Baffinland Iron Mines Corporation
Mary River Project

MARINE SHIPPING AND VESSEL MANAGEMENT REPORT TO THE NUNAVUT IMPACT REVIEW BOARD

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

ABBREVIATIONS

AiS .... Automatic Identification System
AIS .... Aquatic Invasive Species
Baffinland .... Baffinland Iron Mines Corporation
ERP .... Early Revenue Phase
EWI .... Early Warning Indicator
FEIS .... Final Environmental Impact Statement
HTO .... Hunters and Trappers Organization
IIBA .... Inuit Impact and Benefit Agreement
MEEMP .... Marine Environmental Effects Monitoring Program
MEWG .... Marine Environment Working Group
MHTO .... Mittimatalik Hunters and Trappers Association
MMASP .... Marine Mammals Aerial Survey
MTPA .... Million Tonnes Per Annum
NAMRP .... Narwhal Adaptive Management Response Plan
NIRB .... Nunavut Impact Review Board
NIS .... Non-Indigenous Species
NLCA .... Nunavut Land Claim Agreement
PIP .... Production Increase Proposal
PIPE .... Production Increase Proposal Extension
PIPR .... Production Increase Proposal Renewal
RSA .... Regional Study Area
SOP .... Sustaining Operations Proposal
SSA .... Stratified Study Area
the Project .... Mary River Project
QIA .... Qikiqtani Inuit Association
UAV .... Unmanned Aerial Vehicle

1 INTRODUCTION

1.1 BACKGROUND

Project Certificate No. 005 (Amendment 04, dated November 3, 2022), requires that Baffinland Iron Mines Corporation (Baffinland) submit a Marine Shipping and Vessel Management Report (the Marine Shipping Report) to the Nunavut Impact Review Board (NIRB) prior to the commencement of the shipping season informing the Board of six (6) key components, as described in Table 1.1.

Table 1.1: Marine Shipping Report Components

Report Component	Report Section
Anticipated number of ship transits along the approved shipping route	Section 2
Identification of specific areas to be used for drifting and anchorage of vessels with details of how community feedback and comments from the Marine Environment Working Group (MEWG) has been used to inform the selection of suitable areas	Section 3
Timeline for organizing pre- and post-shipping meetings with the community	Section 4
Plans for preventing or mitigating vessel interference with marine mammals and traditional hunting activities pursuant to term and condition 125(a) of the Project Certificate;	Section 5
Evidence of community involvement to review preliminary results of the monitoring programs, and to compare results with experiences of community members and hunters with respect to the marine environment and marine mammals during the shipping season;	Section 6
Evidence of reporting new or non-native species identified as a result of Aquatic Invasive Species monitoring, to Mittimatalik Hunters and Trappers Organization (MHTO) and the Department of Fisheries and Oceans Canada (DFO) with confirmation of whether or not this species had been observed in the past or through other community or regional monitoring initiatives.	Section 7

Subsequent sections will provide additional details to support information requirements associated with components listed in Table 1.1.

2 2023 SHIPPING OPERATIONS

2.1 2023 SHIPPING OPERATIONS

Baffinland is currently approved to ship 4.2 million tonnes of iron ore over the 2023 shipping season along the Northern Shipping Route. On March 16th, 2023, Baffinland submitted an application to the NIRB for a Sustaining Operations Proposal (SOP), which would allow Baffinland to ship 6.0 million tonnes of iron ore, as well as stranded ore from the previous year, until December 31st, 2024 if approved. On April 14th, 2023, Baffinland submitted the Final Environmental Impact Statement (FEIS) Addendum as part of the SOP application, which summarizes potential Project-related impacts, inclusive of potential effects due to shipping, on the marine environment under the 6.0+ million tonnes scenario. This report is designed to cover either a 4.2 mtpa or 6 mtpa season.

The first vessels are anticipated to enter the Regional Study Area (RSA) between August 1 and August 7, subject to prevailing ice conditions. Refer to Figure 2.1 for an example of ore carriers that will be travelling to Milne Inlet throughout the 2023 shipping season. Consistent with 2022, vessels will not enter the RSA until a continuous path along the Northern Shipping Route (see Figure 2.2) of 3/10ths ice concentrations or less is confirmed. As per Section 3.2.1 of the Draft 2023 Shipping and Marine Wildlife Management Plan (SMWMP; Baffinland, 2023a), ice concentrations is defined as: *a ration expressed in tenths (/10) describing the area of water surface covered by ice as a fraction of the whole area.* The draft 2023 SMWMP is currently available on the NIRB Public Registry for intervener responses and details pertaining to the draft SMWMP are as follows: NIRB File No. 08MN053; Application No. 125710; Public Registry Identification No. 344991.

Baffinland will continue to confirm the floe edge is closed to hunters prior to commencement of the shipping season. Baffinland will notify the MHTO and Hamlet in writing 72, and 24 hours in advance of the first anticipated vessels transiting to Milne Port. Vessels will hold at least 40 km to the east of the RSA until approved by the Port Captain to enter and sail towards Milne Port (see Figure 2.3).

See Table 2.1 below for respective definitions and Table 2.2 for anticipated vessel movements for the 2023 season.

Table 2.1: Definitions

Term	Definition
Voyage	The two-way movement of one vessel into and out of Milne Port.
Transit	The one-way movement of one vessel or two or more vessels in a convoy inbound or outbound to/from Milne Port but only for the purpose of/under transit restrictions (i.e., 24-hour time restrictions). A convoy may be treated as a single convoy. A single vessel travelling one-way through the RSA will always be treated as a single transit. Tug activity is excluded when remaining within Milne Port. For additional information pertaining to transits, please review the Operational Guide for Ore Carrier Convoys, which is Appendix F in the most recent draft of the Shipping and Marine Wildlife Management Plan (Baffinland, 2023a).
Convoy	The movement of one or more vessels at the same time tRagged Island and/or Milne Port during either escort or instructed to travel as a group.. In 2022, Baffinland regularly implemented convoys and achieved a 20% reduction in the total number of vessel transits compared to a system without convoys. In 2023, Baffinland will continue to implement convoys, when deemed safe to do so. For additional information pertaining to transits, please review the Operational Guide for Ore Carrier Convoys, which is Appendix F in the most recent draft of the Shipping and Marine Wildlife Management Plan (Baffinland, 2023a).

Table 2.2: Anticipated Vessel Transits in 2023

Vessel Type	Anticipated Number of Voyages to/from Milne Port	Anticipated Number of Transits to/from Milne Port	Note
Icebreaker (MSV Botnica)	Will be primary escort vessel available as needed from end of September to October 31		The icebreaker will not be present at the beginning of the shipping season and is anticipated to first arrive in Milne Port at the end of September. The icebreaker will be available for escort as a precaution, if required by a vessel owner. The Botnica may also provide emergency response support, if required and will continue participation in the Marine Mammal Observer Network (MMON) program while transiting along the Northern Shipping Route. The Botnica will also be used to retrieve two acoustic monitors near Ragged Island and Bruce Head in early October, which will be deployed in early August using Baffinland's research vessel. The acoustic recorders will be redeployed after retrieval by the Botnica to capture any potential dual icebreaker transits at the end of the 2023 shipping season. The purpose of retrieving the acoustic recorders prior to overwintering is to ensure that acoustic data from the 2023 shipping season is downloaded to allow Baffinland to speak to monitoring results related to any cape-sized vessel transits that could occur in 2023.. In October, the Botnica will serve as the platform for the Shipboard Observer Program (SBO), where marine mammal observers monitor for ship strikes while icebreaking is occurring. At the end of the shipping season, the icebreaker will be required to support safe passage of ore carriers as freeze up along the Northern Shipping Route begins. The number of transits are subject to prevailing ice conditions and the number of vessels requiring escort (convoy scenario) during observed ice conditions. Icebreaker operations are limited to when escort of vessels is required.
Icebreaker (MSV Fennica)	Will be contingency escort vessel available as needed from end of September to October 31		The icebreaker will not be present at the beginning of the shipping season and is anticipated to first arrive in Milne Port at the end of September. The icebreaker will be available for escort as a precaution, if required by a vessel owner. The MSV Fennica may also provide emergency response support, if required and may participate in the Marine Mammal Observer Network (MMON) program while transiting along the Northern Shipping Route. The Fennica is not intended to provide support for

Vessel Type	Anticipated Number of Voyages to/from Milne Port	Anticipated Number of Transits to/from Milne Port	Note
			marine monitoring programs. The Fennica will only be used to escort vessels along the Northern Shipping Route at the end of the shipping season if ice conditions pose safety challenges requiring additional support. Unlike the Botnica, the Fennica will only be activated if anomaly ice conditions like those experienced in October 2022 occur again, otherwise the vessel will be anchored at Milne Port.
Tugs	2	4	Tugs will travel to Milne Port, and will remain for the entire shipping season to support ore carriers anchoring and berthing at the Port. The intention is to have the tugs depart together with the last ore carrier(s) and icebreakers in a convoy.
Ore Carriers	56 to 60 75 to 84	112 to 120 150 to 164	Vessels will range in size from Supramax to Cape size (Newcastlemax) Baffinland is approved to ship 4.2 million tonnes of iron ore in 2023. If the Sustaining Operations Proposal (SOP) is approved by the NIRB, then Baffinland will ship 6.0+ million tonnes of iron ore in 2023 on no more than 84 ore carriers.
Resupply Cargo Vessel	2-3	4-6	Cargo vessels may be serving other Nunavut communities either before or after delivery to Baffinland. In 2023, some cargo vessels may be employed for the purposes of backhauling equipment from site.
Fuel Tanker	4	8	Fuel tankers may be serving other Nunavut communities either before or after delivery to Baffinland.

Figure 2.1: Convoy of Three Ore Carriers on July 31, 2022.

Figure 2.2: Milne Inlet Nominal Shipping Route

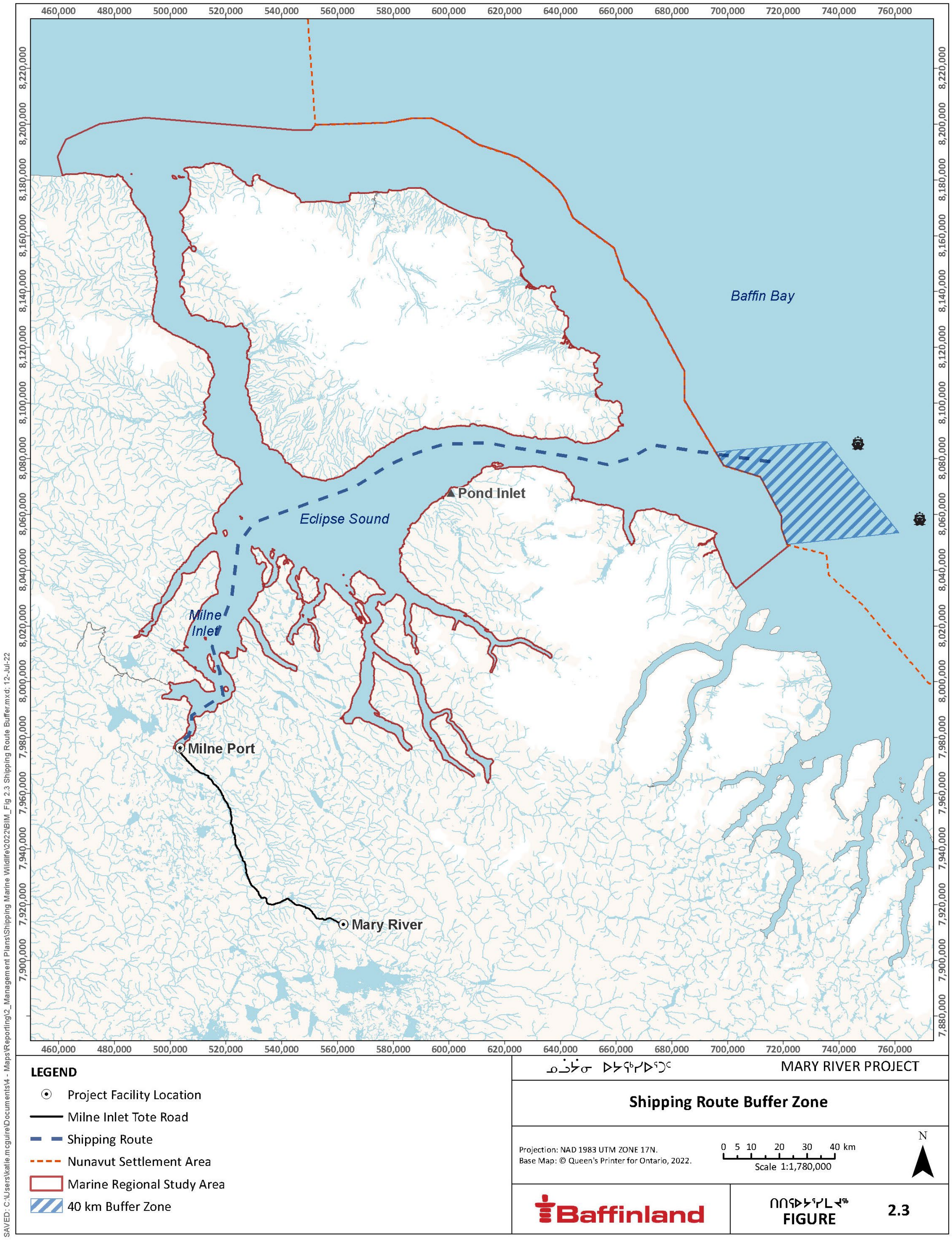

Figure 2.3: Shipping Route Buffer Zone

3 ANCHORING AND DRIFTING AREAS

3.1 CONTEXT

The NIRB has requested that Baffinland identify the specific areas to be used for drifting and anchorage of vessels and also to provide details related to how community feedback and comments from the Marine Environment Working Group (MEWG) have been used to inform the selection of suitable areas.

3.2 2023 ANCHORING AND DRIFTING AREAS

As a critical component to the safety and efficiency of Baffinland's marine operations, two primary locations for anchoring in the RSA will continue to be used in 2023. Vessels waiting for an anchorage at Milne Port will continue to anchor to the west of Ragged Island in North Milne Inlet. Vessels undergoing post arrival formalities, including cargo inspections and ballast water salinity testing, will anchor within the vicinity of Milne Port prior to berthing at the Ore Dock (Figure 3.1).

3.2.1 Community Engagement and Feedback

During a visit to the Mary River Project in 2018, the MHTO proposed two alternative anchorage locations for Baffinland to consider (Eskimo Inlet and South Bylot), as well as an alternative location for vessel drifting (entrance to Baffin Bay). During the pre-shipping season meeting held in Pond Inlet on June 25th, 2019, the MHTO proposed two additional alternative anchorage locations: Guys Bight and Erik Harbour.

In 2020, Baffinland undertook an options exercise of five alternative locations proposed by the MHTO for anchoring and drifting along the Northern Shipping Route. The results of this alternative options exercise confirmed that the established anchorage locations near Ragged Island remain the most suitable for the Project. Table 3.1 below provides a brief summary of rationale for deeming each proposed alternate location as unsuitable. Additional details pertaining to Baffinland's options exercise are summarized in a memorandum that was provided to the North Baffin Hamlet and Hunters and Trappers Organizations (HTOs) on January 13, 2020 (NIRB Registry No. 330789).

Table 3.1: Proposed Anchorage Locations and Rationale for Rejection by Baffinland

Proposed Alternative Location From MHTO	Purpose of Proposed Location	Rationale for Rejection of Proposition by Baffinland
Eskimo Inlet	Anchorage	• Too narrow – only 1.5 nautical miles (nm) wide at greatest extent, which presents safety risk for vessels transiting through corridor. • Exposed nature of inlet increases risk of vessels being trapped by ice • Water depth is unsuitable for anchoring (>250 m)
South Bylot	Anchorage	• Proposed location is in the current shipping lane, which would result in rerouting vessel traffic closer to Pond Inlet to reduce safety risks of vessel overlap • Leaves vessels exposed to extreme weather events (ie. high wings, ice bergs) • Water depth is unsuitable for anchoring (>300 m)
Guys Bight	Anchorage	• Potentially has suitable depths for anchorage • Existing nautical charts are not detailed enough to confirm the feasibility of safe anchorage in this area

Proposed Alternative Location From MHTO	Purpose of Proposed Location	Rationale for Rejection of Proposition by Baffinland
		• Could present potential disruptions to the loading sequence given the considerable distance to Milne Port (120 nm)
Erik Harbour	Anchorage	• Difficult to enter due to a rocky outcropping near the entrance to the Harbour – vessels would need to anchor at the entrance, leaving them exposed to drifting ice from Pond Inlet • Water depth is unsuitable for anchoring (>100 m)
Entrance to Baffin Bay	Vessel Drifting	• Very exposed to weather and ice conditions, which presents safety concerns

Baffinland remains open to exploring feasible alternatives (or further modifying current practices) to anchoring at Ragged Island to minimize interference of shipping on land users, and welcomes feedback from the MHTO and community members of Pond Inlet. Feedback is solicited through various engagements, such as the NIRB marine mitigation workshops, pre-and post-shipping season meetings, pre- and post-shipping radio shows, Marine Environment Working Group (MEWG) meetings, and intervener comments on annual reports related to shipping and the marine environment. For an anchorage location to be deemed suitable for use, it must provide adequate shelter from adverse weather conditions, be within an area that is wide enough for vessels to pass safely, and be of a suitable depth. A suitable anchorage depth varies depending on the size of the vessel. Generally, the length of the anchor chain for the vessel must be 5x the depth of the anchor pocket to the seafloor. For example, 100 m of anchor chain would be required to safely anchor the vessel if the depth of the anchor pocket to the seafloor is 20 m. A supramax vessel traditionally has an anchor chain that is 275-300 m long, which means that the water must be a maximum of 55-60 m deep in order to anchor safely—these are the smallest vessels currently contracted by Baffinland. Cape sized vessels, the largest to potentially be contracted by Baffinland, generally have anchor chains that are 355-385 m in length, which therefore require a maximum depth of 71-77 m. In order to accommodate all Baffinland vessels, **any proposed anchorage locations must be a maximum of 55 m deep**.

Until alternative requests are made, Baffinland will continue to minimize impacts on hunters and those traveling on water by enforcing that no more than three (3) ore carriers anchor at Ragged Island at any time. Baffinland also commits to avoiding its vessels from drifting in Eclipse Sound, unless warranted for safety considerations. Ore carriers are also prohibited from discharging ballast water at the Ragged Island anchorage locations. Furthermore, ore carriers are prohibited from discharging grey water and sewage throughout the RSA.

Baffinland held a pre-shipping meeting in Pond Inlet with the Hamlet on June 28th, 2023, as well as a pre-shipping radio show on June 27th, 2023. No comments/questions related to anchoring or drifting were raised at these two specific engagements.

3.2.2 Marine Environmental Working Group (MEWG)

Since the release of the 2022 Marine Shipping Report and Vessel Management Report to the NIRB on July 19th, 2022, six MEWG meetings were held. The dates of these meetings are as follows:

- August 4, 2022;
- December 2, 2022;
- February 15th, 2023;
- February 16th, 2023;
- April 19th, 2023; and
- July 12th, 2023.

No comments related to Baffinland's anchorage locations were raised by the MEWG, including MHTO, during these meetings.

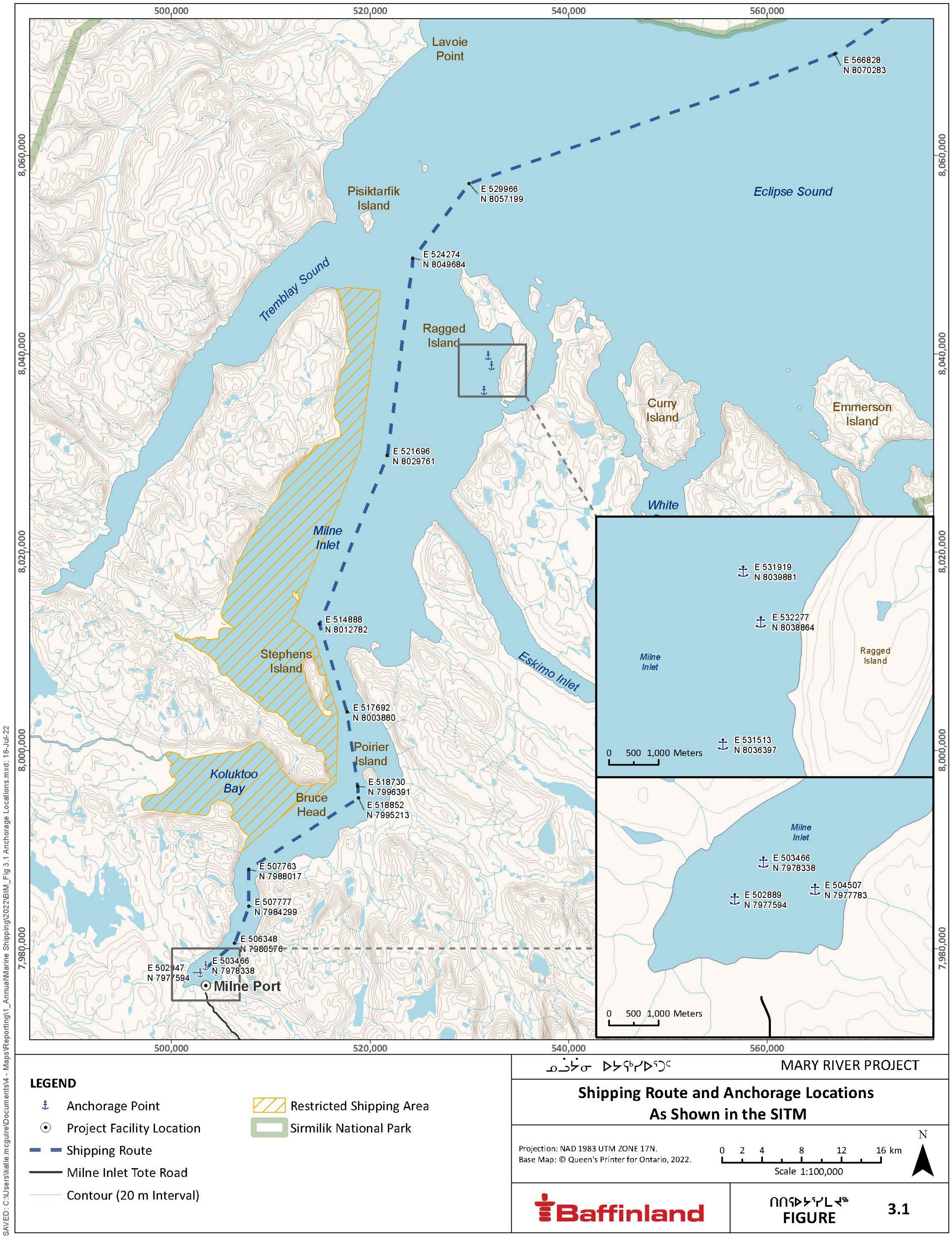

Figure 3.1: **Shipping Route and Anchorage Locations**

4 SHIPPING ACTIVITY-RELATED COMMUNICATIONS

4.1 CONTEXT

As part of its regular operation, Baffinland has as Shipping-related Communications Protocol to guide specific engagement activities with the MHTO and Hamlet of Pond Inlet. As part of this protocol, Baffinland typically hosts pre- and post-shipping season meetings. Baffinland also maintains a number of communication and engagement activities throughout the shipping season. A summary of the key activities is summarized in Table 4.1 below.

Table 4.1: Key Components of Shipping-Related Communications

Timing	Key Component	Description
Pre-season	Pre-Shipping Season Meeting	Baffinland hosted a Pre-Shipping Season Meeting with representatives of MHTO and the Hamlet of Pond Inlet (the Hamlet) on June 28, 2023. Local QIA representation was not present, though notification of this engagement was communicated verbally the week of June 12th and via email June 20th, 2023.
	Confirmation of floe edge closure	Baffinland became aware the MHTO issued closure of the floe edge through social media on July 11, 2023.
	Official start of shipping season	Baffinland notified the MHTO, Hamlet of Pond Inlet and the QIA in a letter dated July 13, 2023, meeting its commitment to advance notification 72 hours before anticipated start of shipping. Additional letters sent 24 hours before start of any shipping activity upon further refinement of start of shipping based on latest ice conditions.
	Ongoing shipping activities-related communications	Baffinland maintained active communication with the MHTO and residents of Pond Inlet about anticipated shipping operations and will continue to do so throughout the summer via multiple modes including local public radio, marine VHF radio, social media, and live ship tracking available on the Baffinland website (www.baffinland.com) under its >Operation>Shipping & Monitoring> webpage.
During Shipping	Ongoing shipping activities-related communications	Shipping Monitors based in Pond Inlet have been hired and are in place for ongoing communications with residents.
		Dedicated email address (shipping@baffinland.com) for concerns, questions and comments directed to Baffinland is active and monitored.
		Maintain comment/concern tracker relevant to shipping season. Posting of Shipping and Marine Monitoring Summary brochure, including Shipping Route, in key locations in Pond Inlet (see Appendix 1).
	Overall shipping season summary	Baffinland to prepare a summary on all vessel-related activity. Maintain comment/concern tracker relevant to shipping season.
		Baffinland to host an End of Shipping Season Meeting with representatives of MHTO, the Hamlet of Pond Inlet and local QIA. Meeting is typically held within the same year of shipping season being discussed after the last Baffinland Project vessel has left the RSA. Baffinland to prepare a summary on all vessel-related activity.
Post-season	End of Shipping Season Meeting	Where possible, Baffinland considers the potential for integrating feedback in planning of next shipping season operations, including

Timing	Key Component	Description
		consideration of adoption of new management and mitigation measures. Baffinland to host an End of Shipping Season Meeting with representatives of MHTO, the Hamlet of Pond Inlet and local QIA. Meeting is typically held within the same year of shipping season being discussed after the last Baffinland Project vessel has left the RSA.
	End of Shipping Season Meeting	Where possible, Baffinland incorporates considers the potential for integrating feedback in planning of next subsequent year's shipping operations, including consideration of adoption of new management and mitigation measures.

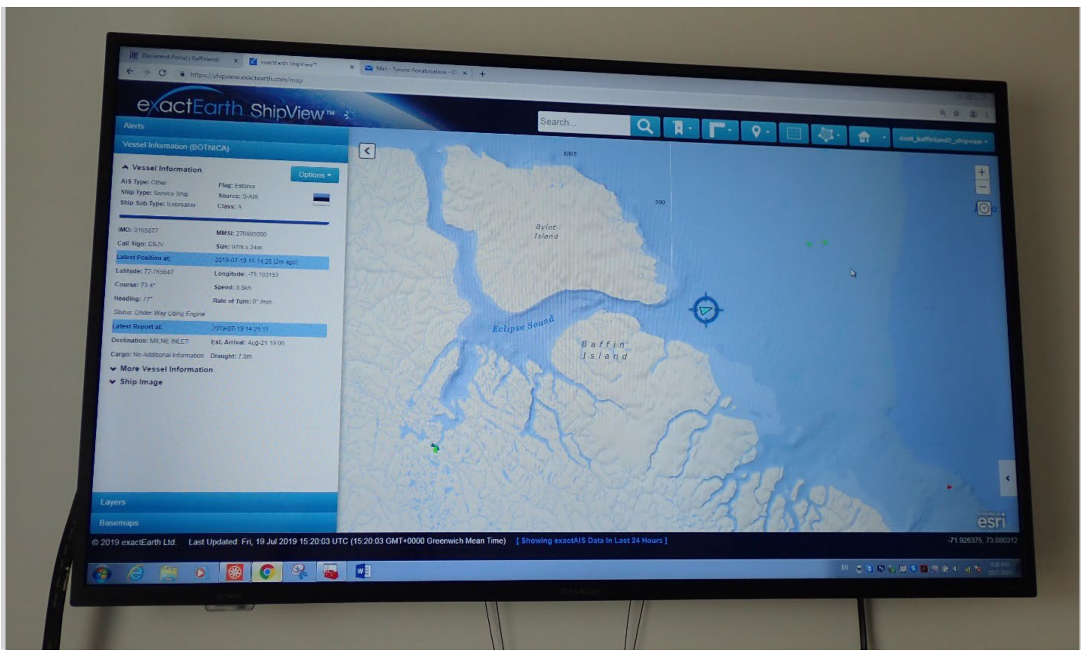

Figure 4.1: Large wall-mounted TV monitor in Baffinland's Shipping Monitor office located on the 2nd floor of the MHTO office building in Pond Inlet showing live ShipView tracking of Baffinland vessels

4.2 SUMMARY OF 2022 IMPLEMENTATION OF BAFFINLAND'S SHIPPING COMMUNICATIONS PROTOCOL

Baffinland's shipping season ended on October 13th, 2022 when all vessels had exited the Regional Study Area. Although Baffinland strives to hold the End of Shipping Season Meeting as soon as it is feasible to do so after the closing of each shipping season, the Company was not able to hold the 2022 End of Shipping Season Meeting until February 8th, 2023. Baffinland made several informal and formal requests between November 2nd, 2022 and January 30th, 2023 through verbal and written methods to obtain potential availabilities of the MHTO board members and to obtain input on agenda items. The 2022 End of Shipping Season meeting was held in person at the Sauniq Hotel in Mittimatalik from 9:00 am – 2:45 pm and included attendees from the MHTO, QIA, the Government of Nunavut, the Hamlet of Pond Inlet, and the public.

The focus of these meetings was to provide representatives with an overview of Baffinland's 2022 shipping season. Concerns noted from representatives were the continued use of Ragged Island for vessel anchorage, ballast water management, the introduction of aquatic invasive species, and the presence of Killer Whales (Orcas). More details about the post-shipping meeting is in Section 4.3.1 (Table 4.2).

4.2.1 2023 PRE-SHIPPING SEASON MEETING

On June 28, 2023, Baffinland representatives met in-person in Pond Inlet with representatives of the MHTO Board and council members for the Hamlet of Pond Inlet. Baffinland's Senior Manager of Environment & Social Governance, Sustainability Specialist and Environmental Engagement Lead also held a radio show on June 27, 2023 to provide updates on plans for the 2023 shipping season and engage in discussions with residents of Pond Inlet.

The following is a brief summary of the key points presented and discussed with residents of Pond Inlet:

i) Overview of 2023 shipping season;

ii) A summary of key mitigation measures that will be implemented this year;

iii) An update regarding communication between the community of Pond Inlet and Baffinland for the upcoming shipping season;

iv) Baffinland's commitment to no ice-breaking during the 2023 spring shoulder season and waiting until there is a continuous path of 3/10s ice concentration prior to commencing shipping;

v) Reasoning for not further lowering the vessel speed limit from the current 9 kn, as described in Section 4.3.1, Table 4.2;

vi) Restrictions imposed on vessels entering the RSA, including the inability to enter unless instructed by the Port Captain;

vii) Mitigation measures enforced at Ragged Island, including a limit of three anchorage locations, and prohibiting vessel drifting in Eclipse Sound unless warranted due to safety concerns.

Baffinland provided an update on the shipping monitor program focused on hiring, primary duties, and communication with the public. Baffinland staff conveyed that shipping monitors are on duty 24/7 and therefore are available to provide information and answer questions about the vessels around the clock.

Similar to 2022, Baffinland will continue to announce the start of the marine mammal aerial surveys using Facebook and provide responses to certain questions received via Facebook. The commencement of the marine mammal surveys will be announced on public radio and marine VHF radio.

On July 11, 2023 the Manager of the MHTO announced on Facebook's Pond Inlet News page that the floe edge has been closed for the 2023 season. As per the communication protocol, Baffinland will follow-up directly with the MHTO to acknowledge and confirm that the floe edge is closed prior to commencing any shipping activities.

4.3 ENGAGEMENT RELATED TO NARWHAL ADAPTIVE MANAGEMENT RESPONSE PLANS

On April 8 2021, Baffinland provided to the NIRB a Technical Memo prepared by Baffinland's marine mammal monitoring technical consultants, Golder (now referred to as WSP), entitled Preliminary Summary of 2020 Narwhal Monitoring Programs (the Memo) (Golder, 2021; NIRB Registry No. :334991). The memo outlined key results of Baffinland's 2020 Marine Mammal Monitoring Programs, notably, that through the 2020 Marine Mammal Aerial Survey, Golder had recorded a statistically significant decline in the abundance estimate for the Eclipse Sound narwhal stock. The memo focused on the implementation of mitigation measures to address the observed decline in narwhal stock. There was a comment and response period facilitated by the NIRB following the submission of the memo. Relevant engagement activities and parties that submitted comments are outlined in Baffinland's 2021 NIRB Marine Shipping and Vessel Management Report (Baffinland, 2021a). In addition to NIRB's facilitated exchange of written comments on the Memo in 2021, Baffinland continued to conduct its own engagements with several Parties. Baffinland recognized that the 2021 Marine Mammal Aerial Survey results as reported in WSP (2022a) indicated a further decline in Eclipse Sound narwhal stock even though shipping activity was reduced in 2021 in comparison to 2020, and icebreaking had not occurred.

Given the uncertainty on the causal mechanisms for these observed reductions in narwhal abundance in 2020 and 2021, Baffinland expanded upon existing measures described within the 2022 Narwhal Adaptive Management Response Plan (NAMRP), which was submitted to the NIRB as an appendix to the 2022 Marine Shipping and Vessel Management Report (Baffinland, 2022). The 2022 Marine Mammal Aerial Survey results (WSP, 2023a), which are summarized in Appendix G.6.2 of the 2022 Annual Report to the NIRB (Baffinland, 2023b), indicate that the 2022 narwhal abundance estimate for the Eclipse Sound stock was statistically higher than the 2021 estimate. The 2022 narwhal abundance estimate for the Eclipse Sound stock was 4,592 in 2022, compared to 2,595 in 2021. Given the increase in the Eclipse Sound narwhal stock abundance, Baffinland does not intend to update the NAMRP for the 2023 shipping season and will continue implementing the same mitigation measures that applied in 2022. Baffinland continues to engage with community members and organizations to receive feedback to be incorporated into future amendments, if required. A summary of engagement attempts/engagement opportunities conducted since the release of the 2022 Marine Shipping and Vessel Management Report (Baffinland, 2022) that relate to the NAMRP, inclusive of marine mitigation measures, monitoring, and shipping are as follows:

1. Held a meeting with the MEWG on February 15th, 2023 to provide an update on 2022 convoy operations for ore carriers, summary of preliminary 2022 marine monitoring results and proposed 2023 marine monitoring programs. These meetings took place from 9:00 am – 5:00 pm in-person in both Ottawa and Iqaluit. Members from the five HTOs from the affected communities were present in-person in Iqaluit and virtually linked to the meetings in Ottawa simultaneously. Presentation materials circulated to the MEWG members occurred on February 9th, 2023 in both English and Inuktitut.
2. Provided the MEWG copies of all its 2022 Final Marine Monitoring Reports on May 3rd, 2023.
3. Submitted to the Nunavut Impact Review Board (NIRB) its 2022Annual Monitoring Report as of May 3rd, 2023, with comments expected back from interested Parties on July 11th, 2023.
4. Baffinland participated in the NIRB's Marine Monitoring and Marine Mitigation Workshop held in-person in Pond Inlet May 24th – 25th, 2023. The focus of this engagement was to provide opportunity for Pond Inlet residents to discuss community-related concerns for project impacts to the marine environment and monitoring activities. Regulatory agencies in attendance were the Department of Fisheries & Oceans Canada (DFO), Transport Canada (TC), and the Canadian Northern Economic Development Agency's Northern Projects Management Office (CANNOR – NPMO). Representatives of the QIA also attended to receive and respond to community feedback and understand the issues of priority for the community with respect to the marine environment.
5. On May 26th, 2023, Baffinland met with members of the MHTO to discuss an in-person meeting date for the Pre-Shipping Season meeting. MHTO indicated they would be available the week of June 26th, 2023. This meeting was for June 28th, 2023.

6. Baffinland's Sr. Manager of Environment & Social Governance, Sustainability Specialist and Environmental Engagement Lead flew to Pond Inlet on June 26th, 2023 to meet with community members, representatives of the MHTO, council members of Hamlet of Pond Inlet, and deliver initial training for the Pond Inlet Community-based Shipping Monitors.
7. On June 27th, 2023, Baffinland held a radio call-in show to provide updates to the community on its 2023 shipping season with a question and answer period.
8. On June 28th, 2023, Baffinland's Sr. Manager of Environment & Social Governance, Sustainability Specialist and Environmental Engagement Lead met in-person with representatives of the MHTO, members of the Hamlet Council to deliver a presentation on plans for the 2023 shipping and subsequent mitigation measures.
9. On June 29th, 2023, Baffinland met with the Chair of the MHTO in-person to discuss potential participation of a MHTO participant for Leg 2 of the 2023 Marine Aerial Survey Program. A request for a letter of support from the MHTO for WSP's marine monitoring work & initial discussion of support from the MHTO for a proposed Narwhal Cortisol Sampling Program, and a potential in-person meeting in August 2023 to discuss participation in a workshop for the Milne Inlet Fish Health Program was also discussed at this time.
10. On July 12th, 2023, Baffinland held a MEWG meeting to provide and operations update for the 2023 shipping season, as well as an overview of confirmed marine monitoring programs. A question and answer period covering the 2023 shipping season, marine monitoring programs, and the 2022 annual monitoring reports was included in the agenda, but time restrictions prevented all topics from being covered. Members were told that outstanding questions could be provided to Baffinland in writing.

4.3.1 Key Outcomes

Through these consultation efforts, to-date Baffinland has received at a high level, the following feedback.

Table 4.2: Summary of Engagement Outcomes from July 2022 – July 2023

Summary of Comment/ Recommendation	Baffinland Response / Outcomes
Recommendations from MHTO to further reduce shipping	• Baffinland will opportunistically implement convoys throughout the 2023 shipping season to reduce the total number of vessel transits within the RSA. Additional details pertaining to convoys are included in Appendix F the draft 2023 SMWMP (Baffinland, 2023a). • Baffinland has committed to allowing no more than 84 ore carriers enter the RSA if approved to ship 6.0+ Mtpa in 2023.
Recommendations from MHTO and the community of Pond Inlet to discontinue the use of acoustic monitors in the RSA	• Baffinland intends to deploy two acoustic recorders in July of 2023 to ensure there are no data gaps related to the use of larger ore carriers. • Baffinland will retrieve the two acoustic recorders in October, 2023. If the second contingency icebreaker is active, Baffinland will re-deploy the acoustic monitors after downloading the data to overwinter and capture dual icebreaker transits at the end of the 2023 shipping season. • Baffinland discussed the use of acoustic recorders at the 2023 Pre-shipping Meeting held in Pond Inlet on June 28th, 2023 with representatives from the Hamlet of Pond Inlet and the MHTO. No objections or concerns were raised relating to the deployment of acoustic recorders in 2023.
Recommendations from Hamlet of Pond Inlet, Parks Canada, DFO and QIA on enhancements to Baffinland's existing and proposed monitoring programs.	Baffinland has committed to working with these Parties on further refinements of these programs (i.e., analysis of Early Warning Indicator [EWI] monitoring at Bruce Head). Baffinland also reaffirmed the need for, and importance of, strengthened regional monitoring that will enhance Baffinland's ability to discriminate Project-related effects from other anthropogenic activities or environmental changes that could be affecting the Eclipse Sound narwhal stock. Baffinland attempted to implement a narwhal tagging program for the 2022 shipping season, but did not receive support from the MHTO to proceed. For the upcoming 2023 shipping season, the DFO will be conducting aerial surveys to provide updated abundance estimates for regional narwhal stocks. Baffinland will continue to conduct marine mammal aerial surveys within the RSA throughout the 2023 shipping season, and has extended an invitation to MHTO to participate. Baffinland has purchased higher resolution cameras for the 2023 MMASP, which will allow DFO to identify individual narwhals using the software WhaleSeeker, should DFO wish to collaborate on the aerial survey monitoring. This helps address community concerns related to whether narwhals are being double-counted, and eliminates observer bias, fatigue, and human error. Additionally, Baffinland is expanding its Aquatic Invasive Species/Non-Indigenous Species (AIS/NIS) monitoring program in 2023 to include a 2-week biological

Summary of Comment/ Recommendation	Baffinland Response / Outcomes
	ballast water sampling pilot program conducted by DFO with support from BIM.
Recommendations from the MHTO to include an MHTO representative on the marine mammal aerial surveys.	Baffinland engaged with MHTO on July 6 and 11th, 2022 to request MHTO participation in Leg 2 of the 2022 Marine Mammal Aerial Survey, occurring August 9th to August 23rd, 2022. Baffinland did not receive confirmation from MHTO that a board member would participate. Baffinland met with the MHTO on May 26th and June 28th, 2023 to inquire about MHTO participation on Leg 2 of the 2023 MMASP. The MHTO verbally confirmed that they would send a representative, however, screening requirements for site deployment are still underway and participation is not secured. Baffinland will continue to correspond with MHTO regarding participation in future aerial studies.
Recommendations from DFO that Baffinland develop a more robust zooplankton monitoring program.	Baffinland's 2022 zooplankton monitoring program involved both the use of settlement plates and vessel-based net tows. DFO offered to provide Baffinland a more robust methodology. DFO met with Baffinland and WSP representatives on April 20th, 2023 to discuss the 2023 proposed zooplankton study design. DFO provided multiple recommendations, all of which were subsequently incorporated into the 2023 study design, with the exception of a single recommendation that presented logistical constraints that deemed it infeasible for this field season. Modifications to the zooplankton monitoring program include: an increase in the number of sampling sites, and an increase in the number of sampling events to allow for more temporal variability.
Multiple organizations from the MEWG recommended that the comment and response system for monitoring reports be revised to correspond with Annual Report dates.	Baffinland revised its annual reporting process in 2023 so marine monitoring reports are submitted as final in tandem with the NIRB Annual Report. The final 2022 marine monitoring reports were appendices in the 2022 NIRB Annual Report (Baffinland, 2023b), which was submitted on April 30th, 2023.
Various MEWG members had concerns related to convoys, including whether these convoys will minimize noise, what the maximum number of vessels per convoy will be, and what the approximate percentage of vessels travelling in convoy will be.	A Convoy Operational Guide is included in Appendix F of the draft 2023 SMWMP (Baffinland, 2023a). Additional details pertaining to acoustic monitoring results for convoys conducted throughout the 2022 season can be found in the Preliminary Analysis of Noise From Vessel Convoys Report and the 2022 Underwater Acoustic Monitoring Program (Open-Water Season) Report; Appendix G.6.5 and G.6.6 of the 2022 NIRB Annual Report, respectively (2023b). The 2022 annual monitoring reports were available for public comment until July 11th, 2023. Concerns related to the use of vessel convoys and acoustic monitoring results included in intervener responses will be addressed by Baffinland within 30 days of receipt.

