weather and human activities. This involves computing the peak pressure level (PK) and sound pressure level (SPL) for each minute of recorded data. The SPL analysis is performed by averaging 120 fast-Fourier transforms (FFTs) that each include 1 s of data with a 50% overlap with application of a Hann window to reduce spectral leakage. The 1 minute average data are stored as power spectral densities (1 Hz resolution) and summed over frequency to calculate decidecade band SPL levels (analogous to 1/3-octave-band levels). The decidecade analysis sums the frequency range from the power spectral density data to a manageable set of bands that approximate the critical bandwidths of mammal hearing.

The acoustic data are presented as band-level plots (averaged received SPLs as a function of time within a given frequency band), long-term spectral averages (LTSAs) (colour plots that show power spectral density levels as function of time and frequency), decidecade box-and-whisker plots, spectral density level percentiles, daily sound exposure levels (SEL; total sound energy over a 24-h period), and cumulative distribution functions which is a metric that quanitifies the proportion of data that exceeds a certain SPL (e.g., the proportion of time sound levels exceed the scientifically established marine mammal acoustic disturbance threshold of 120 dB {NOAA 2013; NOAA 2018}).

The acoustic data are also analyzed using automated detectors for marine mammals and for vessels, to quantify the presence of each throughout the recording period. A susbset of the data undergo systematic review by human analysts, to verify the performance of the automated marine mammal detectors. These analyses allow an examination of things like changes in acoustic detections relative to changes in sound levels and relative to vessel presence. This analysis also provides a quantification of the vessel noise contributions to, and the prevalence of vessel noise in, the overall soundscape.

3.8.5 NARWHAL

The primary focus of the marine mammal monitoring programs is to test for and quantify effects from Baffinland shipping activities on narwhal distribution, relative abundance, and behaviour. To meet this objective, multiple study designs were required due to the differing spatial-temporal scales of the responses being tested. Collectively, the study designs complement each other to form a synergistic effects monitoring program for narwhal relative to shipping operations. An overview of each of the narwhal-focused monitoring programs is provided below.

3.8.5.1 BRUCE HEAD SHORE-BASED MONITORING PROGRAM

Baffinland's Bruce Head Shore-based Monitoring Program was designed to address the following impact pathways:

- Potential changes in narwhal behaviour due to ship traffic and ship noise; and
- Potential changes in narwhal abundance and distribution due to ship traffic and ship noise.

The monitoring design was developed to verify predictions made in the FEIS (Baffinland 2012, 2013) that shipping noise impacts on narwhal will be limited to temporary and localized disturbance effects, with no anticipated large-scale displacement effects or abandonment of narwhal from their summering grounds. The Bruce Head Shore-based Monitoring Program also aims specifically to address the following terms and conditions outlined in Project Certificate No. 005:

- Condition No. 99c and 101g - "Shore-based observations of pre-Project narwhal and bowhead whale behaviour in Milne Inlet that continues at an appropriate frequency throughout the Early Revenue Phase and for not less than three consecutive years".
- Condition No. 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".
- Condition No. 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".
- Condition No. 111: "The Proponent shall develop clear thresholds for determining if negative impacts as a result of vessel noise are occurring."

Program Background

Baffinland first initiated the Bruce Head Shore-based Monitoring Program in 2013 during the construction phase of Milne Port, when Project-related shipping was limited to a small number of fuel tanker and sealift vessel transits along the Northern Shipping Route. Since iron ore shipping operations commenced in 2015, Baffinland has run the Bruce Head Program annually, with the exception of 2018 when the Bruce Head field camp underwent upgrades and was relocated to the observation platform area (Table 3.1). The Program is next scheduled to occur during the 2023 open-water season.

Study Design

The objective of the Bruce Head Shore-based Monitoring Program is to investigate narwhal response to shipping activities along the Northern Shipping Route in Milne Inlet, with data collected annually on relative abundance and distribution (RAD), group composition, and behaviour. Additional data are also collected on environmental conditions and anthropogenic activities (e.g., shipping and hunting activities) to distinguish between the potential effects of Project-related shipping activities and confounding factors which may also affect narwhal behaviour. This program aims to evaluate the effect of Project-related vessel traffic on narwhal at Bruce Head through the analysis of a multi-year dataset of RAD, group composition and behaviour data relative to the respective large vessel traffic data, environmental data, and sampling conditions.

The study is designed to collect three primary types of narwhal data (relative abundance and distribution, group composition, and behaviour) from a shore-based observation platform located on Bruce Head (N 72°4'17.76", W 80°32'35.52") at an elevation of ~215 m above mean sea level. Ship track logs for large vessels are compiled from various sources (e.g. shore-based and satellite-based AIS ship tracking data) and are integrated into a single database. Environmental and other anthropogenic activity data (including local hunting activity) are collected to investigate and to account for additional sources of variability in narwhal relative abundance, distribution, and behaviour. Baseline data collected in the absence of large vessels are valuable and necessary for the investigation of narwhal response to any type of disturbance.

Visual observations by experienced marine mammal biologists and trained Inuit observers are used to document narwhal response to Baffinland vessels in waters near Bruce Head, Milne Inlet. RAD data is systematically collected before, during and after a large vessel enters a defined Stratified Study Area (SSA), as well as during periods when no vessels are in the area. Group size, direction of travel, and substratum are recorded for each narwhal sighting. During each count completed in each of the 10 strata (A to J) in the SSA, observers record environmental conditions within each substratum (e.g., A1, A2, etc.) and the type and location of any anthropogenic activity occurring within the SSA.

In order to statistically test if large vessel presence affects narwhal abundance or distribution in the SSA, narwhal count data are modelled using a generalized linear mixed model (GLMM), with a discrete probability distribution to estimate mean narwhal counts based on observed data. The "mixed" portion 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 with changes in the independent variable, 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 distance from the substratum, its direction relative to the substratum centroid, and whether the vessel was north- or southbound, are all modelled as fixed terms. Environmental covariates are included in the model to account for natural variation in the narwhal count data. 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.

In addition to the RAD data collection program, group composition data is collected on narwhals that swim through a defined Behavioural Study Area (BSA) that is located within ~1,000 m of shore. Group composition data is collected by a survey team employing survey and scan sampling protocols (Mann 1999). Observations are made using a combination of Big Eye binoculars (25 x 100), 10 x 42 and 7 x 50 binoculars, and the naked eye. Photographs are taken when possible and examined later to verify data recorded in the field. Data collected includes group size,

number of narwhals with tusks, and life stage. These data are used to determine if a change in the proportion of immature narwhal in the population, an Early Warning Indicator (EWI) for the Project, is detected.

A drone/UAV operations team is responsible for collecting narwhal behavioural data, allowing for the assessment of narwhal behavioural responses to vessels at close range to passing vessels. The Drone Operations team works closely with Inuit researchers and WSP biologists to carry out focal follow surveys of narwhal using a selection of UAV units, primarily the EVO-2 UAV manufactured by Autel Robotics. The EVO-2 is a compact UAV unit that includes a powerful camera on a 3-axis stabilized gimbal, capable of recording video at 8k resolution up to 25 frames per second and capturing 48 megapixel stills. All survey footage is recorded at 4k or higher. To conduct this work, a Special Flight Operations Certificate (SFOC) is obtained from Transport Canada to perform Beyond Visual Line of Sight (BVLOS) operations.

For each survey, the drone is flown to a predetermined, random start point either within the SSA or slightly to the south, toward Koluktoo Bay. Once at the start point, the drone re-orients north (to facilitate data entry and analysis later) and is then flown until the first group of narwhal is encountered. Emphasis is placed on following groups with immatures to inform behavioural responses of animals in potentially vulnerable life stages. The UAV team follows the focal group for as long as they remain visible and terminate the survey only once the group dives deeply out of sight and does not re-surface for an extended duration, or if members of the group disperse widely, or when other logistical factors (e.g., low battery levels or inclement weather) necessitate termination of the survey.

Detailed methodology on study design, data collection and analytical procedures, along with results from the integrated 2014-2021 Bruce Head Shore-based Monitoring Program, are presented in Golder (2022b).

3.8.5.2 Narwhal Tagging Program

Baffinland's Narwhal Tagging Program was designed to address the following impact pathways:

- Potential changes in narwhal behaviour due to ship traffic and ship noise;
- Potential changes in narwhal abundance and distribution due to ship traffic and ship noise, and
- Potential ice entrapment of narwhal due to icebreaking during the fall shoulder season.

The monitoring design was developed to verify predictions made in the predictions made in the FEIS (Baffinland 2012, 2013) that shipping noise impacts on narwhal will be limited to temporary and localized disturbance effects, with no anticipated large-scale displacement effects or abandonment of narwhal from their summering grounds. The Narwhal Tagging Program also aims specifically to address the following terms and conditions outlined in Project Certificate No. 005:

- Condition No. 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".
- Condition No. 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".

- Condition No. 111: "The Proponent shall develop clear thresholds for determining if negative impacts as a result of vessel noise are occurring."

Program Background

Baffinland implemented a narwhal tagging program during the 2017 and 2018 open-water seasons based in Tremblay Sound. The program involved deploying high resolution satellite-based location tags and dive tags on the backs of live-captured narwhal to effectively track the animal's three-dimensional movements, vocal behaviour and surrounding acoustic environment over an extended time-series as the animals naturally moved through their summer foraging range in the North Baffin Island region. This provided insight into the animal's behaviour over a continuous 24-h period, throughout changing environmental conditions and across a broad geographic range. The deployment of satellite-based location/dive tags on individual narwhal allowed for the tracking of narwhal spatial movement (horizontal and vertical) in relation to shipping events. The 2017–2018 Narwhal Tagging Program was a collaborative study with DFO. Detailed methodology on study design, data collection and analytical procedures, along with results from the 2017-2018 program, are presented in Golder (2020b).

In April of 2022, Baffinland presented a proposal to the MHTO to undertake a narwhal tagging program in Eclipse Sound during the 2022 early shoulder season, referred to as the 2022 Eclipse Sound Narwhal Tagging Study. The program was proposed as a potential collaboration between Golder, the MHTO and Inuit hunters from the community of Pond Inlet. The objective of this program was to remotely deploy high resolution satellite tags on narwhal to fill the existing data gaps related to how narwhal respond to shipping through ice during the early shoulder season. The tagging method proposed involved using a new Inuit-designed tag and dart system that avoided live capture or handling of narwhal (tag is remotely attached to narwhal using a harpoon or air gun, avoiding damage to the skin and blubber during attachment). The study design (narwhal behavioural response study to shipping) aimed to inform several of the behaviour-based response variables in the TARP related to changes in narwhal surface behaviour and dive behaviour following exposure to shipping (Section 5.2) The MHTO responded to the proposal on 17 May 2022 stating that while they understood the desire to collect information to fill the existing data gaps around narwhal behaviour in response to shipping, they were unsupportive of the program as proposed, due to concerns associated with Baffinland (or its consultants) leading this work. The MHTO stated they would prefer to see DFO leading this type of tagging-based monitoring program. Based on MHTO's stated position, Baffinland does not currently have plans to implement further tagging initiatives in the RSA.

3.8.5.3 Marine Mammal Aerial Survey Program (MMASP)

Baffinland's MMASP was designed to address the following impact pathways:

- Potential changes in narwhal abundance and distribution due to ship traffic and ship noise.

The monitoring design was developed to verify predictions made in the FEIS (Baffinland 2012, 2013) that shipping noise impacts on narwhal will be limited to temporary and localized disturbance effects, with no anticipated large-scale displacement effects or abandonment of narwhal from their summering grounds. The Narwhal Tagging Program also aims specifically to address the following terms and conditions outlined in Project Certificate No. 005:

- Condition No. 101: "The Proponent shall incorporate into the appropriate monitoring plans the following items:
  - b. Efforts to involve Inuit in monitoring studies at all levels.
  - c. Monitoring protocols that are responsive to Inuit concerns.
  - e. Schedule for periodic aerial surveys as recommended by the Marine Environment Working Group (MEWG)."
- Condition No. 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".
- Condition No. 111: "The Proponent shall develop clear thresholds for determining if negative impacts as a result of vessel noise are occurring."
- Condition No. 110: "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."

Program Background

Marine mammal aerial surveys conducted for the Project were first undertaken during the 2007–2008 open-water seasons. Subsequent aerial surveys were conducted in 2013 and 2014 to establish marine mammal distribution and density estimates along the Northern Shipping Route during the open-water season and prior to ERP operations. In 2015, aerial surveys were undertaken with a modified approach to attempt to examine potential effects of Project shipping on marine mammal distribution and density estimates during the first year of ERP operations. In 2016, photographic aerial marine mammal surveys were conducted by DFO along the Northern Shipping Route and adjacent inlet areas. Aerial photography from these surveys was analyzed by Golder on behalf of Baffinland in 2016 to calculate narwhal abundance and density estimates for Milne Inlet, Eclipse Sound, Tremblay Sound and Pond Inlet, based on conventional distance sampling methods (Golder 2018). The analysis was limited to two survey days (15 and 21 August 2016). DFO released the results of their analysis of the 2016 aerial surveys in June 2019 (Marcoux et al. 2019). During each open-water season of 2019-2022, Baffinland conducted marine mammal aerial surveys in both Eclipse Sound and Admiralty Inlet narwhal summer stock areas using distance-based line-transect sampling combined with high-resolution photography to obtain abundance estimates of narwhal for both summer stock areas. Aerial surveys were also undertaken during the early shoulder season in each of these years (2019-2022) to determine the relative abundance and distribution of marine mammals near the Pond Inlet floe edge prior to and during initial shipping and icebreaking operations.

Baffinland is presently exploring a collaborative program with DFO to undertake a regional-based narwhal aerial survey program during the summer of 2023, with the goal of obtaining a revised abundance estimate for the Baffin Bay narwhal population as a whole (inclusive of all summer stock areas combined). The Baffin Bay population as a whole was last surveyed in 2013.

Study Design

The primary objective of the MMASP is to obtain an updated abundance estimate for both the Eclipse Sound and Admiralty Inlet narwhal summer stocks. To capture the full summer range of this sub-population, survey coverage includes Milne Inlet, Eclipse Sound, Tremblay Sound, Navy Board Inlet and Admiralty Inlet. The survey design and data collection methodology follow methods developed by DFO (Matthews et al. 2017; Marcoux et al. 2016; Doniol-Valcroze et al. 2015; Asselin and Richard 2011; Golder 2022c) to allow for a comparison to historical abundance estimates available for the region.

The MMASP involves two different survey techniques: a visual-based survey in which marine mammal sightings are collected along established line transects using a double-platform approach with Marine Mammal Observers (MMOs) stationed at independent observation platforms at the front and rear of the aircraft, and a photographic-based survey in which digital single-lens reflex (DSLR) cameras are installed on the aircraft to collect high definition photographic images of the survey area directly below the aircraft. Photographic surveys are flown in areas of high narwhal concentrations where accurate counts are too difficult to obtain using visual means.

The aerial surveys are typically scheduled over a two-week period in early August corresponding with the peak open-water period. The surveys are conducted using two de Havilland Twin Otter (DHC-6) fixed-wing aircraft equipped with four bubble windows on the side and a ventral camera port. Each aircraft is staffed by an independent 5-person survey team comprised of marine mammal biologists and Inuit marine mammal observers (MMOs) from either Pond Inlet or Arctic Bay. The survey design requires conducting simultaneous aerial surveys using the two aircraft, with each team covering their respective half of the full survey grid. Attempts are made to survey the full survey grid within a one to two-day period that corresponds with optimal survey conditions (with as many replicates of the survey grid allowable within the 14-day period). Both aircraft are based out of the Mary River airport terminal for the duration of the study period.

The visual surveys are conducted as a double-platform experiment with independent observation platforms at the front (primary) and rear (secondary) of the survey plane. The two observers stationed on the same side of the aircraft are separated to achieve independence of their conditional detections. A fifth member of the survey team is responsible for setting up the camera system and overseeing navigation along the survey grid. Each survey is flown along the established transects at a target altitude of 305 m (1,000 ft) at a target speed of 185 km/h (100 knots). Observers continuously scan below the aircraft while actively surveying along each transect line. The observers ecord each marine mammal sighting by speaking into a hand-held audio recorder. Each sighting record includes information on species type, beam time (time at which the animal passed abeam of the window), perpendicular declination angle of each sighting relative to the horizontal plane using an inclinometer or geometer, group size, group composition (presence of calves, mother/calf pairs, adults, number of tusks, etc.), direction of travel, and behaviour. A group is defined as two or more animals that are within one or a few body lengths of each other and oriented or moving in a similar direction. Observers give priority to the estimation of group size, especially when densities are high, followed by perpendicular distance and other variables (direction of movement, presence of young, number of tusks) if time allows. Marine mammal sightings, environmental conditions and survey data are

entered into a Mysticetus© database. Position and altitude of the plane is recorded every second using a GPS connected to a laptop running an electronic map software. Weather and observational conditions are recorded by the observers at the beginning, the end, and at regular intervals along the transect or when changes in sighting conditions occur. Conditions include sea state (Beaufort scale), ice concentration (in tenths), fog (% cover and intensity), angle of searching area affected by sun reflection along with sun reflection intensity (four levels: intense, medium, low and none). A Bluetooth GPS unit and iPad is used to track the aircraft location during the survey using specialized navigational mapping software (pre-programmed with the survey transect grid). Each camera is connected to a laptop and controlled remotely (settings, start and stop). Photographs are stored in both high-resolution RAW and .jpeg format.

In addition to visual observations, the aircraft collects continuous photographic records below the aircraft using dual oblique cameras pointing downwards towards either side of the track line. A three-second interval between photographs allows for a target overlap of 20% between successive photographs along the direction of the aircraft at the survey altitude. The aircraft is fitted with a camera belly port hatch to accommodate a camera frame and two Digital Single Lens Reflex (DSLR) still cameras. The camera system consists of two Canon EOS 5DSR DSLR cameras mounted on a custom camera frame.

Instead of visual line transect surveys methods, dedicated photographic surveys are flown in Milne Inlet South and Tremblay Sound, as these areas typically support high narwhal concentrations. The photographic surveys follow a systematic line transect survey grid specific to these areas. Surveys are flown along the established transects at a target altitude of 610 m (2,000 ft) at a target speed of 185 km/h (100 knots).

During visual line-transect surveys, if large aggregations (>50) of narwhals are encountered or when observers cannot accurately keep up with narwhal counts, a photographic survey is flown instead with complete coverage over the group to allow for accurate enumeration of animals. To better quantify large narwhal aggregations observed during the visual surveys, all personnel on board the aircraft are instructed to look out for herds of narwhal and alert everyone when one is sighted. When such an aggregation is encountered, two lines are flown in a cross pattern over the group to determine its spatial extent. Using the pre-planned survey grid, the aggregation is photographed using a systematic grid with complete coverage.

For analysis of the aerial survey data, an adaptive sampling plan is used to calculate narwhal abundance estimates in both survey grids, which combines visual line-transect sampling of the survey area and aerial photographic surveys of designated strata (Asselin and Richard 2011; Marcoux et al. 2016; Matthews et al. 2017). Animal detection rates are also calculated for other marine mammal species and expressed as number of sightings/km and number of animals/km (used as a proxy for relative abundance).

In addition to the abundance surveys, a secondary survey objective is to collect dedicated narwhal group composition data at low altitude (i.e., 1,000 ft) photographic surveys to calculate the 'proportion of immature narwhal relative to the observed population (i.e. Early Warning Indicator or EWI)' in both Eclipse Sound and Admiralty Inlet summer stock areas. The EWI aerial surveys are flown at a ground speed of 185 km/h (100 kn) and target areas associated with high narwhal concentrations, namely Tremblay Sound and Milne Inlet. As part of the image analysis process, only narwhal clearly visible within the top 2 m of the water column are included in the EWI counts. To estimate the proportion of immatures in each survey, the total number of immatures (i.e., calves and yearlings) recorded in the photographs are divided by the total number of categorized narwhals (i.e., calves, yearlings, juveniles, and adults) in the photographs, following methods outlined in Golder (2022c).

3.8.5.4 End of Shipping Season Aerial Surveys

Baffinland's End of Season Aerial Survey Program was designed to address the following impact pathway:

- Potential ice entrapment of narwhal due to icebreaking during the fall shoulder season.

Study Design

The end of shipping aerial surveys generally take place in late October corresponding with the end of the shipping season. The objective of the surveys is to conduct a visual clearance survey to confirm that no narwhal entrapment events have occurred in the RSA following completion shipping operations along the Northern Shipping Route. The surveys are conducted by a five-person survey team based out of Pond Inlet using a survey aircraft chartered from Kenn Borek Air Ltd. Surveys are flown along the shipping corridor and adjacent areas throughout the RSA, including adjoining fjords. A single transect is flown down the centre of each of the fjords. Surveys are conducted at an altitude of 457 m (1,500 ft) and a ground speed of 204 km/h (110 kn) so the MMOs can observe further out from the aircraft. When necessary, i.e., to investigate potential sightings or other observations, the aircraft will drop to an altitude of 305 m (1,000 ft) and a ground speed of 185 km/h (100 kn). When possible, a Canon 5DS R DSLR camera is used to photograph any sightings observed during surveys.