5 MITIGATIONS FOR MARINE MAMMALS AND TRADITIONAL HARVESTING

5.1 ADAPTIVE MANAGEMENT MEASURES FOR 2023

Recognizing the value of the Eclipse Sound narwhal stock to the residents of Pond Inlet, and that there are unknown and/or unmitigated cumulative activities occurring in the Marine RSA that are likely to continue in 2023, Baffinland is committed to taking a precautionary approach and adding additional mitigations to its shipping activities in 2023 on an interim basis.

Baffinland will continue to implement all other existing mitigation measures as described in Section 6 of the SMWMP (Baffinland, 2023a) and in Table 5.1 below, including delaying the shipping season until a continuous path of 3/10ths or less ice concentration is available along the Northern Shipping Route. This mitigation measure, introduced in 2021, can delay the start of shipping between 2 and 3 weeks based on historical ice conditions resulting in a significant loss of revenue for the company. This loss was acutely experienced in 2022 when the shipping season was closed on October 13, 2022. Had Baffinland begun shipping activities two weeks earlier that year, all ore at the Milne Port pad would have been vacated, instead approximately $1.3 mt was left.

In addition to the continued implementation of marine mitigation measures from previous years, Baffinland has elected to establish additional mitigation measures for the 2023 shipping season as a precaution. Baffinland will restrict the use of scrubbers within the RSA, and will require vessels at anchorage to rely on auxiliary power unless not advisable for safety reasons.

5.2 SHIPPING MITIGATIONS MEASURES TO REDUCE IMPACTS ON MARINE MAMMALS

Vessels are instructed to follow the nominal shipping route to the fullest extent possible, however, at the start and end of the shipping season there may be a need for slight deviations from the nominal route to avoid interactions with ice. Any notable deviations are communicated to hunters on the water and in the communities through the Shipping Monitors. In all cases, vessels are instructed to avoid Koluktoo Bay and the western shoreline near Bruce Head to minimize effects on marine mammals, sea birds, and interference with hunting activities (Figure 5.1).

All Project vessels will restrict speed to 9 knots when transiting along the established shipping corridor, and will operate in such a way as to avoid separating an individual member(s) of a group of marine mammals from other members of the group. When marine mammals appear to be trapped or disturbed by vessel movements, the vessel will implement appropriate measures to mitigate disturbance, including stoppage of movement until wildlife move away from the immediate area.

A detailed description of mitigations for minimizing Project-related activities on marine mammals are available for review in Baffinland's SMWMP (Baffinland, 2023a). Table 5.1 summarizes these mitigations:

Table 5.1: 2023 Mitigation Measures for Marine Mammals

Project Activity	Mitigation Measure(s)	Species
Vessel traffic to/from Milne Port	• Maintain constant speed and course when possible. • Reduce vessel speed to 9 knots. • Reduce vessel idling. • No more than 3 ore carriers anchoring at Ragged Island and/or drifting in Eclipse Sound. Drifting to be avoided unless warranted for safety reasons.	Ringed Seal, Bearded Seal, Walrus, Beluga, Narwhal, Bowhead Whale, Polar Bear, Sea birds

Project Activity	Mitigation Measure(s)	Species
	• No icebreaking to commence the 2023 shipping season. Ore carriers will not begin their transit to Milne Port until 3/10ths or less ice is present along the entire shipping route through the Nunavut Settlement Area (NSA) from the entrance of Eclipse Sound and Milne Port. • No breaking of landfast ice will occur. • When marine mammals appear to be trapped or disturbed by Project vessel movements, the vessel will implement appropriate measures to mitigate disturbance, including stoppage of movement until wildlife move away from the immediate area (as safe navigation allows). • All Project vessels will be provided with standard instructions to operate their vessel in a manner that avoids separating an individual member(s) of a group of marine mammals from other members of the group. • All Project vessels will be provided with standard instructions to not approach within 300 m of a walrus, polar bear, or large aggregations of sea birds observed on sea ice; • Vessels awaiting instructions from the Port Captain to enter the RSA will be instructed to wait in Baffin Bay at least 40 km east of the Nunavut Settlement Area. • No more than 84 ore carriers will be chartered during the shipping season, pending approval of the Sustaining Operations Proposal (SOP). This is two (2) ore carriers less than the maximum anticipated and approved in the previous Production Increase Proposal (PIP) and Extension (PIPE) requests, but up to four (4) more ore carriers than the maximum anticipated in and approved in the Production Increase Proposal Renewal (PIPR) request. The use of capesize vessels may allow for fewer transits to reach targeted shipments, resulting in a shorter duration of sound exposure within the RSA. • Use of convoys throughout the 2023 season to further reduce total sound exposure. Acoustic monitoring data indicates that if ore carriers transit in convoys with inter-vessel separation less than 10 km, there is an overall reduction of the total sound exposure in the Regional Study Area compared to multiple individual transits of an equivalent number of vessels. Slight increases of instantaneous sound levels in the regions between the vessels are compensated for by shorter exposure duration,	

Project Activity	Mitigation Measure(s)	Species
	resulting in a net decrease of noise exposure (see Appendix F in Baffinland, 2023a). • Continued implementation of established “no-go zones” along the western shore of Milne Inlet and Koluktoo Bay. • Limiting the number of vessels anchored or drifting at Ragged Island to a maximum of three vessels at any time throughout the shipping season, unless there is a need for safety reasons. • Continued restriction of drifting within Eclipse Sound. • Establishment of voluntary speed restrictions (9 knots) for all Project vessels travelling along the Northern Shipping Route to minimize ship wake and disturbance to marine mammal harvesting activities. • Restricting the discharge of grey water by ore carriers or the Botnica anywhere in the RSA; no disposal of waste overboard. • Establishment of a nominal shipping route for all Project-vessels to follow to increase predictability and safe passage for hunters while Project-vessels are present in the Northern shipping corridor (see Figure 5.1). • Restricting the use of scrubbers within the RSA. • Instructing vessels to power off main engines and rely on auxiliary power at anchorage, unless warranted for safety purposes.	

[1]All vessels ranging in size from Capesize to Newcastlemax will be collectively referred to as Capesize*, equivalent to vessel sizes of Deadweight Tonnage (DWT) range of 200,000 – 220,000, and carrying capacity range of approximately 200,000 to 215,000 metric tonnes.

It is important to note that none of the aforementioned mitigations related to vessel movement, should be read in any way as over-riding the Master’s authority and responsibility for safe navigation and management of the vessel.

Baffinland has also developed several mitigation and management measures to directly minimize the effects of the Project on Inuit hunting and harvesting activities and to ensure land user safety in the presence of Project activities.

Mitigation measures include:

- Waiting for confirmation from the MHTO that the floe edge has been closed for hunting prior to the start of the shipping season
- Submitting advanced notice to the MHTO and Hamlet 72 hours & 24 hours in advance of the first anticipated inbound vessels.
- Development of an extensive Internal Communications Shipping Protocol for Shipping Activities (Baffinland, 2021b), that includes the hiring of a **minimum** of four full-time shipping monitors within Pond Inlet who provide community updates on vessel traffic both over community radio and VHF throughout the shipping season.
- Development of a Baffinland Shipping Facebook page to address community concerns related to shipping.

- Weekly sharing of an anticipated approximate 10-day rolling schedule with the MHTO and Hamlet to ensure hunters and community members are aware of transiting vessels.

Figure 5.1: Nominal Shipping Route and Restricted Shipping Areas

- Establishment of 'no-go zones', specifically near Saviit (along shoreline of Bruce Head), which has been identified as an important hunting area (see Figure 5.1).
- Providing fuel to hunters who visit the Project site.
- Providing food, water and shelter at the Project site.
- Support Inuit in identifying, communicating and using safe routes in or around the Project infrastructure.

5.3 IMPACT AND BENEFIT PROGRAMS FOR INUIT

Consistent with Article 12.5.5 (e) of the Nunavut Agreement, Baffinland has also made the following commitments to compensate for Project-effects on Inuit land use that were predicted within the Early Revenue Phase Final Environmental Impact Statement (ERP FEIS) and Production Increase Proposal Extension (PIPE) Amendment Package and have since been reported by community members since the start of the Project.

When Project activities began in 2013, Inuit and the Company acknowledged that impacts to harvesting may occur from the Project. Specifically, Article 13.1 of the Mary River Project Inuit Impact and Benefit Agreement (IIBA) notes the following:

> *"The objective of Article 13 hereof is to ensure that any potential incompatibility of the rights of Inuit to free and unrestricted travel and access for harvesting to all lands, water and marine areas within the Nunavut Settlement Area with the Company's land use activities and rights of navigation in marine areas may be reduced….The QIA recognizes that the Company's right to operate and manage their activity within the Project area including the rail and shipping corridor, subject to the provisions of this Agreement and QIA recognizes the restriction on Inuit right of access under Sections 5.7.18 and 5.7.25 of the NLCA…"*

More specifically, concerns raised relating the discharge of firearms within the Project area are accounted for under Article 13.5.1 of the IIBA, which states the following:

> *"Inuit travelling in or accessing the Project lands shall not discharge firearms or otherwise pursue access for harvesting, within one (1) mile of a Project building, structure or facility, in conformity with Clause 5.7.17 (b) of the Nunavut Land Claim Agreement (NLCA), subject to wider safety or where the access for harvesting, including the discharge of firearms is incompatible with ongoing land use activity of the Company."*

In consideration of these effects, Article 5 (Financial Participation) ensures that Inuit receive a minimum of $1,250,000 quarterly, or $5,000,000 annually, in the form of resource royalties (IIBA 5.6.3, 2018).

Baffinland also provides funding for the Wildlife Compensation Fund (Article 17.6 of the IIBA); with distribution of this fund managed directly by the QIA. One of the stated purposes of IIBA Article 17 is to establish a wildlife compensation fund that QIA, an HTO, or an Inuk may apply to, as an additional remedy to an NLCA claim for wildlife compensation.

The amended IIBA, which was signed after the QIA provided support for the Production Increase Proposal (PIP), also included the establishment of

- Hunters Enabling Fund which provides 300 Liters of fuel to Inuit over the age of 12 residing in Pond Inlet, with an annual maximum value of $400,000. (IIBA 17.7, 2018),
- Marine Research Equipment which will provide each North Baffin Community with a marine vessel after three amortization years of use (IIBA 17.9, 2018), and

- The Wildlife Monitoring Program which provides $200,000 annually to the MHTO to conduct community based research based on a scope and design established by the community and the MHTO, and subsequent approval by the Joint Executive Committee (IIBA 17.8, 2018).

The Marine Research Equipment (IIBA 17.9) and Wildlife Monitoring Program (IIBA 17.8) were developed in part due to the concerns expressed by harvesters and the desire for more community based monitoring that is planned, led, and carried out by Inuit in the North Baffin Communities. This allows for topics of greatest concern to be actively monitored by Inuit.

Moreover, Baffinland, the MHTO, and the Hamlet of Pond Inlet signed the "Agreement to Establish the Pond Inlet Committee"[1] in response to concerns raised during former engagements related to the Production Increase Proposal (PIP). This agreement recognized the desire for improvements to the way in which Project benefits were being distributed to communities. The agreement commits Baffinland to providing $10,000 to the Tasiuqtiit Working Group (TWG), managed by the MHTO and Hamlet of Pond Inlet, for every ore carrier required to ship in excess of 4.2 Mtpa. Since its signing, this Agreement has led to the direct disbursement of $800,000 to the community of Pond Inlet ($130,000, $240,000, $170,000, $190,000, and $70,000 for years 2018, 2019, 2020, 2021, and 2022, respectively). Baffinland has also committed to providing funding of up to $50,000 towards a TWG Fund Administrator position for this group to support the functioning and disbursement of funds for up to 3 years, though at this time, the position remains unfilled. While Baffinland is currently only approved to ship 4.2 million tonnes, this agreement will be reinstated should the Project be approved to ship above 4.2 Mtpa.

[1] This agreement led to the creation of Tasiuqtiit Working Group (TWG).

6 MONITORING PROGRAM REVIEW

6.1 MARINE MONITORING PROGRAM ENGAGEMENT ACTIVITIES

Section 4 summarizes Baffinland's 2023 engagement activities with the community of Pond Inlet and other Parties, including the MEWG. Five notable outcomes resulted from these engagement activities:

1. MHTO sought approval to participate in the MMASP on June 29, 2022 as part of a MEWG meeting. Baffinland committed to providing an opportunity for MHTO to participate in future aerial surveys and secured a position on Leg 2 of the 2023 MMASP for a MHTO member. This participation is tentative pending approval for site deployment. Should MHTO be unable to participate, Baffinland will seek participation from the Ikajutit Hunters and Trappers Association for participation in Leg 2 or Leg 3 aerial surveys.
2. Baffinland respects the MHTO's proposal to have all organizations suspend the deployment or remove any recording devices from Eclipse Sound and Milne Inlet in the same season on a trial basis, and is committed to work with the MHTO and other organizations to coordinate such an undertaking. In the interim, Baffinland must meet its monitoring obligations as outlined in Project Certificate 005, which requires monitoring of the acoustic environment, especially where data gaps have been identified and can be addressed.
3. Baffinland did not propose a narwhal tagging program for 2023 due to a lack of support for the program in 2022. At the February 2023 MEWG meeting, the MHTO indicated program support if led by the DFO. Baffinland remains open to collaborating with both the MHTO and DFO to execute a narwhal tagging program in future years.
4. Baffinland purchased three, higher resolution cameras for the 2023 MMASP that will allow for the photographic identification of individual marine mammals. This analysis maybe completed by the DFO. Baffinland will be conducting aerial surveys within the RSA throughout the 2023 shipping season, while DFO will be conducting regional surveys.
5. Baffinland recognizes concerns from community and MEWG members regarding cortisol levels in narwhal. Bafflinland supports the sampling of cortisol in narwhal and is actively working to engage the MHTO in providing study design input for a future sampling program.

More generally, historical engagement with the MHTO and the MEWG throughout 2022 and 2023 also resulted in the following key changes to the 2023 marine monitoring programs:

1. The 2023 zooplankton study design for the Marine Environmental Effects Monitoring Program (MEEMP) program was revised to incorporate feedback from the DFO. This included adding additional monitoring stations and an additional sampling event, for a total of 6 monitoring stations and 3 sampling events, to increase spatial and temporal variability.
2. Elimination of the proposed floe-edge narwhal tagging program for the 2022 season.
3. A third year of morphometric data collection of body condition via the drone program at Bruce Head in summer 2023.
4. Delineation of the propeller wash scour adjacent to SW-02 where changes in sediment grain size have been observed.
5. Addition of 12 quadrats for benthic epifauna and epiflora monitoring as per the MEEMP.

6. Baffinland marine consultants, WSP, will continue attempts to establish a suitable reference area for the fish health program (component of the MEEMP) in 2023.
7. Continued participation in the Marine Mammal Observation Network (MMON) to ensure that marine mammal distribution, occurrence, relative abundance and behavioural responses are captured in the event that ice conditions prevent the completion of the Shipboard Observer Program (SBO).
8. Establishment of the collaborative DFO ballast water biological sampling pilot program, which involves onboard sampling of ballast tanks for ore carriers with treatment systems.

6.2 2023 MONITORING ACTIVITIES

Baffinland has several marine mammal monitoring programs designed to assess the effects of Project shipping activities on marine mammals. The marine mammal monitoring programs outlined in Table 6.1 will be implemented during the 2023 shipping season. These programs will serve to further Baffinland's understanding of project related and cumulative effects to narwhal in the Regional Study Area:

Table 6.1: Summary of 2023 Marine Mammal Monitoring Programs

Program	Basic Description	2023 Follow-up Monitoring Priorities/ Considerations
Bruce Head Shore-Based Monitoring Program (Visual)	Visual Observations: • Relative Abundance and Distribution (RAD) • Group Composition and Behaviour • Human Activity ○ Vessel Traffic ○ Hunting • Weather and Anecdotal Observations Project-related vessels tracked via both satellite and shore-based AIS Estimated Start Date: July 26th Estimated Duration: 4 weeks	• Monitor for local change in relative abundance and animal distribution including interannual variation • Monitor behavioural responses to shipping and other stressors (hunting, predation) • Monitor Early Warning Indicator (EWI): change in the proportion of immature narwhal between years – was calving or calf survival potentially impacted based on observations made in 2023, noting that exact causal factor remains unknown since narwhal utilize habitats in the RSA temporarily for only ~up to 4 months per year (i.e., 1/3 of the year), and is dependent on ice conditions. Potential for spatial and temporal interaction with Baffinland shipping activities are therefore limited to the RSA and days over which shipping is occurring.

Program	Basic Description	2023 Follow-up Monitoring Priorities/ Considerations
Bruce Head Shore-Based Monitoring Program (includes Unmanned Aerial Vehicle [UAV])	UAV Observations: • Focal Follows – Northern Shipping Route, Koluktoo Bay Systematic Survey – Stratified Study Area (SSA)Morphometrics – Body Condition Proposed system by InDro Robotics: DJI M300 Estimated Start Date: July 26th Estimated Duration: 4 weeks	• Monitor narwhal behaviour in the presence and absence of vessels – do individual narwhal or narwhal pods modify their behaviour in the presence/absence of vessels in the open-water shipping season (multiple response variables examined)? • Does the distance at which individual narwhal or narwhal groups react to vessels differ from past years, irrespective of the overall abundance of narwhal in the RSA? Do narwhal react to vessels in a similar manner to previous years? • Collect second year of morphometric data to contribute towards a narwhal body condition monitoring program (base year is 2021). The photogrammetric data collection of narwhal (morphometric baseline data) using UAV will be used to monitor for potential interannual and seasonal changes in narwhal body condition (variable length/width measurements along body) that would indicate food/foraging success and/or stress response, noting that narwhal spend only spend up to 1/3 of their year in the RSA with overlapping shipping activities.
Marine Mammal Aerial Survey Program (Leg 1)	• Open-water and floe edge area east of Pond Inlet; Pond Inlet and Baffin Bay strata • Line-transect surveys – data recorded by onboard marine mammal observers (MMOs) • Transition to photographic surveys when large animal	• Monitor narwhal relative abundance and distribution in the RSA prior to and during the early part of the season. Allows comparison to previous year(s) (interannual variation). • Collect simultaneous data on sea ice conditions and killer whale

Program	Basic Description	2023 Follow-up Monitoring Priorities/ Considerations
	aggregations encountered (same as 2019-2022 survey design) Estimated Start Date: July 19th Estimated Duration: 14 days	data, which allows for these factors to be considered in the analysis. • The 2023 Leg 1 aerial surveys will last two weeks and end one week prior to Leg 2 aerial surveys (separate 2-week survey), which will allow for abundance estimates in the RSA throughout the season from the start of shipping operations. • Narwhal sightings data will be used to inform shipping schedule and shipping routing such to avoid concentrations of narwhal in ice leads (if present), though this benefit will be limited in 2023 given that ore carriers will only enter the RSA once specific ice concentration conditions have been met (i.e,3/10ths ice concentrations).
Marine Mammal Aerial Survey Program (Leg 2)	• Same strata as 2016 DFO photographic aerial survey and 2019-2022 BIM aerial survey • Line-transect surveys – data recorded by onboard MMOs • Transition to photographic surveys when large animal aggregations encountered (same as 2019-2022 survey design) Estimated Start Date: August 9th Estimated Duration: 14 days	• Updated abundance estimate for the Eclipse Sound and Admiralty Inlet narwhal summer stocks – compare abundance estimates to previous years. • Survey design and data collection methodology previously developed by Fisheries and Oceans Canada (DFO) (Matthews et al. 2017; Marcoux et al. 2016; Doniol-Valcroze et al. 2015; Asselin and Richard 2011; Golder 2020, 2021; WSP, 2022a) will be used for Leg 2 to allow for a comparison to previously reported abundance estimates.
Marine Mammal Aerial Survey (Leg 3)	• 2-3 days of narwhal clearance flights in RSA at end of shipping	• Visual clearance survey to confirm that no narwhal entrapment

Program	Basic Description	2023 Follow-up Monitoring Priorities/ Considerations
	season – data recorded by onboard MMOs. • No dedicated or systematic transects. Surveys are flown along the Northern Shipping Route within fjords and in areas where previous entrapment events have been recorded. • Transition to photographic surveys when large animal aggregations encountered (same as 2019-2022 survey design) Estimated Start Date: End of 2023 Shipping Season Estimated Duration: 2 days	events have occurred in the RSA following completion of Baffinland's 2023 shipping operations along the Northern Shipping Route.
Passive Acoustic Monitoring Program	Deployment of two recorders near Bruce Head and Ragged Island late July early August. • Will record marine mammals, as well as shipping and tourism activities throughout the shipping season. • Will record until early October 2023 to capture potential cape-sized vessels. Acoustic recorders will be retrieved in October, 2023 to download the acoustic monitoring data to ensure that results can be shared in the 2023 annual monitoring reports. • the recorders will be re-deployed following the data download in October 2023. The recorders will overwinter to capture potential dual icebreaker transits at the end of the shipping season. • If overwintering, recorders will record until July, 2024 to capture the initial inbound vessels for the 2024 shipping season.	• Measure and characterize ambient noise levels along the Northern Shipping Route – compare the data to previous years. • Acoustically monitor for marine mammal presence, notably narwhal, along the shipping corridor – document spatial and temporal variability in the RSA. • Evaluate underwater noise levels from Project shipping and noise levels in relation to established marine mammal underwater acoustic thresholds for injury and onset of disturbance. • Estimate the extent of listening range reduction (LRR) associated with vessel transits along the Northern Shipping Route relative to ambient noise conditions. • Compare measured sound levels of shipping to estimated (modelled) sound levels. • Evaluate vessel noise signatures and potential changes in narwhal

Program	Basic Description	2023 Follow-up Monitoring Priorities/ Considerations
	Estimated Start Date: July 19th, 2023 Estimated Duration: Either 3 or 12 months	vocal behaviour in relation to shipping.
Ship-Board Observer (SBO) Program	• Marine wildlife observers (MWOs) will record systematic marine mammal and seabird observations from the enclosed bridge of the MSV Botnica. • Surveys will be conducted throughout Milne Inlet and Eclipse Sound along the Northern Shipping Route. • In addition to MWO watch periods, the WSP biologists will perform dedicated seabird surveys throughout the daily watch schedule, which will be conducted in accordance with the Canadian Wildlife Service (CWS) Eastern Canadian Seabirds at Sea (ECSAS). Estimated Start Date: October 10th, 2023 Estimated Duration: 14 days	• Estimate relative representation of species • Assess presence, relative abundance, distribution, and behavioural response of narwhal *(Monodon monoceros)* and other marine mammals to vessel traffic and associated activity during the 2023 shipping fall shoulder season. • Compare abundance estimates to previous years (last SBO program completed in 2019)

Figure 6.1: 2022 Bruce Head Shore-Based Program Field Researchers Conducting Visual Observations

Figure 6.2: Still Frame Taken During Focal Follow Survey Showing Group of Narwhal of Mixed Age and Sex on 17 August, 2022 (10:30)

6.3 INUIT PARTICIPATION AND COMMUNITY BASED MONITORING

6.3.1 Inuit Participation in Marine Monitoring Programs

The integration of local Inuit knowledge in field program design is essential for all environmental monitoring programs to be successful. As part of this task, WSP (Baffinland's marine consultants) and Baffinland aim to engage with the Mittimatalik Hunters and Trappers Organization (MHTO) prior to commencing all programs to receive input on the program components. Prior to all field work, WSP will request a Letter of Approval from the MHTO in order for the programs to proceed following receipt of the approval. The letter seeking approval was sent and hard copies provided to the MHTO, and approval was provided in writing on July 5th, 2023. WSP includes Inuit participants in field monitoring programs to ensure that Inuit Qaujimajatuqangit is incorporated. Inuit participation for the 2023 monitoring programs is as follows:

- Marine Mammal Aerial Survey (Leg 1) – 2 participants
- Marine Mammal Aerial Survey (Leg 2) – 2 participants (tentatively a 3rd participant from MHTO—to be confirmed)
- Marine Mammal Aerial Survey (Leg 3) – tentatively 2 participants. Logistics for this program are still being finalized at the time of this report and Inuit representation may change.
- Bruce Head Shore-based Monitoring Program (visual and UAV) – 10 participants, 5 of which are Baffinland and Qikiqtani Inuit Association (QIA) employees.
- Passive Acoustic Monitoring Program – 0 participants, as this is a limited-scope program that only requires 2 participants
- Ship-based Observer Program (SBO) – 1 participant. Logistics for this program are still being finalized at the time of this report and Inuit representation may increase.

In addition, Baffinland has expanded its community-based shipping team in Pond Inlet to include eleven shipping monitors for the upcoming 2023 season, These shipping monitors are based out of the MHTO office building and act as a liaison between community members, hunters, and Baffinland. A community-based Environmental Coordinator was hired in November 2021 to provide a community-based contact in Pond Inlet for residents to engage directly with Baffinland on any environmental matters. This position remains filled and the Pond Inlet Environmental Coordinator continues to be involved in Marine and Terrestrial Working Group Meetings, community engagements, and marine monitoring programs.

6.3.2 Support for Community-Based Monitoring Programs

In 2018, as part of updates to the Inuit Impact Benefit Agreement (IIBA) for the Mary River Project (the Project), Baffinland established the Wildlife Monitoring Program (Article 17.8 of the IIBA), which is a community-based monitoring program, specific to the research interests of the community of Pond Inlet. Baffinland looks forward to considering the results of these community-driven monitoring efforts into the design of future monitoring programs led by Baffinland and as part of contributions to overall adaptive management practices adapted by Baffinland. As results from the community-based monitoring programs become available, Baffinland will seek to work with the MHTO to conduct a comparison of results, where appropriate. Prior to implementing any programs in a given year, the community of Pond Inlet is responsible for developing an annual work plan, which is then presented to the Joint Executive Committee (Baffinland and QIA) (JEC) for review and approval.

7 AQUATIC INVASIVE SPECIES / NON-INDIGENOUS SPECIES MONITORING

7.1 2022 AQUATIC INVASIVE SPECIES / NON-INDIGENOUS SPECIES MONITORING PROGRAM RESULTS

All specimens caught or observed during biological surveys conducted for the 2022 monitoring program (including benthic infaunal samples from twelve stations, benthic epifauna and macroalgae from 26 quadrats and opportunistic incidental sampling conducted during SCUBA surveys of the quadrats, six zooplankton samples, flora and fauna from 31 settlement plates and 21 settlement baskets, fish collected by Fukui trap, hoop net, gillnet, angling and trawling, and analysis of fish gut contents) were compared against the existing taxonomic inventory for Milne Inlet to detect potential non-indigenous species (NIS) or aquatic invasive species (AIS).

To date, the taxonomic inventory for Milne Inlet consists of approximately 880 taxa detected by Baffinland's monitoring programs. Nine of the 362 unique taxa detected in 2022 had not been seen in previous surveys of Milne Inlet, but were reported elsewhere in the Canadian Arctic.

The newly recorded taxa included: two fish species, Half-barred Pout (*Gymnalus hemifasciatus*) and Spatulate Sculpin (*Icelus spatula*); a parasitic worm in the class Cestoda, found in a fish stomach; the tunicate *Halicynthia pyriformis*; the anemone *Stompis* sp.; the bivalve *Musculus glacialis*, the snail *Margarites groenlandicus umbilicalis*; as well as the polychaete worm *Myrianida* sp. Two species on the watch list were collected during the 2022 MEEMP—*Hesperonoe* sp., which was first recorded in Milne Inlet in 2020 and was collected again in 2022; and *Marenzelleria* sp., which was identified at two stations in 2022. *Hesperonoe* sp. was placed on the watch list as it is a poorly described species with limited geographic data. *Marenzelleria* sp. was placed on the watch list due to the globally high risk of invasion of the species *Marenzelleria viridis*, however, this species has not been detected at Milne Inlet.

The *Marenzelleria* specimens collected in 2022 lacked the features required to identify them to species, but to date the only two *Marenzelleria* species confirmed to be present in Milne Inlet are Arctic species which are not considered to be high risk species. Collections in 2022 also included a bryozoan from the superfamily Buguloidea, a group which includes species previously identified in Milne Port with confirmed natural ranges in the Eastern Canadian Arctic, as well as the species of concern *Tricellaria inopinata*. It is likely that the Buguloidea specimens from Milne Inlet represent a Canadian Arctic species, however specimens have been sent to Laval University for independent review, consistent with the DFO recommended protocol, and results will be shared with the MEWG once received. Appendix 8A-1 of the Final 2022 Marine Environmental Effects Monitoring Program (MEEMP) Report (WSP, 2023b) shows a complete list of identified taxa. The number of collected specimens and the respective sampling locations are listed in Figure 8-2 and Table 8.1 of the Final 2022 MEEMP report (WSP, 2023b). The finalized report is publicly available on the NIRB Registry and MEWG members had until July 11th, 2023 to provide comments on the report. Upon release of comment feedback, Baffinland will have 30 days to respond in writing. These responses will be shared with the MEWG and additional follow-up will occur if required.

7.2 2023 AQUATIC INVASIVE SPECIES / NON-INDIGENOUS SPECIES MITIGATION AND MONITORING

In 2023, Baffinland will continue to require all ore carrier vessels with treatment systems to perform both a ballast water exchange and treatment as part of ongoing management and mitigation measures aimed at reducing/eliminating the potential risk of introduction of aquatic invasive species at Milne Port. Baffinland intends to continue implementation of its Ballast Water Management Plan (Baffinland, 2019) in 2023, which includes monitoring for compliance with D-1 Regulations on all Project vessels prior to discharge of ballast water at Milne Port. Baffinland will also continue to implement monitoring of aquatic invasive species/non-Indigenous species (AIS/NIS) sampling at Milne Port in 2023 through marine sediment quality and benthic infauna sampling, as per the

MEEMP. Additionally, Baffinland will be collaborating with the DFO to conduct a two week pilot program involving the biological sampling of ballast water onboard vessels with treatment systems. This program will also involve engagement with Pond Inlet community members to provide hands-on experience, training, and share preliminary findings.

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APPENDIX 1
2023 SHIPPING AND MARINE MONITORING SUMMARY

ᐅᒥᐊᕐᔪᐊᕐᑲᕐᓇᕐᒥᒃ ᑕᕆᐅᕐᒥᓪᓗ ᖃᐅᔨᓴᖅᐸᔅᓯᐊᖅᑭᓐᓇᕐᓂᕐᒧᑦ ᓇᐃᓈᖅᓯᒪᔪᑦ

2023-ᒥ ᐅᒥᐊᕐᔪᐊᕐᑲᕐᓇᖅ

ᐹᕙᓐᓛᓐᑯᑦ ᐊᐅᓪᓚᖅᑎᑦᑎᖃᑦᑕᕐᓂᖕᒋᑦ

ᐃᓗᓕᖕᒋᑦ

ᐸᕐᕕᓐᓛᓐᓱᑦ ᐅᒥᐊᕐᓂᐊᖅᑎᑕ ᐱᓕᕆᓂᖅᑎᑦ

2023-ᒥᑦ ᐸᕐᕕᓐᓛᓐ ᓴᕕᓴᖅ ᐅᔭᕋᖕᓂᐊᖅᕕ ᑯᐊᐳᕆᓴᑦ (“ᐸᕐᕕᓐᓛᓐ ᐅᕝᕙᓗᓐᓂ ‘ᑲᒻᐸᓂ’) ᐅᒥᐊᖅᔪᐊᖅᑎᑦ ᐱᓕᕆᑎᐊᕐᓂᐊᖅᑐ ᐱᔭᕆᐊᑭᑦᑐ ᐊᑐᓕᕐᑯᔭᐅᔪᑦ ᐱᐊᓂᒃᓯᒪᓕᖅᐸᑕ, ᐃᓚᐅᓪᓗᓂ ᑕᐃᑲᓂᑦᑐᕐᑲᕆᐊᕐᑲᖅᑎᑦᑐᖅ ᑐᕙᕐᑲᕇᓐᓂᖅᐸᑦ ᑕᐃᑲᓂ ᐅᑭᐅᖅᑕᖅᑐᒥ ᐊᖅᑯᑕᐅᒐᔪᕐᑐᖅ ᐅᒥᐊᕐᔪᐊᓄᑦ ᐊᒻᒪᓗ ᓇᓗᓇᐃᖅᑕᐅᓗᓂ ᒥᑦᑎᒪᑕᓕᖅᒥᐅ ᓯᓈᖓ ᒪᑐᓯᒪᓕᖅᑐᖅ.

2023–ᒥ, ᐱᔭᕆᐊᑭᑦᑐᑦ ᐊᑐᕆᐊᕐᑲᖅᑕᐅᓯᒪᔪᑦ ᐱᐊᓂᒃᓯᒪᓕᖅᑐᑦ, ᐸᕐᕕᓐᓛᓐ ᓴᕕᒃᓴᓂᒃ ᐅᔭᕋᖕᓂᐊᖅᑏᑦ ᑯᐊᐳᕊᓴᖓ (“ᐸᕐᕕᓐᓛᓐ ᐅᕝᕙᓘᓐᓃᑦ ᑲᒻᐸᓂ”) ᐅᒥᐊᕐᔪᐊᖅᑎᑦ ᐱᓕᕆᓯᕆᐊᕐᓂᐊᖅᑐᑦ. ᑕᒪᒃᑯᐊ ᐊᑐᖅᑕᐅᔭᕆᐊᓖᑦ ᐱᕐᑲᓯᐅᔾᔮᔪᑦ ᑐᕙᕐᑲᕇᓐᓃᖅᐸᑦ ᐅᑭᐅᖅᑕᖅᑐᒥ ᐅᒥᐊᕐᔪᐊᓄᑦ ᐊᖅᑯᑕᐅᓲᓕᒫᒥ, ᐊᒻᒪᓗ ᒥᑦᑎᒪᑕᓕᐅᑉ ᓯᓈᖓ ᒪᑐᓯᒪᓕᖅᐸᑦ.

ᐸᕐᕕᓐᓛᓐᓱᑦ ᐊᑐᓕᖅᑎᑎᓖᓐᓇᕐᓂᐊᖅᑐᑦ ᐊᒃᑐᐃᓗᐊᖅᑕᐃᓕᒫᔪᑎᓂᒃ 2023 ᐅᒥᐊᕐᔪᐊᕐᑲᕐᓇᒥ ᑭᐅᑲᐅᑎᕆᓇᓱᐊᖅᓗᑎᑦ ᐃᓄᐃᑦ ᐅᕐᑲᕐᑲᑦᑕᖅᑕᖅᑎᑦ. ᒥᒃᓵᑎᐊᖅᑎᑦᑎᓯᒪᓇᓱᒃᓗᑎᒃ ᑲᑎᑉᐸᑦᓕᐊᔪᓂᒃ ᐊᒃᑐᐃᓂᕐᓂᒃ ᐱᓕᕆᐊᒥ ᑐᓛᓕᖕᓄᑦ ᐃᒃᐱᖕᓂᖅᓴᕋᐃᑎᓪᓗᑎᑦ, ᐸᕐᕕᓐᓛᓐᓱᑦ ᑭᖑᕙᕆᐊᖅᓯᓯᒪᓂᐊᖅᑐᑦ ᐅᒥᐊᕐᔪᐊᕐᑲᕐᓇᒥ ᑭᓯᐊᓂ ᓯᑯᓂᒃ ᐊᔭᐅᖅᑐᐃᓂᖅ ᐊᑐᖅᑕᐅᔭᕆᐊᕐᑲᓐᓃᕈᓂ ᓴᕕᒃᓴᓂᒃ ᐅᓯᔪᒃᓴᑦ ᐃᖅᑭᕋᕙᓪᓕᐊᑎᓪᓗᑎᑦ ᕿᓐᖑᐊᓂ ᑐᓚᒃᑕᕐᕕᖓᓪᓗ, ᑕᐃᒪᐃᓚᐅᖅᓯᒪᖅᒪᑕ 2021-ᒥ ᐊᒻᒪᓗ 2022-ᒥ. ᑕᒪᑐᒥᖓ ᐃᓱᒪᓕᐅᕈᑎᒎᑦ, ᐱᑎᐊᖅᑎᑦᑎᔾᔪᑏᑦ ᑲᔪᓯᑎᐊᖅᐸᓪᓕᐊᓂᕐᒍᑦ 2023-ᒥ ᐅᒥᐊᕐᔪᐊᕐᑲᕐᓇᒥ ᓯᑯᕐᑲᖏᓪᓗᓂ ᑭᓯᐊᓂ ᐃᖅᑭᕋᐃᓐᓇᕈᓐᓇᕐᓗᑎᒃ 3/10th ᑐᖖᓂᓗᓐᓃᑦ ᓯᑯᕐᑲᕐᓂᖓ ᐊᑯᓐᓂᖓᓂ ᑕᓯᐅᔭ ᐊᒻᒪᓗ ᕿᖑᐊᓂ ᑐᓚᒃᑕᕐᕕᖕᒥ. *ᓯᑯᓯᐅᑎ ᐊᑐᖅᑕᐅᔾᔭᖅᑎᑦᑐᖅ ᓯᑯᓂ ᓯᖅᑯᑦᑎᕆᖅᑎᓪᓗᓂ ᐊᒻᒪᓗ ᒪᓕᒃᑕᐅᓗᑎ ᓴᕕᒃᓴᒥ ᐅᓯᕙᒃᑐ ᓯᑯ ᐊᖅᑭᓂᖅᓴᐅᒍᓂ 3/10th ᑐᕙᕐᑲᕐᓂᖓᓂ. 2022-ᒥ ᐸᕐᕕᓐᓛᓐᓱᑦ ᓴᖅᑮᓯᒪᔪᑦ ᐊᑐᕐᓂᕐᒥᒃ ᐅᒥᐊᕐᔪᐊᑦ ᑭᖑᓕᕆᑦᑎᐊᖑᓪᓗᑎᒃ ᐊᑕᐅᑦᑎᒃᑰᖅᑐᓂᒃ, ᐅᒥᐊᕐᔪᐊᑦ ᐃᖅᑭᕋᕐᑲᑦᑕᕐᓗᑎᒃ ᑲᑎᙱᓗᑎᒃ ᐅᒥᐊᕐᔪᐊᕐᑲᕐᓇᒥᓗᒃᑖᖅ. ᑖᓐᓇ ᑲᑎᓗᒃᑖᖅᓘᒍ ᐃᒫᓂ ᓂᐱᕐᑲᖅᑎᑦᑎᓂᒃ ᒥᒃᓵᑎᐊᖅᑎᑦᑎᓯᒪᓇᓲᑎ, ᐅᓄᕈᓐᓃᖅᑎᑎᐊᕐᓗᑎᑦ ᑕᑯᕐᑲᑦᑕᐅᑎᕐᑲᑦᑕᕐᓃᑦ ᐊᖑᓇᓱᒃᑎᓂᒃ, ᐊᒻᒪᓗ ᑭᒡᓕᓕᕐᓗᑎᑦ ᖃᔅᓯᐅᓂᖅᑎᑦ ᐅᒥᐊᕐᔪᐊᑦ ᑕᑯᔭᐅᕐᑲᑦᑕᖅᑐᑦ. ᐸᕐᕕᓐᓛᓐᓱᑦ ᐊᑐᓕᖅᑎᑦᑎᓂᐊᖅᑐᑦ ᐅᒥᐊᕐᔪᐊᓂᒃ ᑭᖑᓕᕆᑦᑎᐊᖑᓪᓗᑎᒃ ᐊᑕᐅᑦᑎᒃᑰᖅᑐᓂᒃ ᑕᐃᒪᐃᑦᑐᓐᓇᑐᐊᕌᖓᒥᒃ 2023-ᒥᓗᒃᑖᖅ ᐊᑦᑕᕐᓇᙱᑦᑖᖓᑦ ᐊᒻᒪᓗ ᐊᔪᕐᓇᙱᑦᑐᐊᕌᖓᑦ.

ᑭᖑᓪᓕᖅᐹᖅᓯᐅᑎ ᐅᒥᐊᕐᔪᐊᕐᑲᕐᑲᑦᑕᕐᓇᒍᑦ ᐅᓪᓗᒃᓴᖅᑎᑦ ᒪᓕᖕᓂᐊᖅᑐᑦ ᓯᑯᕐᑲᐃᓐᓇᕐᓂᖓ ᕐᑲᓄᐃᓕᖕᒐᓂᖓᓄᑦ. ᐱᑎᐊᖅᑕᐅᒍᓂ, ᐅᒥᐊᕐᔪᐊᕐᑲᕐᑲᑦᑕᕐᓇᖅ ᑲᔪᓯᓂᐊᖅᑐᑦ ᓇᓚᐅᑦᑖᖅᑕᐅᓯᒪᔪᖅ ᐅᑐᐱᕆᐅᐸ ᕿᑎᖕᒐᓕ-ᓄᙳᐊᓄᓪᓘᓐᓃᑦ, ᐅᒥᐊᕐᔪᐊᓗᒃᑖᑦ ᐊᐅᓪᓚᕐᓗᑎᒃ ᓄᓇᓂ ᐊᕕᒃᑐᖅᓯᒪᔪᓂ ᖃᐅᔨᓴᕐᕕᐅᔪᓂ ᐅᖓᑖᓂᐅᙱᑦᑐᑦ ᐅᑐᐱᕆ 31, 2023. ᐸᕐᕕᓐᓛᓐᓱᑦ ᐊᖏᖅᑕᐅᒃᐸᑕ ᐅᓯᒃᖅᑕᕐᓂᕐᒧᑦ 6.0 ᒥᓕᐊᓐ ᑕᓐᓯᓂᒃ (ᐊᒻᒪᓗ ᐊᒥᐊᒃᑯᐃᑦ ᓴᕕᒃᓴᑦ 2022-ᒥᖕᓘᖅᑐᑦ) ᓇᓗᓇᐃᔭᖅᑕᐅᓯᒪᔪᑦ ᑲᔪᓲᓐᓇᕈᓐᓇᖅᑐᒃᑯᑦ ᐊᐅᓚᓂᕐᑲᕐᓂᕐᒧᑦ ᑐᒃᓯᕋᐅᑦ ᑕᑕᑎᖅᑕᐅᓯᒪᔪᒥ, ᓂᕆᐅᒋᔭᐅᓚᕋᔭᖅᑐᑦ ᑎᑭᓪᓗᒍ 84–ᓄᑦ ᓴᕕᒃᓴᓂᒃ ᐅᓯᔪᒃᓴᑦ 2023-ᒥ ᐅᒥᐊᕐᔪᐊᕐᑲᕐᓇᓗᒃᑖᒥ.