During the surveys, MMOs broadly scan the survey area to identify sightings and provide information on weather and ice conditions. During a sighting, the MMOs provide details on the species and number of animals in the group. A 'group' is defined as animals within one or a few body lengths of each other and oriented or moving in a similar direction. When possible, observers provide additional details on the sightings, such as the presence of calves, tusked narwhal, behaviour, and direction of travel.

3.8.6 Ringed Seal

3.8.6.1 Ringed Seal Aerial Survey Program (RSASP)

The RRASP was developed to address residual uncertainty regarding the impact predictions related to the potential effects of shipping on ringed seal associated with the ERP. This program also addresses requirements in Project Certificate No. 005 related to evaluating potential disturbance to ringed seals from shipping activities that may result in changes in animal distribution, abundance, and migratory movements in the RSA. Specifically, this includes the following conditions:

- Condition No. 101 — "The Proponent shall incorporate into the appropriate monitoring plans the following items:

  b. Efforts to involve Inuit in monitoring studies at all levels.

  c. Monitoring protocols that are responsive to Inuit concerns.

  e. Schedule for periodic aerial surveys as recommended by the Marine Environment Working Group (MEWG)."

- Condition No. 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".

- Condition No. 119 — "In conjunction with the MEWG, monitor ringed seal birth lair abundance and distribution for at least two years prior to the start of ice-breaking to develop a baseline, with continue monitoring over the life-time of the project."
- Condition No. 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".

Program Background

Aerial surveys of ringed seal have been traditionally undertaken in the RSA during the basking/molting period (spring) when ringed seal are exposed on the sea ice and easy to count. Ringed seal aerial surveys were first flown in the RSA during late spring (June) in 2006, 2007 and 2008 to characterize baseline conditions (density and distribution) in support of the FEIS (Baffinland 2012). Visual observer data using strip-transect methodology were analyzed for these surveys. The 2006 survey was exploratory in nature covering Milne Inlet, Eclipse Sound and Navy Board Inlet with low survey coverage. Surveys flown in 2007 and 2008 focused on Milne Inlet. Subsequent aerial surveys were flown in 2014 to update baseline data on ringed seal density and distribution. Survey effort in 2014 focused on Eclipse Sound and Milne Inlet, where observer-based sightings data were collected.

Aerial surveys were subsequently undertaken by DFO in June 2016 and 2017 to assess the spring distribution and density of ringed seal in the Eclipse Sound and Milne Inlet areas (Young et al. 2019). Young et al. (2019) used three different survey methods (visual observer with strip-transect methodology, overlayed infrared and photographic data with strip-transect methodology, and visual observer combined with overlayed infrared and photographic data with distance methodology) to determine ringed seal densities in the RSA. The three methods resulted in different density estimates with the distance methodology and infrared/photographic strip-transect methods providing similar results that were approximately 2–3 times greater than the visual observer strip-transect analyses. Young et al. (2019) concluded that strip transect analysis of infrared imagery combined with photographs was the preferred method because it did not require collection of observer-based sightings data from the aircraft (i.e., fewer personnel required), it allowed for a high probability of animal detection, it was associated with a lower visibility bias, and it allowed for simplified data processing and density calculations. Their results provided density estimates ranging from 0.57 to 0.79 seals/km2 for Eclipse Sound, 0.93 to 1.27 seals/km2 for Milne Inlet, and 0.27 to 0.77 seals/km2 for Navy Board Inlet.

In 2021, Baffinland conducted additional ringed seal aerial surveys following feedback provided by Inuit hunters that indicated they had observed localized changes in seal abundance and distribution in the RSA, which was resulting in carry-over effects on seal harvesting. The 2021 RSASP was also undertaken by Golder in June 2021 using forward-looking infrared (FLIR) survey methods to document ringed seal density and distribution in the RSA and allow for a comparison with previous results obtained in 2016 and 2017 (Young et al. 2019). The second objective of the survey was to identify ringed seal hotspots throughout the RSA and identify overlaps with hotspots identified in 2016 and 2017 (Yurkowski et al. 2018).

Study Design

The aerial surveys are typically scheduled over a two-week period in early June, using a de Havilland Twin Otter (DHC-6) fixed-wing aircraft equipped with a ventral camera port. The study area for the RSASP is based on the boundaries used Young et al.'s (2019) 2016 and 2017 surveys. The aerial surveys are designed to characterize ringed seal distribution and density in the RSA during the period when ringed seals are hauled out on the ice during their peak moulting period and to allow for comparison with past surveys. Aerial surveys are conducted in four strata within the RSA: Eclipse Sound (ES), Milne Inlet (MI), Tremblay Sound (TS), and Navy Board Inlet (NBI). Survey design and data collection methodology follow the preferred method identified by Young et al. (2019), using the strip-transect analysis of infrared imagery, coupled with digital photographs. Transects are flown at a target ground speed of 204 km/hour (110 knots) at a target altitude of 305 m (1,000 ft). A Bluetooth GPS unit and iPad is used to track the aircraft location and record its position, altitude, speed, and heading every second during the survey using specialized navigational mapping software (Foreflight) pre-programmed with the survey transect grid.

A data recorder enters environmental conditions into a software package (e.g. Mysticetus database) at the beginning and end of each transect, and when changes in conditions occur along an active transect. Environmental conditions recorded include cloud cover (percent), surface air temperature (°C), surface wind speed (km/h), surface wind direction (N, S, E, W), ice cover (in tenths), ice type, snow/ice roughness (percent), fog cover (in tenths), and fog intensity. Thermal infrared imagery is obtained using a forward-looking infrared camera (FLIR T1020) with a 45° lens. At the target altitude of 305 m, the strip width covered by the FLIR imagery is approximately 250 m wide strip directly below the aircraft. The FLIR T1020 uses an uncooled microbolometer type sensor with a resolution of 1,024 x 768 pixels and able to detect infrared radiation in the range of 7.5–14 µm. The FLIR camera is connected to a laptop and controlled remotely by a camera operator using FLIR ResearchIR Max software version 4.40.11.35 (FLIR Systems, Inc., Wilsonville, OR, USA). Visible light (visual) photographs are obtained using a Canon EOS 5DS R DSLR (digital single-lens reflex) camera fitted with a 35 mm lens (Sigma 35 mm f/1.4 DG HSM). Visual photographs are taken at an interval of two seconds, providing approximately 30% overlap between consecutive photos. At the target altitude of 305 m, the strip width covered by the DSLR camera is 313 m wide strip directly below the aircraft. Visual photographs taken with the Canon EOS 5DS R are captured in .jpg format at the maximum camera resolution setting of 8,688 x 5,792 pixels. The DSLR camera is connected to a laptop and controlled remotely by a camera operator using Breeze Multi-Camera Array software version v2.1.2 (Breeze Systems limited., Camberley, Surrey, UK).

Two types of analyses are performed on the aerial dataset. A strip-transect analysis is performed on the "infrared" data obtained from infrared imagery within a 250 m wide strip following the methods of Young et al. (2015) and Chambellant et al. (2012). The density of ringed seals per km^2 is then estimated following methods described in Buckland et al. (2001). Density surface modelling is used to identify ringed seal hotspots in the RSA using methods described in Golder (2022b).

4.0 ROLES AND RESPONSIBILITIES

Baffinland's Environmental Department is responsible for monitoring compliance with applicable regulations and permit requirements. Resourcing is an important element of environmental management. Table 4.1 outlines the roles and responsibilities of Baffinland staff, as well as QIA staff with a role in environmental management.

Table 4.1 Roles and Responsibilities

Position	Responsibilities
Vice-President, Sustainable Development	Provide corporate resources and overall direction to the implementation of the MMP. Provide review and approval or revised versions of MMP.
Health, Safety, Environment, Security and Training Director	Provide site-based resources and overall direction to the implementation of the MMP
Environmental Manager	Provide technical guidance and final review and approval of revised versions of EPP. Ensure EPP is properly communicated to departmental Site Managers and ensure adequate training is in place for all site Supervisors.
Environmental Superintendents and Coordinators	Conduct a review and revision of the MMP on an as needed basis to determine if updates are required, or at the request of the Environmental Manager. Review revisions to the MMP. Ensure revisions are distributed to managers and supervisors. Perform document controls. Ensure that managers, supervisors and their staff are familiar with the MMP as relevant. Obtain approvals from management for execution of monitoring programs as needed.
Environmental Consultants	Provide training and support as needed to ensure successful implementation of the MMP. Conduct implementation of monitoring and provide additional guidance to site-based staff for site-led marine monitoring programs as needed. Initiate changes to improve and update the MMP as needed and provide technical support for revisions. Provide technical support to Environmental Protection Plan development and ongoing revisions.
Marine Environment Working Group	The MEWG's primary function is to consult with and provide advice to Baffinland with respect to its monitoring programs and mitigation measures, including its efforts to collect baseline data, monitor effects of the Project, and determine any adaptive management measures that may be required during the construction, operations, closure and reclamation of the Project. In fulfilling its role the MEWG may:

Position	Responsibilities
	Make recommendations and provide advice to Baffinland on any aspects of the Marine Monitoring Plan (MMP) which require the adoption of additional or revised monitoring programs and mitigation measures in order to comply with applicable regulatory requirements and/or to mitigate adverse Project effects; Collaborate on research programs, activities, or initiatives relating to the marine environment; Review the MMP, its implementation, and suggest recommended changes; Review and provide technical advice and directions for improvements relating to the following: • monitoring reports and results provided to the MEWG by Baffinland; • the assessment of potential impacts of the Project on the marine environment and marine wildlife; • the effectiveness of mitigation measures implemented by Baffinland; and • Baffinland's plans for the development and implementation of adaptive management and/or mitigation measures.
QIA Regulatory Manager (IIBA)	• Directs QIA's onsite environmental resources • Liaise with Baffinland's Permitting and Compliance Manager and/or Environmental Superintendents • Reviews regulatory submissions on behalf of the QIA • Member of the QIA-Baffinland Adaptive Management Working Group
QIA Environmental Monitor (IIBA)	• Monitors implementation of commitments, environmental compliance, and QIA interests • Participate in routine compliance inspections and monitoring alongside Baffinland staff • Participate follow-up corrective action undertaken regarding non-compliance events including spills • Weekly reporting to the QIA Regulatory Manager • Presents annual monitoring data to communities • The core responsibilities of this position are described completely in the IIBA

5.0 DATA ASSESSMENT AND RESPONSE FRAMEWORK

5.1 OVERVIEW

Monitoring data collected through the MMP requires a systematic data evaluation process, as well as management responses that would be taken, in response to certain data evaluation outcomes. A common assessment (data evaluation) and management response framework will be implemented. This multi-step process includes the following:

Step 1 - Data Management and Evaluation

This step includes the QA/QC; comparisons to the MMP thresholds and to reference and/or baseline; and review of the data using various tools such as Exploratory Data Analysis (EDA) and Statistical Data Analysis (SDA), to determine if change is occurring. A change may be detected statistically or qualitatively, relative to benchmarks, baseline values and/or spatial or temporal trends. A change may be statistically significant, but professional judgement may also be applied using the various evaluation tools to detect a change qualitatively.

If Step 1 does not detect change, then no action is required. If a change is observed, then further evaluation of the data for that/those indicator(s) will be carried out under Step 2.

Step 2 - Determining Whether the Observed Change is Project-Related

Step 2 involves determining if the changes in the indicator(s) of concern are due to the Project or due to natural variability or other causes. This will include, as needed, an evaluation of both Project-related and non-Project related activities to assess potential influences of these factors in the observed change. This question can be addressed using EDA and subsequently using SDA. EDA will be completed to visualize overall data trends, and could include evaluating spatial patterns, to examine the spatial extent and pattern of observed changes.

Exploratory data analyses could include comparisons of data from reference and potential impact areas and from baseline and operational monitoring for BACI programs. This can further assist with determining whether the observed changes were due to natural variability, other anthropogenic activities in the vicinity of the Project, or the Project.

If the Step 2 analysis concludes that the changes in monitoring parameters of concern are, or are likely, due to the Project, the assessment will proceed to Step 3. If it is concluded the observed differences relative to baseline conditions are not due to the Project, no management response will be required.

Step 3 - Determine Action Level

If the evaluation conducted in Step 2 has indicated with some certainly that the measured change is Project-related, Step 3 involves determination of the action level associated with the observed monitoring results through comparisons to the benchmark. Three (3) levels of action have been identified: low, moderate, and high; and the response actions range from increased monitoring and data analysis (i.e., trend analysis); identification of possible sources; to risk assessment and/or mitigation. The specifics for each marine environment component (water and sediment quality, benthic infauna, fish health and fish tissue chemistry) are summarized in Table 5.1 and for marine mammals in Table 5.2.

5.2 Trigger Action Response Plan (TARP)

The TARP identifies monitoring objectives and the adaptive management framework for each of Baffinland's marine-based monitoring programs, including performance indicators, effects thresholds and pre-defined actions (i.e., responses) that are implemented if or when established threshold levels are exceeded. The TARP for the Marine Environment is presented in Table 5.1. The TARP for Marine Mammals is presented in Table 5.2. The TARP is a living document that will be regularly updated as part of Baffinland's adaptive management framework.

Table 5.1 Marine Environment Trigger Action Response Plan (TARP)

Monitoring Program / Key Indicator	Objective	Performance Indicators	Project Activity Monitored	Condition Status / Threshold			Pre-defined Response(s)		
				Low Risk	Moderate Risk	High Risk	Low Risk	Moderate Risk	High Risk
Marine Environmental Effects Monitoring Program (MEEMP) / Marine Water Quality	Monitor for adverse environmental effects from shipping operations (propeller wash) and port operations (effluent discharge, dust dispersion and deposition from ore stockpiles and ship loading) on marine water quality at Milne Inlet. Identify mitigation for avoiding and/or minimizing adverse effects that exceed FEIS predictions	• Metals • TSS • Hydrocarbons • Nutrients	• Propeller wash • Effluent Discharge • Ore dust dispersion and deposition from stockpiles and ship loading	30-day mean concentration of a parameter is greater than 75% of an applicable CCME long-term guideline[7]. OR For parameters without an applicable long-term CCME guideline, 30-day mean concentration is greater than the 2015 MEEMP (mean + 2SD) value (where detectable concentrations were reported in 2015).	Confirmed[8] exceedance of an effects benchmark or an applicable CCME long-term guideline[1] by a mean concentration. AND Effluent monitoring and spatial water quality receiving environment suggest that the confirmed increase in this parameter is related to the Port's effluent discharge.	To be determined based on outcome of moderate response investigations.	Env't Dept: Continue scheduled monitoring Env't Dept: Develop an effects-based benchmark for parameters triggering a Low Risk Status/Threshold as appropriate and possible (i.e., toxicity literature/data available to do so), to be used as the Moderate Risk Status/Threshold. Env't Dept: If Low Risk Status/Threshold is triggered again in the next scheduled program (but Moderate is not), investigate trends over time and consider any uncertainties (i.e., differences in program timing, effort, methods, environmental variables) as a desktop study. Env't Dept: Consider refinement of the Moderate Risk Status/Threshold if appropriate based on results of the desktop study.	Env't Dept and Relevant Operations: If Low Risk Thresholds were not previously exceeded, develop an effects based benchmark for parameters triggering the moderate risk Status/Threshold. Env't Dept and Relevant Operations: Investigate trends over time and consider any uncertainties (i.e., changes in operational processes, potential sources, confounding influences) in a formal Response Plan; Initiate component specific targeted studies, including risk evaluations to understand need and/or scale of mitigation, as part of response planning. Env't Dept and Relevant Operations: Continue monitoring to confirm effects are linked to the project, to assess effectiveness of mitigations, and evaluate need for additional monitoring and/or mitigation. Env't Dept and Relevant Operations: Develop High	Will be developed concomitant with the High Risk Status/Threshold Development response plan. Responsible Dept(s): Implement High Risk Status/Threshold response in Mitigation Toolkit if causal effect or likely relationship is determined.

[7] Canadian Council of Minsters of the Environment (CCME) water quality guidelines for the protection of marine aquatic life. With the exception of silver, total suspended solids (TSS), and turbidity, these are long-term water quality guidelines intended to be applied to the average concentration at a receiving environment station collected over a 5-in-30 sampling program (i.e., average of 5 discrete samples collected over a 30-day period). In lieu of a long-term guideline for silver, the short-term guideline will be applied to discrete measured concentrations. The long-term guidelines for TSS and turbidity will be used.

[8] Confirmed indicates that the Risk Status/ Threshold trigger has been observed in at least two consecutive monitoring programs, whether during the regular monitoring schedule or confirmed through a special study.

Monitoring Program / Key Indicator	Objective	Performance Indicators	Project Activity Monitored	Condition Status / Threshold			Pre-defined Response(s)		
				Low Risk	Moderate Risk	High Risk	Low Risk	Moderate Risk	High Risk
								Action Threshold and Response. Responsible Dept(s): Implement moderate-action response from Mitigation Toolkit (or new mitigation identified through investigation) based on the outcome of targeted studies.	
MEEMP / Marine Sediment Quality	Monitor for adverse environmental effects from shipping operations (propeller wash) and port operations (effluent discharge, dust dispersion and deposition from ore stockpiles and ship loading) on marine sediment quality at Milne Inlet. Identify mitigation for avoiding and/or minimizing adverse effects that exceed FEIS predictions.	• Particle Size • Nutrients • Metals • Hydrocarbons	• Propeller wash • Effluent Discharge • Ore dust dispersion and deposition from stockpiles and ship loading	Measured concentrations of a parameter at one or more stations are > the CCME ISQG or another relevant lower bound guideline[9]. OR Measured gradient[10] in sediment concentration along one or more transects representing a significant change (increase) ($p<0.1$) from Year 1 (2014 MEEMP) or the most recent MEEMP year. AND Spatial and temporal sediment data suggest a pattern indicative of Port-related effects.	Measured concentrations of a parameter at one or more stations are > the CCME PEL or another relevant upper bound guideline[3]. OR Measured gradient[10] in sediment concentration along one or more transects represents a significant change (increase) (i.e., $p < 0.1$) from Year 1 (2014 MEEMP) or the most recent MEEMP year. AND Spatial and temporal sediment data suggest a pattern indicative of Port-related effects. AND	To be determined based on outcome of moderate response investigations.	Env't Dept: Continue scheduled monitoring. Env't Dept: Implement sediment toxicity testing as a special study with appropriate standard test species. Env't Dept: If Low Risk Status/Threshold is triggered again in the next scheduled program (but Moderate is not), investigate trends over time and consider any uncertainties (i.e., differences in program timing, effort, methods, environmental variables) as a desktop study Env't Dept: Consider refinement of the Moderate Risk Status/Threshold if appropriate based on results of the desktop study.	Env't Dept and Relevant Operations: Investigate trends over time and consider any uncertainties (i.e., changes in operational processes, potential sources, confounding influences) in a formal Response Plan; Initiate component specific targeted studies, including risk evaluations to understand need and/or scale of mitigation, as part of response planning. Env't Dept and Relevant Operations: Continue monitoring to confirm effects are linked to the project, to assess effectiveness of mitigations, and evaluate need for additional monitoring and/or mitigation.	Will be developed concomitant with the High Risk Status/Threshold Development response plan. Responsible Dept(s): Implement High Risk Status/Threshold response in Mitigation Toolkit if causal effect or likely relationship is determined.

[9] Concentrations of metals and hydrocarbons in sediment are compared to CCME Interim Sediment Quality Guidelines (ISQGs) and Probable Effect Level (PELs) for the protection of aquatic life in the marine environment (CCME, 2022). To provide a screening value to inform the sediment evaluation, in the absence of a CCME guideline, metals and hydrocarbons are compared to British Columbia Working Sediment Quality Guidelines (WSQG) (BC MOE, 2021), and the National Oceanic and Atmospheric Administration (NOAA) sediment benchmarks (Buchman, 2008).

[10] Measured gradient refers to the spatial patterns in sediment chemistry and benthic community composition observed along each of the transects that radiate out from Milne Port. The purpose of the radial transect design adopted for the sediment and benthic MEEMP monitoring programs is to assess sediment quality and benthic invertebrate communities over time, and relative to previous years, to investigate the potential for project-related effects on these components. The radial transect design allows for repeat measures at select sampling stations to be collected during each MEEMP. The overall trend in sediment and benthic conditions is compared spatially (i.e., to investigate the potential for localized effects) and temporally (i.e., to investigate the potential for alterations relative to previous sampling events). This statistical design is considered more appropriate to detect potential effects related to the project for the sediment and benthic invertebrate programs, compared to other types of designs (i.e., control-impact designs), due to the confounding effects of depth, distance from shore, and grain size (i.e., increased fines content with greater distance offshore) determined during baseline characterizations and previous MEEMP studies.