ᑐᓴᕐᑲᑎᒋᒍᑎᒋᓯᒪᔭᓯ ᐅᕙᑦᑎᓐᓄᑦ

ᐱᒻᒪᕆᐅᓂᖕᒐᓄᑦ ᐅᕐᑲᕐᑲᑎᕐᑲᓚᐅᖅᑎᓪᓗᑕ ᓄᓇᓕᖕᓂ ᐃᓚᒋᔭᐅᔪᓂᒃ, ᐸᕐᕕᓐᓛᓐᓱᑦ ᑐᓴᖅᓯᒪᕗᑦ ᐊᒥᓱᒐᓕᖕᓂᒃ ᐃᓱᒫᓘᑕᐅᓪᓗᐊᑕᐅᔪᓂᒃ ᐊᒃᑐᐊᔪᓄᑦ ᐅᒥᐊᕐᔪᐊᑦ ᐅᑭᐅᖅᑕᖅᑑᑉ ᐊᖅᑯᑎᕆᕙᒃᑕᖅᑎᓐᓂ:

ᐅᒥᐊᕐᔪᐊᑦ ᓄᓇᓕᖕᓂ ᐊᖑᓇᓱᒃᑎᓂᒃ ᐅᓚᕕᓴᐃᖅᑲᑦᑐᐃᓐᓇᕆ ᐊᕐᑲᕐᓂᖅᑎᓐᓂᒃ

ᐳᔪᖅ ᐊᒃᑐᐃᓂᖅᑲᖅᑎᑦᑎᑐᐃᓐᓇᕆ ᐊᕐᑲᕐᓂᖓ ᑕᕆᐅᐸ ᐊᕙᑎᖕᒐᓂᒃ, ᐱᖅᑲᓯᐅᑎᓪᓗᑎᑦ ᐃᒥᖅ ᐃᓱᕐᓂᖕᒐᑕᓗ ᐱᐅᓂᖓ, ᐊᒻᒪᓗ ᑕᕆᐅᕐᒥ ᐆᒪᔪᕋᓛᖅᑎᑦ

ᐅᒥᐊᕐᔪᐊᑦ ᐊᒃᑐᐃᓂᖅᑐᐃᓐᓇᕆᐊ ᖃᕐᓂᖅᑎᑦ ᑕᕆᐅᕐᒥ ᐳᐃᔾᔨᓂᒃ

ᐅᒥᐊᕐᔪᐊᑦ ᐱᓕᕆᓂᖅᑎᑦ ᓯᕋᖅᑎᑦᑐᐃᓐᓇᕆᐊᖅ ᕐᓂᖅᑎᓐᓂᒃ ᖃᓄᐃᙵᑎᐊᕐᓂᖅᑎᓐ ᓂᒃ ᑕᕆᐅᕐᒥ ᐆᒪᓂᖅᑲᖅᑐᑦ ᓇᔪᖕᒋᓐᓂᒃ

ᐃᓱᒫᓘᑎᓂᒃ ᐱᓕᕆᐊᖃᕐᓂᖅ

ᖃᓄᐃᓕᐅᖅᓯᒪᕙᑦ ᐹᕙᓖᓐᑯᑦ ᑲᒪᓯᒃᑎᓪᓗᒋᑦ ᑕᒪᒃᑯᓂᖓ ᐃᓱᒫᓗᑕᐅᔪᓂᒃ?

ᐹᕙᓖᓐᑯᑦ ᐊᕐᕆᖅᓯᒪᔪᑦ ᖃᐅᔨᓴᖅᐸᓪᓕᐊᕆᓐᓇᖃᑦᑕᕐᓂᐊᕐᓗᑎᒃ ᐊᒃᑐᐃᓂᐅᑐᐃᓐᓇᕆᐊᓕᖕᓂᒃ ᐅᒥᐊᕐᔪᐊᑦ ᐱᓕᕆᓂᖕᕆᓐᓂᑦ. ᐅᑯᐊ ᑕᕝᕙ ᐃᓚᖕᒋᑦ ᐱᓕᕆᔾᔪᒻᒋᑦ ᐊᑐᓕᖅᑎᑕᐅᓂᐊᖅᑐᑦ:

1. ᐹᕙᓖᓐᑯᑦ ᐅᒥᐊᕐᔪᐊᕐᒋᑦ ᑐᕙᐃᓴᐃᔅᓭᕆᑦᑐᑦ ᐅᑕᖅᑮᓗᑎᓪᓗ ᓇᓗᓇᐃᖅᑕᐅᓂᖓᓂᒃ ᓯᓈᖓ ᒪᑐᔭᐅᓂᖓᓄᑦ ᑕᓯᐅᔭᕐᒧᐊᓚᐅᖅᑳᖅᑎᓐᓇᒋᑦ. 2022–ᒥ, ᐅᒥᐊᕐᔪᐊᕐᑲᕐᓇᖅ ᐱᒋᐊᑕᐃᓐᓇᕐᓗᓂ ᓇᓗᓇᐃᖅᑕᐅᒃᐸᑦ 3/10–ᖑᓕᕐᓂᖓᓂᒃ ᑐᖕᓕᓂᓗᓐᓃᑦ ᓯᑯᐃᑦ ᐊᑯᓐᓂᖓᓂ ᐃᓯᕆᐊᕙᐊᑕ ᑕᓯᐅᔭᐅᑉ ᐊᒻᒪᓗ ᕿᑭᖑᐊᓂ ᑐᓚᑦᑕᕝᕕᒥ.

2. ᐅᒥᐊᕐᔪᐊᑦ ᑭᖑᓕᕇᑦᑎᐊᖑᓪᓗᑎᒃ ᐊᑕᐅᑦᑎᒃᑯᖅᑐᑦ ᐊᒻᒪᓗ ᐊᕐᕆᓂᖅᓴᑦ ᐊᑐᖅᑕᐅᔪᓐᓇᕐᖓᓚᑕ ᐊᑐᖅᑕᐅᓗᑎᒃ ᒥᒃᓵᕆᐊᖅᓯᓯᒪᓯᑯᓪᓗᒋᑦ ᑲᑎᓗᒃᑖᖅᔪᒋᑦ ᐃᒫᓂ ᓂᐱᖃᖅᑐᑦ ᐊᒻᒪᓗ ᐅᓄᕈᓐᓃᖅᑎᕆᐊᕐᓗᒋᑦ ᑲᑎᓗᒃᑖᖅᔪᒋᑦ ᖃᔅᓯᐅᓂᕆᑦ ᐅᒥᐊᕐᔪᐊᑦ ᐅᒥᖅᑕᖅᑐᑦ.

3. ᐅᒥᐊᕐᔪᐊᑦ ᒪᓕᖕᓂᐊᖅᑐᑦ ᐊᕐᕆᖅᑕᐅᓯᒪᔪᒥᒃ ᐅᑭᐅᖅᑕᖅᑐᒥ ᐅᒥᐊᕐᔪᐊᑦ ᐊᖅᑯᑎᖕᕆᓐᓂ, ᑭᓯᐊᓂ ᐅᐃᕙᕐᓃᑦ ᐊᑐᖅᑕᐅᔭᕆᐊᖃᕈᑎᒃ ᐊᒃᑕᕐᓇᙱᑦᑐᒥᒃ ᐃᕆᕋᓂᕐᒧᑦ ᖃᓄᐃᓕᖓᓂᐅᔪᓄᑦ. ᖃᐅᔾᔮᖃᐃᔾᔪᑎᖃᖅᑐᒍᑦ ᖃᐅᔾᔨᑦᑎᓲᓂᒃ ᐹᕙᓖᓐᑯᑦ ᐃᖅᑲᓇᐃᔭᖅᑎᕆᓐᓂᒃ ᓇᓕᐊᑐᐃᓐᓇᖅ ᐹᕙᓖᓐᑯᑦ ᐅᒥᐊᕐᔪᐊᕆᑦ ᐃᕆᕋᓕᕐᓂᖅᐸᑕ ᓱᒃᑲᓕᔪᓐᓇᖅᑕᕆᑕ ᑭᓪᓕᖓᒍᑦ ᓱᒃᑲᓕᓪᓚᑦᑐᔪᓐᓇᖅᑐᑦ 9 ᓈᑦ) ᐅᖍᐅᓘᓐᓃᑦ ᓯᓚᑖᒍᑦ ᐊᕐᕆᖅᑕᐅᓯᒪᔫᑉ ᐅᑭᐅᖅᑕᖅᑐᒥ ᐅᒥᐊᕐᔪᐊᑦ ᐊᖅᑯᑖᒍᑦ 1 ᓈᑎᑯ ᒪᐃᓕᒥᒃ.

4. ᐅᓄᓈᖑᔪᓐᓇᖅᑐᑦ ᐱᖓᓱᑦ ᐅᒥᐊᕐᔪᐊᑦ ᑭᓴᖅᓯᒪᔪᓐᓇᖅᑐᑦ ᐃᒥᓕᖕᓂ ᐅᖍᐅᓘᓐᓃᑦ ᑎᑎᕋᐅᓗᑎᒃ ᑕᓯᐅᔭᒥ ᖃᖓᓕᓕᒪᖅ. ᑎᒃᑕᐅᑦᑕᐃᓕᒪᓇᓱᖃᑦᑕᕐᓂᐊᖅᑐᑦ ᐊᔪᕐᓇᙱᒃᑳᖓᑦ ᑭᓯᐊᓂ ᐊᑦᑕᖅᓇᖅᑕᐃᓕᒪᓂᕐᒧᑦ ᑕᐃᒪᐃᑦᑕᕆᐊᖃᖅᑎᑕᐅᒍᑎᑦ.

5. ᐹᕙᓖᓐᑯᑦ ᐅᒥᐊᓗᒃᑖᕆᑦ ᒪᓕᖃᑦᑕᕆᐊᓖᑦ ᐅᒥᐊᕐᔪᐊᑦ ᐊᕐᑯᑎᕆᓐᓄᑦ ᒪᓕᒃᑕᐅᓴᕆᐊᓕᖕᓂᒃ, ᑐᓴᐅᒪᔾᔪᑎᖃᖅᑐᑦ ᐅᒥᐊᕐᔪᐊᑦ ᐊᕐᑯᑎᕆᓐᓄᑦ ᑕᒪᒃᑯᓄᖓ ᓱᒃᑲᓕᔪᓐᓇᖅᑕᕆᑦᑕ ᑭᓪᓕᕆᓐᓂᒃ, ᐅᒥᐊᕐᔪᐊᑦ ᐊᖅᑯᑎᕆᓐᓂᒃ, ᐊᒻᒪᓗ ᑭᓴᖅᓯᒪᕙᐅᔪᓐᓇᖅᑐᑦ ᓇᓃᓐᓂᕆᑦ.

6. ᓴᕕᒃᓴᓂᒃ ᐅᓯᒃᖅᑕᖅᑎᑦ ᑯᕕᓯᖃᑦᑕᔾᔮᕆᑦᑐᑦ ᓴᓗᒻᒪᖅᓴᖅᓯᒪᔪᒥᒃ ᐃᒥᕐᒥᒃ, ᑯᕕᖅᑕᑕᐅᓴᕆᐊᓕᕐᒥᒃ ᐅᖍᐅᓘᓐᓃᑦ ᐃᒃᑕᖅᑯᑎᒥᒃ ᐃᒥᕐᒥᒃ ᑕᓯᐅᔭᒥ. ᐃᒃᑕᖅᑯᑦ ᐃᒥᖅ ᑯᕕᔭᐅᔪᓐᓇᖅᑐᖅ ᑭᓯᐊᓂ ᓴᕕᒃᓴᓂᒃ ᐅᓯᓰᓂᑦ ᕿᖓᖑᐊᓂ, ᖃᐅᔨᓴᖅᑕᐅᓚᐅᖅᑎᓪᓗᒋᑦ.

7. ᐹᕙᓖᓐᑯᑦ ᐊᑐᓕᖅᑎᑦᑏᓐᓇᕐᓂᐊᖅᑐᑦ "ᐅᐸᒃᑕᐅᓴᕆᐊᖅᖿᕆᑦᑐᓂ" ᐱᖃᓯᐅᔾᔨᓯᒪᓂᐊᖅᑐᑦ ᐱᓇᖕᓇᖕᓂ ᓯᒃᔭᒥ ᐃᓗᕕᓕᖕᒥ ᐊᒻᒪᓗ ᖁᓗᒃᑑ ᑲᕆᖅᓗᐊᓂ ᑕᑯᖃᑦᑕᐅᑎᓗᐊᖃᑦᑕᖁᓇᕆᑦ ᐊᖑᓇᓱᒃᑎᓂᒃ ᐊᖑᓇᓱᒃᑐᓂᒃ.

8. ᐹᕙᓖᓐᑯᑦ ᐱᓕᕆᖃᑎᖃᐃᓐᓇᕐᓗᑎᒃ ᓄᓇᓕᖕᓂᑦ ᐃᓚᒋᔭᐅᔪᓂᑦ, ᐊᖑᓇᓱᒃᑐᓕᕆᔨᒃᑯᓐᓂ ᐊᒻᒪᓗ Hᐋᒪᓚᒃᑯᓐᓂᑦ ᐃᓱᒫᓗᑕᐅᔪᓄᒃᑖᑦ ᐊᒃᑐᐊᔪᑦ ᐅᒥᐊᕐᔪᐊᑦ ᐱᓕᕆᓂᖃᖅᑎᓪᓗᒋᑦ ᐃᓱᒪᒋᖃᓯᐅᔾᔭᐅᓂᐊᖅᑐᑦ. ᐃᖅᑲᓇᐃᔭᖅᑎᖃᐃᓐᓇᕐᓗᑎᒃ ᐅᒥᐊᕐᔪᐊᓂᒃ ᓇᐅᑦᑎᖅᓱᖅᑎᓂᒃ ᐹᕙᓖᓐᑯᑦ ᒥᑦᑎᒪᑕᓕᖕᒥ ᑎᑎᕋᕕᖕᒋᓐᓂ ᖃᐅᑕᒫᑦ ᐃᑲᔪᕐᓂᐊᕐᓗᑎᒃ ᖃᐅᑕᒫᑦ ᖃᐅᔨᓴᕐᓂᐅᔪᓂᒃ ᐊᒻᒪᓗ ᓇᐅᑦᑎᖅᓱᕐᑯᑦᓗᑎᒃ ᐊᖅᑯᓵᖅᑐᓂᒃ ᑕᓯᐅᔭᒃᑯᑦ ᑕᐅᕗᖕᒋᓕᒫᖅ ᕿᖓᖑᐊᓄᑦ ᑐᓚᑦᑕᕝᕕᖑᑦ.

9. ᐹᕙᓖᓐᑯᑦ ᐱᓕᕆᐊᕐᑲᕐᓂᐊᖅᑐᑦ ᑕᕆᐅᒥ ᐳᐃᔾᔨᓂᒃ ᖃᐅᔨᓴᕐᓂᕐᒥᒃ ᖃᖓᓚᑖᒃᑯᑦ ᐊᒻᒪᓗ ᓯᓭᒦᓪᓗᑎᒃ ᖃᐅᔨᓴᖅᐸᓪᓕᐊᕆᓐᓇᕐᓂᕐᓂᒃ 2023-ᒥᓗᒃᑖᖅ ᐅᒥᐊᕐᔪᐊᕐᑲᕐᓇᒥ ᖃᐅᔨᓴᖅᐸᓪᓕᐊᕆᓐᓇᕐᑯᓪᓗᑎᑦ ᑑᓕᓕᖕᓄᑦ ᐊᒃᑐᐊᔪᑦ ᐅᓄᕐᓂᕆᓐᓄᑦ, ᐃᕐᓂᐅᕐᕕᕆᒃᑦᑕᖅᑕᕆᓐᓂ, ᐊᒻᒪᓗ ᐃᓕᖅᑯᓯᕆᓕᖅᐸᒃᑕᕆᓐᓄᑦ.

10. ᐹᕙᓖᓐᑯᑦ ᐊᑐᓕᖅᑎᑦᑏᓐᓇᕐᓂᐊᖅᑐᑦ ᐳᔪᕋᓕᐅᓗᐊᖅᑕᐃᓕᒪᓂᕐᒥᒃ ᐊᒻᒪᓗ ᐊᒃᑐᐃᓗᐊᖅᑕᐃᓕᒫᔪᑎᓂᑦ, ᐊᒻᒪᓗᑦᑕᐅᖅ ᖃᐅᔨᓴᖅᐸᓪᓕᐊᕆᓐᓇᕐᓗᑎᒃ ᐳᔪᕋᖅᑲᖅᑐᓂᒃ ᕿᓚᒻᒥᐊᓂ ᖃᓂᒋᔭᕆᓐᓂᓗ.

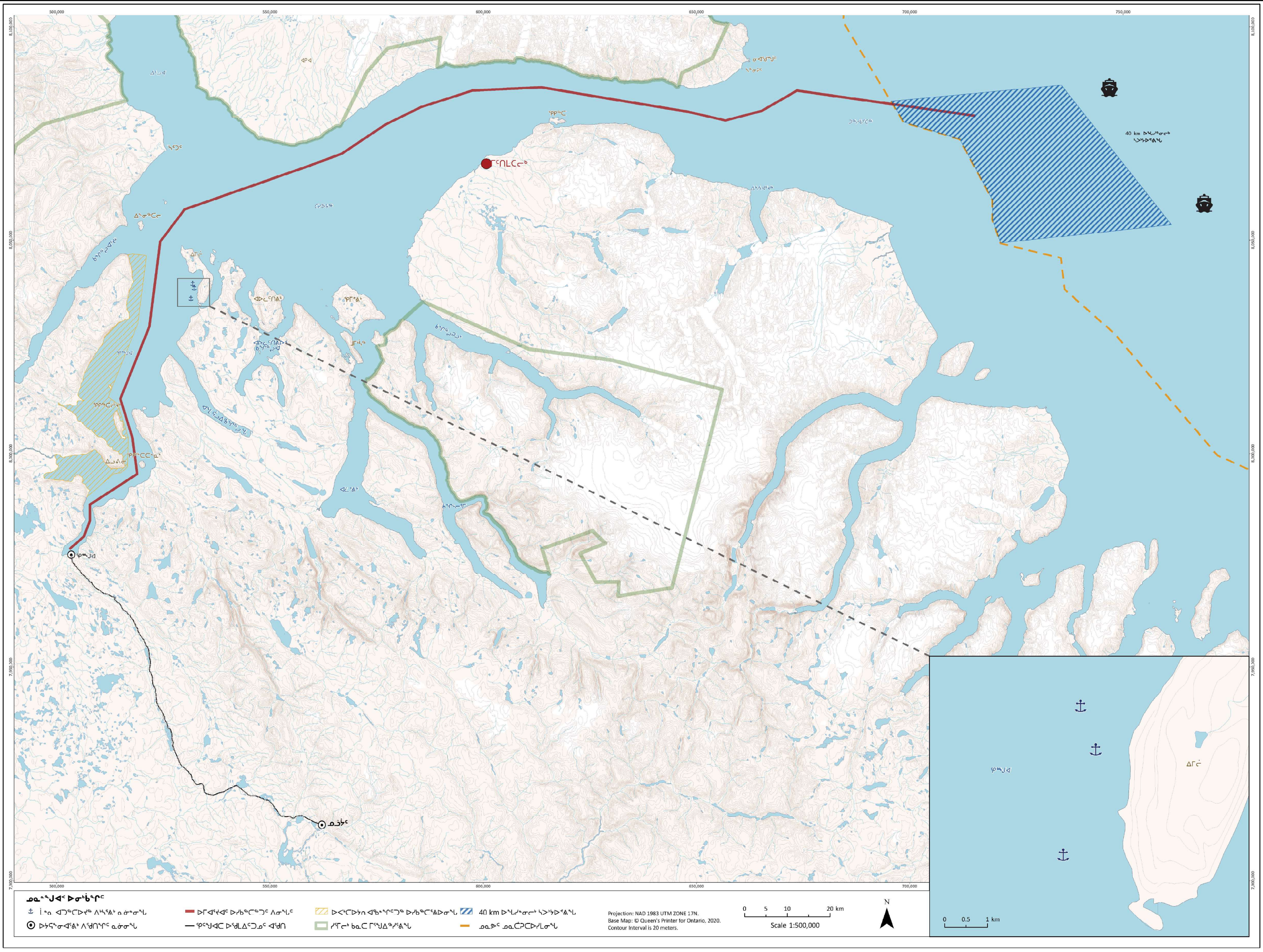
11. ᐊᑐᕐᓂᖅ ᓴᓗᒻᒪᖅᓴᐅᑎᖃᖅᑐᓂᒃ ᐅᖅᓯᐊᓗᖕᒧᑦ ᐊᑐᖁᔭᐅᔾᔮᕆᑦᑐᑦ ᐃᓗᐊᓂ ᓄᓇᓂ ᐊᕕᒃᑐᖅᓯᒪᔪᓂ ᖃᐅᔨᓴᕝᕕᐅᔪᓂ.

12. ᐅᒥᐊᕐᔪᐊᑦ ᖃᒥᑦᑎᖃᑦᑕᕆᐊᓖᑦ ᐊᐅᓚᐅᑎᓪᓗᐊᑕᕆᓐᓂᒃ ᑭᓴᕐᓯᒪᕝᕙᕆᓐᓂᒃ ᐊᒻᒪᓗ ᐊᑐᕈᓐᓇᖅᑐᑦ ᐃᑯᒪᖁᑎᓕᐅᕈᑎᓪᓗᐊᑕᓂᒃ ᐊᐅᓚᐅᑎᓂᒃ, ᑭᓯᐊᓂ ᐊᐅᓚᑎᑕᐅᔪᓐᓇᖅᐸᑕ ᐊᑦᑕᖅᓇᖅᑕᐃᓕᒪᓃᑦ ᐱᔾᔪᑕᐅᓗᑎᒃ, ᓂᐱᑭᓐᓂᖅᓴᐅᖁᓪᓗᒋᑦ.

13. ᐹᕙᓖᓐᑯᑦ ᐱᓕᕆᖃᑦᑕᖅᑐᑦ ᐱᔪᒥᓂᕐᒥᓄᑐᐃᓐᓇᖅ ᑕᕆᐅᖑᓂᖓᓂᒃ ᖃᐅᔨᓴᕐᓂᒃ ᐅᒥᐊᕐᔪᐊᒥᓗᑎᒃ ᐊᑐᓂ ᓴᕕᒃᓴᓂᒃ ᐅᓯᔪᒃᓴᓂ ᑐᓚᖕᓂᐊᖅᑐᓂ ᕿᖓᖑᐊᓄᑦ ᑐᓚᒃᑕᕝᕕᖑᑦ ᑯᕕᓯᖅᑳᖅᑎᓐᓇᒋᑦ ᐃᒃᑕᖅᑯᑕᐅᔪᒥᒃ ᐃᒥᕐᒥᒃ. ᐱᓕᕆᐊᒥ ᐅᒥᐊᕐᔪᐊᓗᒃᑖᑦ ᐱᓕᕆᔭᕆᐊᖅᑲᖅᑐᑦ ᑯᕕᑎᑦᑎᓗᑎᒃ ᐃᒃᑕᖅᑯᑕᐅᔪᒥᒃ ᐃᒥᕐᒥᒃ ᑎᑭᖅᑳᖅᑎᓐᓇᒋᑦ ᕿᖓᖑᐊᓄᑦ ᑐᓚᒃᑕᕝᕕᖑᑦ ᐊᒻᒪᓗ ᐅᒥᐊᕐᔪᐊᓗᒃᑖᑦ ᓴᓗᒻᒪᖅᓴᐅᑎᖃᖅᑐᑦ ᐅᒥᐊᕐᔪᐊᒥ ᓴᓗᒻᒪᖅᓴᐃᔭᕆᐊᓖᑦ ᐃᒃᑕᖅᑯᑕᐅᔪᒥᒃ ᐃᒥᕐᒥᒃ ᖃᒃᑲᓐᓂᐊᒍᓐᓗ ᑯᕕᓗᒍ. 2023-ᒥ, 90+ ᐳᓴᑦ ᐅᒥᐊᕐᔪᐊᑦ ᐱᓕᕆᖃᑦᑕᓕᕐᓂᐊᖅᑐᑦ ᑕᒪᕐᒦᕐᓂᒃ ᐃᒃᑕᖅᑯᑕᐅᔪᒥᒃ ᐃᒥᕐᒥᒃ ᑯᕕᓯᓗᑎᒃ ᐊᒻᒪ ᓴᓗᒻᒪᖅᓴᐃᓗᑎᒃ.

ᐱᒻᒪᕆᐅᕗᖅ ᐃᖅᑲᐅᒪᓗᑕ ᐃᓄᐃᑦ ᐋᓐᓂᐊᕐᑲᖅᑕᐃᓕᒪᓂᖏᑦ ᐊᒻᒪᓗ ᐊᑦᑕᕐᓇᖅᑕᐃᓂᓕᒪᓂᖏᑦ ᐹᕙᓖᓐᑯᑦ ᓯᕗᓪᓕᐅᑏᓐᓇᐅᔭᕐᒪᑦ. ᐃᓛᓂᒃᑯᑦ, ᐅᒥᐊᕐᔪᐊᓂᒃ ᐊᕐᑯᑏᑦ ᐊᓯᐊᒍᕐᓕᕆᐊᕐᑲᑐᐃᓐᓇᕆᐊᖃᕐᒪᑕ ᒪᓕᒃᑕᐅᒐᔪᒃᑐᑦ ᒪᓕᒋᐊᖃᖅᑕᕆᑕ ᐊᐅᓚᔾᔪᓯᕆᓐᓄᑦ ᐊᓂᒍᐃᑦᑎᐊᕐᑯᓪᓗᒋᑦ ᐊᑦᑕᕐᓇᙱᑦᑐᒃᑯᑦ.

ᐅᒥᐊᕐᔪᐊᑦ ᐊᖅᑯᑎᖏᑦ



ᐊᐱᖅᑯᑎᒃᓴᖃᖅᐲᑦ ᐃᓱᒫᓘᑎᖃᖅᐱᓪᓗᓐᓂᑦ?

ᐃᒫᓂᒃᑯᕝᕙᑦ ᒫᓐᓇᑲᐅᑎᒋᑦ ᑲᒪᒋᔭᕆᐊᓕᖕᒥᒃ ᐃᓱᒫᓘᑎᖃᕈᕝᕙᑦ, **ᑐᓴᖅᑎᒃᑭᑦ ᐅᒥᐊᕐᔪᐊᓂᒃ ᓇᐅᑦᑎᖅᓱᖅᑏᑦ ᐆᑮᒃᑯᑦ 26–ᒦᑦᑐᖅ**.

ᕈᕝᕚᓪᓚᑦ ᑎᑎᕋᕐᕕᖕᒐᓗᐊᕐᓗᑎᑦ ᐅᖃᖃᑎᒋᔭᖅᑐᕐᓗᒋᑦ ᐅᒥᐊᕐᔪᐊᓂᒃ ᓇᐅᑦᑎᖅᓱᖅᑏᑦ ᐅᕙᕗᓐᓂᑦ **ᐅᒥᐊᕐᔪᐊᑦ ᓇᓂᓯᕐᒪᖔᑕ ᑕᑯᔭᖅᑐᕐᓗᑎᑦ** ᒥᑎᒪᑕᓕᖕᒥ ᐊᖑᓇᓱᒃᑐᓕᕆᔾᔪᑯᓐᓂ, ᖁᔭᓐᓂᑦᑐᑦ.

ᑎᑎᕋᕝᕕᒋᓗᑎᒍᑦ ᖃᓄᐃᑉᐳᒃᑯᑦ ᐃᖕᒋᓐᓂᕆᓇᐅᑎᒃᑯᑦ:
shipping@baffinland.com

ᐅᖄᓚᐅᑎᑦ ᐅᕙᑦᑎᓐᓄᑦ:
(867) 899-1807

ᐅᒥᐊᕐᔪᐊᑦ ᓇᓂᓯᕐᒪᖔᑕ ᓄᑖᖑᓛᖑᔪᑦ ᑕᑯᔪᓇᖅᑕᑎᑦ ᖃᓄᐃᑉᐳᒃᑯᑦ:
www.baffinland.com

- ᐊᐅᓚᓃᑦ
- ᐅᒥᐊᕐᔪᐊᖃᕐᑲᑦᑕᕐᓂᖅ ᐊᒻᒪᓗ ᓇᐅᑦᑎᖅᓱᕐᓂᖅ

ᐊᒃᑐᐃᓂᐅᑐᐃᓐᓇᕆᐊᓖᑦ ᐊᕙᑎᒧᑦ

ᐅᒥᐊᕐᔪᐊᖅᑲᖅᑲᑦᑕᕐᓂᖅ ᐊᒃᑐᐃᑐᐃᓐᓇᕆᐊᓂᒃ ᑕᕆᐅᒥ ᐳᐃᔾᓂᒃ:

- ᓇᓃᓐᓂᖕᒋᑦ ᐅᓄᕐᓂᖕᒋᓪᓗ
- ᐃᓚᖅᑯᓯᖕᒋᑦ
- ᓇᔪᖓᖕᒋᑦ

ᐅᒥᐊᕐᔪᐊᖅᑲᖅᑲᑦᑕᕐᓂᖅ ᐊᒃᑐᐃᑐᐃᓐᓇᕆᐊᓛᒃ ᓄᓇᓖᑦ ᑕᕆᐅᖓᑕ ᐊᕙᑎᖓᓂ ᐃᒪᓐᓇ:

- ᓴᖅᑮᓗᑎᒃ ᐃᒫᓂᑦ ᑕᒫᓂᕐᒥᐅᑕᐅᙱᑦᑐᓂᒃ ᐆᒪᔪᓂᒃ
- ᐊᓯᔾᔨᕐᓗᓂ ᐱᐅᓂᖕᒋᑦ ᐅᕙᓘᓐᓃᑦ ᐅᓄᕐᓂᖕᒋᓪᓘᓐᓃᑦ ᐃᖃᓗᐃᑦ ᓇᔪᖓᖕᒋᑕ
- ᐊᓯᔾᔨᕐᓗᓂ ᐃᒪᖓᑕ ᖃᓄᐃᓚᖓᓂᖓ ᖃᓂᒋᔮᓂ ᕿᙳᐊᑕ ᑐᓚᑦᑕᕝᕕᖓᓂ


ᑕᓪᓕᒪᑦ ᑑᒐᓖᑦ ᑕᑯᔭᐅᓚᐅᖅᑐᑦ ᕿᙳᐊᓂ (4 ᐋᒡᒋᓯ 2022-ᒥ) ᐅᖓᓯᖕᓂᖃᖅᑰᑐᑎᒃ 4 ᑭᓛᒥᑕᓂᒃ ᐊᐅᓪᓚᖅᐸᓪᓕᐊᔪᒥᑦ ᐅᒥᐊᕐᔪᐊᒥᑦ

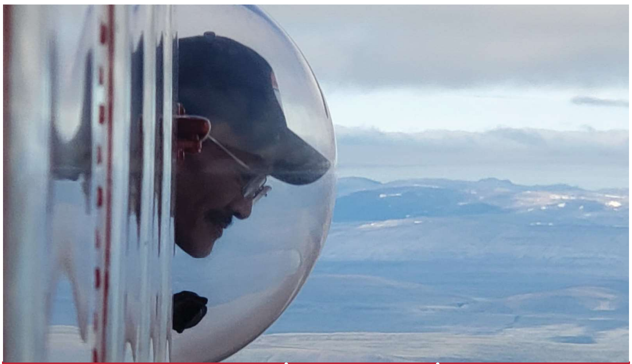
ᑕᕆᐅᕐᒥ ᖃᐅᔨᓴᖅᐸᓪᓕᐊᓐᖏᓐᓇᕐᓂᕐᒧᑦ ᐱᓕᕆᐊᑦ

ᖃᓄᐃᓕᐅᖅᐱᑕ ᖃᐅᔨᓴᖅᐸᓪᓕᐊᓐᖏᓐᓇᖅᑎᓪᓗᑕ ᑕᕆᐅᑉ ᐊᕙᑎᖓᓂᒃ?

ᖃᐅᔨᓴᖅᐸᓪᓕᐊᓐᖏᓐᓇᕐᑯᓪᓗᑕ ᐊᒃᑐᐃᓂᐅᑐᐃᓐᓇᓇᐊᓕᕐᓂᒃ ᐅᒥᐊᕐᔪᐊᓂᑦ ᑕᕆᐅᑉ ᐊᕙᑎᖓᓄᑦ, ᐹᕙᓐᓃᓐᑯᑦ ᐃᖏᕐᕋᑎᑦᑎᓂᐊᖅᑐᑦ ᐅᓄᖅᑐᓂᒃ ᐊᔾᔨᒌᖏᑦᑐᓂᒃ ᖃᐅᔨᓴᖅᐸᓪᓕᐊᓐᖏᓐᓇᕐᓂᕐᒧᑦ ᐱᓕᕆᐊᓂᒃ ᐅᒥᐊᕐᔪᐊᕐᑲᕐᓇᐅᑎᓪᓗᒍ.

ᑕᕆᐅᒥ ᖃᐅᔨᓴᖅᐸᓪᓕᐊᓐᖏᓐᓇᕐᓃᑦ ᐱᓕᕆᓃᑦ ᐃᒪᐃᓕᐅᕐᓂᐊᖅᐳᖅ:

- ᖃᐅᔨᓴᕐᓗᒋᑦ ᐊᒃᑐᐃᓂᖏᑦ ᑖᒃᑯᐊ ᐅᒥᐊᕐᔪᐊᑦ ᐊᒃᑐᖅᑕᖏᑦ ᑕᕆᐅᑉ ᐊᕙᑎᖓᓂ
- ᖃᐅᔨᓴᖅᑕᐅᓗᓂ ᑕᒪᖅᓯᒪᙱᒃᑲᓗᐊᕐᒪᖔᑦ ᐊᒃᑐᐃᓂᐅᑐᐃᓐᓇᓇᐊᕐᑲᕋᓱᒋᔭᐅᔪᑦ ᓇᓚᐅᑕᐅᓯᒪᔪᑦ
- ᓇᓗᓇᐃᔭᕐᓗᒋᑦ ᐋᖅᑭᒋᐊᕐᕕᖃᐃᓐᓇᖅᑐᒥᒃ ᐊᒃᑐᐃᓗᐊᖅᑕᐃᓕᒪᔾᔪᑏᑦ ᓴᖅᑭᑕᐅᔭᕆᐊᖃᕐᒪᖔᑦ.



ᑕᕆᐅᒥ ᐳᐃᔩᓂᒃ ᖃᖓᑕᓲᒃᑯᑦ ᖃᐅᔨᓴᖅᐸᓪᓕᐊᓐᖏᓐᓇᕐᓂᖅ

ᖃᐅᔨᓴᖅᐸᓪᓕᐊᓐᖏᓐᓇᕐᓂᖅ ᑑᒑᓖᑦ ᐅᓄᕐᓂᖏᓐᓂᒃ ᓇᓃᓐᓂᖏᓐᓂᓪᓗ ᐊᒻᒪᓗ ᐊᓯᖏᑦ ᑕᕆᐅᒥ ᐳᐃᔩᑦ ᐱᓕᕆᐊᑉ ᖃᓂᒋᔮᓃᑦᑐᓂᒃ ᐊᐅᔭᓕᒫᖅ.

ᐃᓗᕕᓕᐅᑉ ᓯᒡᔭᖓ ᖃᐅᔨᓴᖅᐸᓪᓕᐊᓐᖏᓐᓇᕐᓂᖅ

ᖃᐅᔨᓴᖅᑕᐅᓗᑎᒃ ᑑᒑᓖᑦ ᖃᓄᐃᓕᖓᓕᖅᑲᑦᑕᕐᒪᖔᑕ ᐅᒥᐊᕐᔪᐊᖅᑲᑦᑕᖅᑎᓪᓗᒍ ᑕᐅᕗᖓ ᐅᑭᐅᖅᑕᖅᑐᒥ ᐅᒥᐊᕐᔪᐊᑦ ᐊᖅᑯᑖᓂ ᑕᐅᑐᖅᑲᑦᑕᕐᓗᑎᒃ ᐃᓗᕕᓕᐅᑉ ᕿᑎᖓᓂᖅᐹᖓᓂ.

ᑕᕆᐅᑉ ᐊᕙᑎᖓᓄᑦ ᐊᒃᑐᐃᓃᑦ ᐊᒻᒪᓗ ᑎᑭᐸᒃᑐᑦ ᐆᒪᔪᕋᓛᑦ ᐊᔾᔨᒌᙱᑦᑐᑦ ᓇᔪᒐᕐᓂᖓᓗ ᑭᙵᕝᕕᓃᑦ

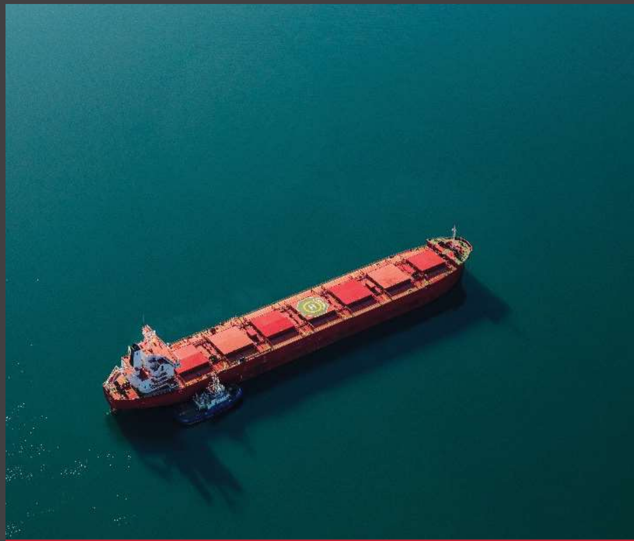
ᖃᐅᔨᓴᖅᐸᓪᓕᐊᓐᖏᓐᓇᕐᓃᑦ ᐃᒪᕐᒥᒃ ᐃᓱᖅᑐᓂᓪᓗ ᐱᖃᓯᐅᑎᓗᒋᑦ ᓴᕕᕋᔭᖅᑲᖅᑐᑦ, ᐃᖅᑲᖓᓂᕐᒥᐅᑕᑦ, ᐃᖅᑲᖓᓂ ᐆᒪᔪᑦ ᐊᒻᒪᓗ ᐱᕈᖅᑐᑦ, ᐃᖃᓗᐃᑦ ᐅᓄᕐᓂᖏᑦ ᐊᒻᒪᓗ ᖃᓄᐃᖏᓐᓂᖏᓐᓗ (ᑐᕌᓚᓇᔭᐅᓗᑎᒃ ᐃᖃᓗᐃᑦ) ᐃᓚᐅᓪᓗᑎᒃ ᓱᕈᔪᖕᓂᒃ ᖃᐅᔨᓴᕐᓂᖅ, ᐃᑦᑕᖅᑯᑎᐅᑉ ᐃᒥᖓ ᑯᕕᔭᐅᖅᑲᑦᑕᕐᓂᖓᓄᑦ ᒪᓕᒃᑕᐅᑦᑎᐊᕋᓱᐊᕐᒪᖔᑕ ᖃᐅᔨᓴᖅᑕᐅᓗᑎᒃ.