Monitoring Program / Key Indicator	Objective	Performance Indicators	Project Activity Monitored	Condition Status / Threshold			Pre-defined Response(s)		
				Low Risk	Moderate Risk	High Risk	Low Risk	Moderate Risk	High Risk
					Sediment toxicity testing as a special study indicates a mine-related effect.			Env't Dept and Relevant Operations: Develop High Action Threshold and Response. Responsible Dept(s): Implement moderate-action response from Mitigation Toolkit (or new mitigation identified through investigation) based on the outcome of targeted studies.	
MEEMP / Benthic Infauna	Monitor for adverse environmental effects from shipping operations (propeller wash, ballast water discharges) and port operations (effluent discharge, dust dispersion and deposition from ore stockpiles and ship loading) on benthic infauna at Milne Inlet. Identify mitigation for avoiding and/or minimizing adverse effects that exceed FEIS predictions.	• Density • Taxa Richness • Simpson's Diversity Index • Simpson's Evenness Index	• Propeller wash • Effluent Discharge • Ballast water discharge • Ore dust dispersion and deposition from stockpiles and ship loading	Measured gradient[10] in community metric along one or more transects represents a significant change ($p<0.1$) from Year 1 (2018 MEEMP) or the most recent MEEMP year. AND Spatial receiving environment data (both sediment and benthic) suggest a pattern indicative of Port-related effects.	Measured gradient[10] in density and richness represents a significant change (i.e., $p < 0.1$) from Year 1 (2018 MEEMP) or the most recent MEEMP year. AND Spatial receiving environment data (both sediment and benthic) suggest a pattern indicative of Port-related effects. AND Moderate Risk Status/Threshold is triggered for sediment	To be determined based on outcome of moderate response investigations.	Env't Dept: Continue scheduled monitoring Env't Dept: If Low Action Risk Status/ Threshold is triggered again in the next scheduled program (but Moderate is not), investigate trends over time and consider any uncertainties (i.e., differences in program timing, effort, methods, environmental variables) as a desktop study. Env't Dept: Consider refinement to a Moderate Risk Status/Threshold within a regulated review process if appropriate based on the results of the trend analysis.	Env't Dept and Relevant Operations: Investigate trends over time and consider any uncertainties (i.e., changes in operational processes, potential sources, confounding influences) in a formal Response Plan; Initiate component specific targeted studies, including risk evaluations to understand need and/or scale of mitigation, as part of response planning. Env't Dept and Relevant Operations: Continue monitoring to confirm effects are linked to the project, to assess effectiveness of mitigations, and evaluate need for additional monitoring and/or mitigation. Env't Dept and Relevant Operations: Develop High Action Threshold and Response. Responsible Dept(s): Implement moderate-action response from	Will be developed concomitant with the High Risk Status/Threshold Development response plan. Responsible Dept(s): Implement High Risk Status/ Threshold response in Mitigation Toolkit if causal effect or likely relationship is determined.

Monitoring Program / Key Indicator	Objective	Performance Indicators	Project Activity Monitored	Condition Status / Threshold			Pre-defined Response(s)		
				Low Risk	Moderate Risk	High Risk	Low Risk	Moderate Risk	High Risk
								Mitigation Toolkit (or new mitigation identified through investigation) based on the outcome of targeted studies.	
MEEMP / Fish Health	Monitor for adverse environmental effects from shipping operations (propeller wash) and port operations (effluent discharge, dust dispersion and deposition from ore stockpiles and ship loading) on fish health in Milne Port. Identify mitigation for avoiding and/or minimizing adverse effects that exceed FEIS predictions.	• Body condition[11]	• Propeller wash • Effluent Discharge • Ore dust dispersion and deposition from stockpiles and ship loading	A statistically significant difference ($p<0.1$) in effect indicators[11] relative to the reference area and change is in direction that indicates an impairment to fish health and is of magnitude greater than or equal to a defined critical effect size (CES) [12] for that effect indicator.	Confirmed[13] Low Risk Status/ Threshold and mean/median[14] for the same effect indicator is beyond the baseline (FEIS) normal range[15] (if available) or regional normal range[16] AND Is supported by consistent effects in one or more other study components (i.e., water quality, sediment quality and benthic invertebrates) which links the results to the Project.	To be determined based on outcome of moderate response investigations.	Env't Dept: Continue scheduled monitoring. Env't Dept: If Low Risk Status/ Threshold is triggered again in the next scheduled program (but Moderate is not), investigate trends over time and consider any uncertainties (i.e., differences in program timing, effort, fishing methods, environmental variables, IQ input) as a desktop study. Env't Dept: Consider refinement to a Moderate Risk Status/ Threshold if appropriate based on the results of the trend analysis.	Env't Dept and Relevant Operations: Investigate trends over time and consider any uncertainties (i.e., changes in operational processes, potential sources, confounding influences) in a formal Response Plan; Initiate component specific targeted studies, including risk evaluations to understand need and/or scale of mitigation, as part of response planning. Env't Dept and Relevant Operations: Continue monitoring to confirm effects are linked to the project, to assess effectiveness of mitigations, and evaluate need for additional monitoring and/or mitigation. Env't Dept and Relevant Operations: Develop High	Will be developed concomitant with the High Risk Status/ Threshold Development response plan. Responsible Dept(s): Implement High Risk Status/ Threshold response in Mitigation Toolkit if causal effect or likely relationship is determined.

[11] Effect indicators include: *Hiatella arctica*: whole animal wet weight, relative gonad size (gonad weight against body weight) if observable, whole-animal dry weight, dry shell or soft tissue weight related to shell length, and length frequency analysis; Fourhorn sculpin: size at age/length (i.e., body weight against age/length), relative gonad size (gonad weight against body weight), body weight relative to length (i.e., condition), relative liver weight (liver weight against body weight) and length frequency analysis.

[12] Definition of a magnitude of change that is indicative of impairment to fish health is based on the critical effect sizes defined by Environment Canada's Metal Mining Effluent Regulations Guidance Document (Environment Canada, 2012) and refers to an increase or a decrease in fish health endpoints. Additional critical effect sizes may be defined in the future (i.e., beyond those defined by ECCC).

[13] Confirmed indicates that the Risk Status/ Threshold trigger has been observed in at least two consecutive monitoring programs, whether during the regular monitoring schedule or confirmed through a special study. For fish, the two or more endpoints that triggered the Moderate Risk Status/ Threshold may be in one species (i.e., two endpoints in one species) or two species (i.e., one endpoint in one species, as second endpoint in another species).

[14] The use of the mean or median will depend on the normality of the dataset used to calculate the normal range for each endpoint or tissue chemistry parameter (i.e., if raw or transformed data do not meet the assumptions of normality, the median will be used to provide an estimate of central tendency instead of the mean).

[15] Baseline (FEIS) normal range is based on the FEIS dataset, including operational monitoring data from Milne Inlet and Steensby Inlet, and includes fish length, weight and condition (K).

[16] Regional normal range will be calculated using all available reference area data (i.e., will include annual and ongoing reference area data as it becomes available).

Monitoring Program / Key Indicator	Objective	Performance Indicators	Project Activity Monitored	Condition Status / Threshold			Pre-defined Response(s)		
				Low Risk	Moderate Risk	High Risk	Low Risk	Moderate Risk	High Risk
								Action Threshold and Response. Responsible Dept(s): Implement moderate-action response from Mitigation Toolkit (or new mitigation identified through investigation) based on the outcome of targeted studies.	
MEEMP / Fish Health	Monitor for adverse environmental effects from shipping operations (propeller wash) and port operations (effluent discharge, dust dispersion and deposition from ore stockpiles and ship loading) on fish health in Milne Port. Identify mitigation for avoiding and/or minimizing adverse effects that exceed FEIS predictions.	Fish Tissue Chemistry[17] • Metals	• Propeller wash • Effluent Discharge • Ore dust dispersion and deposition from stockpiles and ship loading	A statistically significant difference ($p<0.1$) in one or more metals concentrations in a sentinel species relative to the reference area, and change is in the direction[18] that indicates impairment to fish health and is of magnitude[19] greater than or equal to the defined CES.	A confirmed[20] Low Risk Status/ Threshold for one or more metals that is also outside the regional normal range[21], and is supported by consistent effects in one or more other study components (i.e., water quality, sediment quality and benthic invertebrates) which links the results to the Project. OR The mean mercury or selenium concentrations (or ≥50% of the individual samples) in Arctic Char tissue chemistry samples are beyond the respective	To be determined based on outcome of moderate response investigations.	Env't Dept: Continue scheduled monitoring. Env't Dept: If results are confirmed in next scheduled program, investigate trends over time and address any uncertainties (i.e., program timing, effort, fishing methods, environmental variables, IQ input) as a desktop study. Env't Dept: Consider refinement to a Moderate Risk Status/ Threshold within a regulated review process, if appropriate based on the results of the trend analysis.	Env't Dept and Relevant Operations: Investigate trends over time and consider any uncertainties (i.e., changes in operational processes, potential sources, confounding influences) in a formal Response Plan; Initiate component specific targeted studies, including risk evaluations to understand need and/or scale of mitigation, as part of response planning. Env't Dept and Relevant Operations: Continue monitoring to confirm effects are linked to the project, to assess effectiveness of mitigations, and evaluate need for additional monitoring and/or mitigation.	Will be developed concomitant with the High Risk Status/ Threshold Development response plan. Responsible Dept(s): Implement High-Risk Status/ Threshold response in Mitigation Toolkit if causal effect or likely relationship is determined.

[17] The Fish Tissue Chemistry program may not always be undertaken as a regular monitoring component (i.e., mercury and selenium monitoring are only required under the MDMER if effluent concentrations trigger a fish tissue study); therefore, the Risk Status/ Thresholds described herein will be implemented as and when a tissue chemistry program is implemented.

[18] For tissue chemistry, only an increase in concentration will be considered indicative of a toxicological response.

[19] For fish tissue chemistry parameters, the critical effect size is a difference of 100%.

[20] Confirmed indicates that the Action Status/Threshold trigger has been observed in at least two consecutive monitoring programs, whether during the regular monitoring schedule or confirmed through a special study.

[21] Regional normal range is anticipated to include Arctic Char tissue chemistry data from the FEIS (i.e., Milne Inlet and Steensby Inlet) as well as ongoing reference area tissue chemistry data (for *Hiatella arctica* and Arctic Char).

Monitoring Program / Key Indicator	Objective	Performance Indicators	Project Activity Monitored	Condition Status / Threshold			Pre-defined Response(s)		
				Low Risk	Moderate Risk	High Risk	Low Risk	Moderate Risk	High Risk
					CFIA[22] or BCMOE[23] guidelines.			Env't Dept and Relevant Operations: Develop High Action Threshold and Response. Responsible Dept(s): Implement moderate-action response from Mitigation Toolkit (or new mitigation identified through investigation) based on the outcome of targeted studies.	
NIS/AIS Monitoring Program (integrated in MEEMP)	Monitor for potential introductions of an NIS or AIS as a result of Project activities. Identify mitigation for avoiding and/or minimizing adverse effects that exceed FEIS predictions	• Occurrence of an NIS/AIS	• Ballast water discharge • Hull biofouling	To be determined in consultation with DFO in accordance with the Canadian Rapid Response Framework for Aquatic Invasive Species (Locke et al. 2011)			To be determined in consultation with DFO in accordance with the Canadian Rapid Response Framework for Aquatic Invasive Species (Locke et al. 2011)		
TBD	Placeholder for Inuit OITR'S	TBD	TBD	To be determined in consultation with Inuit.			To be determined in consultation with Inuit.		