ᐅᒥᐊᕐᔪᐊᒦᓪᓗᑎᒃ ᓇᐅᑦᑎᖅᓱᖅᑏᑦ ᖃᐅᔨᓴᖅᐸᓪᓕᐊᓐᖏᓐᓇᕐᓂᖏᑦ

ᑕᕆᐅᒥ ᐳᐃᔩᓂᒃ ᓇᐅᑦᑎᖅᓱᖅᑏᑦ ᐃᓂᖅᑲᖅᓗᑎ ᓱᑯᓂᒃ ᐊᔭᐅᖅᑐᐃᔨᒥᒃ MSV ᐹᑦᓂᑲ ᖃᐅᔨᓴᖅᐸᓪᓕᐊᓐᖏᓐᓇᕐᑯᓪᓗᒋᑦ ᐅᒥᐊᕐᔪᐊᑦ ᐊᐳᖅᓯᑐᐃᓐᓇᓇᐊᖅᑲᕐᓂᖏᓐᓄᑦ ᑕᕆᐅᒥ ᐳᐃᔩᓂᒃ ᓄᓇᓂ ᐊᕕᒃᑐᖅᓯᒪᔪᓂ ᖃᐅᔨᓴᕝᕕᐅᔪᒥ ᐊᒻᒪᓗ ᑎᑎᕋᖅᑕᐅᕐᑯᓪᓗᒋᑦ ᐊᒃᑐᐊᔪᑦ ᐅᓄᕐᓂᖏᓐᓄᑦ ᑕᕆᐅᒥ ᐳᐃᔩᑦ ᑕᕆᐅᒥᓗ ᐳᐃᔩᑦ ᑎᖕᒥᐊᑦ ᐊᔾᔨᒌᙱᑦᑑᑎᑦ ᐱᓕᕆᕝᕕᐅᔫᑉ ᐃᓂᐊᓂ ᐊᒃᑐᐊᔪᑦ ᓱᑯᓂᒃ ᐊᔭᐅᑐᐃᖅᑲᑦᑕᕐᓂᖏᓐᒧᑦ

ᓂᐱᖃᐃᓐᓇᖅᑐᓂᒃ ᖃᐅᔨᓴᖅᐸᓪᓕᐊᖏᓐᓇᕐᓂᖅ

ᖃᐅᔨᓴᖅᐸᓪᓕᐊᖏᓐᓇᕐᓂᐅᑐᐃᓐᓇᕆᐊᓖᑦ ᐃᒫᓂ ᓂᐱᓂᒃ ᒪᕐᕉᖕᓂ (2) ᐃᓂᓂ ᖃᓂᒋᔮᓂ ᐃᓗᕕᓕᐅᑉ ᐊᒻᒪᓗ ᐃᒥᖠᕐ. ᓂᐱᓕᐅᕈᑏᑦ ᐋᖅᑭᒃᑕᐅᓂᐊᖅᑐᑦ ᓅᕝᕙᐃᓂ ᔪᓚᐃ, 2023-ᒥ ᐊᒻᒪᓗ ᐲᖅᑕᐅᓗᑎᒃ ᐅᑐᐱᕆᒥ ᓂᐱᓕᐅᖅᑕᖏᑦ ᖃᕆᓴᐅᔭᒨᐊᖅᑲᖅᑕᐅᕐᑯᓪᓗᖏᑦ ᐅᒥᐊᕐᔪᐊᖅᑲᕐᓇᒥᖗᕐᓗᑎᒃ. ᑕᒪᕐᒥᒃ ᓂᐱᓕᐅᕈᑏᒃ ᐋᖅᑭᒃᑕᐅᓕᖅᑭᒡᓗᑎᒃ ᐅᑐᐱᕆᒥ ᐅᑭᐅᕐᑯᓪᓗᒋᑦ 2024-ᒥ ᐊᒻᒪᓗ ᓂᐱᓕᐅᕆᕐᑯᓪᓗᒋᑦ ᓯᑯᓂᒃ ᐊᔭᐅᖅᑐᐃᔾᔪᑦ ᐃᖏᕋᑎᓪᓗᒋᑦ ᐱᔭᕇᓕᖅᑎᓪᓗᒍ 2023-ᒥ ᐅᒥᐊᕐᔪᐊᖅᑲᕐᓇᖅ. ᑕᒪᓐᓇ ᐱᓕᕆᐊᒃᓴᖅ ᒪᓕᒃᑐᖅ ᐊᖏᔪᕐᔪᐊᑦ ᐅᒥᐊᕐᔪᐊᑦ ᐊᑐᖅᑕᐅᓂᐊᒪᖔᑕ 2023-ᒥ ᐅᒥᐊᕐᔪᐊᖅᑲᕐᓇᓗᒃᑖᒥ.



ᑎᑭᑉᐸᒃᑐᑦ ᐆᒪᔪᕋᖀᑦ ᐊᔾᔨᒌᖕᒋᑦᑐᑦ ᐃᒃᑕᖅᑯᑕᐅᕙᒃᑐᒥ ᐃᒥᕐᒥᒃ ᖃᐅᔨᓴᖅᐸᓪᓕᐊᖏᓐᓇᕐᓃᑦ (ᐱᓕᕆᖃᑎᖃᕐᓗᑎᒃ ᐃᒪᕐᒥᐅᑕᓕᕆᔨᒃᑯᓐᓂᒃ ᑲᓇᑕᒥ)

ᐹᕙᖏᓐᓂᑦ ᓴᖅᑮᖏᖅᑐᑦ ᒪᕐᕉᖕᓄᑦ – ᐱᓇᓱᐊᕈᓰᖕᓄᑦ ᖃᐅᔨᓴᕈᑕᐅᔪᒥᒃ ᐱᓕᕆᐊᒥᒃ ᓯᑎᐱᕆᒥ, 2023-ᒥ ᐱᓕᕆᖃᑎᖃᕐᓗᑎᒃ ᐃᒪᕐᒥᐅᑕᓕᕆᔨᒃᑯᓐᓂᒃ ᑲᓇᑕᒥ ᑐᕋᒐᖃᕐᓂᐊᕐᓗᑎᒃ ᐆᒪᔪᕕᓂᕐᓂᒃ ᖃᐅᔨᓴᒐᒃᓴᓕᐅᕐᓂᕐᓂᒃ ᐃᒃᑕᖅᑯᑕᐅᕙᒃᑐᒥ ᐃᒥᕐᒥ. ᑕᒪᓐᓇ ᐱᓕᕆᐊᖅ ᑐᕋᒐᖃᖅᑎᑕᐅᓇᓱᐊᖅᑐᑦ ᖃᐅᔨᓴᖅᐸᓪᓕᐊᖏᓐᓇᖅᑕᐅᕐᑯᓪᓗᒋᑦ ᓴᖅᑮᓐᓇᔭᕐᓂᖏᑦ ᑎᑭᑉᐸᒃᑐᑦ ᐆᒪᔪᕋᖀᑦ ᐃᒃᑕᖅᑯᑕᐅᕙᒃᑐᒃᑯᑦ ᐃᒥᖅ ᑯᕕᔭᐅᓂᖓᒍᑦ ᐊᒻᒪᓗ ᐱᖃᓯᐅᔾᔨᓂᐊᖅᑐᑦ ᐱᓕᒻᒪᒃᓴᖅᑎᑕᐅᓗᑎᒃ ᐃᓕᓐᓂᐊᖅᓯᓐᓈᕐᓗᑎᒃ ᑲᑎᒪᓗᑎᒃ ᓄᓇᓕᖕᒐᓂ ᒥᑦᑎᒪᑕᓕᖕᒥ.

ᑐᓴᐅᒪᖃᑦᑕᐅᑎᓃᑦ

ᑐᓴᐅᒪᖃᑦᑕᐅᑎᑦᑎᐊᕐᓂᖅᓴᐅᕐᑯᓪᓗᒋᑦ ᐹᕙᒍᓐᓄᑦ ᐅᒥᐊᕐᔪᐊᖏᓐᓄᑦ ᐱᓕᕆᓂᕐᓂᒃ, ᐅᓪᓗᓕᒫᖅ ᐃᖅᑲᓇᐃᔭᖅᑎᖃᐃᓐᓇᕐᓂᐊᖅᑐᑦ ᐅᒥᐊᕐᔪᐊᓂᒃ ᓇᐅᑦᑎᖅᓱᖅᑎᓂᒃ ᐅᒥᐊᕐᔪᐊᖃᕐᓇᓕᒫᖓᓂᒃ ᐱᓕᕆᕝᕕᖃᕐᓗᑎᒃ ᐹᕙᒍᓐᓄᑦ ᒥᑦᑎᒪᑕᓕᖕᒥ ᐊᕐᕌᓂᒃᑐᓗᓇᐅᔪᑦ ᑎᑎᕋᕝᕙᖓᓐᓂᓪᓗᑎᒃ ᖁᒍᓯᓂ. ᐊᐱᖅᑯᑎᒃᓴᖃᕈᕕᑦ, ᐅᖃᐅᓯᒃᓴᖃᕈᕕᑦ ᐃᓱᒫᓘᑎᖃᕈᕕᓪᓗᓐᓂᑦ ᐹᕙᒍᓐᓄᑦ ᐅᒥᐊᕐᔪᐊᖏᓐᓄᑦ, ᑐᓴᕝᕕᒋᒃᑭᑦ ᐹᕙᒍᓐᓄᑦ ᐅᐸᒡᓗᑎᑦ ᐅᒥᐊᕐᔪᐊᓂᒃ ᓇᐅᑦᑎᖅᓱᖅᑎᖏᑦ, ᐅᕙᓘᓐᓃᑦ ᐃᓱᒪᓘᑎᒋᔭᑎᑦ ᐅᖃᐅᓯᕆᓗᒋᑦ ᑭᒡᒐᖅᑐᐃᔨᓄᑦ ᒥᑦᑎᒪᑕᓕᖕᒥ ᐊᕙᓐᓇᓱᒃᑐᓕᕆᔾᔪᓐᓄᑦ ᐅᖃᕋᔭᕐᓂᖏᓐᓄᑦ ᐹᕙᒍᓐᓄᑦ.

ᖀᒃᑲᓐᓂᐊᒍᑦ ᑐᓴᐅᒪᕖᕆᓗᒋᑦ ᐅᒥᐊᕐᔪᐊᓂᒃ ᓇᐅᑦᑎᖅᓱᖅᑏᑦ, ᐅᒥᐊᕐᔪᐊᖃᕐᓇᖅ 2023-ᒥ ᖃᐅᔨᓴᕋᔭᖅᑐᑦ ᐊᔾᔨᒌᖏᑦᑑᑎᓂᒃ ᐱᓕᕆᔾᔪᓯᕐᓂᒃ ᐅᑯᐊ ᐱᖃᓱᐅᑎᓗᒋᑦ:

1. ᑕᑯᓗᒋᑦ ᐹᕙᒍᓐᓄᑦ ᖃᕆᓴᐅᔭᒃᑯᑦ ᐃᑭᐊᖅᑭᕝᕙᖓᒍᑦ (www.baffinland.com) ᐅᑯᐊ ᒪᓕᒡᓗᒋᑦ “ᐊᐅᓚᓃᑦᐅᒥᐊᕐᔪᐊᖅᑲᕐᓇᖅ ᐊᒻᒪᓗ ᖃᐅᔨᓴᖅᐸᓪᓕᐊᖏᓐᓇᕐᓃᑦ”, ᑕᑯᔭᐅᔪᓐᓇᕐᒥᔪᑦ ᐹᕙᒍᓐᓄᑦ ᒥᑦᑎᒪᑕᓕᖕᒥ ᑎᑎᕋᕐᕕᐊᓂ
2. ᒥᑦᑎᒪᑕᓕᖕᒥ ᐹᕙᒍᓐᓄᑦ ᑎᑎᕋᕐᕕᖕᒐᓄᐊᕐᓗᑎᑦ ᑕᐅᑐᒍᒪᒍᕕᑦ ᓇᐅᑦᑎᖅᓱᖅᑕᐅᖏᓐᓇᓲᑦ ᐊᑐᖅᑕᐅᓪᓗᑎᒃ ᐃᖕᖏᓐᓇᑦ ᐅᒥᐊᕐᔪᐊᑦ ᓇᓃᓐᓂᖏᓐᓂᒃ ᐱᓕᕆᔾᔪᑏᑦ (AIS) ᖃᐅᔨᓴᖅᐸᓪᓕᐊᖏᓐᓇᕈᓐᓇᐅᑎ, ᐊᒻᒪᓗ ᖃᐅᔨᓗᒋᑦ ᖃᓄᐃᑦᑑᓂᖏᑦ ᐅᒥᐊᕐᔪᐊᑦ ᐹᕙᒍᓐᓄᑦ ᐊᐅᓚᑕᐅᔭᕆᐊᖃᕐᑦ ᐊᐅᓚᓂᖏᓐᓄᑦ
3. ᑐᓴᖅᑎᑕᐅᖃᑦᑕᕐᓃᑦ ᐅᒥᐊᕐᔪᐊᑦ ᐱᓕᕆᓂᕆᓂᐊᖅᑕᖏᓐᓄᑦ ᐱᖃᓱᐅᑎᓪᓗᒋᑦ ᐅᒥᐊᕐᔪᐊᑦ ᑲᑎᙶᓗᑎᒃ ᐃᖏᕋᖃᑦᑕᕐᓂᖏᑦ ᐅᖃᓪᓚᕝᕕᒃᑯᑦ ᒥᑦᑎᒪᑕᓕᖕᒥ ᐅᖃᐅᓯᐅᒪᔪᖕᓂᐊᖅᑐᑦ
4. ᓈᓚᓚᐅᖅᐸᒡᓗᑎᑦ ᑐᓴᒐᒃᓴᓇᔭᐅᖃᑦᑕᕐᓂᐊᖅᑐᓂᒃ ᖃᐅᑕᒫᑦ ᐊᒻᒪᓗ ᐱᓕᕆᐊᖑᕙᓪᓕᐊᓂᐊᖅᑐᑦ ᐅᒥᐊᕐᔪᐊᓂᑦ ᐱᓕᕆᓃᑦ ᐱᖃᓱᐅᑎᓪᓗᒋᑦ ᐅᒥᐊᕐᔪᐊᑦ ᑭᖑᓕᕇᑦᑎᐊᖑᓪᓗᑎᒃ ᐊᑕᐅᑦᑎᒃᑯᖅᑐᑦ ᐃᒪᖅᓯᐅᑎᒃᑯᑦ ᐆᕚᕋᖀᒃᑯᑦ ᕿᔾᔭᓪᓗᒐᖅ 26-ᑯᑦ.
5. ᕙᐃᔾᐳᒃᑯᑦ ᑎᑎᕋᕝᕆᕙᒃᑕᖓ ᑕᑯᔭᖅᑐᖅᓱᒍ ᖃᕆᓴᐅᔭᒃᑯᑦ ᐹᕙᒍᓐ ᓴᕝᕋᓂᒃ ᐅᔭᕋᖕᓂᐊᖅᑎᓂᙱᖅᑐᑦ, ᒥᑦᑎᒪᑕᓕᖕᒥ ᐱᕙᓪᓕᐊᔪᑦ ᐊᒻᒪᓗ ᒥᑦᑎᒪᑕᓕᖕᒥ ᐊᕙᓐᓇᓱᒃᑐᓕᕆᔾᔪᑎᓐᓂ ᑐᓴᒐᒃᓴᖃᕕᒃ ᓴᖅᑭᑎᓚᐅᖃᑦᑕᕐᓂᖏᓐᓄᑦ ᐊᓂᒍᖅᑐᓂᒃ, ᒫᓐᓇᐅᔪᖅ ᓯᕗᓂᒃᓴᑎᓐᓂᓗ ᐅᒥᐊᕐᔪᐊᑦ ᐱᓕᕆᖃᑦᑕᕐᓂᖏᓐᓂᒃ.

ᐊᐱᖅᑯᑎᖃᖅᐲᑦ? ᐅᕝᕙ ᖃᐅᔨᒪᔾᔪᑏᑦ ᖃᓄᖅ ᐅᖃᖃᑎᖃᕈᓐᓇᖅᒪᖔᖅᐱᑦ ᐅᕙᑦᑎᓐᓂᒃ

ᐊᐱᖅᑯᑎᖃᕈᕕᑦ, ᐅᖃᐅᓯᒃᓴᖃᕈᕕᑦ ᐃᓱᒫᓘᑎᖃᕈᕕᓪᓘᓐᓃᑦ ᐹᕙᓐᓛᓐᑯᑦ ᐅᒥᐊᕐᔪᐊᖏᓐᓄᑦ, ᐅᖃᖃᑎᒋᒃᑭᑦ ᓇᓕᐊᖕᓄᑐᐃᓐᓇᖅ ᐅᒥᐊᕐᔪᐊᓂᒃ ᓇᐅᑦᑎᖅᓱᖅᑏᑦ ᐹᕙᓐᓛᓐᑯᓐᓂ ᒥᑦᑎᒪᑕᓕᖕᒥ ᑎᑎᕋᕐᕕᖓᓂ (ᒥᑦᑎᒪᑕᓕᖕᒥ ᐊᖑᓇᓱᒃᑐᓕᕆᔨᒃᑯᓐᓂ ᖁᑖᓃᑦᑐᒥᒃ), ᐅᖃᖃᑎᒋᑎᒍᑦ ᐆᕙᖅᓵᒃᑯᑦ 26–ᒦᑦᑐᒥᒃ, ᐅᕝᕙᓘᓐᓃᑦ ᐃᓱᒫᓘᑎᒋᓴᑎᑦ ᐅᖃᐅᓯᕆᓗᒋᑦ ᒥᑦᑎᒪᑕᓕᖕᒥ ᐊᖑᓇᓱᒃᑐᓕᕆᔨᒃᑯᓐᓄᓪᓚᑖᖅ.

ᓇᓕᐊᖕᓄᓪᓚᑖᖅ ᐅᒥᐊᕐᔪᐊᑉ ᐊᐅᓚᓂᖓᓄᑦ ᐃᓱᒫᓘᑎᓄᑦ, ᐊᔪᕐᓇᖏᑉᐸᑦ, ᓇᓗᓇᐃᖅᓱᒍ ᐅᒥᐊᕐᔪᐊᑉ ᐊᑎᖓ, ᓇᓃᓐᓂᖓ, ᐅᓪᓗᖓ ᖃᔅᓯᒧᐊᖅᑎᓪᓗᒍ ᑕᑯᔭᑦ, ᐊᓯᖏᓪᓗ ᓇᓗᓇᐃᔭᐅᑏᑦ ᐃᓱᒫᓘᑎᒋᔭᕐᓄᑦ. ᑐᓂᖃᓯᐅᑎᓗᒍᑦ ᐊᔾᔨᙳᐊᑦ ᓂᐱᓕᐅᖅᓯᒪᔪᓂᓪᓗ ᐊᑐᐃᓐᓇᐅᒃᐸᑕ ᑐᓂᓗᒍ.

ᐲᑕ ᐋᒃᒪᓐ
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SHIPPING AND MARINE MONITORING SUMMARY

2023 Shipping Season

BAFFINLAND SHIPPING

Contents

BAFFINLAND SHIPPING ACTIVITIES

In 2023, Baffinland Iron Mines Corporation ('Baffinland' or the 'Company') will begin its shipping activities once certain minimum requirements have been met, including no presence of landfast ice along the entire Northern Shipping Route, and confirmation that the Pond Inlet floe edge has been closed.

Baffinland will continue to implement mitigation measures for the 2023 shipping season in direct response to Inuit input. In an effort to reduce potential cumulative impacts of the Project to narwhal during this sensitive time period, Baffinland will again delay the start of the shipping season until icebreaking is no longer required for ore carriers transiting towards Milne Port, as done in 2021 and 2022. With this decision, the trigger to commence the beginning of the 2023 shipping season will be the presence of a continuous path of 3/10ths or less ice concentrations between the entrance of Eclipse Sound and Milne Port. An icebreaker will therefore not be used to be used to break ice and escort ore carriers when ice is greater than 3/10ths ice concentration. In 2022, Baffinland introduced the use of convoys, where vessels travelled in groups throughout the shipping season. This reduced total underwater sound exposure, reduced potential interactions with hunters, and limited the number of vessel observations. Baffinland will implement convoys opportunistically throughout 2023 when it is deemed safe and possible.

The final shipping schedule will depend on prevailing ice conditions. Once initiated, shipping will continue until approximately mid-to-late October, with all vessels exiting the Regional Study Area no later than October 31st, 2023. If Baffinland is approved to transport up to 6.0 million tonnes (and an excess of stranded ore from 2022) as outlined in the Sustaining Operations Proposal (SOP) application, then there is expected to be up to 84 ore carriers throughout the 2023 shipping season.

What you've shared with us

Through valuable conversations with local community members, Baffinland has heard a number of concerns related to shipping through the Northern Shipping Route:

The potential for shipping to interfere with local hunting

The potential for dust to impact the marine environment, including water and sediment quality, and marine organisms

The potential for vessels to affect marine mammals

The potential for shipping activity to harm the health of the marine ecosystem

ADDRESSING CONCERNS

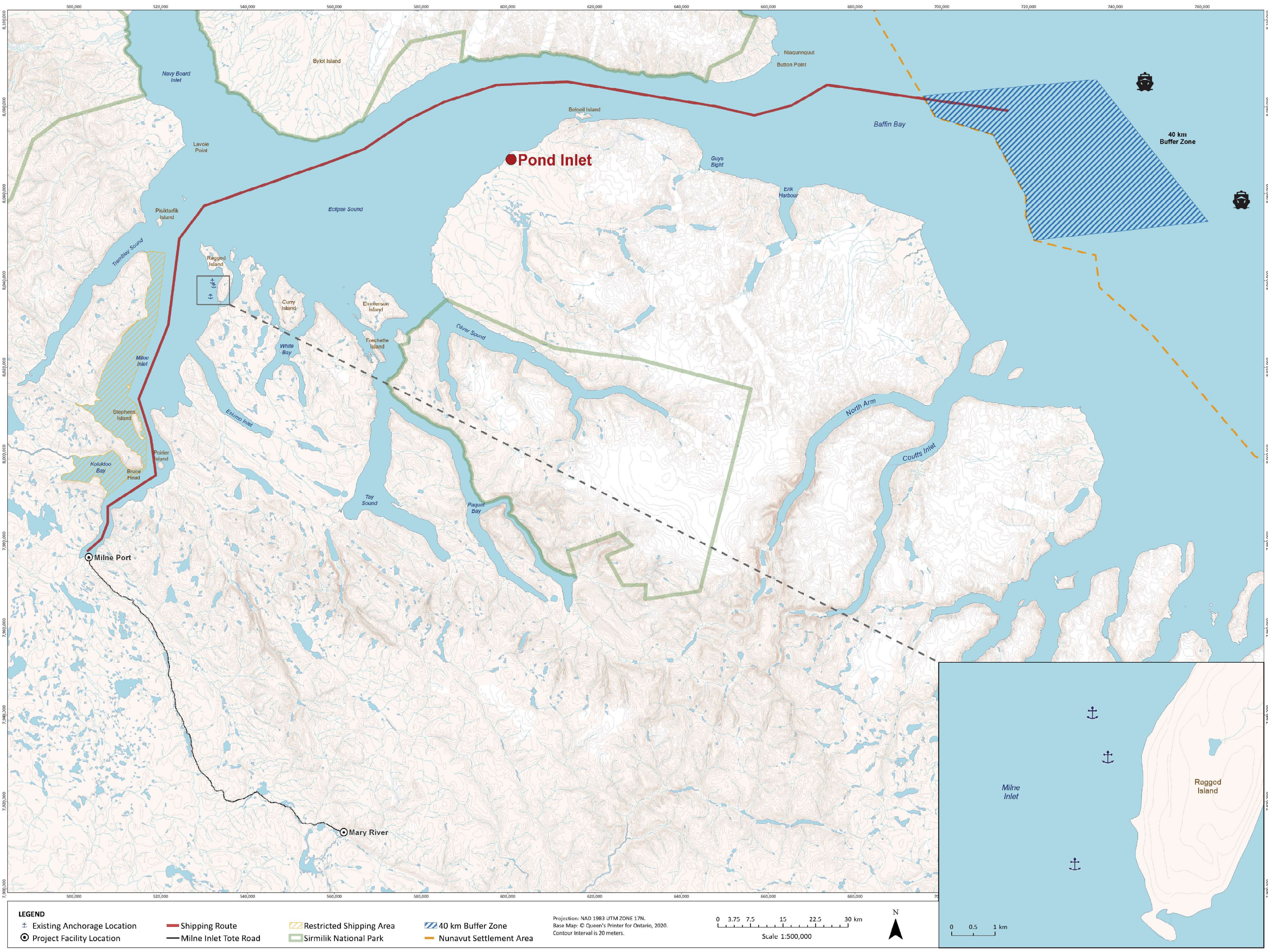
How has Baffinland addressed these concerns?

Baffinland is committed to continuing to monitor any potential effects of shipping activities. Here are some of the measures we will be implementing to manage and mitigate potential issues:

1. Baffinland vessels will not break through landfast ice and will wait for confirmation that the floe edge has been closed before entering Eclipse Sound. In 2023, the shipping season will only start once it is confirmed that there is a continuous path of 3/10ths or less ice concentrations between the entrance of Eclipse Sound and Milne Port.
2. Convoys and larger vessels will be used opportunistically to further reduce total underwater sound exposure and reduce the total number of vessel transits.
3. Vessels will follow the approved Northern Shipping Route, unless deviations are required to ensure safe sailing conditions. We have a notification system that alerts Baffinland staff if any Baffinland vessels are travelling above the speed limit (maximum of 9 knots) or outside of the approved Northern Shipping Route by more than 1 nautical mile (nm).
4. A maximum of three vessels can be anchored or drifting at Ragged Island at any one time. Vessels are only permitted to drift within the established drifting zone and Ragged Island, which is strictly for safety purposes.
5. Ensuring that all Baffinland vessels follow the Standing Instructions to Masters which provides information to vessel captains on speed limits, the shipping route, and anchorage locations.
6. No grey water, sewage or ballast water will be discharged in Eclipse Sound by ore carriers. Ballast water is only discharged by ore carriers at Milne Port after compliance testing.
7. Baffinland continues to enforce "no-go zones," which include the western shoreline near Bruce Head and Koluktoo Bay to minimize interference with hunting activities.
8. Baffinland will continue to work with community members, Hunters and Trappers Organizations and Hamlets to ensure that all concerns related to shipping activities are considered. Full-time Shipping Monitors will be available in the Baffinland Pond Inlet office to support daily tracking and viewing of vessels passing through Eclipse Sound all the way to Milne Port.
9. Baffinland will conduct marine mammal aerial surveys and shore-based monitoring throughout the 2023 shipping season to monitor narwhal relative abundance, calving rates, and behaviour.
10. Baffinland will continue to implement dust suppression and mitigation measures, as well as monitor dust concentrations in Milne Inlet and surrounding areas.
11. The use of scrubbers is prohibited within the Regional Study Area.
12. Vessels turn off the main engine at anchorage and only use auxiliary power, unless warranted for safety reasons, to reduce sound exposure.
13. Baffinland conducts voluntary salinity testing on board each ore carrier calling to Milne Port prior to discharging ballast water. All Project vessels are required to conduct a ballast water exchange prior to arriving at Milne Port and all vessels with a treatment system on board are required to treat ballast water in addition to conducting an exchange. In 2023, 90+ % of vessels will undergo both ballast water exchange and treatment.

It is important to remember that the health and safety of people is always Baffinland's top priority. In some situations, the vessel captains may need to deviate away from standard operating procedures to ensure safe passage.

SHIPPING ROUTE



HAVE QUESTIONS OR CONCERNS?

If you are on the water and have an immediate concern, **contact our shipping monitor via VHF radio channel 26.**

Visit the Baffinland office and speak with our shipping monitors or **view vessel tracks** in the Mittimatalik Hunters and Trappers Organization (MHTO) building, 2nd floor.

Email us at :
shipping@baffinland.com

Call us at:
(867) 899-1807

For shipping updates visit:
www.baffinland.com
> Operation
> Shipping & Monitoring

POTENTIAL EFFECTS ON THE ENVIRONMENT

Shipping may affect marine mammals:

- Distribution and abundance
- Behaviour
- Habitat

Shipping could potentially affect the local marine environment by:

- Introducing aquatic invasive species
- Altering the quality or quantity of fish habitat
- Altering water quality near Milne Port

Five Narwhal Observed in Milne Inlet (4 August 2022) at a Distance of 4 Km from a Southbound Vessel

MARINE MONITORING PROGRAMS

What are we doing to monitor the marine environment?

To monitor potential effects from shipping on the marine environment, Baffinland will be running a number of different monitoring programs throughout the shipping season.

The marine monitoring programs will:

- Measure the effects that shipping is having on the marine environment
- Assess the accuracy of predictions of effects
- Determine if adaptive mitigation measures need to be developed.

Marine Mammal Aerial Surveys

Monitors the abundance and distribution of narwhal and other marine mammal species in Project area throughout the summer.

Bruce Head Shore-based Monitoring

Investigates narwhal response to shipping along the Northern Shipping Route by observing them from the top of Bruce Head.

Marine Environmental Effects and Aquatic Invasive Species and Habitat Offset

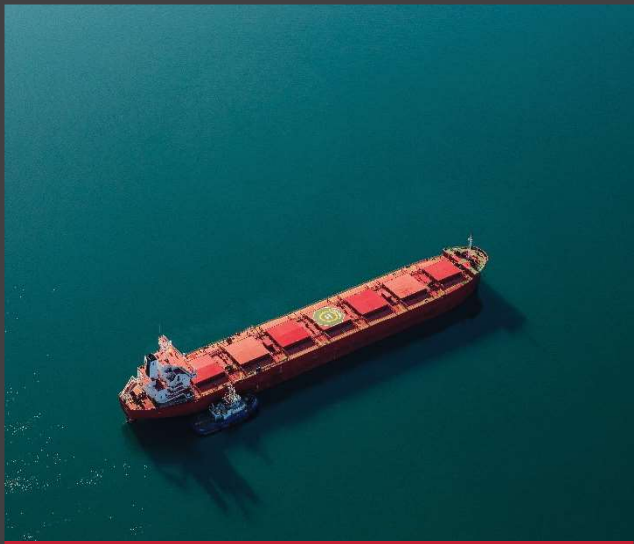
Monitors water and sediment quality including metals, benthic infauna, epifauna and epiflora, fish abundance and health (focus on Arctic char) including contaminant analysis, and ballast water compliance testing.

Shipboard Observer Monitoring

Marine Mammal Observers (MMOs) based off of the icebreaker MSV Botnica monitor for potential ship strikes on marine mammals in the Regional Study Area and document the relative abundance of marine mammal and seabird species in the Project area relevant to icebreaking operations.

Passive Acoustic Monitoring

Potential monitoring of underwater noise at two (2) locations near Bruce Head and Ragged Island. Acoustic recorders will be deployed in late July, 2023 and retrieved in October to download data from the shipping season. Both recorders will be re-deployed in October to overwinter during 2024 and capture icebreaker transits at the end of the 2023 shipping season. This program is contingent on whether cape-sized vessels will be used throughout the 2023 shipping season.



Aquatic Invasive Species Ballast Water Monitoring (DFO Collaboration)

Baffinland will be launching a two-week pilot program in September, 2023 in collaboration with the Department of Fisheries and Oceans that will focus on biological sampling of ballast water. This program is intended to monitor for the introduction of invasive species through ballast water discharges and will include training workshops in the community of Pond Inlet.

COMMUNICATIONS

In order to provide better communications about Baffinland vessel activities, full-time Shipping Monitors will be available over the entire shipping season working from the Baffinland Pond Inlet office located in the Mittimatalik Hunters and Trappers Organization (MHTO) office building (2nd Floor). If you have questions, comments or concerns about Baffinland vessels, please contact Baffinland by visiting one of our Shipping Monitors, or provide your concern to a representative from the MHTO who can then relay the message to Baffinland.

In addition to interacting directly with Shipping Monitors, vessel traffic in 2023 may be monitored through a variety of methods including:

1. Accessing the Baffinland website (www.baffinland.com) and follow the path to "Operation>Shipping & Monitoring", access also available in the Baffinland Pond Inlet office.
2. Visiting the Pond Inlet Baffinland office to observe live tracking of vessels through the Automatic Identification System (AIS) monitoring station, and learning more about the type of vessels that Baffinland requires for its operations.
3. Announcements about upcoming vessel activity including convoys will be made on the local Pond Inlet radio at regular intervals.
4. Listening to periodic announcements of daily and upcoming vessel activity including convoys on marine VHF radio channel 26.
5. Accessing Facebook pages for Baffinland Iron Mines, Pond Inlet News and Pond Inlet Hunters Information Page for periodic postings about past, current and future shipping activities.

QUESTIONS? HERE IS HOW YOU CAN REACH US

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L6H 0C3

If you have questions, comments or concerns about Baffinland vessels, please contact us by visiting one of our Shipping Monitors at the Baffinland Pond Inlet office (in Mittimatalik Hunters and Trappers Organization (MHTO) building, 2nd floor), contact us via marine VHF radio channel 26, or provide your concern directly to the MHTO. For specific vessel operation concerns, if possible, please indicate the name of the vessel, location, the date and time of observation, as well as any details about your concern. Please provide photos and video if available.

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APPENDIX 2
SELF ASSESSMENT OF SIGNIFICANCE AGAINST NIRB CRITERIA – NEWCASTLE MAX

Table 1. Capesize Trial 2023 – Self Assessment of Proposed Amendment to Approved Project

<table>
<tr><th>Self-Assessment Criteria</th><th>Baffinland Self Assessment</th></tr>
<tr><td>A sufficiently detailed scope of project components and activities to be undertaken during the proposed modification, contrasted with the scope of the original project as previously considered by the NPC, the NIRB and/or the NWB</td><td>The NIRB’s approval of the Early Revenue Phase considered the use of up to 58 vessels, sized Handymax to Post-Panamax. The Production Increase Proposal series of approvals considered 80 – 86 vessels, sized Handymax to Capesize. The use of Cape size vessels was specifically assessed and submitted to the NIRB on March 5, 2023 as a response to the NIRB’s 2019-2020 Mary River Project NIRB Annual Monitoring Report and Recommendations.

In 2023 two (2) Cape size (Cape size) vessels would be chartered to complete two round trips each during the shipping season. These trips would occur in open water. A Cape size vessel would be capable of carrying up to 204kt. With the average vessel load out of Milne Port being 76,862 kt in 2021, the use of Cape size could reduce the number of maximum number of vessels needed by 7:

<table>
<tr><td>Cape size Capacity</td><td>209,000t</td></tr>
<tr><td>X 4 trips (2 trips by 2 vessels)</td><td>836,000t</td></tr>
<tr><td>Avg Vessel Capacity in 2021</td><td>76,862t</td></tr>
<tr><td>Total 2022 Cape size capacity divided by Avg Vessel capacity in 2021</td><td>11 (10.87)</td></tr>
<tr><td>Difference between Cape size trips (4) and 2021 Avg vessel trips (11)</td><td>7</td></tr>
</table>

Only minor modifications to Milne Port ore dock are required (installation of additional tidal gauge screen to be reviewed live by vessel captains, installation of new fenders previously and bollards above high water mark).</td></tr>
<tr><td>Information demonstrating the proponent has considered the significance of the potential impacts associated with the proposed modification using the factors for determining significance as set out in s. 90 of the NuPPAA reflecting any other guidance or information requirements of the NPC, the NIRB and/or the NWB to evaluate the significance of the proposed modification;</td><td>See Table 2.</td></tr>
<tr><td>The proponent should also identify whether any new or modified permits, licenses or</td><td>No new or modified permits, licenses or other approvals are required to support the proposed activities.</td></tr>
</table>

other approvals are anticipated to be necessary for the proposed works or activities	• Appendix P of the North Baffin Regional Land Use Plan does not specify vessel size; Cape size trial conforms to Appendix P and does not require amendment. • There is no Project Certificate Term and Condition that dictates vessel mix or maximum vessel size. No amendment to the PC is required; the use of Cape size was explicitly assessed and submitted to NIRB in March 2021 • There are no implications for water or waste, no amendment or modification is required to the Type A or B Water License. • There are no implications on the Ore Dock #1 FAA. • There are no other permits, licenses or other approvals relevant to this activity.
For proposed modifications to approved projects with a NIRB Project Certificate, information should also be provided as to whether the grounds for a reconsideration of the existing Project Certificate terms and conditions have been met	The proposed modification to the shipping plan for 2022 does not meet the definition of 'project' under the Nunavut Planning and Project Assessment Act (NuPPAA). The use of two Cape size vessels traveling at restricted speeds (9 knots) produces less acoustic disturbance than what was assessed for Post-Panamax traveling at greater speeds (14 knots). Further, the reduction in the total number of vessels required by using larger vessels reduces the season's cumulative noise generation, which is an improvement. Accordingly, the proposed activities are better characterized as an environmental improvement. According to the NIRB's April 8th guidance document 'Approaches to Assessment of Proposed Amendments to Approved Projects', the proposal is manifestly insignificant and does not require submission to the NPC or NIRB for further review. The Cape size trial activities will be subject to Baffinland's existing marine monitoring program. No changes to the monitoring program are required to account for the modified activities.

Table 2. Change in Factors Related to Section 90 (NuPPAA) Significance Criteria

Section 90 NuPPAA Significance Criteria		Change in Factors Related to Significance of Impacts
a	Size of Geographic Area and Wildlife Habitats Likely to be Affected	**No change.** All activities and components associated with the larger vessel transits will be located entirely within the shipping lane (Baffin Bay-Eclipse Sound-Milne Inlet) considered under the Approved Project. Therefore, no changes are predicted for any VEC with respect to the size of the geographic area and wildlife habitats likely to be affected.
b	Ecosystemic Sensitivity of the Area	**No change.** The Eclipse Sound and Milne Inlet are home to the Eclipse Sound summer stock of narwhal. The area is known to host narwhal calving activities throughout the summer. The larger vessels will transit within the existing project boundaries and no new environmental sensitivities have been identified. **Note -** Given their close co-relationship with sea-ice, narwhal are predicted to be highly sensitive to effects of climate change. Direct and indirect effects of climate change on narwhal include increasingly erratic sea ice activity, seasonal and permanent sea ice decline, increased human activity in narwhal habitat (commercial fisheries, shipping), colonization of narwhal home range by species not previously present in the high north including predators, and impacts on food chain and prey availability (affecting narwhal foraging behaviour and energetics). In the FEIS (BIM 2012), the significance of potential impacts on marine mammals was evaluated in light of the state of health of the ecosystem and its predictable evolution, taking account global climate change. Therefore, the ecosystemic sensitivity of the Arctic relevant to climate change was accounted for in the original FEIS, and this has not changed since.
c	Historical, Cultural, and Archaeological Significance of Area	**No Change.** The shipping lane passes through Eclipse Sound and Milne Inlet. During the summer months, these waters are occupied by recreational traffic including local hunting boats. Hunters harvest narwhal, ringed seal, bearded seal and Arctic char from the marine environment during the open-water season. The larger vessel transits will be confined to the existing project boundaries; no new features of historical, cultural or archaeological significance will be affected.
d	Size of Human and Animal Populations Likely to be Affected	**No Change.** Vessels will be visible to the community of Pond Inlet (population 1617 (2016)) but they would continue to hug the south coast of Bylot Island and would unlikely be discernable from the Post Panamax vessels that already travel the shipping route. Hunters and land users may see the vessels on the water, or from their cabins along the shipping route at a closer range. While the differences in the size of vessels may not be generally discernable, Pond Inlet residents and hunters will experience up to 7 fewer vessels transiting the waters than they would have otherwise.

		Note - Recent aerial survey results have indicated that narwhal abundance in Eclipse Sound was statistically lower in 2020 and 2021 than in previous survey years (2013, 2016 and 2019) (Golder 2022). However, the combined narwhal abundance in Eclipse Sound and Admiralty Inlet was shown to be similar in 2020 to that observed in previous survey years (2013 and 2019); and was statistically higher in 2021 than in previous survey years (2013, 2019 and 2020) (Golder 2022). Collectively, these results suggest one or more of the following: • A portion of the Eclipse Sound stock occupied the Admiralty Inlet summering ground during the 2020 and 2021 open-water seasons. Potential primary drivers of displacement considered in 2020 included i) acoustic disturbance effects from icebreaking, ii) acoustic disturbance effects from construction activities (e.g., Year 1 of impact pile driving) associated with the Pond Inlet Small Craft Harbour (SCH) Project, and/or iii) increased killer whale presence in the RSA (Golder 2021c). Note that open-water shipping was not identified as a likely contributing factor to the observed decline in 2020 for reasons identified in Baffinland (2021), and that rationale remains valid for 2021. • Favorable environmental conditions (e.g., prey availability, ice coverage, lower predation pressure) during the spring and/or summer seasons in Admiralty Inlet may have attracted a larger influx of narwhal from the Eclipse Sound summer stock, and potentially from other proximal summer stock areas (i.e., Somerset Island, East Baffin Island) during the 2020/2021 open-water seasons. • There is a natural exchange of narwhal between the two putative summer stock areas (i.e., Eclipse Sound and Admiralty Inlet) during the open-water season. This has been previously suggested by DFO based on historical aerial survey results (Doniol-Valcroze et al. 2015, 2020; DFO 2020b) and telemetry studies (DFO 2020b). Natural exchange of narwhal between these stock areas during the open-water season is also strongly supported by available Inuit Qaujimajatuqangit (IQ) (NWMB 2016a, 2016b; QWB 2022). As noted in Golder (2021c), the above factors may have independently or cumulatively contributed to the observed decrease in narwhal numbers in Eclipse Sound. Prior to the start of the 2021 shipping season, it was not possible to determine whether one of these factors alone was the source of the narwhal decline in Eclipse Sound, whether the combined influence of one or more of these factors was responsible, or whether the observed change was natural in occurrence. Baffinland's commitment to the community of Pond Inlet to not undertake icebreaking during the early shoulder season of 2021 provided an opportunity to determine whether Project activities were the cause of the

		observed changes in narwhal abundance in Eclipse Sound in 2020 (Baffinland 2021; Golder 2021c). The precautionary and temporary adaptive management measure applied in 2021 eliminated the possibility of acoustic disturbance to narwhal from icebreaking during the timing of narwhal migration into Eclipse Sound in 2021, and also served to avoid the potential for cumulative noise effects associated with the Pond Inlet SCH Project. As a result of this, underwater noise from icebreaking operations was not considered to be an influencing factor on narwhal abundance in Eclipse Sound during the 2021 season. It also provides additional confidence that observed changes in 2020 were likely not a result of Project activities (i.e., early shoulder season icebreaking). With respect to underwater noise generated by the SCH construction in Pond Inlet, DFO confirmed that impact pile driving undertaken in 2021 was limited to seven days between 24 June and 01 July (DFO 2021), prior to breakup of the landfast ice and what DFO stated to be the possible arrival of narwhal into Eclipse Sound. DFO therefore concluded that underwater noise from pile driving could not be considered an influencing factor on narwhal abundance in Eclipse Sound or nearby waters during the 2021 season (DFO 2021). No further analysis on this can be completed given the lack of publicly available data. Any additional analysis would remain the responsibility of the Proponent for the SCH construction Project and associated regulatory authorities (i.e., DFO). <u>Other Considerations:</u> For the past three consecutive years (2019-2021), combined surveys of both Admiralty Inlet and Eclipse Sound summering stock areas have been undertaken. The primary impetus for running the combined stock surveys (as opposed to the Eclipse Sound summer stock only) was based on available IQ, which indicates that the geographic and genetic distinction between these two summering stocks may be invalid (NWMB 2016a; 2016b; QWB 2022). DFO has also been investigating the extent to which there is a natural exchange of narwhal between these stock areas during the open-water season (Doniol-Valcroze et al. 2015, 2020; DFO 2020b). Natural exchange between the two summering areas was proposed as a possible reason why the 2013 survey results for Admiralty Inlet (~35,000 narwhal) and Eclipse Sound (~10,000 narwhal) differed substantially from previous survey results for the same stocks (18,000 for Admiralty Inlet in 2010 and 20,000 for Eclipse Sound in 2004) (Doniol-Valcroze et al. 2015). All of these surveys (i.e., 2004, 2010, 2013) occurred prior to the start of Baffinland iron ore shipping operations. In summary, despite the adaptive management measure of eliminating underwater noise from icebreaking in 2021, results from the 2021 monitoring programs again indicated lower narwhal numbers in Eclipse Sound during the 2021 shipping season. While underwater noise from open-water shipping cannot be ruled out as a potential cause of narwhal displacement from the RSA, monitoring results collected to date demonstrate that responses to Project-related shipping activities are temporary and localized, suggesting that there are likely

		other factors contributing to the observed change (Austin et al. 2022a, 2022b; Baffinland 2021; Golder 2020a, 2021b). Given that the combined stock estimate for Admiralty Inlet and Eclipse Sound indicates that the regional narwhal population remains stable relative to pre-shipping conditions, and in consideration of the available IQ regarding the degree of exchange between narwhal groups on their summering grounds, the observed decrease in narwhal relative abundance in Eclipse Sound likely reflects natural exchange between the two putative stock areas, or alternatively, that animals shifted to Admiralty Inlet due to more favorable ecological conditions related to sea ice conditions, prey availability and/or predation pressure (Chambault et al. 2020; Franeira et al. 2017; Heide-Jorgensen et al. 2021; Higdon et al. 2012; Laidre et al. 2008, 2015; Lefort et al. 2020; Steiner et al. 2019, 2021), all of which are known to be influenced by a rapidly changing climate in the Arctic (Stroeve et al. 2012; IPCC 2013; Overland and Wang 2013). To better understand what is occurring, additional engagement and monitoring with Inuit stakeholders and regulatory agencies are needed, inclusive of collaborative regional scale monitoring that looks at the population dynamics of the entire Baffin Bay narwhal stock
e	Nature, Magnitude, and Complexity of Impacts	**No Change/Improvement**. While Capesize vessels do have a marginally larger acoustic sound field than Post-Panamax vessels, the use of larger vessels offset the total number of vessels needed in a season to call on Milne Port. Acoustic modeling completed for the FEIS indicated that a Post-Panamax carrier traveling at 14 knots would generate underwater noise capable of resulting in a behavioral disturbance at distances up to 70 km from the source (Zykov and Matthews (2010). Acoustic modeling undertaken in support of the FEIS Addendum for Phase 2 (BIM 2018) indicated that a Capesize carrier traveling at 9 knots would generate underwater noise capable of resulting in a behavioral disturbance at distances up to 29.5 km (Quijano et al 2018). The noise field associated with a Cape size vessel traveling at 9 knots would be similar to that of the Capesize vessel described above, and would therefore result in a smaller acoustic footprint than what was predicted in the original assessment (FEIS). Furthermore, the cumulative noise exposure on marine mammals would be slightly lower in 2022 given that the introduction of two Cape size voyages in 2022 would result in a net decrease in the overall number of transits animals would be exposed to during the season. *Quijano, J.E., C. O'Neill and M. Austin. 2018. Underwater Noise Assessment for the Mary River Project – Phase 2 Proposal: Construction and operation activities in Milne Port and along the Northern Shipping Route. Document 01621. Vesrion 1.0.* *Zykov, M and M.N.R. Matthews. 2010. Assessment of Underwater Noise for the Mary River Iron Mine Constrtion and Operitona of the mIlne Inlet Port Facility. Version 2.1. Technical report prepared for LGL Limited by JASCO Applied Sciencs.*

f	Probability of Impacts Occurring	**No Change.** The effects of the larger vessel transits are consistent with the Approved Project and will not exceed any significance thresholds or change the determination of significance, including the probability of an impact occurring.
g	Frequency and Duration of Impacts	**No Change.** The effects of the larger vessel transits are consistent with the Approved Project and will not exceed any significance thresholds or change the determination of significance, including the frequency or direction of an impact occurring. In fact, the reduction in overall vessel requirements will reduce the frequency of impacts from shipping transits.
h	Reversibility or Irreversibility of Impacts	**No Change.** The effects of the larger vessel transits are consistent with the Approved Project and will not exceed any significance thresholds or change the determination of significance, including the reversibility or irreversibility of environmental effects.
i	Cumulative Impacts	**No Change.** The cumulative effects assessed for the Approved Project are not evaluated to change as a result of the larger vessel transits.
j	Any Other Factor that the Board Considers Relevant	Baffinland is not aware of any other factor that NIRB considers relevant to the assessment of the significance of environmental effects.

APPENDIX 3
SELF ASSESSMENT OF SIGNIFICANCE AGAINST NIRB CRITERIA – CONTINGENCY ICEBREAKER

Table 1. Ice Escort Contingency – Self-Assessment of Proposed Amendment to Approved Project

Self-Assessment Criteria	Baffinland Self-Assessment
A sufficiently detailed scope of project components and activities to be undertaken during the proposed modification contrasted with the scope of the original project as previously considered by the NPC, the NIRB and/or the NWB	BIM is chartering a second ice breaker (MSV Fennica) to ensure our ability to safely escort vessels out at the end of the season in adverse ice conditions like those experienced in October 2022. The conditions experienced in 2022, where multiyear ice flushed into Eclipse Sound through Navy Board Inlet in early October, are rare compared to the last 25 years of recorded ice conditions in the area. As such, the MSV Fennica will be present as a contingency and anchored at Milne Port unless conditions trigger the need for its use. The use of two icebreakers are intended to increase the availability of ice escorts along the shipping route within the marine Regional Study Area, allow shipping to continue through to October 31 while still remaining within the shipping conditions permitted under Project Certificate 005 Term and Condition 187 (no breaking land fast ice). We have overall limited the charter period on both ice breakers to half of what we have chartered in previous seasons. Between 2018 and 2022 Baffinland contracted the MSV Botnica for 120 days and in 2023 the two icebreakers will not arrive in the marine RSA until the end of September. The use of a second icebreaker was specifically assessed and submitted to the NIRB on March 5, 2023 as a response to the NIRB's 2019-2020 Mary River Project NIRB Annual Monitoring Report and Recommendations. Within the capabilities of the second icebreaker and within applicable regulations: (1) Escort ice-breaking for bulk cargo vessels, tankers or other vessels which are loading or unloading or performing operations at Milne Port (2) Ice management in the vicinity of the terminal at Milne Port in the Mary River area of Baffin Island, Nunavut, Canada (3) Loading, storage, deployment, recovery, cleaning and discharge of pollution cleanup and containment gear such as spill booms, absorbent pads, skimmers. Equipment and personnel to be supplied by the Charterer. (4) Provision of emergency services to other ships, including oil spill response, fire fighting and damage control

	(5) Assistance accessing any ship chartered by Charterers or its facilities
Information demonstrating the proponent has considered the significance of the potential impacts associated with the proposed modification using the factors for determining significance as set out in s. 90 of the NuPPAA reflecting any other guidance or information requirements of the NPC, the NIRB and/or the NWB to evaluate the significance of the proposed modification;	See Table 2
The proponent should also identify whether any new or modified permits, licenses or other approvals are anticipated to be necessary for the proposed works or activities	Under the Flag Waiver obtained by Baffinland, Transport Canada and possibly the Canadian Border Service Agency (CBSA) will inspect the vessel to ensure it meets all applicable standards. Once the vessel has been cleared a certificate will be issued. No new or modified permits, licenses or other approvals are required to support the proposed activities. • Appendix P of the North Baffin Regional Land Use Plan does not specify vessel size; Cape size trial conforms to Appendix P and does not require amendment. • There is no Project Certificate Term and Condition that dictates vessel mix or maximum vessel size. No amendment to the PC is required; the use of a second icebreaker was explicitly assessed and submitted to NIRB in March 2021 • There are no implications for water or waste, no amendment or modification is required to the Type A or B Water License.
For proposed modifications to approved projects with a NIRB Project Certificate, information should also be provided as to whether the grounds for a reconsideration of the existing Project Certificate terms and conditions have been met	The chartering of a second icebreaker for the stated purpose does not meet the definition of 'project' under the Nunavut Planning and Project Assessment Act (NuPPAA). The activation of a second icebreaker in the Fall has been previously defined as part of the existing Project and assessed. According to the NIRB's April 8th guidance document 'Approaches to Assessment of Proposed Amendments to Approved Projects', the proposal is manifestly insignificant and does not require submission to the NPC or NIRB for further review. The potential use of a second icebreaker in the Fall will be subject to Baffinland's existing marine monitoring program. No changes to

	the monitoring program are required to account for the modified activities.

Table 2. Change in Factors Related to Section 90 (NuPPAA) Significance Criteria

Section 90 NuPPAA Significance Criteria		Change in Factors Related to Significance of Impacts
a	Size of Geographic Area and Wildlife Habitats Likely to be Affected	The 'Activity' (potential increase in icebreaking operations from 1 to 2 icebreakers during late shoulder season only) remains confined entirely within the PDA for the Approved Project. Therefore, no changes are predicted for any VEC with respect to the size of the geographic area and marine mammal habitats likely to be affected.
b	Ecosystemic Sensitivity of the Area	The activity remains within the existing PDA; no new environmental sensitivities have been identified for marine mammal VECs.
c	Historical, Cultural, and Archaeological Significance of Area	As described in the SOP addendum, the Baffin Region of Nunavut has a rich and visible archaeological heritage dating back many thousands of years. There are many archaeological sites with varying degrees of importance that have been found in the PDA, particularly around Milne Port and Steensby Port, and the transportation corridors between them. However, the activity remains confined to the existing PDA; no new features of historical, cultural or archaeological significance will be affected.
d	Size of Human and Animal Populations Likely to be Affected	The activity is not predicted to more adversely affect the size of animal populations or human demographics in the RSA. The population size of narwhal affected by the activity would be lower in late October than other times of the shipping season (i.e., July/August) as the majority of narwhal would have already completed their outmigration from the RSA and into Baffin Bay (as described in Baffinland 2021). The population size of ringed seal affected by the Activity would remain the same as originally assessed and as described in Baffinland (2021). From a human population perspective, North Baffin communities have grown over the past 20 years although the SOP is unlikely to introduce any additional demographic changes beyond what the current operation of the Approved Project has induced.
e	Nature, Magnitude, and Complexity of Impacts	The activity may result in incremental changes for most of the VECs included in the scope of the assessment; however, these effects are consistent with the Approved Project and will not exceed any significance thresholds or change the determination of significance. See Baffinland response to NIRB Recommendation #5 (Baffinland 2021) for additional details regarding impact on marine mammal VECs as a result of two icebreakers operating during fall shoulder season.
f	Probability of Impacts Occurring	The activity may result in an increase in the probability of environmental effects on certain VECs; however, these are consistent with the Approved Project and will not exceed any significance thresholds or change the determination of significance. See Baffinland response to NIRB Recommendation #5 (Baffinland 2021) for additional details regarding impact of two icebreakers on marine mammal VECs during fall shoulder season.
g	Frequency and Duration of Impacts	The activity may result in a net increase in the frequency and/or duration of icebreaking impacts on marine mammal VECs in the RSA (as described in

		Baffinland 2021); however, these are consistent with the Approved Project and will not exceed any significance thresholds or change the determination of significance.
h	Reversibility or Irreversibility of Impacts	In consideration of the nature of the potential interactions and environmental effects associated with the activity, no changes are predicted for marine mammal VECs with respect to the reversibility or irreversibility of this impact pathways (two icebreakers operating during fall shoulder season).
i	Cumulative Impacts	The cumulative effects assessed for the Approved Project are not evaluated to change as a result of the activity.
j	Any Other Factor that the Board Considers Relevant	Baffinland has taken into consideration community comments share directly from the communities, with QIA and through the NIRB process relevant to the above topics. Baffinland is not aware of any other factor that NIRB considers relevant to the assessment of the significance of environmental effects.

Table 2: Modelled distance to the 120 dB disturbance onset threshold for narwhal and total exposure period >120 dB re 1 uPa per icebreaker transit for three different icebreaker escort scenarios (based on Phase 2 Proposal) in various ice conditions along the Northern Shipping Route

Icebreaker Transit Scenario	Vessel speed (knots)	Ice concentration	Range (R95%) to 120 dB disturbance threshold* (km)	Total exposure period >120 dB per icebreaker transit
2 icebreakers + 2 capesize carriers	4.6	10/10	44.3	10.4 h
	9	3/10	42.5	5.1 h
	9	0/10 (open)	26.3	3.2 h
1 icebreaker + 2 capesize carriers	4.6	10/10	40.3	9.5 h
	9	3/10	37.3	4.5 h
	9	0/10 (open)	25.9	3.1 h
1 icebreaker + 1 capesize carrier	4.6	10/10	40.4	9.5 h
	9	3/10	34.9	4.2 h
	9	0/10 (open)	18.6	2.2 h

*Acoustic threshold for onset of disturbance in narwhal (onset of behavioural responses that can range from subtle changes in swim speed and direction to minor and localized avoidance of a sound source) (NOAA 2013).

APPENDIX 4

ASSESSMENT OF ICE BREAKING – SUBMITTED FOR PRODUCTION INCREASE PROPOSAL EXTENSION, MARCH 2021

March 5, 2021

MEMO

Response to Board Recommendation No. 5

In this recommendation, NIRB has requested Baffinland provide an assessment of the ongoing ice-management activities using the icebreaker (MSV Botnica), specifically in relation to the potential effects of these activities on noise levels on marine mammals and their activities along the Northern Shipping Route.

Firstly, Baffinland wished to note that shipping in support of the current Project is consistent with the nominal dates approved under the Early Revenue Phase (ERP). As described in Section 5.3.6 of the Supporting Information Package submitted by Baffinland for the 2020 Production Increase Proposal Extension Request ('Extension Request'), Baffinland has conducted an extensive environmental assessment for the Phase 2 Proposal ('Proposal'). While the Extension Request does not contain a dedicated Assessment of Icebreaking Operations, it does make reference to the one provided in relation to Phase 2, which has been publicly available since May 17, 2019 (Public Registry ID No. 325033-325047).

1.1 CURRENTLY ACTIVITY DESCRIPTION

Shipping currently occurs between approximately July 15 and October 15 each year, as approved under the original ERP Proposal. Under the currently approved Production Increase Proposal Extension to December 31, 2021 Baffinland is allowed to ship up to 6 Mtpa via 84 ore carriers during the shipping season. Shipping at the beginning and end of the shipping season requires ore carriers to be escorted by an icebreaking when ice concentrations and thickness warrant it. In the Spring transits that require icebreaker escorts are subject to transit restrictions for the purposes of limiting underwater noise and potential disturbance to marine mammals, including narwhal.

Icebreaking undertaken along the Northern Shipping Route is a limited Project activity that is only required at the beginning and end of the shipping season (referred to as the shoulder seasons). During these respective shoulder seasons, ice concentrations along the Northern Shipping Route are known to be variable on both a temporal and spatial scale. Consequently, icebreaking does not occur continuously along the entire Northern Shipping Route during these periods but rather at intermittent points during a given transit when thicker ice conditions are otherwise unavoidable by Project vessels. Based on annual ice conditions in the Regional Study Area (RSA), the level of icebreaking (e.g., duration, frequency, extent) will likely vary from year to year, and is likely to change over the lifetime of the Project given anticipated effects of climate change on annual sea ice extent.

1.1.1 Proposed Icebreaking Activities Associated with the Proposal

The following assumptions and scenarios were made and evaluated in the Golder (2019) Phase 2 Assessment of icebreaking operations during shipping shoulder seasons on marine biophysical Valued Ecosystem Components ('Icebreaking Assessment'):

1. Two icebreakers would be escorting vessels along the Northern Shipping Route, with each icebreaker escorting between one to four Project vessels (i.e. tug vessels, ore carriers, freight vessels or fuel tankers).
2. Two icebreakers with vessels in escort may cross paths at some point along the Northern Shipping Route
3. Two icebreakers would travel in tandem with one another to escort larger Capesize vessels.
4. Shipping would occur between July 01 and November 15 of each year, subject to ice conditions
5. If a remnant track from a previous transit was available, the icebreaker would follow the same path to minimize ice interactions
6. Icebreakers will maintain sustained speeds of 9 knots, unless prevailing safety conditions require a need to deviate from this speed restriction
7. Landfast ice must be naturally broken along the entire Northern Shipping Route before the start of the shipping season begins, including icebreaking operations.

As is highlighted in points number 1 to 3 above, and as was outlined in Section 5.3.1 of the Extension Request, icebreaking activities associated with the current operations are smaller in scope than what was assessed for the Proposal (Table 1). Subsequently, it was noted in the Production Increase Proposal Extension Request Application ('PIP Application') that the Icebreaking Assessment is overly conservative and provides a reasonable level of certainty that no significant adverse effects are predicted to occur as a result of icebreaking activities associated with current operations.

Table 1: Comparison of Approved Project to Scope Assessed for Phase 2

Description	Approved Project	Phase 2
Season Length	July 1 – November 15	July 15 – October 15~
Shipping Route	Baffin Bay-Eclipse Bay-Milne Inlet	Baffin Bay-Eclipse Bay-Milne Inlet
# of Vessels/# of Transits	84/168	176/352
# of Icebreaker	1	2
Speed Limits	9 knots	9 knots

1.1.2 Scope of Memo

It is noted that the icebreaking assessment for Phase 2 included an assessment of all potential effects of icebreaking on marine mammals (hearing impairment, acoustic disturbance, acoustic masking, ice entrapment and ship strikes) using multiple indicator species occurring in the RSA (bowhead whale, beluga, narwhal, Atlantic walrus, ringed seal, polar bear). For the purposes of addressing Board Recommendation No. 5, this memo is focused on summarizing the effects of icebreaking on local sea ice conditions, and the effects of icebreaking noise on the key marine mammal indicator species in the RSA; narwhal and ringed seal. For additional details, please refer to the PIP Application, the Icebreaking Assessment and additional documentation referenced below.

1.2 SEA ICE BREAK-UP AND FREEZE-UP DECAY AND FORMATION

At the start of the shipping season, icebreaking after landfast ice has naturally fractured could have an effect of slightly speeding up the transition process from heavy sea ice concentrations to open-water conditions, and therefore may slightly advance the date when open-water conditions prevail.

At the end of the shipping season, icebreaking could act to delay sea ice formation and produce relatively rough ice surfaces within the localized area affected by the icebreaker passage. The delay in freeze-up would be on the order of hours to days, depending on local air temperatures and wind/wave conditions. Any localized disruption in the timing of ice freeze-up would be restricted to a narrow swath along the ship track (assuming ice conditions are thick enough to result in the creation of a track). The effects would therefore be minimal in the context of the naturally occurring variability in the timing of formation and in the spatial context of landfast ice development. For additional information regarding historical break up and freeze up and impacts of icebreaking on ice, see Appendix 1.

During both shoulder seasons, if the ice is thick enough, icebreaking will spatially disturb contiguous ice cover by temporarily creating an open-water channel for the passage of Project ore carriers. It has been assumed that the beam width of an icebreaker and ore carrier is 24 m and 56 m, respectively. A conservative estimate of the total width of an icebreaker transit corridor (with escorted vessels) is 200 m. The Northern Shipping Route is 264 km long form Milne Port to the outer RSA boundary. This would result in a total sea ice area of 52.8 km2 that would be affected by icebreaking, which is equivalent to approximately 0.33% of available marine / sea ice habitat in the RSA. It is noted however, that this represents a worst-case scenario where ice conditions are concentrated such that the icebreaker creates a channel through ice along the entire length of the shipping corridor in the RSA, rather than travelling through ice that is already broken up and no longer contiguous in nature (as is normally the case during the shoulder seasons).

Overall, icebreaking activities are not expected to result in significant adverse effects on sea ice as Project icebreaking is strictly limited to the shoulder season and not during periods of landfast cover. Considering the overall speed over which the sea ice break-up and freeze-up process occurs naturally and the limited ice corridor that would be impacted by icebreaking activities during the shoulder seasons, the potential effects of icebreaking on local sea ice conditions are predicted to be negligible (unlikely to result in any significant changes in the timing of ice break-up and/or freeze-up).

1.2.1 Uncertainty

The linkages through which icebreaking can affect sea ice are well understood, and Project activities that may affect sea ice have been considered where appropriate. Prediction confidence for adverse effects on marine mammal ice habitats as a result of icebreaking is considered moderate to high as the extent of the habitat loss/fragmentation is well known and easy to measure. However, the historical record of repeated icebreaker escort activities along the Northern Shipping Route and in Milne Port is limited. Nevertheless, shipping through ice infested waters has been ongoing in the Canadian Arctic for many years, and experience gained from those operations has contributed to the effects assessment presented here.

1.3 UNDERWATER NOISE IMPACTS ON MARINE MAMMALS

1.3.1 Acoustic Assessment Overview

The assessment of potential underwater noise effects on marine mammals from icebreaking activities carried out in support of the Proposal included the following:

- a summary of marine mammal baseline conditions in the RSA during ice break-up and freeze-up periods;
- a review of the hearing abilities of the species under consideration;
- issues scoping (identification of key issues related to underwater noise and marine mammals for carry forward in the assessment);
- identification of underwater noise impact criteria for marine mammals (i.e., existing marine mammal acoustic thresholds for injury and behavioural disturbance);
- underwater noise modelling of icebreaking operations using different exposure scenarios for predicting the spatial and temporal extents of Project-generated underwater noise (i.e. zone of influence) relative to existing acoustic threshold criteria;
- a review of underwater noise monitoring results including sound level measurements of the MSV Botnica as it transited over two underwater recording stations in Eclipse Sound (under various ice escort configurations) during the 2019 early shoulder season, including a comparison to modelling results;
- a detailed evaluation of icebreaking impacts on marine mammals (including a summary of known effects of icebreaker noise on narwhal and ringed seal);
- identification of Project mitigation measures to avoid and/or minimize adverse effects of noise on marine mammals in the RSA;
- identification of residual effects (i.e., those effects remaining following effective application of mitigation), including a summary of:
    - the proportion of time icebreaking sound levels measured at two recording stations in Eclipse Sound exceeded the 120 dB disturbance onset threshold;

  - o the estimated range (R95%) of the 120 dB sound field radiating from the icebreaker based on both modelling results;
  - o an estimate of the daily disturbance exposure period marine mammals occurring along the shipping route would experience following exposure to icebreaking activities during the shoulder season (based on both modelling and monitoring data);
  - o an estimate on the total number of animals potentially exposed to icebreaker noise capable of resulting in injury or behavioural disturbance (per vessel transit);
  - o a review of narwhal movement data in the presence of icebreaking activities during the 2018 fall shoulder season based on animal-borne satellite tagging data;
- a determination of significance for each Project residual effect (by indicator species).

1.3.2 Mitigation Measures

In Section 5.3.4 of the PIP Application approved by NIRB, Baffinland provided a high-level summary of all relevant mitigations committed to by Baffinland to minimize effects on marine mammals. This list included those relevant to icebreaking activities associated with the current Project and are as follows:

- Defined shipping lane throughout RSA.
- Maintain constant speed and course when possible.
- No breaking of landfast ice.
- Between the period of 01 July and 30 July, a maximum of one icebreaker transit (with escorted vessels) will occur per 24-hour period where ice concentrations of 6/10 or greater cannot be avoided along the shipping route.
- Between the period of 01 July and 30 July, a maximum of two icebreaker transits (with escorted vessels) will occur per 24-hour period where ice concentrations of 3/10 or greater cannot be avoided along the shipping route.
- All Project vessels will reduce speeds to a voluntary maximum of 9 knots when travelling within the RSA.
- Establishment of a 40-km buffer zone (set-back area) at the floe-edge (extending from the Nunavut Settlement Boundary).
- All ice breaking activities will be conducted outside of the period of ringed seal denning, pupping, nursing and breeding periods.
- When marine mammals appear to be trapped or disturbed by Project vessel movements, the vessel will implement appropriate measures to mitigate disturbance, including stoppage of movement until wildlife move away from the immediate area (as safe navigation allows).

- All Project vessels will be provided with standard instructions to not approach within 300 m of a walrus or polar bear observed on sea ice.
- All Project vessels will be provided with standard instructions to operate their vessel in a manner that avoids separating an individual member(s) of a group of marine mammals from other members of the group.
- Baffinland will place Marine Wildlife Observers (via the SBO program) on ice breaking vessels during the shoulder season that will be responsible for recording relative abundance, group composition and behavior of marine mammals, and if relevant any incidences of marine mammal strike of near misses with Project vessels.
- Posting of ice analyst on board icebreaking vessels.
- Project aircrafts (helicopter and airplanes) will maintain an altitude of 450m over marine waters when possible.
- Establishment of restricted “no-go” zones to avoid key sensitive areas (Koluktoo Bay, Tremblay Sound, Bruce Head shoreline).
- No drifting in Eclipse Sound.
- Maximum of 3 vessels anchored at Ragged Island.
- Limiting vessel idling.

It is important to note that several of these mitigation measures have been implemented on a voluntary basis by Baffinland and exceed any applicable regulatory requirements in Canada. This suite of measures represents a more conservative practice of vessel traffic management than is demonstrated by any other industrial/commercial shipping operator or government vessel in the RSA (i.e., Canadian Coast Guard, Fisheries and Oceans Canada). Additionally, since receiving approval from the NIRB on the Extension Request, Baffinland has worked with DFO to update Baffinland’s commitments on the transit restrictions mitigations, which will apply beginning in summer 2021. The commitments are as follows:

1. Apply spring transit restriction mitigations as long as ice concentrations, as defined by the Canadian Ice Service, of greater than 3/10 persist along the Northern Shipping Route, or meet the obligations of applicable commitments to others if more conservative, to determine the earliest date for commencing the shipping season. Initiation of this commitment will begin in 2021.
2. Beginning in 2021, apply the following transit restriction mitigations in the fall:

   - When a continuous sailing route of open water and/or new ice (<10 cm) occurs between the entrance of Pond Inlet and Milne Port, then icebreaker transits and other unescorted vessels in the RSA may proceed under open-water operating conditions.
   - A maximum of two transits or four half transits will occur per day (24-h period) where grey ice (10-15 cm) cannot be avoided along the shipping route.

- No breaking of landfast ice along the shipping route.

A supplementary table on Project mitigations and monitoring was also provided in response to FWS Comments from DFO on the Extension Request (Appendix 2). This table outlined how, for each potential effect associated with the shipping operations for the Project, a mitigation to minimize or eliminate the effect has been applied by Baffinland and also described associated monitoring results that support conclusions about the efficacy of those mitigations to the time of submission.

1.3.3 Assessment Results for Narwhal

1.3.3.1 Acoustic Injury

Acoustic propagation modelling results indicated that underwater noise generated by icebreaking activities during the shoulder seasons would not exceed the established threshold for auditory injury in narwhal under any of the modelling scenarios considered in the Icebreaking Assessment (Golder 2019). The risk of acoustic injury (i.e., hearing impairment) in narwhal from icebreaking noise was therefore predicted to be negligible.

The model predictions were verified by measurements collected in the field during the 2019 shoulder season. All sound level measurements of icebreaker activities undertaken along the Northern Shipping Route in 2019 were below the threshold for auditory injury for narwhal (Frouin-Mouy et al. 2020).

3.3.3.2 Potential Acoustic Disturbance:

Based on best available science regarding underwater noise impacts on marine mammals, the assessment assumed that narwhal exposed to non-impulsive sound from icebreaking activities may exhibit a disturbance response where sound levels exceeded 120 dB re 1 µPa (SPL rms) (NOAA 2013).

Acoustic Modelling Results

For each icebreaker transit scenario considered in the acoustic model, the maximum distance to the 120 dB disturbance onset threshold was calculated. 'Disturbance onset' is considered to represent the threshold at which narwhal may begin to demonstrate behavioural responses ranging from subtle changes in swim speed and direction to minor and localized avoidance of a sound source.

Based on modelling results (Golder 2019), the range (R95%) associated with disturbance onset in narwhal was predicted to extend up to 44.3 km from the source in 10/10 ice, 42.5 km in 3/10 ice, and 26.3 km in open-water (0/10 ice) based on a maximum-case icebreaker transit scenario (two icebreakers escorting two capesize ore carriers in Eclipse Sound) (Table 1). For this scenario, a stationary narwhal positioned along the shipping corridor would have the potential to be in the 120 dB disturbance zone for a period of up to 10.4 h (for transits at 9 knots in 0/10 ice), 5.1 h (for transits at 9 knots in 3/10 ice), and 3.2 h (for transits at 4.6 knots in 10/10 ice) per icebreaker transit (Table 2).

Table 2: Modelled distance to the 120 dB disturbance onset threshold for narwhal and total exposure period >120 dB re 1 uPa per icebreaker transit for three different icebreaker escort scenarios (based on Phase 2 Proposal) in various ice conditions along the Northern Shipping Route

Icebreaker Transit Scenario	Vessel speed (knots)	Ice concentration	Range (R95%) to 120 dB disturbance threshold* (km)	Total exposure period >120 dB per icebreaker transit
2 icebreakers + 2 capesize carriers	4.6	10/10	44.3	10.4 h
	9	3/10	42.5	5.1 h
	9	0/10 (open)	26.3	3.2 h
1 icebreaker + 2 capesize carriers	4.6	10/10	40.3	9.5 h
	9	3/10	37.3	4.5 h
	9	0/10 (open)	25.9	3.1 h
1 icebreaker + 1 capesize carrier	4.6	10/10	40.4	9.5 h
	9	3/10	34.9	4.2 h
	9	0/10 (open)	18.6	2.2 h

*Acoustic threshold for onset of disturbance in narwhal (onset of behavioural responses that can range from subtle changes in swim speed and direction to minor and localized avoidance of a sound source) (NOAA 2013).

Acoustic Monitoring Results

Underwater sound levels measured at two recording stations in Eclipse Sound during the 2019 early shoulder season were analyzed to determine the amount of time that sound levels exceeded the narwhal disturbance threshold of 120 dB re 1 µPa (Table 2; full summary in Frouin-Mouy et al. 2020). The one-minute averaged sound pressure level (SPL) was shown to rarely exceeded the 120 dB re 1 µPa threshold at either station, with exceedances observed for 1.9% of the total recording duration (28 days) at Ragged Island (AMAR–RI) and 1.4% of the total recording duration (28 days) at Bylot Island (AMAR–BI). On average, received sound levels at these stations exceeded the disturbance threshold of 120 dB re 1 µPa for less than one hour per day (Table 3).

Table 3: Average and maximum daily exposure durations for disturbance (120 dB re 1 µPa) for each recorder during the 2019 early shoulder

Acoustic Recorder		Average time per day with SPL > 120 dB (hours [minutes])	Maximum time per day with SPL > 120 dB (hours [minutes])
AMAR-BI (Bylot Island)	All recorded data	0.2 [12.6]	8.6 [516]
	Only data with vessels detected	0.2 [12.6]	8.6 [516]
AMAR-RI (Ragged Island)	All recorded data	1.3 [77.3]	10.6 [637]
	Only data with vessels detected	0.7 [44.1]	7.1 [427]

Predicted (i.e., modelled) values were compared to actual recorded icebreaking noise levels (as measured in the field) to assess accuracy of the model predictions including estimates of daily noise exposure > 120 dB. This was based on underwater sound levels of five separate icebreakers transiting in open-water over the Bylot Island recorder between 07 July and 04 August 2019. Results are presented in Table 4, including the total time per transit that underwater noise levels exceeded the 120 dB disturbance threshold. These measured values at Bylot Island were compared to the modelled value for the same icebreaker transit configuration (icebreaker + two capesize carriers in 0/10 ice) (highlighted in grey in Table 5). Results demonstrated that the measured noise fields associated with disturbance onset were less than half those predicted by modelling (Table 5) even when considering the loudest of the five icebreaker transits analyzed. For example, based on acoustic modelling, it was predicted that a narwhal exposed to an icebreaker accompanied by two ore carriers transiting in 0/10 ice would be subject to noise levels exceeding the disturbance threshold (≥120 dB) for a period lasting up to 3.1 h per transit. However, measured values at Bylot Island ultimately only exceeded 120 dB re 1 µPa for a maximum period of 0.5 to 1.3 h per transit (>58% lower than predicted). These results demonstrate that the acoustic modelling results are conservative and over-represent actual noise fields produced by icebreakers in the receiving environment. A summary of these results was presented in a technical memorandum filed with the Board in 2020 (Golder 2020; Public Registry ID No. 331438; Appendix 3).

For each icebreaker transit scenario, the calculated ‘120 dB vessel disturbance period’ was multiplied by the number of anticipated icebreaker transits per day (based on existing transit restrictions during the shoulder season) to determine the total time in a day that noise levels would exceed the 120 dB disturbance threshold, known as the ‘daily 120 dB disturbance period’ (Table 5). Based on modeling data, the daily 120 dB disturbance period for narwhal ranged from 9.5 h in 10/10 ice conditions (restricted to one daily transit only) to 12.4 h in 0/10 ice conditions (assuming a maximum of 4 icebreaker transits per day would be possible in the shoulder season). These values correspond to transits of 1 icebreaker and 2 Capesize ore carriers. Based on measured data (which was only available for icebreaking transits in 0/10 ice conditions), the daily 120 dB disturbance period would be 5.2 h (based on 4 transits per day of 1 icebreaker and 2 Capesize ore carriers), equivalent to 18.8 h of ‘quiet’ time.

Table 4: Exposure Period ≥ 120 dB for Icebreaker Transits over Bylot Island station AMAR-BI in July 2019

Transit #	Date	Scenario	Speed (kn)	Horizontal Range to AMAR (m)	Course Heading	Time (min) > 120 dB per transit	Time (h) > 120 dB per transit
1	18-July-2019	Botnica with 2 carriers + tug	8.7	<70	250.4	75	1.3
2	19-July-2019	Botnica with no escorts (solo)	8.3	<120	71.3	33	0.5
3	20-July-2019	Botnica with 2 carriers	8.4	<64	250	43	0.7
4	22-July-2019	Botnica with 3 carriers	8.0	<43	250.6	69	1.2
5	23-July-2019	Botnica with 2 carriers	8.2	<82	65.4	37	0.6

Table 5: Comparison of modelled vs. measured daily disturbance exposure periods for icebreaker transits

Scenario	Speed	Ice Cover	Noise field – R95% range (km)	120 dB exposure period (h) per transit	# of transits per Day	120 dB daily exposure period (h)	"Quiet time" per day (h)**
1 icebreaker + 2 capesize carriers – MODELLED	4.6 knots	10/10	40.3	9.5	1	9.5	14.5
	9 knots	3/10	37.3	4.5	2	9	15
	9 knots	0/10	25.9	3.1	4	12.4	11.6
1 icebreaker + 2 capesize carriers - MEASURED (Bylot)	9 knots	0/10	N/A	1.3*	4	5.2	18.8

* 1.3 used as most conservative value as it is associated with the highest sound levels and largest noise field of the five transit scenarios.
** "quiet time" is defined as time in which marine mammals would not be exposed to ship noise above the 120 dB disturbance threshold

Based on a maximum-case icebreaker transit scenario (2 icebreakers escorting 2 capesize carriers), using corrected narwhal density estimates available for July/August and October/November (Baffinland 2012; Elliott et al 2015; Thomas et al. 2015), the estimated number of narwhal predicted to occur in the modelled disturbance zone is:

- 4,722 individuals during the Heavy Ice Regime (early summer);
- 4,702 individuals during the Moderate Ice Regime (early summer);

- 4,534 individuals during the Light Ice Regime (early summer);
- 3,745 individuals during the Heavy Ice Regime (fall); and
- 3,560 individuals during the Moderate Ice Regime (fall).

Based on a typical-case icebreaker transit scenario (1 icebreaker escorting 2 capesize carriers), using corrected narwhal density estimates identified above, the estimated number of narwhal predicted to occur in the modelled disturbance zone is:

- 4,717 individuals during the Heavy Ice Regime (early summer);
- 4,688 individuals during the Moderate Ice Regime (early summer);
- 4,510 individuals during the Light Ice Regime (early summer);
- 3,731 individuals during the Heavy Ice Regime (fall); and
- 3,536 individuals during the Moderate Ice Regime (fall).

In summary, up to 4,700 narwhal in Milne Inlet and Eclipse Sound may be temporarily exposed to sound levels capable of resulting in disturbance behaviour per icebreaker transit. This represents approximately 23% of the Eclipse Sound summer stock (estimated at 20,211 individuals based on NAMMCO 2010) and approximately 3% of the Baffin Bay population (estimated at 141,909 individuals based on Doniol-Valcroze et al. 2015). Temporary exposure in this case has been defined using existing acoustic monitoring data, with a total exposure period per icebreaker transit ranging from 30 min to 1.3 h (Table 4). This effect would be further mitigated through a daily limit on icebreaker transits in the RSA during the shoulder season when ice conditions exceed 3/10 concentration, as outlined in Section 3.2.2.

It is important to note that the estimates provided above for 'total daily disturbance exposure period' and 'total number of animals exposed to >120 dB per transit' are considered highly conservative with respect to assessing disturbance effects in narwhal. This is because they are based on disturbance range estimates derived from acoustic modelling (which are demonstrated to overestimate the extent of the noise fields) and they assume that all narwhal in the RSA are non-motile and occur exclusively on the shipping corridor.

Additionally, it is important to clarify that the 120 dB threshold does not account for the frequency of the ship noise source relative to narwhal hearing sensitivity. Shipping noise generally dominates ambient noise at low frequencies, with most energy occurring between 20 to 300 Hz and some components extending into the 1 to 5 kHz range (Richardson et al. 1995). Narwhal are considered high-frequency cetaceans (Southall et al. 2019) (previously recognized as mid-frequency cetaceans; NMFS 2018) with their most sensitive hearing occurring in the 20 to 100 kHz range (Richardson et al. 1995). Narwhal vocalization studies indicate that this species primarily vocalizes in the 300 Hz to 24 kHz range (Ford and Fisher 1978; Marcoux et al. 2011; Marcoux et al. 2012). Ship noise is therefore unlikely to result in major disturbance effects in narwhal given it is primarily emitted in the frequency band in which both species have lower hearing sensitivity (see Figure 1 and 2 below).

Observed Behavioural Responses to Icebreaking Activities in RSA

In August 2018, two narwhal (NW21 and NW22) were live captured in the RSA, instrumented with satellite telemetry tags and high-resolution dive tags, and released back to the ocean for the purpose of monitoring their daily movements in relation to fluctuating ice conditions in the RSA and in response to icebreaking operations and ship traffic along the Northern Shipping Route during the shipping season. Results from this study are available in a document filed with the NIRB (Golder 2019b, Appendix 4), with a brief summary provided below to provide context related to the present discussion of potential disturbance effects on narwhal from icebreaking activities.

Both NW21 and NW22 were shown to remain in the vicinity of the Northern Shipping Route for extended periods during the2018 fall shoulder season, despite being exposed to thickening ice conditions and regular icebreaking activities during the late shoulder season. Although the location data associated with NW21 were not of sufficient resolution to assess fine scale movements of this animal in relation to icebreaker movements, it was evident from the daily narwhal tracks that exposure to icebreaker and ship traffic during this time did not result in any large scale displacement of either narwhal from the RSA. In general, NW22 had multiple close encounters with the icebreaker and all vessel types throughout the fall shoulder season and did not appear to actively avoid icebreaking operations and associated vessel traffic as the season progressed. Of the total narwhal-vessel interaction events recorded for NW22 in 2019, 25 of these events occurred in relation to icebreaking transits undertaken by the MSV Botnica and one event occurred in relation to icebreaking transits by the CCGS Terry Fox. The distance between NW22 and an icebreaker during active transits (CPA < 54.4 km) ranged between 0.84 km and 52.97 km. Throughout the 19-day study period, NW22 remained within the modelled '120 dB disturbance' zone of the icebreaker (54.4 km) for 47.4% of the time.

NW22 interacted more closely with the MSV Botnica (with vessels in escort) toward the latter part of the late shoulder season (see Figure 13 in Golder 2019b). This finding may indicate possible habituation of the animal to icebreaking operations. It may also indicate that both the icebreaking vessel and animal were utilizing the path of least resistance (i.e., area with the least ice present) as the ice becomes increasingly dense later in the fall shoulder season. It is also possible that increasing ice concentration restricts movements by the animal, causing it to rely more heavily on the path created by icebreaking operations.

NW22 made regular crossings across the bow and the stern of all vessel types during the 2018 fall shoulder season (see Figure 14 in Golder 2019b). However, NW22 did not cross behind the stern of the Botnica (with vessels in escort) for a period of 4.5 hours following an active transit. As sound generated from vessels is known to radiate asymmetrically, with sound levels from the stern aspect typically being highest (Arveson and Vendittis 2000; McKenna et al. 2012), this finding may signify the animal's attempt to avoid the noisiest aspect of the vessel. However, the gap may also be due to data scarcity during the 2018 fall shoulder season (limited to one tagged animal). In addition, given the characteristics of sound that are generated from icebreaking operations and the way in which sound propagates under ice, the interpretation of the 4.5 h gap of crossing behind the stern of the vessel is not straightforward. It is also important to note that this result is based on a very limited dataset (a single animal over the course of

19 days), and further data collection and analysis is required to further evaluate this potential avoidance response. Continued acoustic monitoring of Project-related icebreaking operations is therefore warranted to assess the sound levels radiated from the stern of individual vessels, including icebreakers. This work is presently underwater as part of JASCO's 2020 icebreaking noise monitoring program with a summary draft report anticipated to be submitted to the Marine Environmental Working Group (MEWG) in Q2 2021.

Acoustic Masking

Icebreaking operations are anticipated to result in some degree of acoustic masking in narwhal; however, there currently are no established regulatory thresholds for masking to indicate at what level of masking may occur in marine mammals or what level of masking may result in biological consequences. In general, the science on the effects of masking is relatively young. Given this limitation, in order to better understand potential masking effects, JASCO analyzed the 2018-2019 acoustic monitoring data to estimate the level of listening range reduction (LRR) that would occur for narwhal due to icebreaker/shipping noise during the shoulder season relative to ambient conditions. Results from this work demonstrated that sound levels capable of masking would be intermittent and temporary in nature, and that narwhal are already exposed to similar levels of masking from natural sounds like wind and waves. This suggests they narwhal likely have some form of existing strategy for undertaking their normal day to day functions within an intermittently noisy environment.