[22] Value is 0.5 mg/kg ww per CFIA (2014) Canadian Food Inspection Agency Fish Products Standards and Methods Manual: Appendix 3 Canadian Guidelines for Chemical Contaminants and Toxins in Fish and Fish Products. Ottawa, ON.

[23] Protection of aquatic life chronic criterions for fish tissue are 15.1 mg/kg dw for ovary, 8.5 mg/kg dw for whole body, or 11.3 mg/kg dw for skinless, boneless muscle fillet per USEPA (2016) Technical Support for Fish Tissue Monitoring for Implementation of EPA's 2016 Selenium Criterion Draft, EPA 820-F-16-007, United States Environmental Protection Agency, Office of Water.

Table 5.2 Marine Mammal Trigger Action Response Plan (TARP)

Monitoring Programs (Key Indicator)	Objective	Performance Indicators	Project Activity Monitored	Condition Status / Threshold			Pre-defined Response(s)		
				Low Risk	Moderate Risk	High Risk	Low Risk	Moderate Risk	High Risk
Marine Mammal Aerial Survey Program (MMASP) Bruce Head Shore-based Monitoring Program Narwhal Tagging Program (Narwhal)	Monitor for potential effects of shipping (vessel noise, vessel presence) on narwhal in the RSA and identify responses for avoiding and/or minimizing adverse effects that exceed FEIS predictions.	• Decrease in stock abundance • Change in relative abundance • Change in proportion of immatures relative to observed population	• Shipping operations • Icebreaking operations during fall shoulder season	Confirmed[26] Moderate severity behavioural responses (Severity Score 5 and 6[25]) that do not persist longer than two hours following the exposure event [27]. This may include: ▪ Change in dive behaviour (i.e. surface time, bottom dive, dive duration) ▪ Change in surface behaviour <u>Note:</u> For the threshold to be met, responses in movement behaviour would need to be observed as a trend in the movement data across individuals	Confirmed[26] Moderate severity behavioural responses (Severity Score 5 and 6[25]) that persist for more than two hours following the exposure event[27]. This may include: ▪ Prolonged change in dive behaviour (surface time, bottom dive, dive duration) ▪ Prolonged change in surface behaviour AND (ii) a statistically significant decrease in the proportion of immature narwhal relative to baseline conditions (2014/2015 values). <u>Note:</u> For the threshold to be met, responses in movement behaviour would need to be observed as a trend in the movement data across individuals.	Confirmed[26] Moderate severity behavioural responses (Severity Score 5 and 6[25]) that persist for more than two hours following the exposure event, as described in moderate risk column AND/OR	<u>Env't Dept</u>: Continue scheduled monitoring <u>Env't Dept:</u> If Low Action Threshold is triggered again in the next scheduled program (but Moderate is not), investigate trends over time and consider any uncertainties (i.e., differences in program timing, effort, methods, environmental variables) as a desktop study. <u>Env't Dept:</u> Consider refinement of the Moderate Risk Threshold if appropriate based on results of the desktop study.	<u>Env't Dept and Relevant Operations:</u> Investigate trends over time and consider any uncertainties (i.e., changes in operational processes, potential sources, confounding influences) in a formal Response Plan; Initiate component specific targeted studies as part of response planning. <u>Env't Dept and Relevant Operations:</u> Continue monitoring to confirm effects are linked to the project, to assess effectiveness of mitigations, and evaluate need for additional monitoring and/or mitigation. <u>Env't Dept:</u> Based on the results of continued monitoring and additional studies, consider refinement of the High Risk Threshold if appropriate. <u>Responsible Dept(s):</u> Implement moderate-action response from Mitigation Toolkit (or new mitigation identified through investigation) based on the outcome of targeted studies.	Will be developed concomitant with the High Action Level Development response plan. <u>Responsible Dept(s)</u>: Implement high-action level response in Mitigation Toolkit if causal effect or likely relationship is determined.

[25] Moderate severity behavioural responses are consistent with Level 5 and 6 severity response scores from Southall et al. (2007, 2021) and Finneran et al. (2017). These consist of responses that could become significant (defined for this purpose as responses with potential to impact critical life functions and/or responses consistent with the level of 'harassment' as defined under the U.S. Marine Mammal Protection Act) if sustained over a longer duration (lasting over a period of several hours, or enough time to significantly disrupt a narwhal's daily routine). These would be responses that fall within (if not sustained) or above (if prolonged) predicted behavioural responses in the FEIS and FEIS Addendum for the ERP.

[26] Confirmed indicates that the Risk Status/ Threshold trigger has been observed in at least two consecutive monitoring programs, whether during the regular monitoring schedule or confirmed through a special study.

[27] The exposure event is considered the period during which the vessel remains within 5 km of the exposed animal.

Monitoring Programs (Key Indicator)	Objective	Performance Indicators	Project Activity Monitored	Condition Status / Threshold			Pre-defined Response(s)		
				Low Risk	Moderate Risk	High Risk	Low Risk	Moderate Risk	High Risk
		• Change in surface or dive behaviour[24]				Confirmed[26] High severity responses (Severity Score 7 to 10[28]). This would include: ▪ Severe and or sustained (long-term) avoidance of disturbance zone area ▪ Outright panic, obvious flight or freeze response, stampede, or stranding events that can be directly linked to shipping AND (iii) a statistically significant decrease in the proportion of immature narwhal relative to baseline conditions (2014/2015 values). AND/OR (iv) >25.0% decrease in stock[29] size (abundance) relative to 2019 aerial survey abundance			

[24] Application of certain behavioural response indicators are contingent on securing necessary permits and MHTO support for running a tagging/telemetry program with concurrent AIS data.

[28] High severity behavioural responses are consistent with Level 7-10 severity responses from Southall et al. (2007) and Finneran et al. (2017). These consist of responses with immediate consequences (i.e. stranding) and those affecting animals in vulnerable life stages (i.e., calving, pupping) and are therefore always considered to be a significant behavioural reaction. Thresholds to be refined as narwhal behavioural data and underwater acoustic analyses proceed. These would be responses that are above predicted behavioural responses in the FEIS and FEIS Addendum for the ERP.

[29] Eclipse Sound summer stock

Monitoring Programs (Key Indicator)	Objective	Performance Indicators	Project Activity Monitored	Condition Status / Threshold			Pre-defined Response(s)		
				Low Risk	Moderate Risk	High Risk	Low Risk	Moderate Risk	High Risk
Ringed Seal Aerial Survey Program (RSASP) (Ringed Seal)	Monitor for potential effects of shipping on ringed seal density and/or distribution in the RSA. Identify mitigation for avoiding and/or minimizing adverse effects that exceed FEIS predictions.	▪ Change in seal density	• Shipping operations	None	None	(i) Confirmed[30]>25.0% decrease in density throughout the Local Study Area (LSA)	N/A	N/A	Will be developed concomitant with the High Action Level Development response plan. <u>Responsible Dept(s)</u>: Implement high-action level response in Mitigation Toolkit if causal effect or likely relationship is determined.
Ship-based Observer (SBO) Program (All Marine Mammal Species in RSA)	Monitor for potential ship strikes on marine mammals in RSA, and potential changes in relative abundance and behaviour due to Project shipping. Identify mitigation for avoiding and/or minimizing adverse effects that exceed FEIS predictions.	▪ Ship strike occurence	• Shipping operations • Icebreaking operations during fall shoulder season.	(i) Ship strike of 1 individual	(i) Ship strike of more than 1 individual in a shipping season	(i) Observed trend of ship strikes (i.e. over multiple years) of more than 1 individual	<u>Env't Dept</u>: Continue scheduled monitoring <u>Env't Dept:</u> If Low Action Threshold is triggered again in the next scheduled program (but Moderate is not), investigate trends over time and consider any uncertainties (i.e., differences in program timing, effort, methods, environmental variables) as a desktop study. <u>Env't Dept:</u> Consider refinement of the Moderate Risk Threshold if appropriate based on results of the desktop study.	<u>Env't Dept and Relevant Operations:</u> Investigate trends over time and consider any uncertainties (i.e., changes in operational processes, potential sources, confounding influences) in a formal Response Plan; Initiate component specific targeted studies as part of response planning. <u>Env't Dept and Relevant Operations:</u> Continue monitoring to confirm effects are linked to the project and evaluate need for additional monitoring. <u>Env't Dept:</u> Based on the results of continued monitoring and additional studies, consider refinement of the High Risk Threshold if appropriate. <u>Responsible Dept(s):</u> Implement moderate-action response from Mitigation Toolkit (or new mitigation identified through investigation) relevant to ship strikes	Will be developed concomitant with the High Action Level Development response plan. <u>Responsible Dept(s)</u>: Implement high-action level response relevant to ship strikes in Mitigation Toolkit (or new mitigation identified through investigation)

[30] Confirmed indicates that the Risk Status/ Threshold trigger has been observed in at least two consecutive monitoring programs, whether during the regular monitoring schedule or confirmed through a special study.

Monitoring Programs (Key Indicator)	Objective	Performance Indicators	Project Activity Monitored	Condition Status / Threshold			Pre-defined Response(s)		
				Low Risk	Moderate Risk	High Risk	Low Risk	Moderate Risk	High Risk
								based on the outcome of targeted studies	
TBD	Placeholder for Inuit OITR'S	TBD		To be determined in consultation with Inuit.			To be determined in consultation with Inuit.		

5.3 MITIGATION TOOLKIT

The preliminary Moderate and High Action Pre-Defined Responses to be implemented in the event of an exceedance of a moderate risk or high risk threshold are outlined in Table 5.3 for the Marine Environment and Table 5.4 for Marine Mammals. These responses should not be considered exhaustive and may be supplemented pending the results of adaptive management investigations and subsequent QIA approval.

Note - The Moderate and High Action Pre-Defined Responses are preliminary and subject to further review and assignment into specific Moderate and High Risk categories before finalization of the adaptive management components of the Environmental Management Plans, currently planned for August 2021. Even when finalized these responses should not be considered exhaustive and may be supplemented pending the results of adaptive management investigations and subsequent QIA approval.