There are several examples in the scientific literature where marine mammals have demonstrated an ability to modify their vocal behaviour to overcome competing sound sources in their environment (Au et al. 1985; Lesage et al. 1999); although this has not yet been studied in narwhal. As an example, beluga whales, a close relative of the narwhal, are known to be able to modify their calling frequency in the presence of shipping to avoid masking effects; by up-shifting their calls to frequencies that do not overlap with the shipping noise. The vocal repertoire of narwhal includes five different types of calls. Four of these call types have minimal frequency overlap with ship noise, including those associated with echolocation (i.e., biosonar) that is used for foraging and navigation. The fifth call type (whistles), which is associated with a social function, can occur at frequencies below 1 kHz which can overlap in frequency with ship noise, but generally occurs at frequencies of several kilohertz where there is little vessel noise overlap. For visual context, the degree of overlap between narwhal vocalizations and communication range relative to shipping noise is presented in Figure 1 and Figure 2.

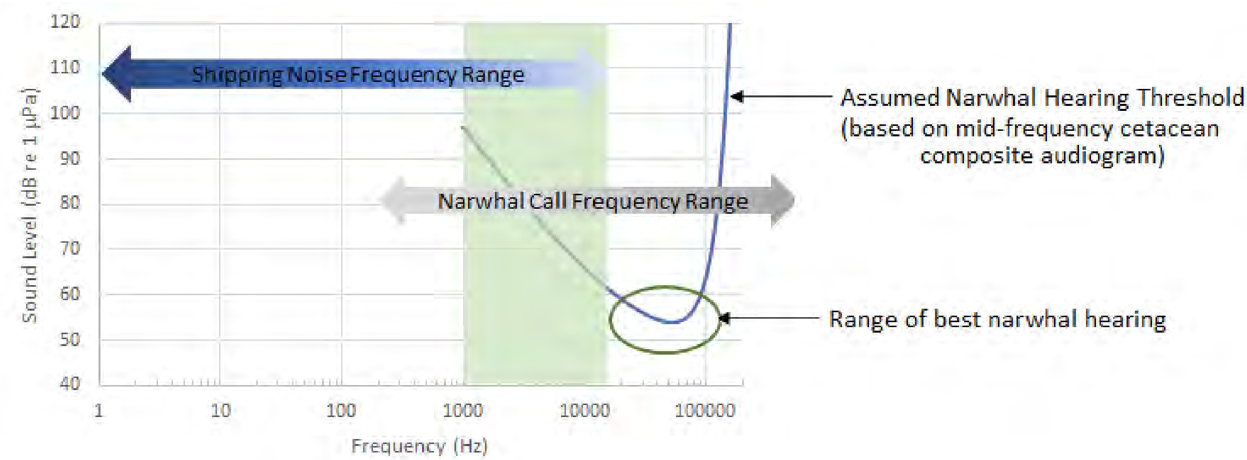

Figure 1: Shipping Noise in Comparison to Narwhal Communication Range

Notes: Blue arrow depicts frequencies where vessel noise occurs. Ship noise is louder at low frequencies (left of plot) shown in darker blue shading and quieter at higher frequencies (right of plot) shown in lighter blue shading.
Grey arrow depicts frequencies where narwhals vocalize; the lowest frequencies are used less often (shown in lighter grey) and the higher frequencies are used more often (shown in darker grey).
The area shaded in green represents the area of frequency overlap area between vessel noise and the narwhal hearing ability.
The blue curve shows the hearing threshold for mid-frequency cetaceans including narwhal. Their most sensitive hearing in the frequency range is circled in green, which is fully outside of the range where there is vessel noise.

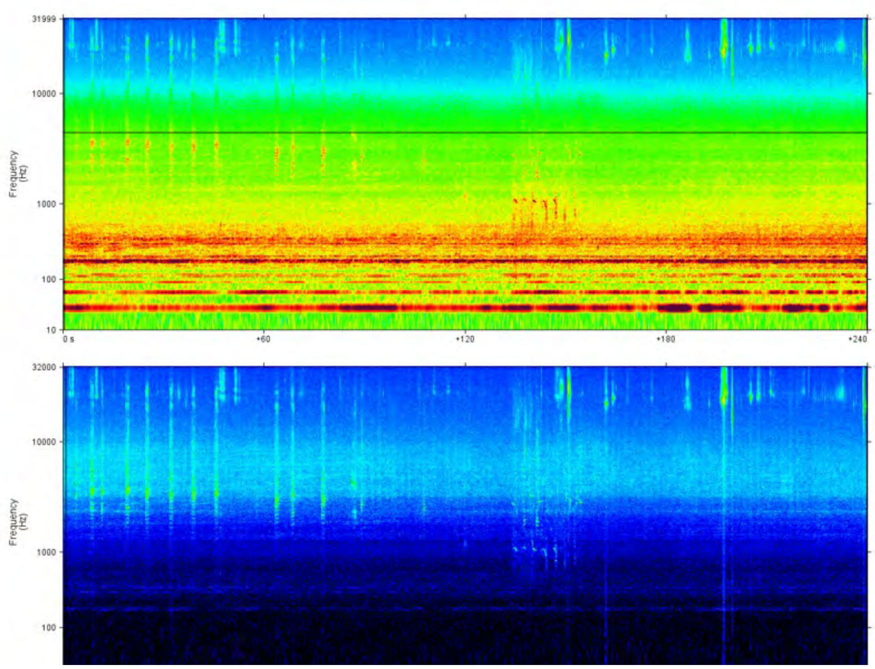

Figure 2: Shipping Noise Relative to Narwhal Hearing Ability

Notes: Top plot represents full broadband sound levels with no frequency filtering applied to account for narwhal hearing. Bottom plot represents sound levels filtered for narwhal hearing (showing only the sound that narwhal can hear).
In the top plot, the thick solid red bands running across the plot at the bottom of the plot show vessel noise. The spots of red and green in the middle and top of the plot are different types of narwhal calls. Note that the vessel noise shown in red is not visible in the bottom plot, but note the narwhal calls in the middle and top of the plot are still present and detectable.

In summary, given that some level of frequency overlap exists between shipping noise and narwhal communication, there is potential for some degree of acoustic masking to occur at an unknown distance from the source. Given that icebreaking noise is predicted to be temporary in nature, that narwhal are already exposed to similar levels of masking from natural sounds in their environment (i.e., wind and waves), and that narwhal communication and hearing occurs predominantly at much higher frequencies than icebreaker noise, it is considered unlikely that residual acoustic masking effects will result in a measurable change at the population or stock level within the RSA. Effects are predicted to be limited to temporary and localized disturbance effects. The residual environmental effect of masking on narwhal due to icebreaking noise is therefore predicted to be not significant.

1.3.4 Assessment Results for Ringed seal

1.3.4.1 Acoustic Injury:

Acoustic propagation modelling results indicated that underwater noise generated by icebreaking activities during the shoulder seasons would not exceed the established threshold for auditory injury in ringed seal under any of the modelling scenarios considered in the Icebreaking Assessment (Golder 2019). The risk of acoustic injury (i.e., hearing impairment) in ringed seal from icebreaking noise was therefore predicted to be negligible.

The model predictions were verified by measurements collected in the field during the 2019 shoulder season. All sound level measurements of icebreaker activities undertaken along the Northern Shipping Route in 2019 were below the threshold for auditory injury for ringed seal (Frouin-Mouy et al. 2020).

1.3.4.2 Potential Acoustic Disturbance

Based on acoustic modelling results, the predicted range (R95%) for disturbance onset in ringed seal (based on a 70 dB sensation level) was predicted to extend up to 1.03 km from the source in 10/10 ice, 85 m in 3/10 ice, and 70 m in open-water (0/10 ice) based on a maximum-case icebreaker transit scenario (two icebreakers escorting two capesize ore carriers in Eclipse Sound (Table 6). For these scenarios, a stationary ringed seal positioned along the shipping corridor would have the potential to be in the disturbance zone for a period of up to 1 min (for transits at 9 knots in 0/10 ice), 6 min (for transits at 9 knots in 3/10 ice), and 15 min (for transits at 4.6 knots in 10/10 ice) per icebreaker transit.

Table 6 presents the estimated ranges for disturbance onset at each modelled location for all transit speeds and ice conditions considered in the acoustic model. Detailed modelling results are presented in Golder (2019a). Distances to the disturbance onset threshold are considered conservative estimates as this threshold does not account for the overall duration of noise exposure to the animal, nor does it account for the frequency of the noise source relative to ringed seal hearing sensitivity.

Table 6 Distance (R95%) to Ringed Seal Disturbance Onset Threshold (70 dB sensation level) based on Maximum-Case Icebreaker Transit Scenario (2 icebreakers escorting 2 capesize ore carriers) at Study Locations in RSA in 10/10, 3/10* and 0/10 Ice Concentrations.

Table 6: Distance (R95%) to Ringed Seal Disturbance Onset Threshold (70 dB sensation level) based on Maximum-Case Icebreaker Transit Scenario (2 icebreakers escorting 2 capesize ore carriers) at Study Locations in RSA in 10/10, 3/10* and 0/10 Ice Concentrations

Modelled Location	Disturbance Range (R95%) in m		
	10/10 Ice @ 4.6 knots	3/10* Ice @ 9 knots	0/10 Ice @ 9 knots
Milne Inlet	1,030	850	70
Eclipse Sound	1,030	850	70
Pond Inlet	800	350	70
Floe Edge	N/A	N/A	N/A

Note: Source data (JASCO 2019 from Golder 2019 – Table 12). *indicates disturbance and avoidance distance when icebreaker is actually engaged with ice (in 3/10 ice concentrations, icebreaker is assumed to engage with ice at most 30% of the time).

Estimated Number of Ringed Seal Exposed Per Transit

An estimated 15,947 ringed seals are predicted to occur in the combined areas of Eclipse Sound, Pond Inlet and Milne Inlet (5,755 individuals in Eclipse Sound East; 2,457 individuals in Eclipse Sound West; 4,212 individuals in Pond Inlet; 2,763 individuals in Milne Inlet North, and 759 individuals in Milne Inlet South). This is based on ringed seal density estimates from Yurkowski et al. (2019): 1.40 individuals/km2 for Milne Inlet and 0.98 individuals/km2 for Eclipse Sound, and includes a correction factor of 2.46 for availability bias (Born et al. 2002) and 1.22 for perception bias (Frost et al. 1988).

Based on a maximum-case icebreaker transit scenario (2 icebreakers escorting 2 capesize carriers), using corrected ringed seal density estimates available for June (Yurkowski et al. 2018), the estimated number of ringed seal predicted to occur in the calculated disturbance zone is:

- 199 individuals during the Heavy Ice Regime (early summer);
- 128 individuals during the Moderate Ice Regime (early summer);
- 84 individuals during the Light Ice Regime (early summer);
- 238 individuals during the Heavy Ice Regime (fall); and
- 93 individuals during the Moderate Ice Regime (fall).

As no region-specific density estimates were available for ringed seal during the shoulder season months (July/August, October/November), density estimates for June were used to estimate the number of individuals likely to exhibit avoidance and disturbance behaviour. Actual numbers will be lower as some of the ringed seal population will have left the Local Study Area (LSA) to embark on their foraging phase during the early shoulder season and during the latter shoulder season some of the ringed seal population will not have returned yet from their foraging phase. It is quite likely that at least some of the same ringed seals, will be affected multiple times by icebreaking during the course of a single shoulder season.

For icebreaking operations, if it is assumed that approximately 70 to 200 ringed seal in Milne Inlet and Eclipse Sound will exhibit avoidance of the icebreaking noise source per icebreaker transit, this represents <1% of the population of ringed seals in the Canadian Arctic. Based on available evidence, ringed seals seem tolerant of industrial activity, and disturbance effects are expected to be localized, temporary and restricted to the shoulder season, we would not anticipate abandonment or long-term displacement behavior, or any carry-over effects at the population level. As a result, the residual effects of disturbance on ringed seal from icebreaking activities is expected to be not significant.

The above estimates are meant to serve as a guide for potential effects and indicators for monitoring and follow-up. There is uncertainty associated with these estimates, including the avoidance threshold level, density estimates and their correction factors, vessels modelled in the acoustic study, and how ringed seal in the RSA may respond to icebreaker transits during the shoulder season. There is also uncertainty regarding the duration of the effect and how repeated exposure to icebreaking activities may affect ringed seal (e.g., the number of ringed seal exposed to noise levels above the 80 dB avoidance criterion over the full duration of the shoulder seasons). Based on available evidence, ringed seals seem tolerant of industrial activity, and disturbance effects are expected to be localized, temporary and restricted to the shoulder season, we would not anticipate abandonment or long-term displacement behavior, or any carry-over effects at the population level.

1.3.4.3 Acoustic Masking

The potential effects of acoustic masking in ringed seal are dependent on the received sound level and the frequency content of the received sound signal relative to hearing ability in this species and the level of natural background noise. Ringed seals are not a particularly vocal species, with highest calling rates observed during the spring breeding season (Stirling et al. 1983). The majority of their calls occur in the 400 Hz to 16 kHz frequency range (Stirling 1973; Cummings et al. 1984), which is in the frequency range of the loudest icebreaking noise. Ringed seal have a flat audiogram between 1 kHz and 30 to 50 kHz (Møhl 1968; Terhune and Ronald 1972, 1975; Terhune 1981), with best in-water hearing sensitivity reported at 49 dB re 1 µPa (12.8 kHz) (Sills et al. 2015).

There is no evidence of acoustic masking in ringed seal in the available literature, although given the degree of frequency overlap between icebreaker noise and ringed seal hearing, animals occurring within the modelled disturbance zones are predicted to experience some degree of masking due to icebreaker noise on a temporary basis (limited to icebreaker interactions occurring within the shoulder season). Masking effects on ringed seal are likely limited as animals are likely to temporarily move out of the zone of avoidance during an icebreaker transit.

It is anticipated that ringed seal will actively avoid icebreakers traveling along the Northern Shipping Route and any effect would be localized and short-term. With the effective implementation of mitigation, the residual environmental effects of acoustic masking on ringed seal from icebreaker noise are predicted to be not significant.

1.3.5 Uncertainty

This section identifies key sources of uncertainty in the present effects assessment and the level of confidence that adverse effects will not be worse than predicted. Confidence in the assessment of environmental significance is related to the following elements:

- Understanding of marine mammal population dynamics, foraging ecology, dive behaviour, functional hearing ability and vocal behaviour, predator/prey dynamics, seasonal migratory movements, reproductive and social behaviour, and ecological role in the Eastern High Arctic ecosystem;
- Adequacy of baseline data for understanding current conditions and future changes unrelated to the Project (e.g., extent of future developments, climate change, catastrophic events);
- Understanding of Project-related adverse effects on complex ecosystems that contain interactions across different scales of time and space; and
- Knowledge of the effectiveness of the environmental design features and mitigation for reducing or removing adverse effects (e.g., vessel speed restrictions).

Ecosystems are complex, characterized by interactions across multiple scales, nonlinearity, self-organization, and emergent properties (Boyce 1992; Holling 1992; Levin 1998; Wu and Marceau 2002). These characteristics can confound understanding of ecosystem processes and limit capacity to make predictions on, for example, population sizes. One of the challenges is to aggregate and simplify available ecological knowledge, retain what is essential and disregard that which is not essential at the particular scale of interest.

Like all scientific results and inferences, residual impact predictions must be tempered with uncertainty associated with the data and the current knowledge of the system. It is anticipated that the baseline data are moderately sufficient for understanding current conditions, and that there is a moderate level of understanding of Project related adverse effects on the ecosystem.

It is understood that development activities will directly and indirectly affect marine habitat, and behaviour/movement of marine wildlife species; however, long-term monitoring studies documenting the resilience of marine animals to development and the time required to reverse adverse effects are lacking. Direct disturbance from previous, existing, and future development footprints was estimated to affect a small fraction of the natural range of most marine mammal indicator species considered in the present assessment. However, uncertainty remains surrounding the degree to which some effects may occur (e.g., magnitude and duration).

Forecasting a future that may be outside the range of observable baseline environmental conditions is clearly challenging (because of climate change for example; Walther et al. 2002). Quantifying changes to habitat provides a static assessment of a species' environment, ignoring change that may occur over time as a result of ecological succession and natural disturbances such as climatic events. Thus, there is less certainty in long-term predictions of reversibility (e.g., over periods extending beyond 100 years).

However, there is a high level of confidence that the regional landscape will be different with or without the Project in future decades.

There is some uncertainty in terms of how narwhal will respond to icebreaking traffic in the narrow waterways of Milne Inlet. There exists similar uncertainty concerning masking effects on narwhal communication from icebreaking noise in these areas. Baffinland will continue to conduct tailored environmental effects monitoring programs to evaluate narwhal responses to vessel traffic along the shipping corridor, including future icebreaking transits. This will include acoustic monitoring studies to assess for potential acoustic masking effects of shipping on narwhal, as well as potential adverse effects of shipping on narwhal communication. Baffinland remains committed to working with DFO and the MEWG to ensure its environmental management and monitoring programs adequately account for its shoulder season activities, including icebreaking operations.

1.4 SUMMARY

Table 7 provides a summary of the impact rating criteria and significance determinations for the effects assessment as it relates to underwater noise effects on narwhal and ringed seal. The ratings consider both Project incremental and Project combined effects for both species based on the three key effect pathways associated with underwater noise: acoustic injury, behavioural disturbance and acoustic masking. The information provided for in Table 7 was previously submitted to the NIRB in a 2019 marine mammal monitoring memo (Golder 2020; Public Registry ID No. 331438; Appendix 4). A detailed description of the assessment methodology is provided in FEIS Volume 2, Section 3, including the approach used for characterizing residual effects and determining significance (Baffinland 2012).

Given that no significant residual effects are predicted with respect to icebreaking impacts on marine mammals for the Proposal, it is reasonable to assume this also applies to icebreaking activities associated with current operations. It is also noted that mitigation measures developed for icebreaking activities under Phase 2 are also presently applied to current icebreaking operations.

In closing, icebreaking noise associated with the current phase of the Project are not predicted to result in significant residual effects on marine mammals in the RSA. Project mitigation measures have been, and will continue to be monitored for at an appropriate frequency throughout the life of the Project to confirm that effects of the Project remain within the range of effects identified in the assessment predictions, to identify any unforeseen effects, should they occur, and to confirm that mitigations are working as intended.

Table 7: Residual effect ratings and significance determinations for underwater noise impacts from icebreaking activities on narwhal and ringed seal along the Northern Shipping Route

Residual Effect	Residual Effect Evaluation Criteria					Significance	Qualifiers**	
	Magnitude	Extent	Frequency	Duration	Reversibility		Probability (Likelihood of Effect Occurring)	Certainty (Confidence in Effects Prediction)
Narwhal (BB and ES*)								
Hearing impairment	-	-	-	-	-	-	I (Unlikely)	III (High)
Disturbance	Level II	Level II	Level II	Level II	Level I	N	II (Moderate)	II (Medium)
Acoustic masking	Level II	Level II	Level II	Level II	Level I	N	II (Moderate)	II (Medium)
Combined Project Effects[1]	Level II	Level II	Level II	Level II	Level I	N		II (Medium)
Ringed seal								
Hearing impairment	-	-	-	-	-	-	I (Unlikely)	III (High)
Disturbance	Level II	Level II	Level II	Level II	Level I	N	II (Moderate)	II (Medium)
Acoustic masking	Level II	Level II	Level II	Level II	Level I	N	II (Moderate)	II (Medium)
Combined Project Effects	Level II	Level II	Level II	Level II	Level I	N		II (Medium)

Notes:
Magnitude: 1 (Level I) = an effect on the exposed indicator/VEC that results in a change that is not distinguishable from natural variation and is within regulated values; 2 (Level II) = an effect that results in some exceedance of regulated values and/or results in a change that is measurable but allows recovery within one to two generations; 3 (Level III) = an effect predicted to exceed regulated values and/or result in a reduced population size or other long-lasting effect on the subject of the assessment.
Extent: 1 (Level I) = confined to the LSA; 2 (Level II) = beyond the LSA and within the RSA; 3 (Level III) = beyond the RSA
Frequency: 1 (Level I) = infrequent (rarely occurring); 2 (Level II) = frequent (intermittently occurring); 3 (Level III) = continuous
Duration: 1 (Level I) = short-term (<5 years); 2 (Level II) = medium-term (life of Project); 3 (Level III) = long-term (beyond the life of the project) or permanent
Reversibility: 1 (Level I) = fully reversible after activity is complete; 2 (Level II) = partially reversible after activity is complete; 3 (Level III) = non-reversible after the activity is complete. Note: Reversibility is considered for biological VECs at the population level. Therefore, although an effect like mortality is irreversible, the effect at the population level might be reversible.
Significance Rating: S=Significant, N=Not Significant, P=Positive
Qualifiers- only applicable to significant effects**
Probability: 1 (Level I) = unlikely; 2 (Level II) = moderate; 3 (Level III) = likely
Certainty: 1 (Level I) = low; 2 (Level II) = medium; 3 (Level III) = high
*BB: Baffin Bay population; ES: Eclipse Sound summer stock (sub-population)
** Inclusion of qualifiers for probability and certainty is not consistent with original FEIS methodology which stipulates that qualifiers are only applicable to significant effects.

[1] Regarding the combined effect of behavioral disturbance and acoustic masking, it is important to note that acoustic masking is actually a type of behavioural disturbance, with masking effects occurring at the lower level of behavioural impacts in marine mammals (Pine et al. 2018). In essence, these two pathways are already inherently combined, as reflected in the assessment by the identical effect ratings and significance determinations in Table 7. While limited masking from ship noise is predicted to occur for narwhal and ringed seal in the RSA as demonstrated through acoustic modelling, the levels are comparable to those animals in the RSA already regularly experience from ambient noise sources (i.e., natural weather events), and it is not presently possible to determine or calculate the biological consequence of this effect, if one exists.

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Appendix 1

Impacts of Ice Breaking on Ice

Impact of icebreaking activities within the approaches to the Milne Inlet Port Site (Northern Shipping Route to Milne Port)

1. Standard definitions

Fast ice: Sea ice which forms and remains fast along the coast, where it is attached to the shore, to an ice wall, to an ice front, between shoals or grounded icebergs. [...] Fast ice may be formed in situ from sea water or by freezing of floating ice of any age to the shore, and it may extend a few metres or several hundred kilometres from the coast. (Source: WMO Sea Ice Nomenclature, volume 1, 2014 https://library.wmo.int/doc_num.php?explnum_id=4651)

Pack ice: Term used in a wide sense to include any area of sea ice other than fast ice no matter what form it takes or how it is disposed. [This term is used] when concentrations are high, i.e. 7/10 or more. (Source: WMO Sea Ice Nomenclature, volume 1, 2014 https://library.wmo.int/doc_num.php?explnum_id=4651)

Breakup: This term refers to a particular length of time in which ice disappears in a given area (generally 1 to 2 weeks). However, breakup does not necessarily imply a decay or melt of ice, but can also indicate a movement of ice out of a particular area. (Source: Canadian Ice Service Ice Glossary, https://www.canada.ca/en/environment-climate-change/services/ice-forecasts-observations/latest-conditions/glossary.html)

Freeze-up: This term refers to a particular length of time in which ice appears in a given area (generally 1 to 2 weeks). However, freeze-up does not necessarily imply a growth of ice, but can also indicate a movement of ice into a particular area. (Source: Canadian Ice Service Ice Glossary, https://www.canada.ca/en/environment-climate-change/services/ice-forecasts-observations/latest-conditions/glossary.html)

2. Impact of breaking ice at the beginning of the shipping season

Breaking ice, after the landfast ice has fractured, could have an effect of slightly speeding up the process of clearing out all the ice in the channels.

Ships heading to the Milne Inlet Port Site can enter Pond Inlet as soon as the fracture of the fast ice occurs (referred to as breakup). Since the approaches to the port site are infested with sea ice for days after the initial breakup, an icebreaker escort is needed to ensure safe and efficient navigation along the Northern Shipping Route to the Milne Inlet Port Site.

When breakup occurs, what was landfast ice is fractured into vast floes that linger in Pond Inlet, Eclipse Sound and Pond Inlet. Initially, some of these floes can span almost the full width of the channel. They repeatedly fracture into smaller pieces that, ultimately, are either flushed out into Baffin Bay, or melt before getting there. This process unfolds rapidly, with the ice cover going from landfast to open water in as little as two weeks (Table 1).

Because icebreaking activities involve fragmenting ice floes into smaller pieces, they can have a minor catalyzing effect in the transition from high sea ice concentration to open water, and therefore may slightly advance the date when open water conditions prevail. In order to facilitate the escort operation, the icebreaker will generally aim to follow a route that is as straight as possible, which may result in breaking floes rather than following leads or fractures. That being said, once the ice concentration begins to diminish, the vessels can navigate more easily through the open leads and areas (regimes) that contain less ice, thereby reducing the impact of icebreaking on the sea ice cover.

Table 1. Dates of Ice events for the for the Milne Inlet, Eclipse Sound, and Pond Inlet area (approaches to Baffinland port) from 1997 to 2018, based on Canadian Ice Service daily and weekly ice charts.

Year	Break-up	Open water	Freeze-up	Fast Ice	Presence of drift ice during OW season	Open water season
1997	July 24	August 7	October 2	November 13	Late Aug. / early Oct.	56 days
1998	July 16	August 10	October 19	November 16	No	70 days
1999	July 26	August 18	October 11	November 8	No	54 days
2000	July 12	July 31	October 16	November 6	No	77 days
2001	July 23	August 15	October 15	November 5	No	61 days
2002	July 27	August 15	October 21	November 4	No	67 days
2003	July 15	August 1	September 29	November 10	Mid Aug. / late Sept.	59 days
2004	July 19	August 11	October 18	November 15	Late Sept. / early Oct.	68 days
2005	July 29	August 15	October 14	Late December	No	60 days
2006	July 14	July 28	October 23	November 27	No	87 days
2007	July 19	August 6	October 11	November 19	No	66 days
2008	July 18	August 1	October 6	November 24	No	66 days
2009	July 17	August 6	October 12	November 16	No	67 days
2010	July 15	August 5	October 11	November 15	No	67 days
2011	July 8	July 29	October 21	November 14	No	84 days
2012	July 12	August 18	October 15	November 19	No	58 days
2013	July 20	August 9	October 7	November 4	No	59 days
2014	July 24	August 9	October 23	October 27	No	75 days
2015	July 17	July 25	October 19	November 9	No	86 days
2016	July 11	July 23	October 10	November 16	Early Oct.	79 days
2017	July 15	August 8	October 10	November 6	Mid Aug. / early Oct.	63 days
2018	July 20	August 13	September 27	October 22	Early Aug. / early Oct.	46 days
Mean	*July 18*	*August 6*	*October 12*	*November 11*	*N/A*	*67 days*
Variability	*21 days*	*26 days*	*26 days*	*36 days*	*N/A*	*40 days*

3. Impact of breaking ice at the end of the shipping season

At freeze-up, ship passage can slow down the formation of the ice and the resulting broken ice pieces could add rubble into an otherwise somewhat-smooth landfast ice surface.

The document "Mary River Project Final Environmental Impact Statement, Volume 8 Marine Environment" (2012) describes the impact of vessel passage on the formation of new ice at the time of freeze-up, in fall. The following text applies as much to the Steensby Port area as to the Northern Shipping Route to Milne Port, and covers well the expected impacts of icebreaking on sea ice at the time of freeze-up.

> [...] Icebreaking could delay formation of a continuous, competent ice surface due to repeated disturbance of newly formed ice. The timing of freeze-up is variable and can begin between late October and late November, depending upon weather conditions. It is thought that any localized disruption in the timing of ice formation will be restricted to a small area around the ship track, the effects of which would be minimal in the context of the naturally occurring variability in the timing of formation, and in the spatial context of landfast ice development [...].
>
> Ice freeze up occurs during period of low temperature and calm seastate (no winds). Under these conditions, ice forms quickly and newly formed ice then acts as a buffer to retard wind-induced wave formation. During this period of rapid ice formation, high winds or other phenomena can act to break up the newly formed ice and cause it to raft and otherwise break up. Eventually, the low air temperature and even brief periods of calm water will result in formation of an ice cover that is thick enough to resist these disruptive forces and the ice continues to grow both in thickness and aereal extent. [...] Vessel passage during the period of ice freeze up can act to delay ice formation and can produce relatively rough ice surface within the area affected by the ships passage (VBNC, 1997). The delay would be in the order of hours to days, depending on the air temperature and presence of calm conditions (low wind, waves). The effect can be moderated by reducing ships speed as it passes through areas of landfast ice formation. [...]
>
> As an aside, the presence of even modest surface disturbance due to wind/waves will cause new ice to break up during the initial freeze period. The bow wave and the wake of a ship will have the same effect. With enough cold weather, ice formation will occur regardless of surface disturbance, but ice broken during the initial freezing will have a rougher surface than that which is formed under calm conditions. The spatial extent of this will be highly variable, depending upon the timing and level of disruption by wind, naturally occurring waves, and by ships during the initial freeze period. Alteration of the ice surface will have negligible effect on the sea ice.

Appendix 2

Summary of Mitigation and Monitoring

Table 1: Baffinland Mitigation and Monitoring Overview

Potential Effect	Mitigation	Intended Outcome of Mitigation	Monitoring Program	Summary of Project Monitoring Results 2015-2019
Ship Strike	9 knot speed restriction Placement of Marine Wildlife Observers on icebreaking vessels Commitment to not break landfast ice All icebreaking activities will be conducted outside of sensitive life cycle periods for ringed seal (pupping, nursing and mating periods) All Project vessels will maintain constant speed and course (as save navigation allows) When marine mammals appear to be trapped or disturbed by Project vessel movements, the vessel will implement appropriate measures to mitigate disturbance All Project vessels are provided with standard instructions to not approach within 300m of a walrus or polar bear observed on sea ice All Project vessels are provided with standard instructions to operate their vessel in a manner that avoids separating an individual member(s) of a group of marine mammals from other members of the group. Establishment of restricted "no-go" zones to avoid key sensitive areas (Koluktoo Bay, Tremblay Sound, western shore of Milne Inlet).	Avoid marine mammal mortality or injury as a result of Project operations	Ship-Based Observer Program Bruce Head Shore-Based Monitoring Program Narwhal Tagging Monitoring Program Marine Mammal Aerial Surveys	No ship-strikes to any marine mammals have been observed since the start of Project operations from any of the marine-based monitoring programs, nor reported by any of the Project vessel operators, through community-based monitoring initiatives or by local community members. 2017 and 2018 narwhal tagging data demonstrate that narwhal effectively avoid ships at ranges that would impede being struck by the vessel. Based on aerial survey data, the Eclipse Sound narwhal summer stock population has remained stable since start of shipping operations. Current abundance estimate of the stock is consistent (within 10%) with pre-shipping levels (e.g. 2014) confirmed via 2016 and 2019 aerial surveys.
Ice Entrapment	Commitment to not break landfast ice Avoidance of ice if and when safe to do so When marine mammals appear to be trapped or disturbed by Project vessel movements, vessels will implement appropriate management measures to mitigate disturbance.	To avoid ice entrapment events as a result of icebreaking activities.	Narwhal Tagging Monitoring Program Ship-Based Observer Program End of Season Aerial Clearance Survey	Based on 2017 and 2018 tagging data, all tagged narwhal had migrated out of the RSA into Baffin Bay by mid-October, prior to formation of landfast ice in the RSA. Based on tagging studies and SBO data, icebreaking effects on narwhal during the late shoulder season are consistent with those predicted in the FEIS (limited to temporary and localized disturbance effects, no entrapment predicted). Project-related icebreaking operations did not result in displacement of narwhal from the RSA. Evidence of narwhal actively avoiding the sternward track of icebreaking vessels for a period of several hours following interaction.

Table 1: Baffinland Mitigation and Monitoring Overview

Potential Effect	Mitigation	Intended Outcome of Mitigation	Monitoring Program	Summary of Project Monitoring Results 2015-2019
				Based on aerial surveys undertaken during the fall of 2019 (after completion of shipping), no entrapment events were recorded.
Hearing Impairment	Not required as marine mammal acoustic injury thresholds were not exceeded in any of the modelling scenarios. This was subsequently confirmed through passive acoustic monitoring program.	N/A	Passive Acoustic Monitoring Program	Monitoring results confirm modelling predictions that marine mammal injury thresholds are not being exceeded as a result of Project activities.
Acoustic Disturbance	Establishment of a 40-km 'buffer zone' at entrance of RSA Avoidance of ice if and when safe to do so Establishment of restricted "no-go" zones to avoid key sensitive areas (Koluktoo Bay, Tremblay Sound, western shore of Milne Inlet).	Reduce the acoustic disturbance zone (spatial area) in the RSA.	Marine Mammal Aerial Survey Program (including pre-season aerial survey and post-season clearance survey) Bruce Head Shore-Based Monitoring Program Ship-Based Observer Program Narwhal Tagging Program Passive Acoustic Monitoring Program (Bruce Head, Milne North, Eclipse Sound)	Based on aerial survey data, the Eclipse Sound narwhal summer stock population has remained stable since start of shipping operations. Current abundance estimate of the stock is consistent (within 10%) with pre-shipping levels (e.g. 2014) confirmed via 2016 and 2019 marine mammal aerial surveys. Based on aerial survey and SBO data, higher number of bowhead whale recorded in 2019 (when shipping levels were highest in the RSA) than in previous survey years. Based on shore-based monitoring data, the total number of narwhal (standardized by effort) recorded at Bruce Head was higher in heavier shipping years (2016, 2018, 2019) than prior to shipping (2014) and Year 1 of shipping (2015). The mean proportion of calves recorded at Bruce Head was similar across all survey years (and higher in 2019 than all other survey years except for 2015). Based on tagging studies and shore-based monitoring data, disturbance effects on narwhal are consistent with those predicted in the FEIS (limited to temporary and localized effects). Acoustic recordings of a Post-Panamax vessel travelling in Eclipse Sound, collected in 2019 as part of JASCO's acoustic monitoring program, indicate that the daily 120 dB exposure period is, on average, less than 1.3 h per day, or equivalent to 22.7 h of quiet time per day.
	Restriction of transits in heavier ice conditions	To minimize the amount of time narwhal will be exposed to noise levels that would onset disturbance and avoidance behaviours.		
	9 knot speed restriction	Reduce the noise output of all Project vessels		
	Commitment to not break landfast ice	Reduce the noise output of icebreaker operations, and therefore reduce acoustic disturbance zone and daily exposure period.		
	All Project vessels will maintain constant speed and course (as safe navigation allows)	Reduce the acoustic disturbance zone (spatial area) in the RSA		

Table 1: Baffinland Mitigation and Monitoring Overview

Potential Effect	Mitigation	Intended Outcome of Mitigation	Monitoring Program	Summary of Project Monitoring Results 2015-2019
	No drifting of Project vessels in Eclipse Sound (as safe navigation allows)	Reduce the acoustic disturbance zone (spatial area) and daily exposure period		
	Maximum of 3 vessels anchored at Ragged Island	Reduce the acoustic disturbance zone (spatial area)		
Acoustic Masking	Establishment of a 40-km 'buffer zone' at entrance of RSA Establishment of restricted "no-go" zones to avoid key sensitive areas (Koluktoo Bay, Tremblay Sound, western shore of Milne Inlet).	Reduce the acoustic disturbance zone (spatial area) in the RSA.	Marine Mammal Aerial Survey Program (including pre-season aerial survey and post-season clearance survey) Bruce Head Shore-Based Monitoring Program Ship-Based Observer Program Narwhal Tagging Program Passive Acoustic Monitoring Program (Bruce Head, Milne North, Eclipse Sound)	Based on aerial survey data, the Eclipse Sound narwhal summer stock population has remained stable since start of shipping operations. Current abundance estimate of the stock is consistent (within 10%) with pre-shipping levels confirmed via 2016 and 2019 marine mammal aerial surveys. Based on shore-based monitoring data, the total number of narwhal (standardized by effort) recorded at Bruce Head was higher in heavier shipping years (2016, 2018, 2019) than prior to shipping (2014) and Year 1 of shipping (2015). The mean proportion of calves recorded at Bruce Head was similar across all survey years (and higher in 2019 than all other survey years except for 2015). Based on tagging studies and shore-based monitoring data, disturbance effects on narwhal are consistent with those predicted in the FEIS (limited to temporary and localized effects). Acoustic recordings of a Post-Panamax vessel travelling in Eclipse Sound, collected in 2019 as part of JASCO's acoustic monitoring program, indicate that the daily 120 dB exposure period is, on average, less than 1.3 h per day, or equivalent to 22.7 h of quiet time per day.
	Restriction of transits in heavier ice conditions	To minimize the amount of time narwhal will be exposed to noise levels that would onset disturbance and avoidance behaviors.		
	9 knot speed restriction	Reduce the noise output of all Project vessels		
	Commitment to not break landfast ice	Reduce the noise output of icebreaker operations, and therefore reduce acoustic disturbance zone and daily exposure period		
	All Project vessels will maintain constant speed and course (as safe navigation allows)	Reduce the acoustic disturbance zone (spatial area) in the RSA		
	No drifting of Project vessels in Eclipse Sound (as safe navigation allows)	Reduce the acoustic disturbance zone (spatial area) and daily exposure period		
	Maximum of 3 vessels anchored at Ragged Island	Reduce the acoustic disturbance zone (spatial area)		

Appendix 3

2019 Marine Mammal Monitoring Summary

GOLDER

TECHNICAL MEMORANDUM

DATE 25 May 2020 1663724-186-TM-Rev3-38000

TO Lou Kamermans
Baffinland Iron Mines Corporation

FROM Phil Rouget, Golder Associates Ltd. **EMAIL** prouget@golder.com

SUMMARY OF RESULTS FOR THE 2019 MARINE MAMMAL MONITORING PROGRAMS

1.0 INTRODUCTION

This technical memorandum serves as an update to an earlier technical memorandum entitled '2019 Marine Mammal Monitoring Programs – Updated Preliminary Results' (Golder 2020a) submitted to the Nunavut Impact Review Board (NIRB) on 21 February 2020. Newly presented information includes additional and updated analyzed data for the 2019 marine mammal monitoring programs. Details on methodology are provided in the earlier version of the report (Golder 2019a) and in the respective annual reports for each monitoring program.

Notification of Errata in original version of Golder Technical Memorandum No. 1663724-186-TM-Rev2-38000 (Golder 2020f): Please note that Table 22 (page 68) has been revised in this version of the technical memorandum. The correction applied to Table 22 relates specifically to the 'Probability' and 'Certainty' qualifiers for combined Project effects on bowhead whale. The 'Probably' qualifier was initially identified as a Level 1 (unlikely); this has been corrected to 'no qualifier' (blank cell). The 'Certainty' qualifier was initially identified as a Level III (High) – this has been corrected to a Level II (medium).

2.0 PROJECT OVERVIEW

In 2019, the following marine mammal programs were undertaken by Baffinland:

- Marine Mammal Aerial Survey Program
- Bruce Head Shore-based Monitoring Program
- Passive Acoustic Monitoring (PAM) Program
- Ship-based Observer (SBO) Program
- 2017/2018 Narwhal Tagging Study (integrated data analysis and reporting completed in 2019)

3.0 2019 MARINE MAMMAL AERIAL SURVEY PROGRAM

This section presents a summary of the results of the 2019 Marine Mammal Aerial Survey Program which substantiate the conclusions of the assessment of Project effects on marine mammals relative to Baffinland's Phase 2 Proposal (see Section 7.0).

Marine mammal aerial surveys were conducted by Golder Associates Ltd. (Golder) in the North Baffin area during August 2019 in collaboration with Inuit researchers from Pond Inlet and Arctic Bay. The objectives of the surveys were to obtain abundance and density estimates of narwhal during the peak open-water season for the Eclipse Sound summer stock area. Aerial surveys were conducted using visual/observer-based line-transect sampling combined with aerial photography surveys. Survey design, methodology and analysis were finalized in consultation with DFO Science. Results from two of the aerial surveys (Aug 21-22 and Aug 25-27) completed in Eclipse Sound during the open-water season were used to generate a 2019 abundance estimate for the Eclipse Sound narwhal summer stock. These surveys were considered to have high precision as they were conducted in optimal survey conditions and were largely based on photographic results. A detailed description of data collection and analytical methodology for the 2019 Marine Mammal Aerial Survey Program is provided in Golder (2019a; 2020e).

3.1 Summary of Results

A total of five surveys were attempted in the Eclipse Sound survey grid during the open-water season (Figures B-6 through B-10 in Golder 2020e) between 17–30 August 2019. Each survey included data collected by on-board Marine Mammal Observers (MMOs) as well as photographic surveys for segments of the survey grid with high concentrations of narwhal. Survey tracklines are presented in Golder 2020e (Appendix B - Figures B-1 through B-15) along with locations of marine mammal sightings recorded by the onboard observers (uncorrected for distance from trackline). Four of the five surveys (Surveys 1,3,4 and 5) achieved complete coverage of the survey grid. Survey conditions were good to moderate for the majority of the five surveys. Survey 2 could not be completed due to logistical issues (aviation fuel closure at Pond Inlet airport). The total number of marine mammals recorded on each survey, based on observer-based data only, is presented in Table 1. Photographic surveys were flown in these strata on Surveys 1, 3, 4, and 5; photographic results are presented in

Table 2.

Narwhal were concentrated in Tremblay Sound and in Milne Inlet South / Koluktoo Bay during the open-water season, as shown in Figure 1A and 1B (Survey 3), Figure 2A and 2B (Survey 4) and Figures 3A and 3B (Survey 5) which depict observer-based and photographic data combined (note these figures present sightings data for both Admiralty Inlet and Eclipse Sound survey grids, although the present memorandum is focused specifically on the Eclipse Sound area). During Survey 5, large numbers of narwhal were recorded in Milne Inlet North but not in dense enough aggregations to warrant a photographic survey (Figures B-9 and B-10 in Golder 2020e). Relatively few narwhal were recorded in Eclipse Sound or Navy Board Inlet during the five surveys conducted in August. Four bowhead whales were observed in the RSA during the open-water surveys on August 17. Three of the bowheads were observed opportunistically by observers during a photographic survey in Tremblay Sound and one was observed on-transect near the entrance to Tremblay Sound.

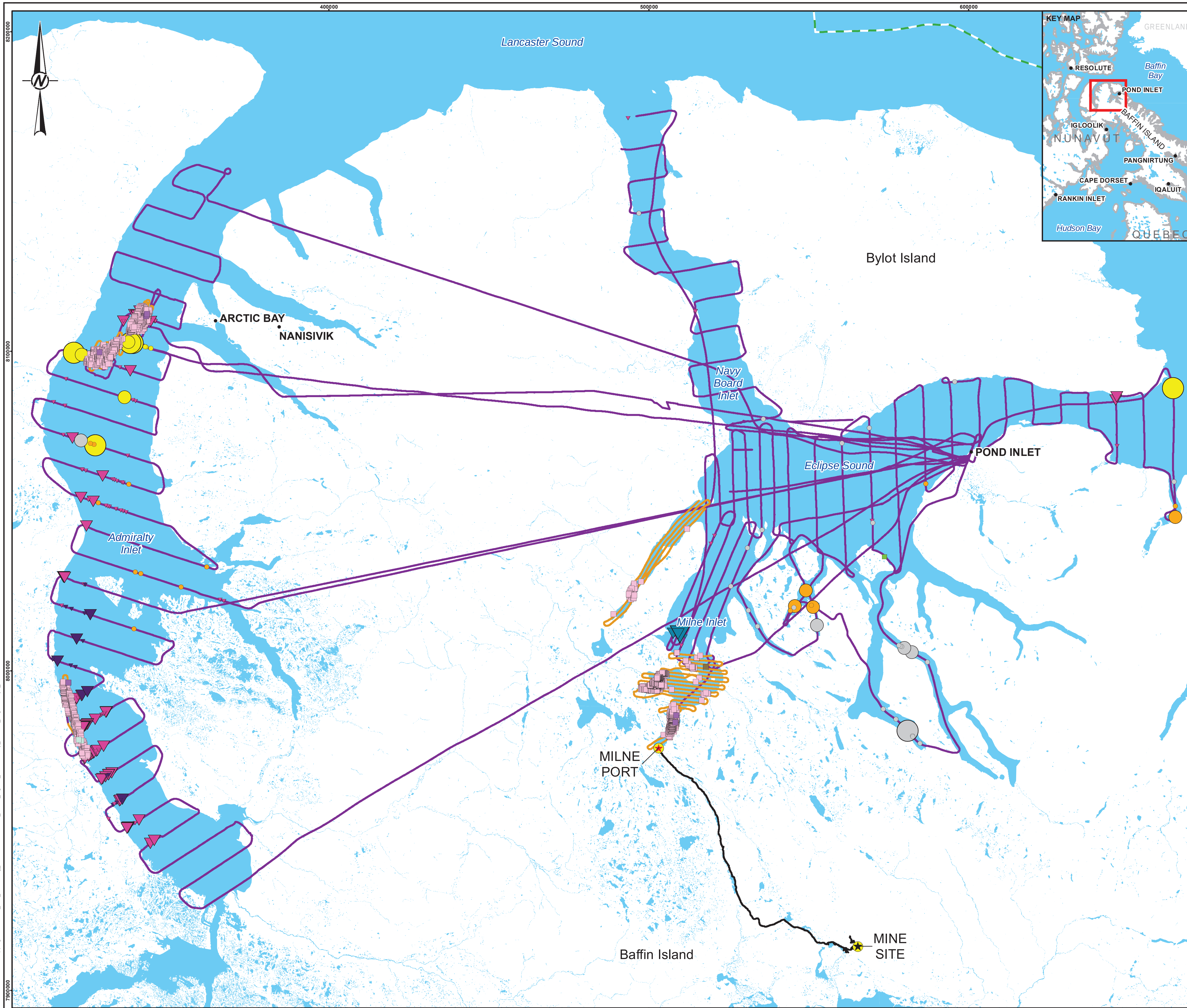
Table 1: Marine mammal sightings (on and off-effort) recorded during visual-surveys in Eclipse Sound - August 2019

Species	Survey 1		Survey 2		Survey 3		Survey 4		Survey 5	
	No. Sightings	No. Animals	No. Sightings	No. Animals	No. Sightings	No. Animals	No. Sightings	No. Animals	No. Sightings	No. Animals
Narwhal	39	172	4	4	9	11	101	265	37	64
Bowhead Whale	4	4	0	0	0	0	0	0	0	0
Beluga Whale	1	1	0	0	0	0	0	0	0	0
Killer Whale	0	0	0	0	1	11	1	3	1	15
Unidentified Whale	1	1	0	0	0	0	0	0	0	0
Ringed Seal	5	5	0	0	8	14	0	0	4	4
Harp Seal	30	404	0	0	1	15	8	96	6	154
Bearded Seal	0	0	0	0	0	0	0	0	2	2
Unidentified Seal	9	11	23	23	26	72	5	9	16	46
Polar Bear	2	4	0	0	1	1	2	7	2	2
Total	**91**	**602**	**27**	**27**	**46**	**124**	**117**	**380**	**68**	**287**

Table 2: Photographic survey sightings in the Eclipse Sound grid during August 2019

Grid	Survey	Stratum[a]	Narwhal		Bowhead[b]		Polar Bear[b]		Unidentified Seal	
			No. Sightings	No. Animals	No. Sightings	No. Animals	No. Sightings	No. Animals	No. Sightings	No. Animals
Eclipse	3	MIS	1,417	3,176	1	1	0	0	0	0
Eclipse	3	TS	93	240	0	0	0	0	0	0
Eclipse	4	MIS	1,901	3,644	0	0	0	0	85	87
Eclipse	4	MIN	751	997	0	0	0	0	15	15
Eclipse	4	TS	218	424	0	0	1	1	57	58
Eclipse	5	MIS	924	1,558	0	0	0	0	107	129
Eclipse	5	TS	163	463	0	0	0	0	43	57

[a] MIN=Milne Inlet North, MIS=Milne Inlet South, TS=Tremblay Sound
[b] Not including re-sightings



LEGEND

- COMMUNITY
- MILNE PORT
- MINE SITE

PHOTOGRAPHIC SURVEY MARINE MAMMAL SPECIES OBSERVATIONS

- BELUGA
- BOWHEAD
- NARWHAL
- SEAL

VISUAL SURVEY MARINE MAMMAL SPECIES OBSERVATIONS (GROUP SIZE)

BOWHEAD WHALE

- 1
- 2 - 10

HARP SEAL

- 1
- 2 - 10
- 10+

KILLER WHATE

- 1
- 2 - 10
- 10+

NARWHAL

- 1
- 2 - 10

POLAR BEAR

- 1

RINGED SEAL

- 1
- 2 - 10

UNIDENTIFIED SEAL/PINNIPED

- 1
- 2 - 10
- 10+

- MILNE INLET TOTE ROAD

AERIAL SURVEY TRACK TYPE

- PHOTOGRAPHIC
- VISUAL
- NUNAVUT SETTLEMENT AREA BOUNDARY
- WATERBODY

0 25 50

1:1,200,000 KILOMETRES

NOTE(S)

1. CONDITIONS GOOD WITH BF 0-3 FOR MUCH OF THE SURVEY AREA AND NO FOG. BF 4-5 ENCOUNTERED ON EASTERN THREE TRANSECTS IN ECLIPSE SOUND. NARWHALS CONCENTRATED IN SOUTHERN END OF TREMBLAY SOUND AND DISPERSED THROUGHOUT SOUTH MILNE INLET/KOLUKTOO BAY AREA.
2. CONDITIONS GOOD WITH BF 0-3 AND FOG ON THREE OF THE NORTHERN TRANSECTS. NARWHALS CONCENTRATED IN THE SOUTHERN PORTION OF ADMIRALTY INLET ALONG THE WESTERN SHORE AND IN THE CENTRAL PORTION OF THE INLET CLOSE TO ARCTIC BAY. FOUR PHOTOGRAPHIC SURVEYS WERE FLOWN.

REFERENCE(S)

MILNE PORT INFRASTRUCTURE DATA BY HATCH, JANUARY 25, 2017, RETRIEVED FROM KNIGHT PIESOLD LTD. FULCRUM DATA MANAGEMENT SITE MAY 19, 2017. HYDROGRAPHY, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

PROJECT
MARY RIVER PROJECT

TITLE
DISTRIBUTION OF MARINE MAMMAL SPECIES DURING LEG 2, SURVEY 3 ON AUGUST 21-22, 2019 IN THE ECLIPSE SOUND AND ADMIRALTY INLET GRIDS

CONSULTANT

GOLDER

YYYY-MM-DD	2020-05-08
DESIGNED	KK
PREPARED	AA
REVIEWED	PR
APPROVED	PR

PROJECT NO.	CONTROL	REV.	FIGURE
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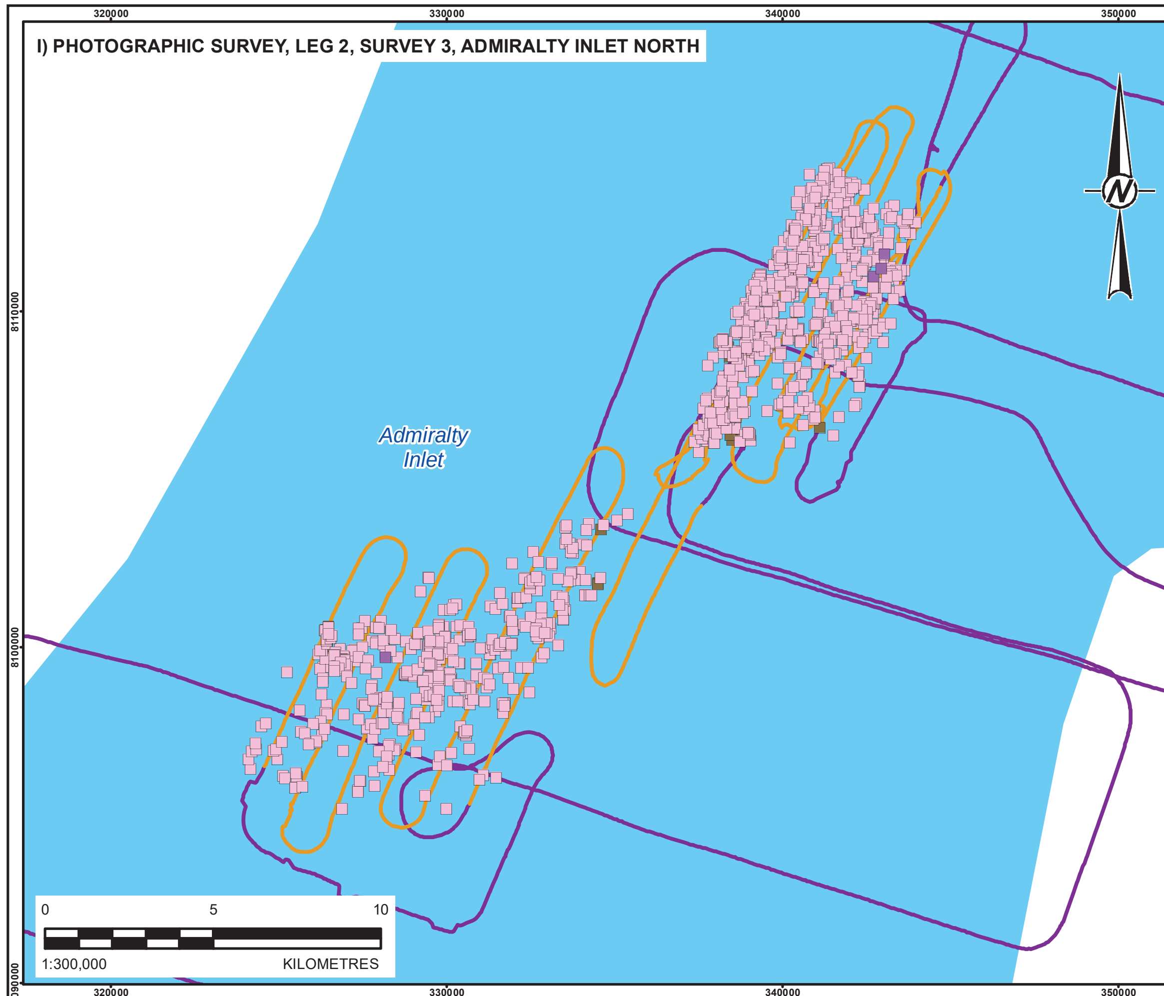
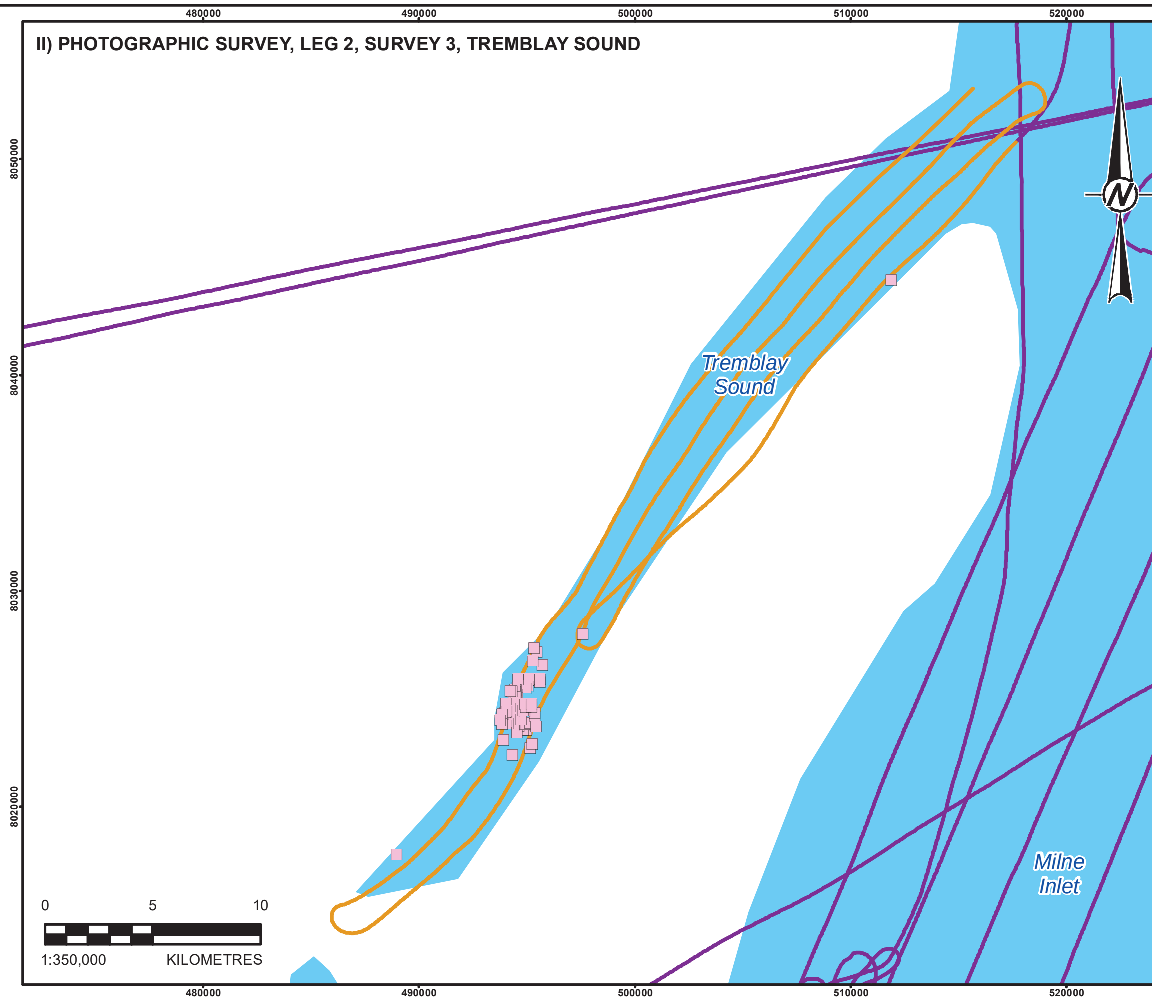
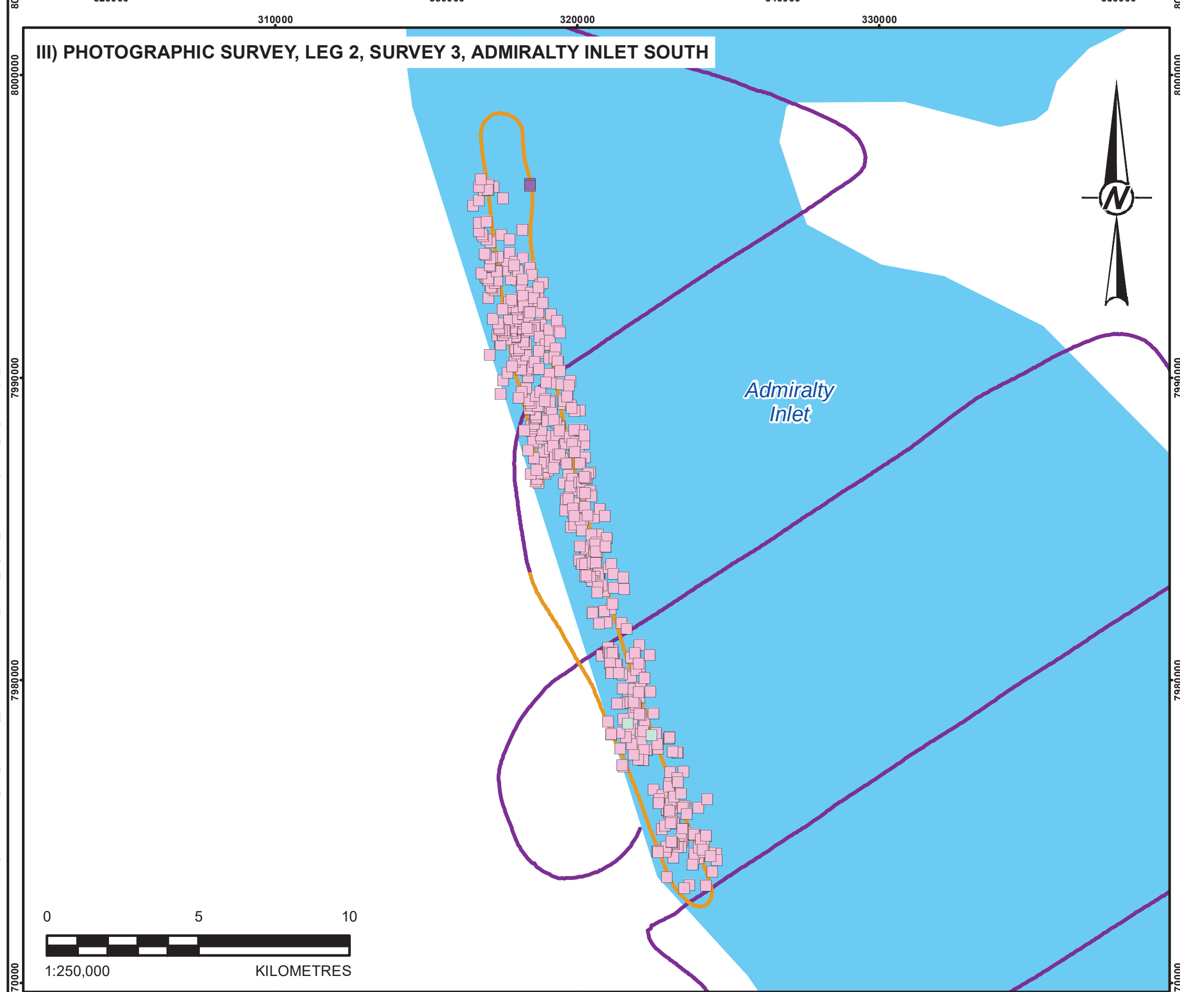
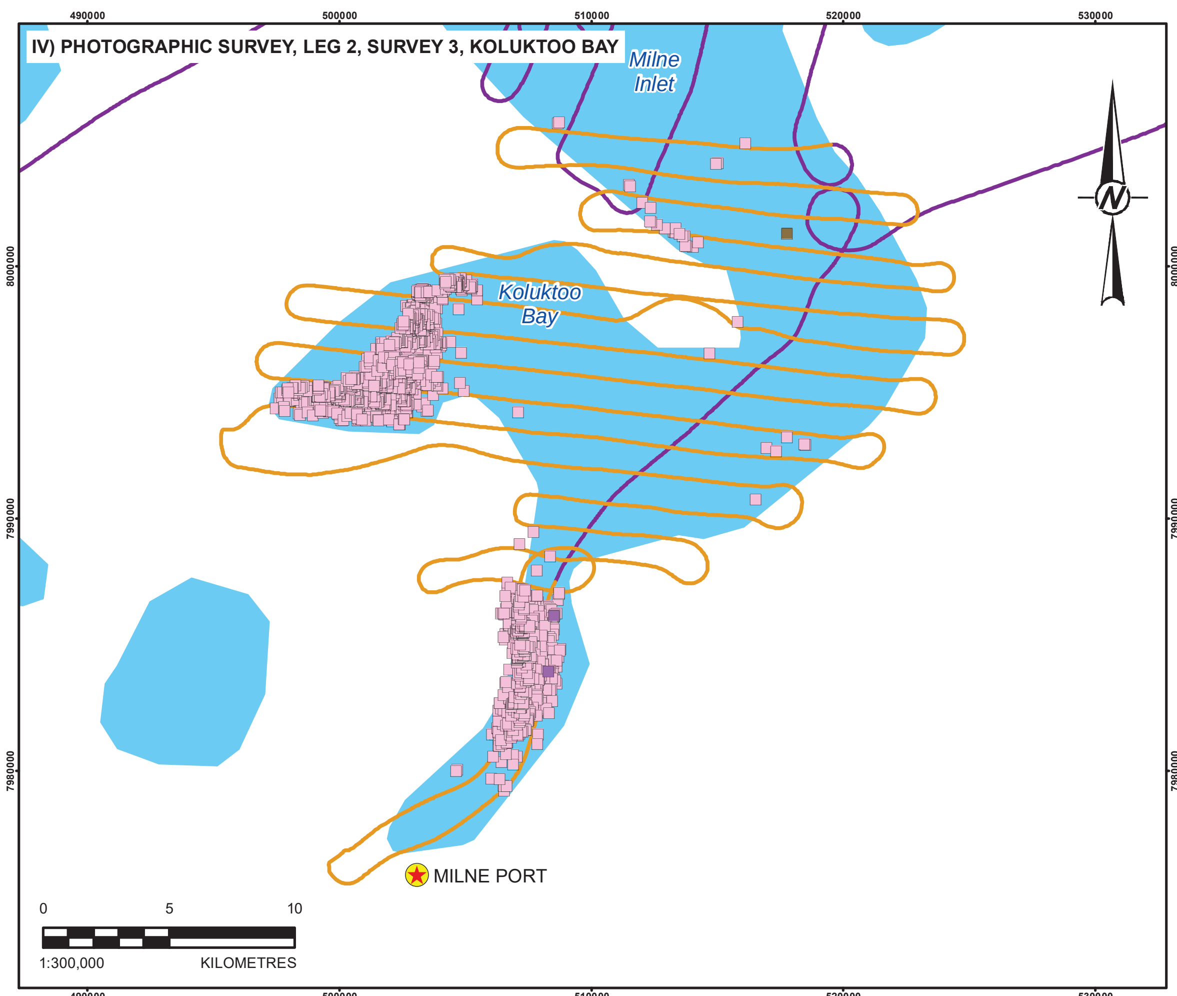








LEGEND

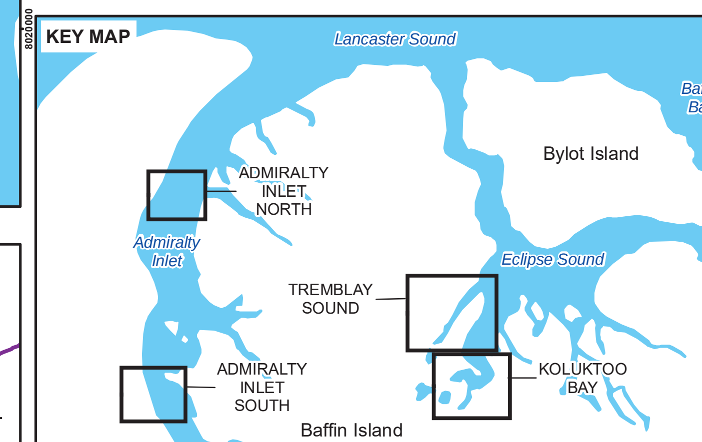
- COMMUNITY
- MILNE PORT

PHOTOGRAPHIC SURVEY MARINE MAMMAL SPECIES OBSERVATIONS

- BELUGA
- BOWHEAD
- NARWHAL
- SEAL

AERIAL SURVEY TRACK TYPE

- PHOTOGRAPHIC
- VISUAL
- WATERBODY



REFERENCE(S)

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PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

PROJECT
MARY RIVER PROJECT

TITLE
PHOTOGRAPHIC SURVEYS DURING LEG 2, SURVEY 3 ON AUGUST 21-22, 2019 IN THE ECLIPSE SOUND AND ADMIRALTY INLET GRIDS

CONSULTANT
GOLDER

YYYY-MM-DD	2020-05-08
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PREPARED	AA
REVIEWED	PR
APPROVED	PR

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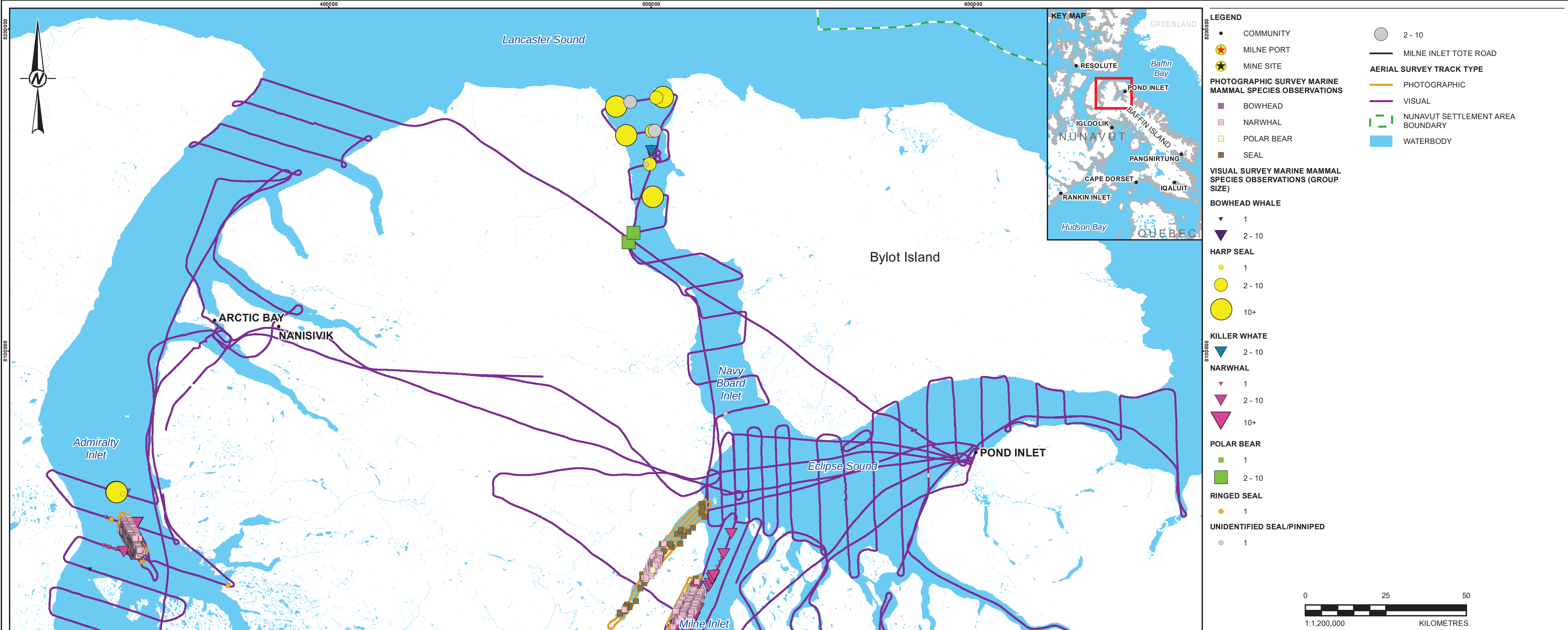

NOTE(S)

1. CONDITIONS GOOD WITH BF 0-3 FOR MUCH OF THE SURVEY AREA AND NO FOG. BF 4-5 ENCOUNTERED ON EASTERN PORTION OF ECLIPSE SOUND AND PORTIONS OF NAVY BOARD INLET. NARWHALS CONCENTRATED IN THE CENTRAL PORTION OF TREMBLAY SOUND AND DISPERSED THROUGHOUT SOUTH MILNE INLET/KOLUKTOO BAY AREA. KILLER WHALES OBSERVED IN NORTHERN NAVY BOARD INLET.
2. CONDITIONS MODERATE WITH BF 0-5 AND NO FOG. NARWHALS CONCENTRATED IN THE SOUTHERN PORTION OF ADMIRALTY INLET ALONG THE WESTERN SHORE AND IN THE CENTRAL PORTION OF THE INLET NORTH OF YEOMAN ISLAND. TWO PHOTOGRAPHIC SURVEYS WERE FLOWN.

REFERENCE(S)

MILNE PORT INFRASTRUCTURE DATA BY HATCH, JANUARY 25, 2017, RETRIEVED FROM KNIGHT PIESOLD LTD. FULCRUM DATA MANAGEMENT SITE MAY 19, 2017. HYDROGRAPHY, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

PROJECT
MARY RIVER PROJECT

TITLE
DISTRIBUTION OF MARINE MAMMAL SPECIES DURING LEG 2, SURVEY 4 ON AUGUST 25-27, 2019 IN THE ECLIPSE SOUND AND ADMIRALTY INLET GRIDS

CONSULTANT

GOLDER

YYYY-MM-DD	2020-05-08
DESIGNED	KK
PREPARED	AA
REVIEWED	PR
APPROVED	PR

PROJECT NO.	CONTROL	REV.	FIGURE
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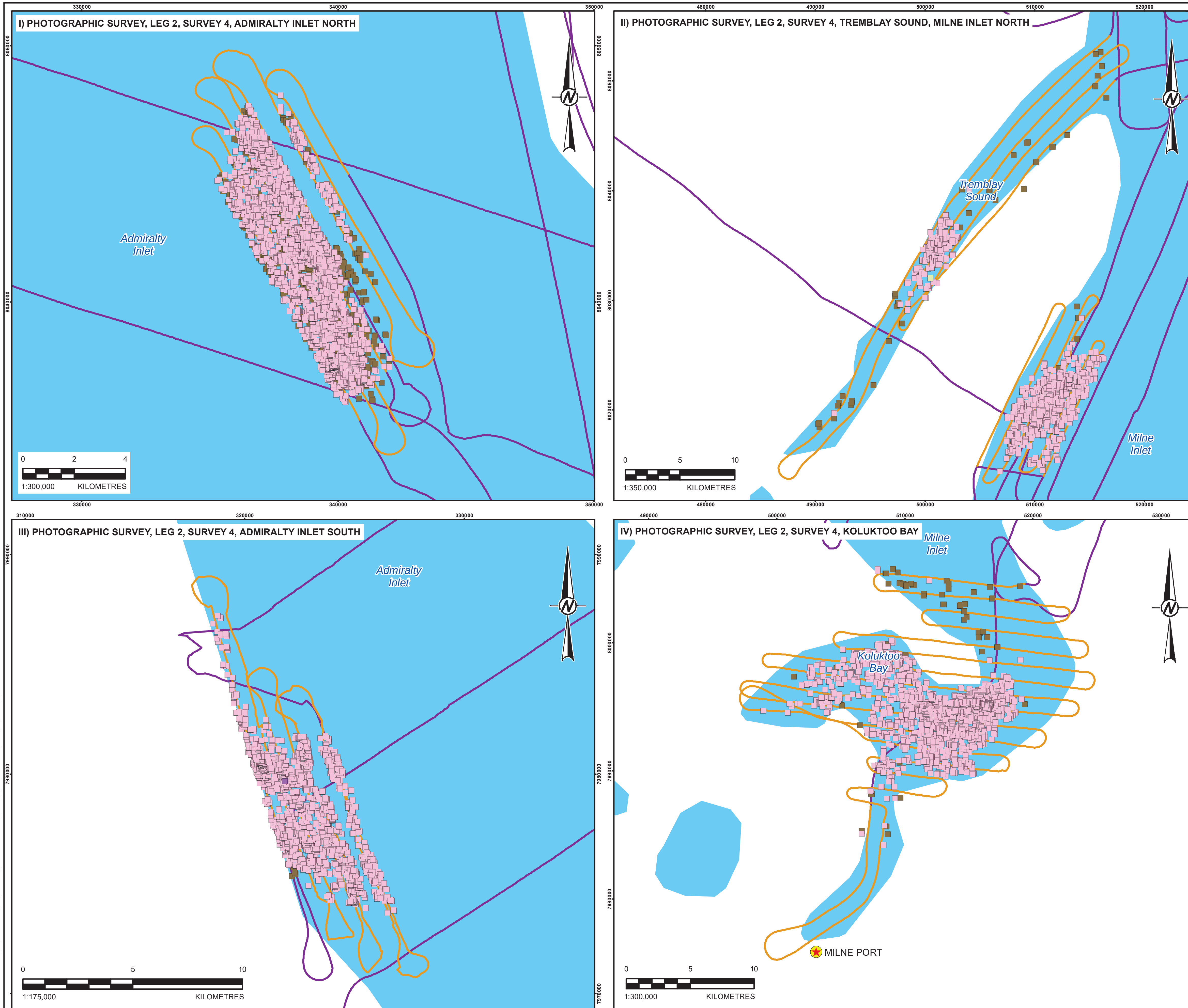


LEGEND

- COMMUNITY
- MILNE PORT

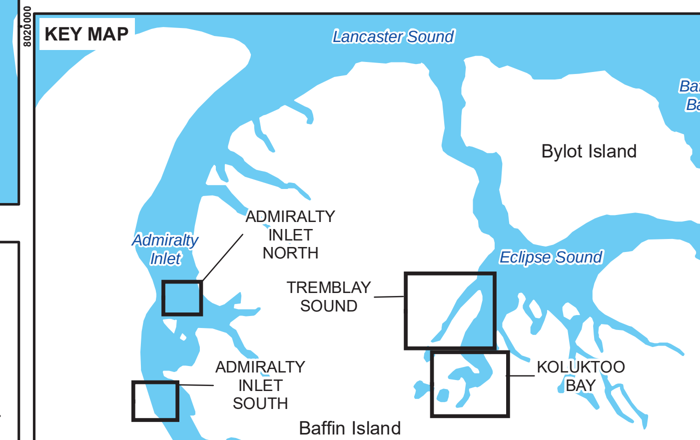
PHOTOGRAPHIC SURVEY MARINE MAMMAL SPECIES OBSERVATIONS

- BOWHEAD
- NARWHAL
- POLAR BEAR
- SEAL

AERIAL SURVEY TRACK TYPE

- PHOTOGRAPHIC
- VISUAL
- WATERBODY

KEY MAP



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PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

PROJECT
MARY RIVER PROJECT

TITLE
PHOTOGRAPHIC SURVEYS DURING LEG 2, SURVEY 4 ON AUGUST 25-27, 2019 IN THE ECLIPSE SOUND AND ADMIRALTY INLET GRIDS

CONSULTANT
GOLDER

YYYY-MM-DD	2020-05-08
DESIGNED	TT
PREPARED	AA
REVIEWED	PR
APPROVED	PR

PROJECT NO.	CONTROL	REV.	FIGURE
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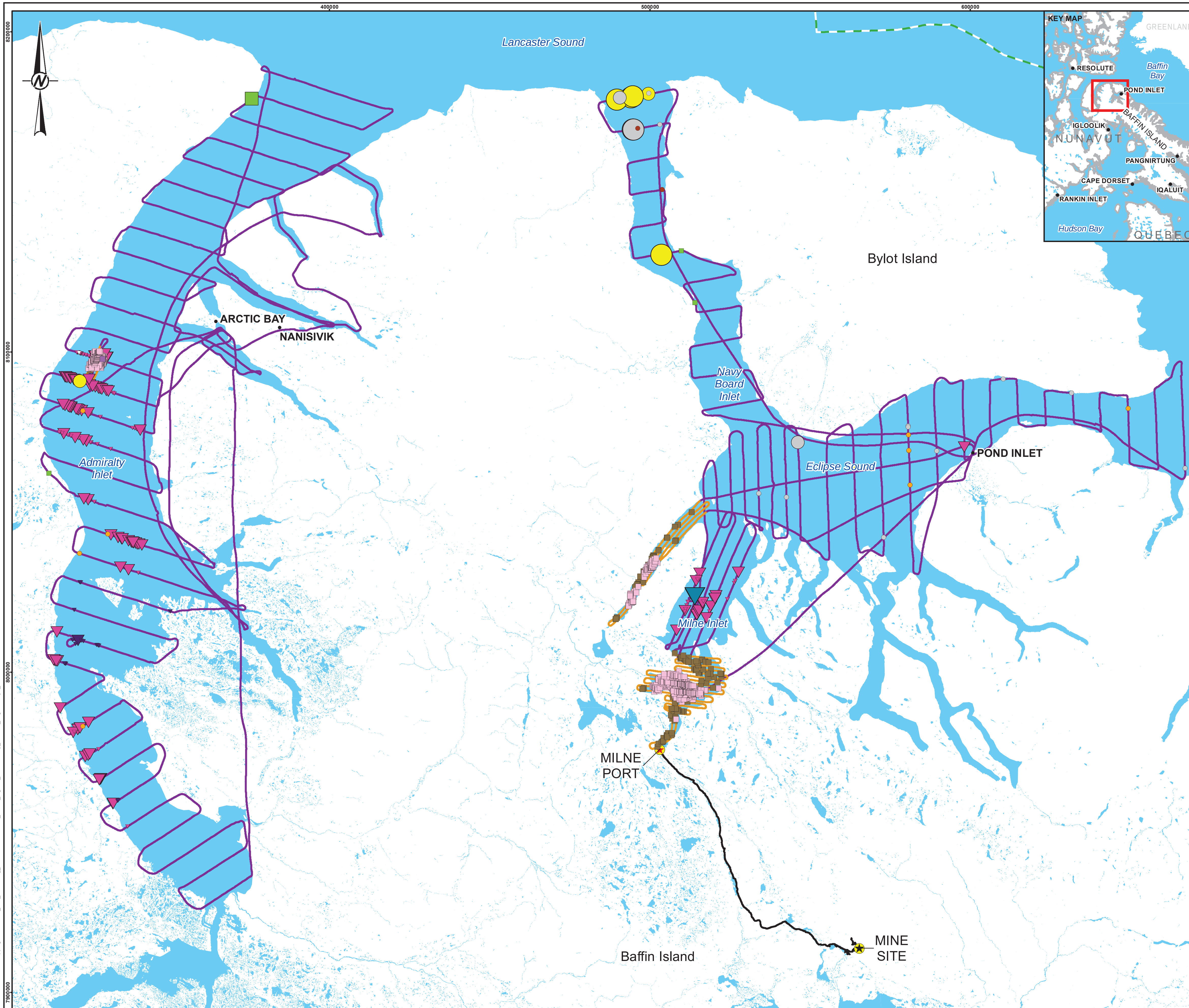


LEGEND

- COMMUNITY
- MILNE PORT
- MINE SITE

PHOTOGRAPHIC SURVEY MARINE MAMMAL SPECIES OBSERVATIONS

- BOWHEAD
- NARWHAL
- SEAL

VISUAL SURVEY MARINE MAMMAL SPECIES OBSERVATIONS (GROUP SIZE)

BEARDED SEAL
- 1

BOWHEAD WHALE
- 1
- 2 - 10

HARP SEAL
- 1
- 2 - 10
- 10+

KILLER WHATE
- 10+

NARWHAL
- 1
- 2 - 10
- 10+

POLAR BEAR
- 1
- 2 - 10

RINGED SEAL
- 1

UNIDENTIFIED SEAL/PINNIPED
- 1
- 2 - 10
- 10+

UNIDENTIFIED WHALE/CETACEAN
- 1

- MILNE INLET TOTE ROAD

AERIAL SURVEY TRACK TYPE
- PHOTOGRAPHIC
- VISUAL

- NUNAVUT SETTLEMENT AREA BOUNDARY
- WATERBODY

0 25 50

1:1,200,000 KILOMETRES

NOTE(S)

1. CONDITIONS GOOD WITH BF 0-3 FOR MUCH OF THE SURVEY AREA AND NO FOG. BF 4 ENCOUNTERED ON PORTIONS OF EASTERN ECLIPSE SOUND. NARWHALS CONCENTRATED IN THE CENTRAL PORTION OF TREMBLAY SOUND AND DISPERSED THROUGHOUT SOUTH MILNE INLET/KOLUKTOO BAY AREA. KILLER WHALES OBSERVED IN NORTH MILNE INLET.
2. CONDITIONS MODERATE WITH BF 0-5 AND FOG ON PORTIONS OF THE NORTHERN FOUR TRANSECTS. NARWHALS CONCENTRATED IN THE CENTRAL PORTION OF ADMIRALTY INLET. ONE PHOTOGRAPHIC SURVEY WAS FLOWN.