Table 5.3 Marine Environment - Moderate and High Action Pre-Defined Responses

Area	Potential Response
Land Based Source Control	• Source dust control: Redesign engineering controls. Spray (or respray piles) with approved dust suppressant. Research for alternate dust suppression products. Evaluate surface watering and sprinkler system options via mister trucks or trailers. Where applicable, install or redesign conveyor shrouding for fugitive dust. Review of new technology and solutions available on the market for dust control. • Erosion and sedimentation control Stabilize eroding surfaces with rip rap or other measures. Install sediment control infrastructure (i.e. check dams) Explore redesign of water conveyance structures and culverts. Construct diversion ditches or berms. Direct non-contact water away from site infrastructure. Conduct review of new technology and solution available on the market for erosion and sedimentation control. • Water management Assess potential use and effectiveness of batch water treatment with reagents, and/or flocculants. Construct water management structures (i.e. additional settlement ponds, dams etc.) Install stream specific water treatment plant. Implement alternate water treatment technologies (i.e., permeable reactive barriers) • Reduction or cessation of activity: Adapt production rate to environmental conditions
Marine Based Source Control	• Altered shipping activities (altered ship and/or tug approach/path to dock, slower approach/departure from dock and/or Milne Inlet)
Assessment and/or monitoring	• Update country food risk assessment • Development of site-specific risk based guidelines
Negotiation of compensation	

Table 5.4 Marine Mammal - Moderate and High Action Pre-Defined Responses

Area	Potential Response
Shipping Activities	• Implement vessel convoy requirements – either southbound, northbound, in certain areas along shipping corridor, certain times of shipping season etc. Refer to the SMWMP for additional details. • Limit the number of vessels allowed to call on Milne Port over the entire shipping season, or during specific periods within the shipping season • Implement transit restrictions • Modify vessel mix (i.e. vessel sizes) according to market availability • Explore feasibility of temporary and/or permanent alternative shipping route to Milne Port through Navy Board Inlet • Temporary deviations from established shipping route through Eclipse Sound and Milne Inlet to avoid heavy ice concentrations during the shoulder seasons •
Monitoring	• Install alternate technology for ship-based monitoring (i.e. cameras) as supplement for MWOs • Increase monitoring programs outside of the Regional Study Area
Negotiation of compensation	

5.4 REPORTING

The monitoring program results will be presented annually and reports will be delivered to NIRB on a schedule as agreed with Baffinland and the MEWG. Final reports, along with responses to comments received on the reports, are posted on the Baffinland Document Portal (www.baffinland.com) and the NIRB public registry.

6.0 REVIEW OF PLAN EFFECTIVENESS

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

6.1 ANNUAL REVIEW OF COMPLIANCE AND UNANTICIPATED ADVERSE EFFECTS

Baffinland conducts internal inspections and audits throughout the year. Throughout the year, immediate corrective actions are taken as appropriate to address instances of non-compliance, as well as unanticipated effects observed. Follow-up corrective actions may also be required. These immediate and follow-up corrective actions are documented in the annual report.

During the annual reporting cycle, Baffinland staff will review whether any unanticipated adverse effects have been identified through the monitoring program s and determine if a review of plan effectiveness is appropriate. Should there be a significant unanticipated effect, determined by the Inuit Committee and/or community observations, a review of plan effectiveness will be completed. This process is articulated on Figure 6.1.

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

6.2 SCHEDULED UPDATES

The MMP is a "living" document and will be revised regularly as new information becomes available, methods are further developed, refined or replaced, and/or to account for adaptive management measures. Further details will continually be developed following discussions with the Qikiqtani Inuit Association (QIA), community Hunters and Trappers Organizations (HTOs), the Marine Environment Working Group (MEWG) and other involved parties. In addition to the annual review cycle described above, scheduled Plan reviews will occur according to the schedule presented in Table 6.1.

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

Table 6.1 Plan Review Schedule

Review Event	Description
Prior to construction and or operations 1	Incorporate any additional requirements specified in the DFO Fisheries Act Authorization and amended Project Certificate
Every 3 years during operation	Mandatory management review

NOTE:

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

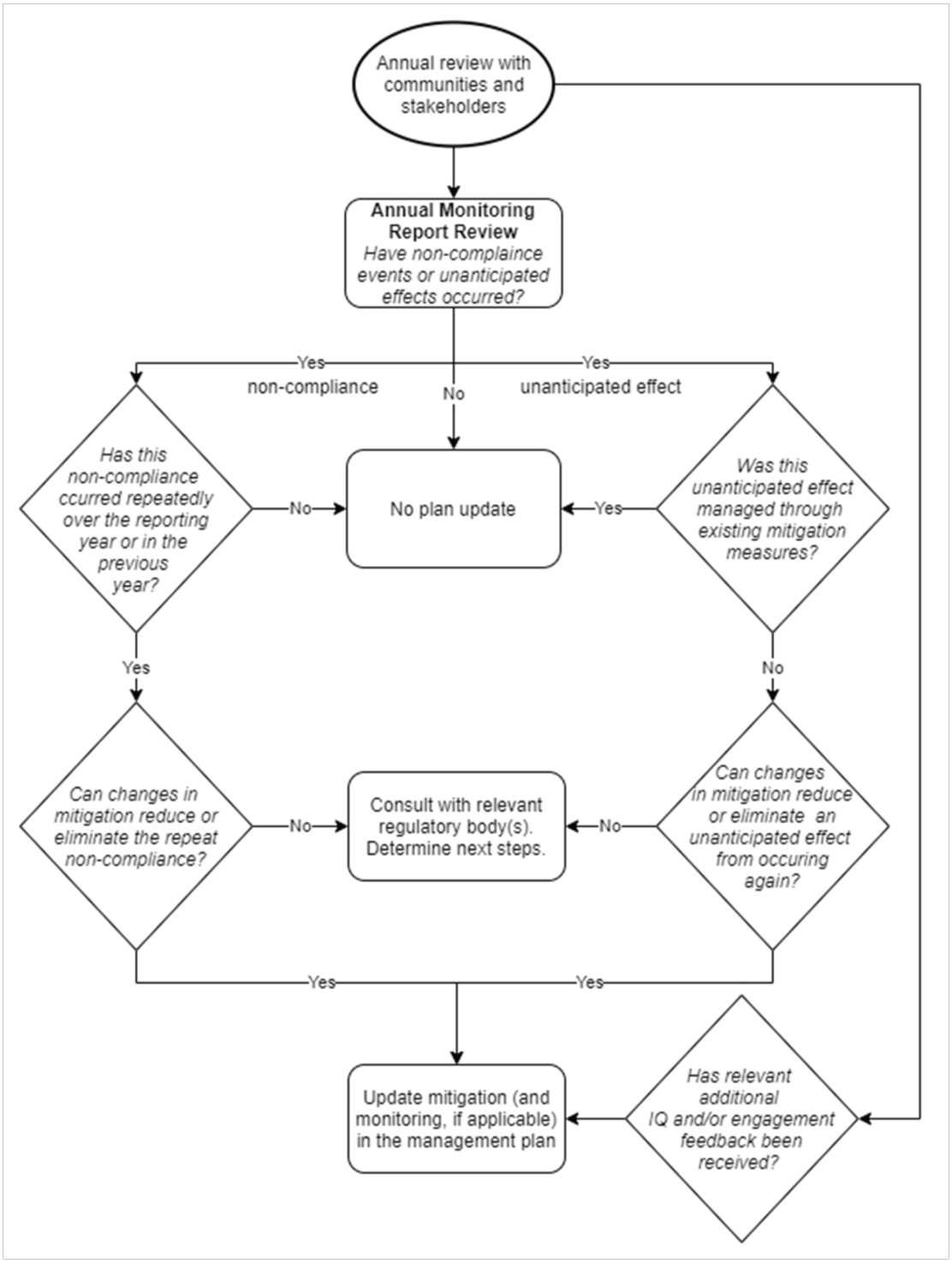


Figure 6.1 Annual Review of Plan Effectiveness

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Appendix A
Corporate Policies

Baffinland Iron Mines Corporation

Health, Safety and Environment Policy

BAF-PH1-800-POL-0001

Rev 3

Approved by: Brian Penney

Title: Chief Executive Officer

Date: May 3rd, 2019

Signature: 

DOCUMENT REVISION RECORD

Issue Date MM/DD/YY	Revision	Prepared By	Approved By	Issue Purpose
05/07/15	0	EM	TP	For Use
03/07/16	1	JS	BP	Minor edits
04/20/18	2	TS	SA/BP	Minor edits
05/03/19	3	TS	BP	Minor edits

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

We implement this Policy through the following commitments:

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

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

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

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

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

Brian Penney
Chief Executive Officer
May 2019

Sustainable Development Policy

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

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

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

Health and Safety

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

Environment

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

Upholding Human Rights of Stakeholders

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

Sustainable Development Policy

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

Transparent Governance

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

Brian Penney
Chief Executive Officer
March 2016

Appendix B
Project Terms and Conditions Relevant to the MMP

Below are Concordance Tables of this management plan with amended NIRB Project Certificate No. 005, October 2018 (main text) and Appendix A to NIRB Decision Report.

TABLE B-1: CONCORDANCE TABLE WITH NIRB PROJECT CERTIFICATE NO. 005 TERMS AND CONDITIONS

No.	Term and Condition	Comments
Marine Environment		
76	Develop a comprehensive environmental effect monitoring program to address concerns and identify potential impacts on the marine environment.	This document is prepared to address the concerns and potential impacts to the marine environment.
77 (revised)	The Proponent shall establish a Marine Environment Working Group	Section 4.0, Table 4.1
78	The Proponent shall update baseline information for landfast ice using a long term data-set and with inter-annual variation.	See Shipping and Marine Wildlife Management Plan (BAF-PH1-830-0024) for landfast ice data.
79	The Proponent shall provide the Canadian Hydrographic Services with bathymetric data and other information in support of Project shipping where possible.	Baseline formation collected in 2014; see Section 3.2.3., 3.3.3, 3.4.3, 3.5.3, and 3.6.3, for baseline information on Marine Sediment Quality, Benthic Communities, Marine Fish and Fish Habitat, Aquatic Invasive Species, and Marine Mammals.
80	The proposal shall conduct a detailed risk assessment for Project related shipping accidents prior to shipping iron ore.	See Shipping and Marine Wildlife Management Plan (BAF-PH1-830-0024) for shipping accidents.
81	The Proponent shall reassess the potential for ship wake impacts to cause coastal change following changes to the proposed shipping route.	
82	The proponent shall have ore carriers subjected to sea trials to measure wake characteristics at various speeds.	
83	The Proponent shall install tidal gauges at Steensby and Milne Ports to monitor sea levels and storm surges.	
83 (a)	The Proponent shall identify potential for and conduct monitoring to identify effects of sediment, and sampling should be undertaken to validate the model and inform sampling sites and the monitoring plan.	Section 3.2
84	The Proponent shall update sediment redistribution modelling once ship design has been completed and sampling should be undertaken to validate the model and inform sampling sites and the monitoring plan.	Section 3.2

No.	Term and Condition	Comments
85	The Proponent shall develop a monitoring plan to verify Project impact predictions associated with sediment redistribution resulting from propeller was in shallow water locations along the shipping route. Additional mitigation measures are required if monitoring detects negative impacts.	Section 3.2
86	The Proponent shall use more detailed bathymetry prior to shipping ore, collected from Steensby and Milne Inlets to model anticipated ballast water discharges from ore carriers. This information should be used to update ballast water discharge impact predictions and sampling should be conducted to validate the model.	Refer to Baffinland's Ballast Water Management Plan (BAF-PH1-830-P16-0050) for ballast water monitoring requirements and testing protocols.
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. Initiate program several years prior to any ballast water discharge at Steensby or Milne Inlets.	Section 2.4
88	Prior to commercial shipping of iron ore, the Proponent shall provide update risk analysis regarding ballast water discharge to assess the adequacy of treatment and implications on the receiving environment	Refer to Baffinland's Ballast Water Management Plan (BAF-PH1-830-P16-0050) for ballast water monitoring requirements and testing protocols.
89	The Proponent shall develop and implement a ballast water management program that may include the treatment and monitoring of ballast water discharges in a manner consistent with or exceeds applicable regulations. The management program should reflect all inclusions outlined in the condition.	Refer to Baffinland's Ballast Water Management Plan (BAF-PH1-830-P16-0050) for ballast water monitoring requirements and testing protocols.
90	The Proponent shall incorporate into the Project Shipping and Marine Wildlife Management Plan provisions to achieve compliance with the requirements under the International Convention for the Control and Management of Ships Ballast Water and Sediment (2004) or its replacement regulation as amended.	Refer to Baffinland's Ballast Water Management Plan (BAF-PH1-830-P16-0050) and Shipping and Marine Wildlife Management Plan (BAF-PH1-830-0024).
91	The Proponent shall develop a detailed monitoring plan for Steensby and Milne Inlets for fouling that complies with all applicable regulatory requirements and guidelines issued by Transport Canada.	Refer to Shipping and Marine Wildlife Management Plan (BAF-PH1-830-0024), Section 6.4.2.
92	The Proponent shall maintain the necessary equipment and trained personnel to respond to all sizes of potential spills in a self sufficient manner.	Refer to Baffinland's Spill at Sea Response Plan (BAF-PH1-830-P16-0042) for actions and reporting requirements during a fuel spill from shipping operations and Shipping an Marine Wildlife Management Plan

No.	Term and Condition	Comments
		(BAF-PH1-830-0024) for the means Baffinland ships, fuel, equips the site, and exports iron.
93	Prior to construction based on vessel selection, the Proponent shall reassess the risk analysis of using vessel - based fuel storage with the inclusions outlined in the condition.	Ongoing
94	The Proponent shall consult directly with affected communities regarding its plans for over-wintering of fuel in Steensby Inlet.	Section 4.0, Table 4.1
95	The Proponent shall meet or exceed all regulatory regulations and requirements to the practice of overwintering of a fuel vessel at Steensby Inlet with reporting to NIRB and Transport Canada.	
96	The Proponent shall update the NIRB on the results of all compliance monitoring and site inspections undertaken by government agencies for the overwintering of a fuel vessel at Steensby Inlet.	
97	Prior to commercial shipping of iron ore, the Proponent shall conduct fuel spill dispersion modelling that minimally includes those items outlined in the condition.	Refer to Baffinland's Spill at Sea Response Plan (BAF-PH1-830-P16-0042) for actions and reporting requirements during a fuel spill from shipping operations and Shipping and Marine Wildlife Management Plan (BAF-PH1-830-0024) for the means Baffinland ships, fuel, equips the site, and exports iron.
98	The Proponent shall incorporate the results of revised fuel dispersion modelling into its impact predictions for the marine environment and the spill response and emergency preparedness plans.	Refer to Baffinland's Spill at Sea Response Plan (BAF-PH1-830-P16-0042) for actions and reporting requirements during a fuel spill from shipping operations and Shipping and Marine Wildlife Management Plan (BAF-PH1-830-0024) for the means Baffinland ships, fuel, equips the site, and exports iron.
Marine Wildlife		
99	With the Marine Environment Working Group, the Proponent shall consider and identify priorities for conducting supplemental baseline assessments for the items outlined in the condition.	Ongoing; Section 2.3, Table 2.3.2

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100	The Proponent shall update the Project 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.	Ongoing; Section 2.3, Table 2.3.2
101	The Proponent shall incorporate all items outlined in the condition into the appropriate monitoring plans.	
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 real-time available to communities in Nunavut and Nunavik.	Refer to Shipping and Marine Wildlife Management Plan (BAF-PH1-830-0024), Section 4.2.3.
103	The Proponent shall report annually to the NIRB regarding project related ship track and sea-ice information including all items outlined in the condition.	Refer to Shipping and Marine Wildlife Management Plan (BAF-PH1-830-0024), Section 5.0.
104	The Proponent shall plan shipping routes to Steensby Port in accordance with the items outlined in the condition. Summarize all incidences of significant deviations from the nominal shipping route presented in the FEIS to/from Milne and Steensby Ports.	Refer to Shipping and Marine Wildlife Management Plan (BAF-PH1-830-0024), Section 3.3.
105	The Proponent shall ensure that measures to reduce the potential for interaction with marine mammals particularly in Hudson Strait and Milne Inlet area identified and implemented prior to commencement of shipping operations.	Refer to Shipping and Marine Wildlife Management Plan (BAF-PH1-830-0024), Section 1.5.
106	The Proponent shall ensure that shipboard observers are employed during seasons where shipping occurs and provided with the means to effectively carry out the duties. The role of shipboard observers should be taken into consideration in the design of any Project purpose built ships.	Section 3.6.2.2
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.	Section 3.3.1, 3.4.3, and 3.5.3
108	The Proponent shall ensure that data produced by the surveillance monitoring program is analysed by experienced analysts (in addition to being discussed as proposed in the FEIS) to maximize effectiveness in providing baseline information and/or detecting potential effects. Data from the long term monitoring should be treated with the same rigor.	Section 3.3.1, 3.4.3, and 3.5.3
109	The Proponent shall conduct a monitoring program to confirm the predictions in the FEIS with respect to	Section 3.6

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	disturbance effects from ships noise on the distribution and occurrence of marine mammals.	
110	The Proponent shall immediately develop a monitoring protocol that includes acoustical monitoring to assess short, long term and cumulative effects of vessel noise on marine mammals. Work with the MEWG to identify appropriate early warning indicators that will ensure rapid identification of negative impacts along southern and northern shipping routes.	Section 3.6
111	The Proponent shall develop clear thresholds for determining if negative impacts as a result of vessel noise is occurring.	Section 3.6
112	Prior to commercial shipping of iron ore, the Proponent in conjunction with the MEWG shall develop a monitoring protocol that includes acoustical monitoring that provides an assessment of the negative effects of vessel noise on marine mammals. Consideration of early warning indicators and thresholds of impacts should be included.	Section 3.6
113	The Proponent shall conduct monitoring of marine fish and fish habitat including monitoring for Arctic Char stock size and health condition in Steensby and Milne Inlets, as recommended by the MEWG.	Section 3.4
114	The Proponent shall, in the event of the development of a commercial fishery in Steensby Inlet or Milne Inlet areas, in conjunction with the MEWG, shall update the monitoring program for fish and fish habitat to ensure that the ability to identify Arctic Char stock(s) and any changes in stock size and structure of affected stocks and fish health is maintained to address any monitoring issues relating to the commercial stock fishery.	Section 3.4
115	The Proponent shall continue to explore off-setting options in both the freshwater and marine environment to offset serious hard to fish which will result from the construction and infrastructure associated with the project.	Section 3.4
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 compliance with the Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters.	
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 freshwater should occur to the greatest degree possible in open water. Blasting during ice covered periods must meet requirements established by Fisheries and Oceans Canada.	

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118	Prior to construction, the Proponent shall incorporate into the appropriate mitigation plan, thresholds for the use of specific mitigation measures meant to prevent or limit marine wildlife disturbance.	Section 5.2
119	In conjunction with the MEWG, the Proponent shall monitor ringed seal birth lair abundance and distribution for at least two years prior to the start of ice-breaking to develop a baseline, with continue monitoring over the life-time of the project.	Section 2.6, 5.2
120	The Proponent shall ensure, subject to vessel and human safety, that all Project shipping adhere to mitigation measures outlined in the condition for the protection of marine wildlife.	
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.	See Section 3.4 for marine mammals, and the Terrestrial Environment Mitigation and Monitoring Plan (BAF-PH1-830—P16-0027) for seabird colonies.
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.	See Section 3.4 for marine mammals, and the Terrestrial Environment Mitigation and Monitoring Plan (BAF-PH1-830—P16-0027) for seabird colonies.
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 throughout the lifecycle of the Project. The marine wildlife observer protocol should include those items outlined in the condition.	See Section 3.4 for marine mammals, and the Terrestrial Environment Mitigation and Monitoring Plan (BAF-PH1-830—P16-0027) for seabird colonies.
124	The Proponent shall prohibit all Project employees from recreational boating, fishing and harvesting of marine wildlife in Project areas, including Steensby and Milne Inlets.	Section 1.3
125	Prior to the use of acoustic deterrent devices, the Proponent shall carry out consultations with communities along the shipping routes and nearest to Steensby and Milne Inlet Ports to assess acceptability of the devices. Feedback from consultation should be incorporated into the mitigation plan.	Section 2.2
125(a)	The Proponent shall consult with potentially affected communities and groups, particularly the Hunters and Trappers Organizations regarding the identification of Project vessel anchor sites and potential areas of temporary refuge for Project vessels along the shipping	Section 2.2

No.	Term and Condition	Comments
	routes within the Nunavut Settlement Area. Feedback from the consultation should be incorporated.	
126	The Proponent shall design monitoring programs to ensure that local users of the marine area in communities along the shipping route have opportunity o be engaged throughout the life of the Project in assisting with monitoring and evaluating potential Project-induced impacts and changes in marine mammal distributions.	Section 2.2
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.	Section 2.2
128	The Proponent shall consult with local communities as fish habitat off-setting options are being considered and demonstrate incorporation of this input in the design of the Fish Habitat Off-Setting Plan.	Section 2.2