REFERENCE(S)

MILNE PORT INFRASTRUCTURE DATA BY HATCH, JANUARY 25, 2017, RETRIEVED FROM KNIGHT PIESOLD LTD. FULCRUM DATA MANAGEMENT SITE MAY 19, 2017. HYDROGRAPHY, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

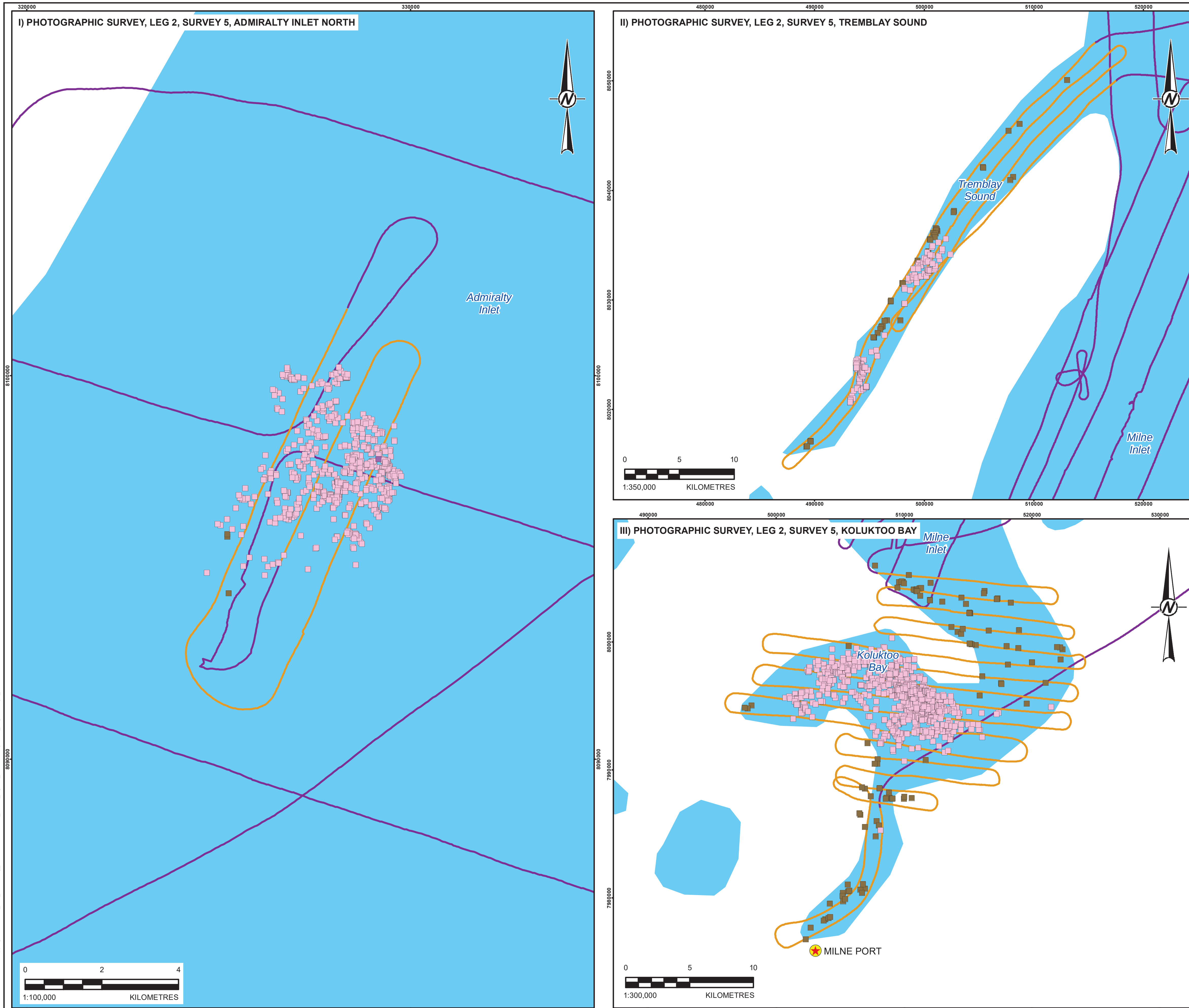
PROJECT
MARY RIVER PROJECT

TITLE
DISTRIBUTION OF MARINE MAMMAL SPECIES DURING LEG 2, SURVEY 5 ON AUGUST 29-30, 2019 IN THE ECLIPSE SOUND AND ADMIRALTY INLET GRIDS

CONSULTANT
GOLDER

YYYY-MM-DD	2020-05-08
DESIGNED	KK
PREPARED	AA
REVIEWED	PR
APPROVED	PR

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	38000	0	3-A



LEGEND

- COMMUNITY
- MILNE PORT

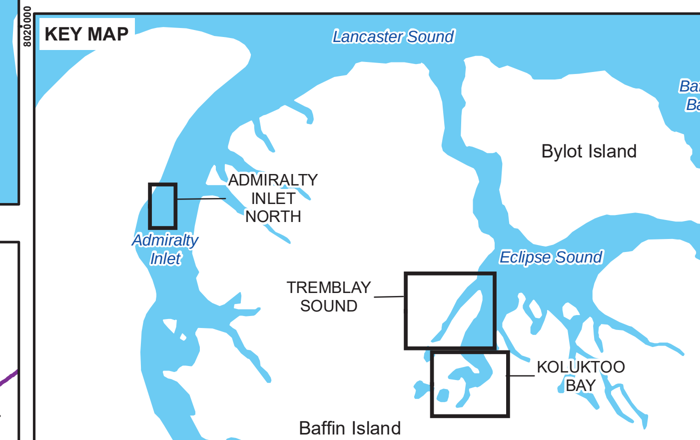
PHOTOGRAPHIC SURVEY MARINE MAMMAL SPECIES OBSERVATIONS

- BOWHEAD
- NARWHAL
- SEAL

AERIAL SURVEY TRACK TYPE

- PHOTOGRAPHIC
- VISUAL
- WATERBODY

KEY MAP



REFERENCE(S)
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PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

PROJECT
MARY RIVER PROJECT

TITLE
PHOTOGRAPHIC SURVEYS DURING LEG 2, SURVEY 5 ON AUGUST 29-30, 2019 IN THE ECLIPSE SOUND AND ADMIRALTY INLET GRIDS

CONSULTANT
GOLDER

YYYY-MM-DD	2020-05-08
DESIGNED	TT
PREPARED	AA
REVIEWED	PR
APPROVED	PR

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	38000	0	3-B

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

3.2 Narwhal Eclipse Sound Stock – 2019 Abundance Estimate

For the Eclipse Sound summer stock, narwhal abundance estimates were calculated for three surveys (Table 3). Narwhal abundance estimates for the Eclipse Sound grid ranged from 4,879 to 12,088 narwhals (CV=0.06 and 0.08, respectively; Table 3). Survey 3 and 4 were completed within a total of six days, and the difference in the abundance estimates may have been due to sampling variation resulting from non random movements of narwhal within the survey period or influences from killer whales which may have positively or negatively biased the numbers, as opposed to a true change in abundance. Survey 5 may have missed an aggregation of narwhals which resulted in the low abundance estimate. Consequently, we averaged the two abundance estimates from Survey 3 and 4 using an effort-weighted mean, where effort was measured by the area covered over the total area of the survey. This resulted in a final Eclipse Sound 2019 stock estimate of 9,931 narwhals (CV=0.05).

Table 3: Narwhal abundance estimates based on visual and photographic surveys in Eclipse Sound - August 2019

Survey #	Survey Type	Estimate	CV	95% CI
3	Visual	223	0.40	105 – 475
3	Photographic	7,542	0.04	6,983 – 8,145
3	Combined	7,765	0.04	7,182 – 8,396
4	Visual	1,514	0.59	522 – 4,390
4	Photographic	10,574	0.03	10,004 – 11,176
4	Combined	12,088	0.08	10,388 – 14,066
3 and 4	**Combined**	**9,931**	**0.05**	**9,009 – 10,946**
5	Visual	1,090	0.25	667 – 1781
5	Photographic	3,789	0.03	3,562 – 4,030
5	Combined	4,879[a]	0.06	4,322 – 5,507

[a] Possible narwhal aggregation missed during survey according to local hunters.

3.3 Comparison to Previous Aerial Surveys

For comparative purposes, the 2019 Eclipse Sound narwhal summer stock abundance estimate based on data from Survey 3 and 4 was consistent with previous yearly estimates including those prior to the start of Baffinland shipping operations in 2015 (Table 4). The abundance estimate of 9,931 narwhal falls within the 95% CI of all previous DFO abundance estimates for the Eclipse Sound summer stock. This finding is consistent with impact predictions made in the FEIS Addendum for the Early Revenue Phase (ERP) that the Project is unlikely to result in significant residual adverse effects on narwhal in the RSA (defined as effects that would compromise the integrity of the population either through mortality or via large-scale displacement or abandonment of the RSA).

Table 4: Comparison of abundance estimates for Eclipse Sound narwhal summer stock (2004-2019)

Stock	Year	Date	Abundance	CV	95% CI	Source
Eclipse Sound	2004	August	20,225	0.36	9,471 – 37,096	Richard et al. 2010
Eclipse Sound	**2013**	**18-19 Aug**	**10,489**	**0.24**	**6,342 – 17,347** [b]	**Doniol-Valcroze et al. 2015**
Eclipse Sound	**2016**	**Aug 7-10**	**12,039**	**0.23**	**7,768 – 18,660**	**Marcoux et al. 2019**
Eclipse Sound	2016	Aug 15	20,093	0.57	6,449 – 104,339	Golder 2018 (DFO data)
Eclipse Sound	2016	Aug 21	12,955	0.16	7,245 – 23,166	Golder 2018 (DFO data)
Eclipse Sound	2019	Survey 3 (Aug 21/22)	7,765	0.04	7,182–8,396	Golder 2020e (Baffinland data)
Eclipse Sound	2019	Survey 4 (Aug 25-27)	12,088	0.08	10,388–14,066	Golder 2020e (Baffinland data)
Eclipse Sound	2019	Survey 5 (Aug 29/30)	4,879[a]	0.06	4,322–5,507	Golder 2020e (Baffinland data)
Eclipse Sound	**2019**	**Survey 3 and 4**	**9,931**	**0.05**	**9,009–10,946**	**Golder 2020e (Baffinland data)**

3.4 End of Shipping Season Aerial Clearance Survey

An aerial survey (i.e., clearance survey) was flown in the RSA at the end of the shipping season on 30-31 October 2019. The purpose of this survey was to monitor the shipping corridor and adjacent areas for potential narwhal entrapment events following the completion of Baffinland's 2019 shipping operations in the RSA. Ice conditions in the RSA during the aerial survey consisted of 4-6/10 in Milne Inlet South, 9-10/10 in Milne Inlet North, a mixture of 1-1/10 in Western Eclipse, 7-8/10 in Eastern Eclipse, and open water (<1/10) in Pond Inlet and the entrance to Baffin Bay. Figure 4 shows the distribution of regional ice concentrations for 30 October 2019 based on Canadian Ice Service Charts.

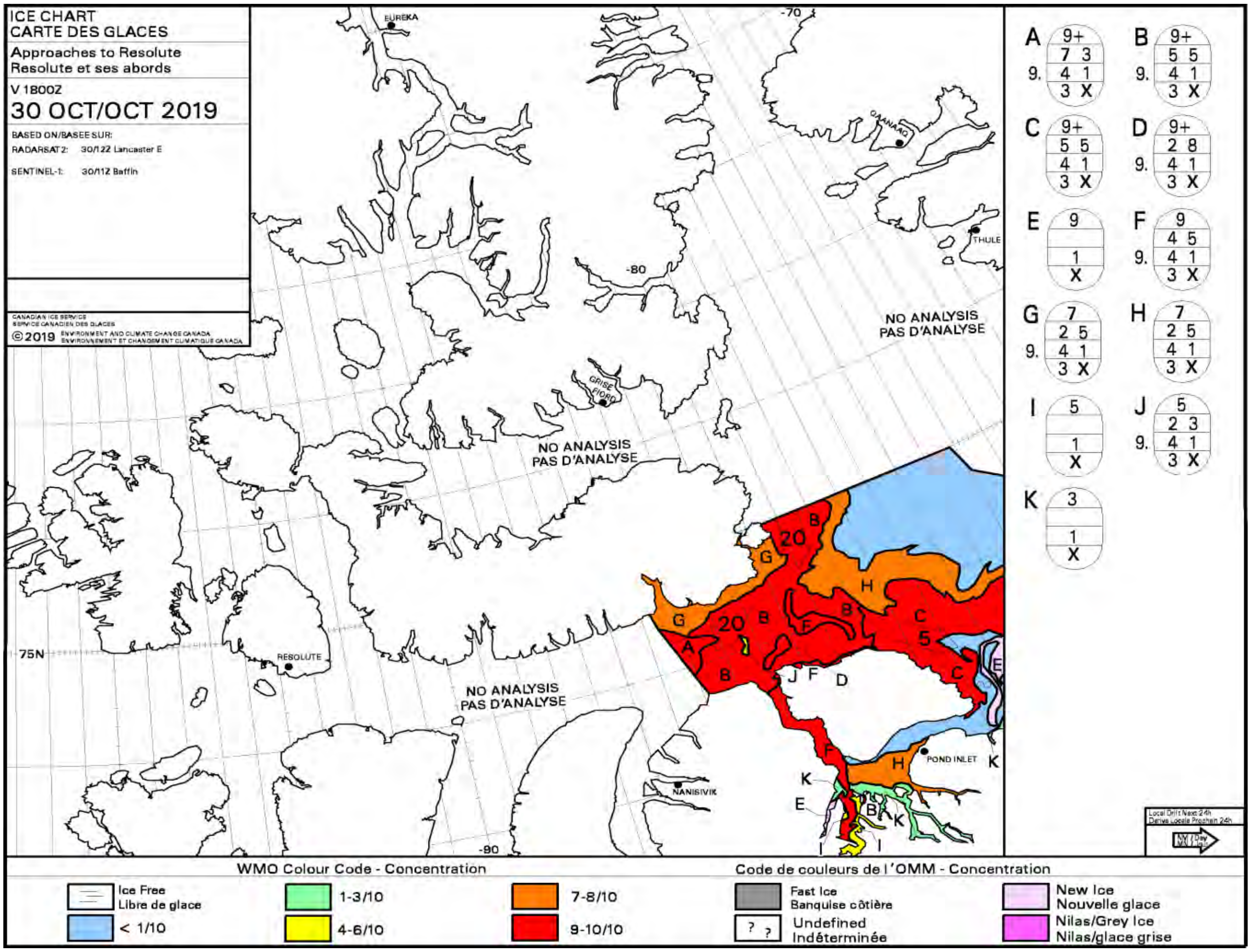


Figure 4: Canadian Ice Service chart for 30 October showing ice concentrations in Eclipse Sound and Milne Inlet.

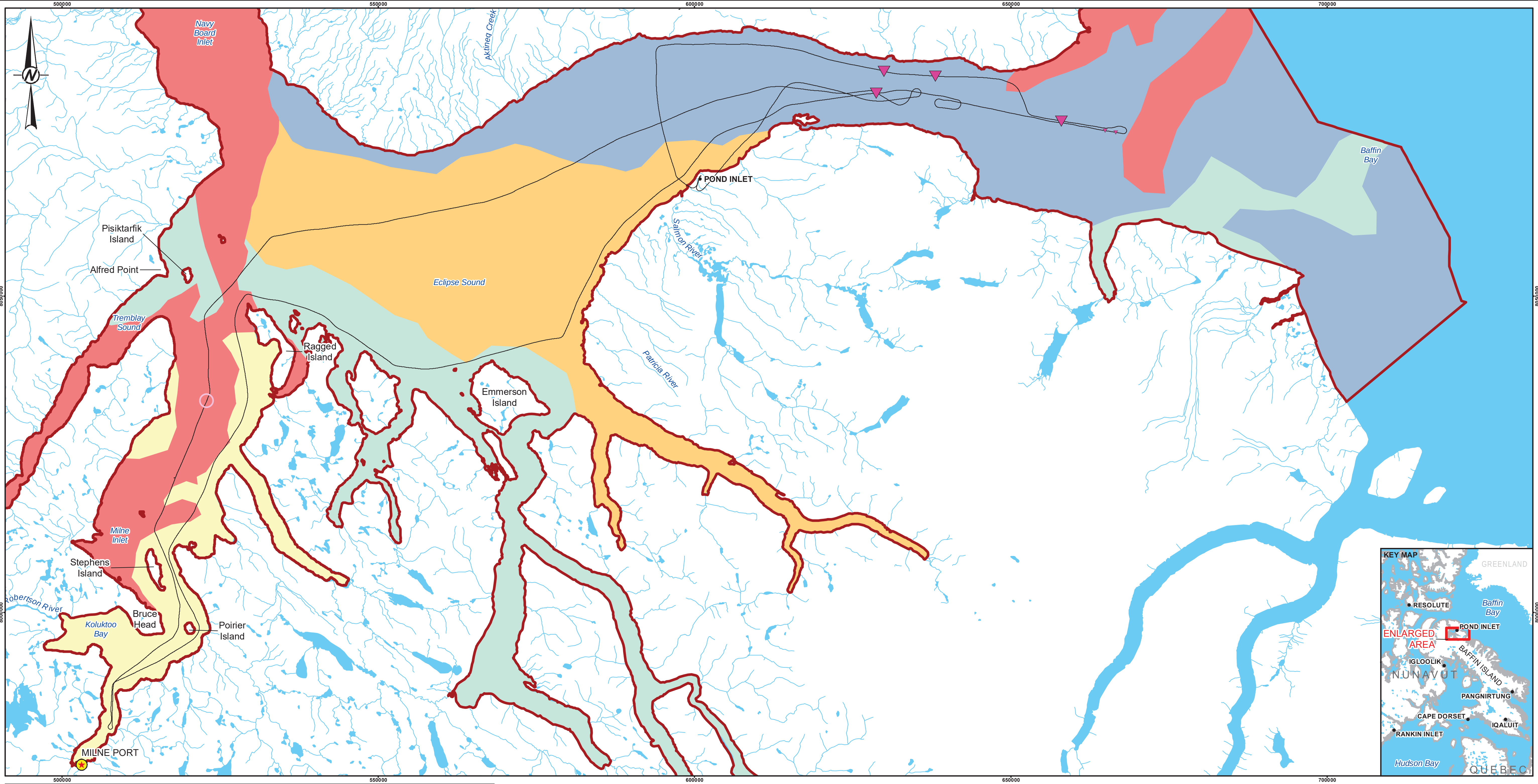
The first clearance survey was flown on 30 October, corresponding with the last icebreaker transit out of the RSA (while escorting a single ore carrier). At the time of the aerial survey, the icebreaker was located east of Pond Inlet transiting eastward toward Baffin Bay. Total aerial survey effort on 30 October consisted of 3 hours and 19 minutes, covering 604.3 km (Figure 5). The aircraft flew the clearance survey at a speed of 100 knots and at an approximate altitude of 333 m (1,000 feet) along the full extent of the nominal shipping route from the entrance of the RSA to Milne Port. The aircraft then returned north tracking along the east shore of Milne Inlet, the south shores of Eclipse Sound West, Eclipse Sound East, and Pond Inlet returning to the entrance of the RSA. The aircraft then returned westward following the south coast of Bylot Island to Sermilik Glacier, and then crossing southward across Eclipse Sound and returning to Pond Inlet (Figure 5). Historical entrapment areas in the RSA, including south of Bylot Island and north of Ragged Island, were covered during the survey. A total of six narwhal sightings comprising 14 individuals were recorded during the 30 October survey. All animals were located east of Pond Inlet and near the entrance to Baffin Bay, with all animals travelling eastbound at the time of sighting. The three most easterly sightings (n=7) were observed in the general vicinity of the icebreaker escort. One sighting of a potential narwhal footprint (depression left in water or thin ice following a dive) was also reported in Milne Inlet North between Athole

Point and Eskimo Inlet. The aircraft circled over this area repetitively to confirm the sighting but no narwhal were observed.

The second clearance survey was flown on 31 October when all Project vessels were confirmed to be outside of the RSA. Total aerial survey effort on 31 October consisted of 4 hours and 32 minutes, covering 709 km (Figure 6). The aircraft flew the clearance survey at a speed of 100 knots and at an approximate altitude of 333 m, transiting initially westward through central Eclipse Sound, then turning south in Milne Inlet North following the nominal shipping route to Milne Port. Upon arriving at Milne Port, the aircraft turned north to survey Koluktoo Bay, then transited eastward to the east side of Poirier Island before turning north and tracking along the eastern shore of Milne Inlet up to Ragged Island. The aircraft then crossed Milne Inlet and entered the north end of Tremblay Sound but had to abort this portion of the survey due to low cloud cover. The aircraft tracked back down the western shore of Milne Inlet to the south end of Stephens Island, returning north through central Milne Inlet following the nominal shipping to Eclipse Sound West, before proceeding into south Navy Board Inlet. Due to poor weather and low cloud cover in Navy Board Inlet, the plane turned back south into Eclipse sound and surveyed the areas north of Ragged Island and Curry Island before returning back to Pond Inlet via the south coast of Bylot Island (Figure 6). Historical entrapment areas in the RSA, including south of Bylot Island and north of Ragged Island, were covered during the survey.

No narwhal sightings were recorded during the 31 October survey. Two sightings of potential narwhal footprints were recorded, both in Eclipse Sound West north of Ragged Island. The aircraft circled over this area repetitively to confirm the sighting but no narwhal were observed (Figure 6). Other marine mammals recorded on 31 October included eight sightings of unidentified seals: three in western Eclipse Sound, four in central Milne Inlet near Stephens Island and one south of Ragged Island.

Results of the end of season aerial clearance survey confirm that no entrapments occurred in 2019 as a result of Project shipping.



LEGEND

POSSIBLE NARWHAL FOOTPRINTS

MARINE MAMMAL SPECIES OBSERVATIONS (GROUP SIZE)

NARWHAL

- 1
- 2-9
- 10+

- COMMUNITY
- MILNE PORT
- CLEARANCE SURVEY AERIAL TRACK
- WATERCOURSE
- MARINE MAMMAL REGIONAL STUDY AREA
- WATERBODY

ICE CONCENTRATION

- < 1/10
- 1-3/10
- 4-6/10
- 7-8/10
- 9-10/10

0 10 20
1:600,000 KILOMETRES

REFERENCE(S)
ICE CONCENTRATION OBTAINED FROM CANADIAN ICE SERVICE, GOVERNMENT OF CANADA. DAILY ICE CHARTS – APPROACHES TO RESOLUTE BAY. ACCESSED SEPTEMBER 19, 2019 AND DECEMBER 13, 2019. GEOGRAPHIC NAMES, HYDROGRAPHY, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

PROJECT
MARY RIVER PROJECT - 2019 SHIP-BASED OBSERVER PROGRAM

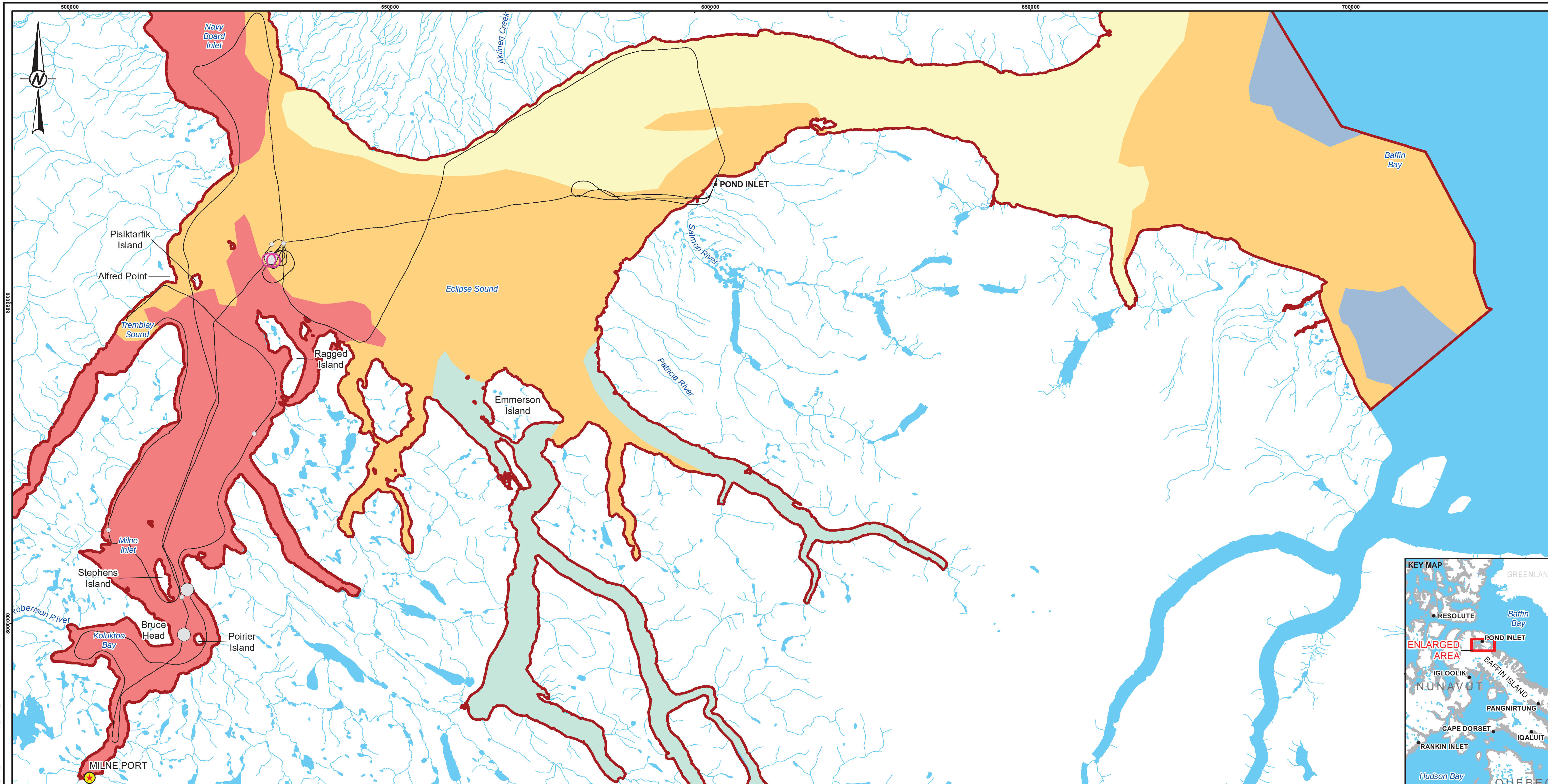
CONSULTANT

GOLDER

YYYY-MM-DD	2020-05-08
DESIGNED	KG
PREPARED	AA
REVIEWED	PR
APPROVED	PR

TITLE
MARINE MAMMAL SIGHTINGS RECORDED DURING END OF SEASON CLEARACE AERIAL SURVEY - OCTOBER 30

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	38000	0	5



LEGEND

NARWHAL FOOTPRINTS

MARINE MAMMAL SPECIES OBSERVATIONS (GROUP SIZE)

UNIDENTIFIED SEAL

- 1
- 2-9

- COMMUNITY
- MILNE PORT
- CLEARANCE SURVEY AERIAL TRACK
- WATERCOURSE
- MARINE MAMMAL REGIONAL STUDY AREA
- WATERBODY

ICE CONCENTRATION

- < 1/10
- 1-3/10
- 4-6/10
- 7-8/10
- 9-10/10

0 10 20
1:600,000 KILOMETRES

REFERENCE(S)
ICE CONCENTRATION OBTAINED FROM CANADIAN ICE SERVICE, GOVERNMENT OF CANADA. DAILY ICE CHARTS – APPROACHES TO RESOLUTE BAY. ACCESSED SEPTEMBER 19, 2019 AND DECEMBER 13, 2019. GEOGRAPHIC NAMES, HYDROGRAPHY, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

PROJECT
MARY RIVER PROJECT - 2019 SHIP-BASED OBSERVER PROGRAM

CONSULTANT
GOLDER

YYYY-MM-DD	2020-05-08
DESIGNED	KG
PREPARED	AA
REVIEWED	PR
APPROVED	PR

TITLE
MARINE MAMMAL SIGHTINGS RECORDED DURING END OF SEASON CLEARACE AERIAL SURVEY - OCTOBER 31

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	38000	0	6

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

3.5 Inuit Researcher Feedback

Following the completion of the 2019 Aerial Survey Program, all Inuit Researcher participants were interviewed to garner feedback on the program, observations made in the field, and recommendations moving forward. Following is a summary of the feedback provided specific to this program:

- Ice was thin this year compared to other years.
- No narwhals last year. This year we saw them.
- One of the first surveys, saw narwhal following the ship coming through the ice.
- Aerial survey saw whales at the same places that hunter see them, but you can see more from the plane.
- Seal are everywhere; lots of seals out there. Number of seals are not down due to hunting or boating.
- One beluga seen in a group of 80-100 narwhal.
- 50 bowhead whales spotted; that was quite unexpected.
- Hard to tell if shipping activities have changed whale behaviour.
- When the ships had no speed limits, the narwhal would move away. When the ships have a speed limit, the narwhal aren't as afraid. The speed limit is good.
- Ore carriers are slow enough that they don't change the behaviour of the whales. Ships could go faster.
- Heard that ships were parked at the floe edge last year. No ships at the floe edge this year and the whales came in. Thinking this helped.
- Before the ships, narwhal used to the fill the whole fjord, but now with shipping they hug the shore.
- Cruise ships were going faster than the ore carriers.
- No narwhals around the ore carriers.

4.0 2019 BRUCE HEAD SHORE-BASED MONITORING PROGRAM

To investigate narwhal response to shipping noise and close ship encounters along a confined section of the Northern Shipping Route, the Bruce Head Shore-based Monitoring Program has been conducted annually (with the exception of 2018) since 2014, following a pilot project in 2013. This program was designed to specifically evaluate potential disturbance of marine mammals from shipping activities that may result in changes in animal abundance, distribution, and migratory movements within the RSA. This section presents a summary of the integrated results from the five-year monitoring program at Bruce Head, which substantiate the conclusions of the combined assessment of Project effects on marine mammals relative to Baffinland's Phase 2 Proposal (Section 7.0).

During the open water season of 2019, visual survey data were collected from a cliff-based observation platform overlooking the Northern Shipping Route to investigate potential narwhal response to shipping activities, with information collected on relative abundance and distribution (RAD), group composition, and behaviour of narwhal (Figure 7). Additional data were 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 that may also affect narwhal behaviour. A detailed description of data collection and analytical methodology for the 2019 Marine Mammal Aerial Survey Program is provided in Golder (2019a; 2020c).

Figure 7: Inuit researcher Ryan Arnakallak recording survey data on narwhal at the observation platform.

4.1 Summary of Results

A total of 285 RAD surveys were completed over the course of 26 days between 6 August and 1 September 2019. A summary of the 2019 RAD data, compared to that collected from 2014 to 2017, is included in Table 5. Similar to previous years, narwhal were the most common species recorded at Bruce Head in 2019, followed by ringed seal and bearded seal. Less common species sightings recorded during 2019 included killer whale (multiple sightings), bowhead whale (n=1), beluga (n=2), and polar bear (n=2, observed on opposite shore). The total number of narwhal sightings (corrected for effort) in 2019 was shown to be comparable to that reported in previous survey years, including from baseline monitoring conducted in 2014, prior to the start of shipping operations in the RSA (Table 5; Golder 2019a, 2019c; 2020c).

Table 5. Relative Abundance and Distribution (RAD) surveys at Bruce Head (2014–2019)

Statistic	Survey Year				
	2014	2015	2016	2017	2019
Survey dates	3 Aug–5 Sept	29 July–5 Sept	30 July–30 Aug	31 July–29 Aug	6 Aug–1 Sept
No. of active survey days	23	29	27	26	26
No. of survey days lost to weather	14	9	11	2	0
No. of observer hours (total)	103.2	148.7	159.3	97.3	139.3
Average daily survey effort (No. of RAD surveys)	7.8	10.8	11.9	6.2	11.0
No. of attempted RAD surveys	179	314	321	160(1)	289
No. of complete RAD surveys	166	313	311	109	285
Number of RAD surveys with zero narwhal counts	74	164	127	35	88
No. of narwhal sightings	**10,463**	**14,599**	**28,309**	**11,831**	**14,680**
No. of narwhal excluding 'impossible' sightability, standardized by effort (narwhal / h)	**101.4**	**98.2**	**178.0**	**121.8**	**107.6**
No. of ship transits during RAD effort	7	11	21	22	32

(1) = one survey out of the total 160 surveys was omitted from due to high chance of double-counting animals. All other values shown for 2017 in this table exclude this survey.

Daily standardized counts of narwhal in the Stratified Study Area (SSA) in 2019 ranged from zero narwhal/h (on 16, 23, and 28 August) to 360 narwhal/h on 15 August (Figure 8). The annual median value of daily standardized counts in 2019 (79.2 narwhal/h) was higher in 2019 than most previous years with the exception of 2017, whereas the annual mean value (105.6 narwhal/h) was lower in 2019 than most previous years with the exception of 2015.

Based on narwhal group size data recorded in the Behavioural Study Area (BSA), a total of 1,373 groups were recorded in 2019 with a mean group size of 3.7 narwhal/group (Figure 9). In comparison, 2014-2016 surveys resulted in records of only 250-761 groups, whereas 2017 surveys resulted in records of 2,424 groups. Mean annual group sizes in previous years ranged from 3.3 narwhal/group in 2016 to 4.34 narwhal/group in 2014.

These results suggest that, despite year over year increases in shipping in the RSA, narwhal continue to use the Bruce Head area and that relative narwhal abundance in this area, inferred from sighting rate (narwhal/h), remained consistent with pre-shipping (2014) levels. These results supported impact predictions made in the FEIS Addendum for the Early Revenue Phase (ERP), indicating that the Project is unlikely to result in significant residual adverse effects on narwhal in the RSA, defined as effects that compromise the integrity of the population either through mortality or via large-scale displacement or abandonment of the RSA

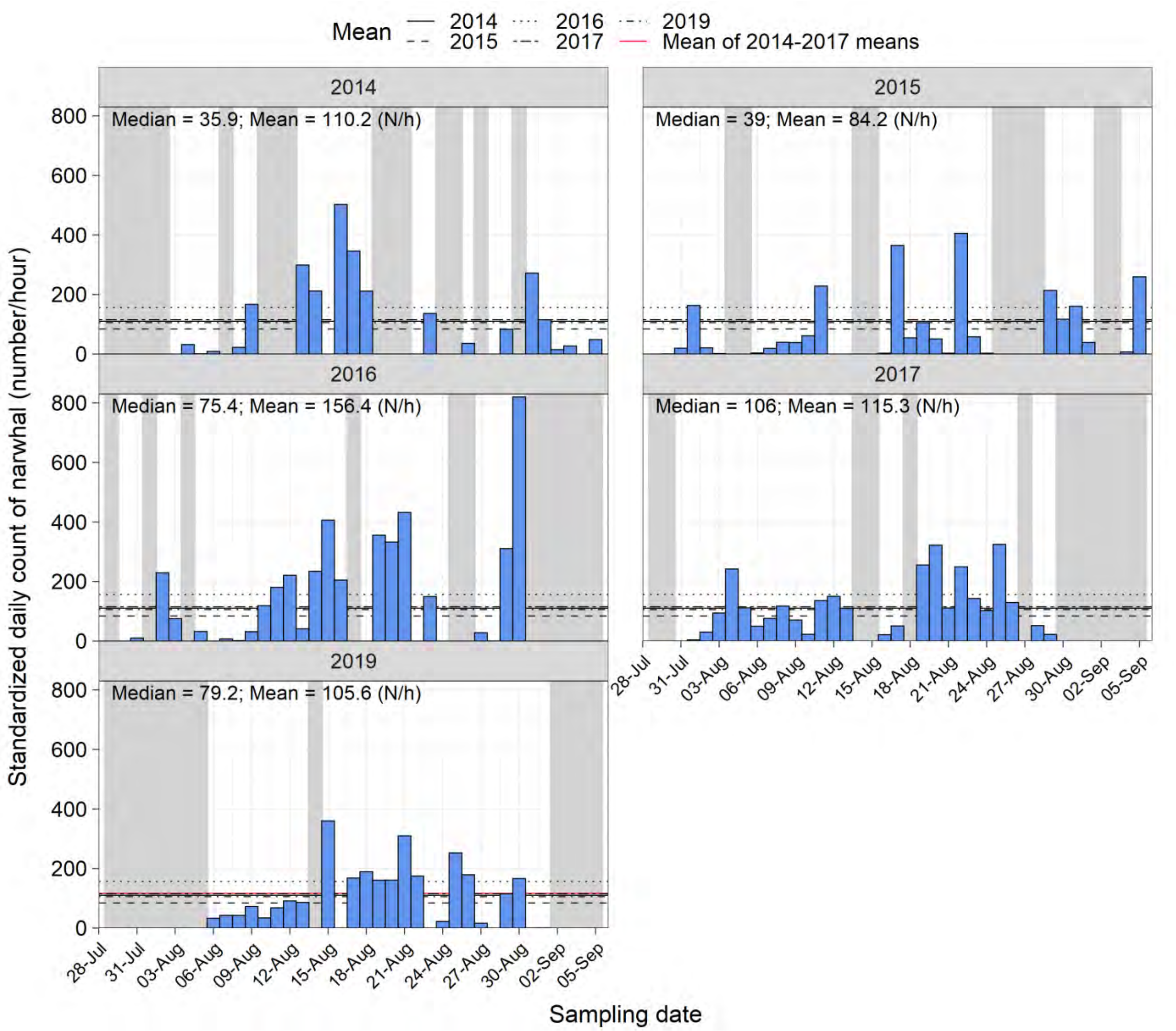


Figure 8: Standardized daily count of narwhal (animals/h) in SSA during RAD Surveys (2014-2019). Note: Grey shaded background represents days where no surveys occurred.

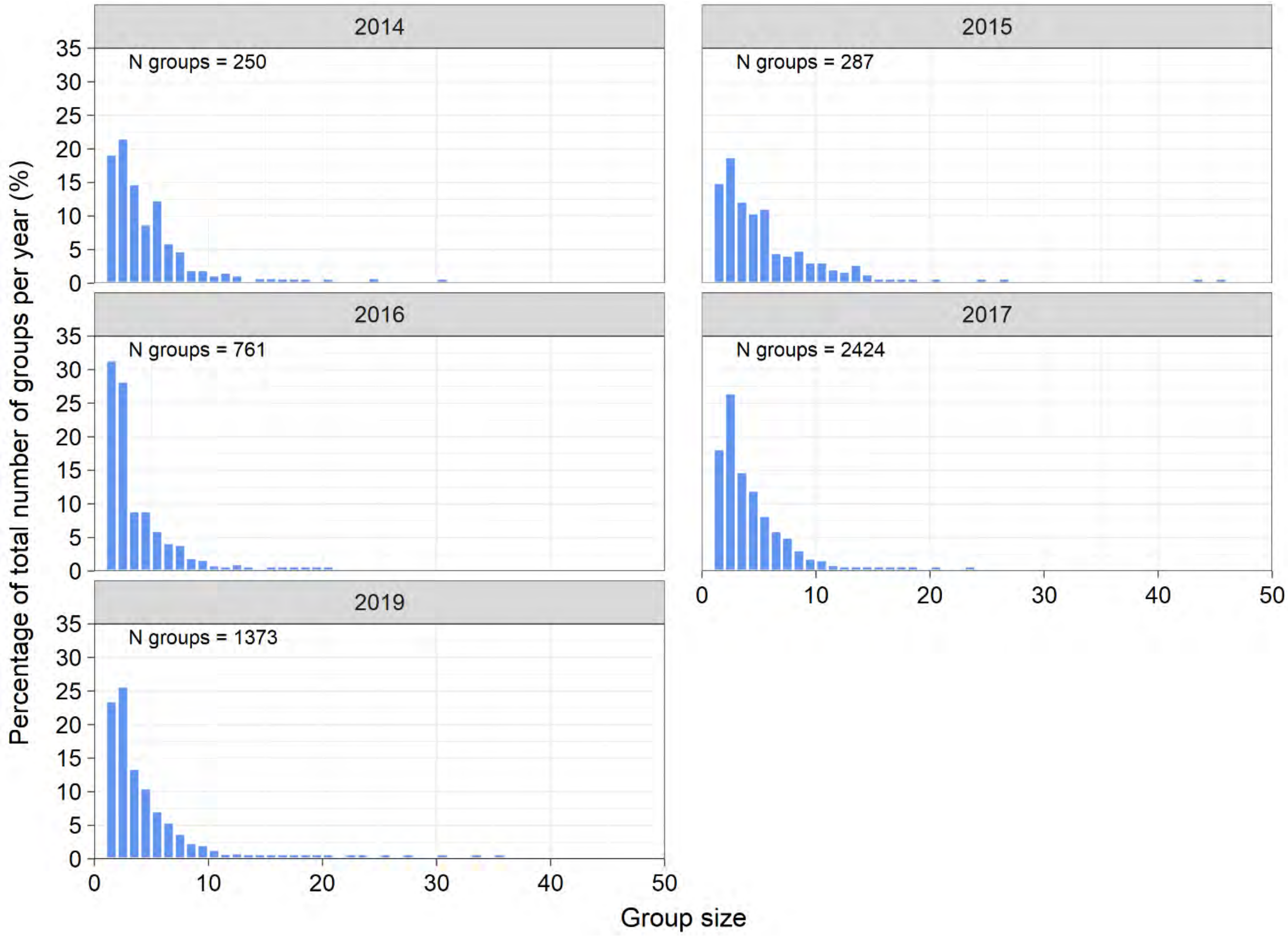


Figure 9: Group size and number of groups observed during narwhal counts in BSA (2014-2019).

Group Composition

A qualitative assessment of group composition by life stage recorded in 2019 indicated an overall similar group composition to previous years, with the majority of the sightings consisting of adult whales, followed by the yearling/juvenile category, followed by calves (Figure 10). Similar to previous years, both calves and yearlings were observed during most sampling days, with only two days (15 and 28 August 2019) with no calves or yearlings recorded. In 2019, the daily proportion of calves (relative to total narwhal counts) ranged between 0% (on 15 and 28 August) and 19% (on 9 August 2019). In previous years, mean annual percentage of calves ranged between 0% (in all years) and 23-50% (23% in 2014 and 50% in 2017). Annual mean values in 2019 (11.2%) were higher than all previously estimated annual means (2014=10.7%, 2016=9.7%, 2017=7.7%), except for 2015 when a mean annual value of 14% was recorded. The mean proportion of calves recorded in 2019 suggested that calf presence (calving success) at Bruce Head was occurring at a rate consistent with pre-shipping conditions, despite year-over-year increases in shipping in the RSA. These results supported impact predictions made in the FEIS Addendum for the ERP indicating that the Project is unlikely to result in significant residual adverse effects on narwhal in the RSA (those resulting in potential population-level effects).

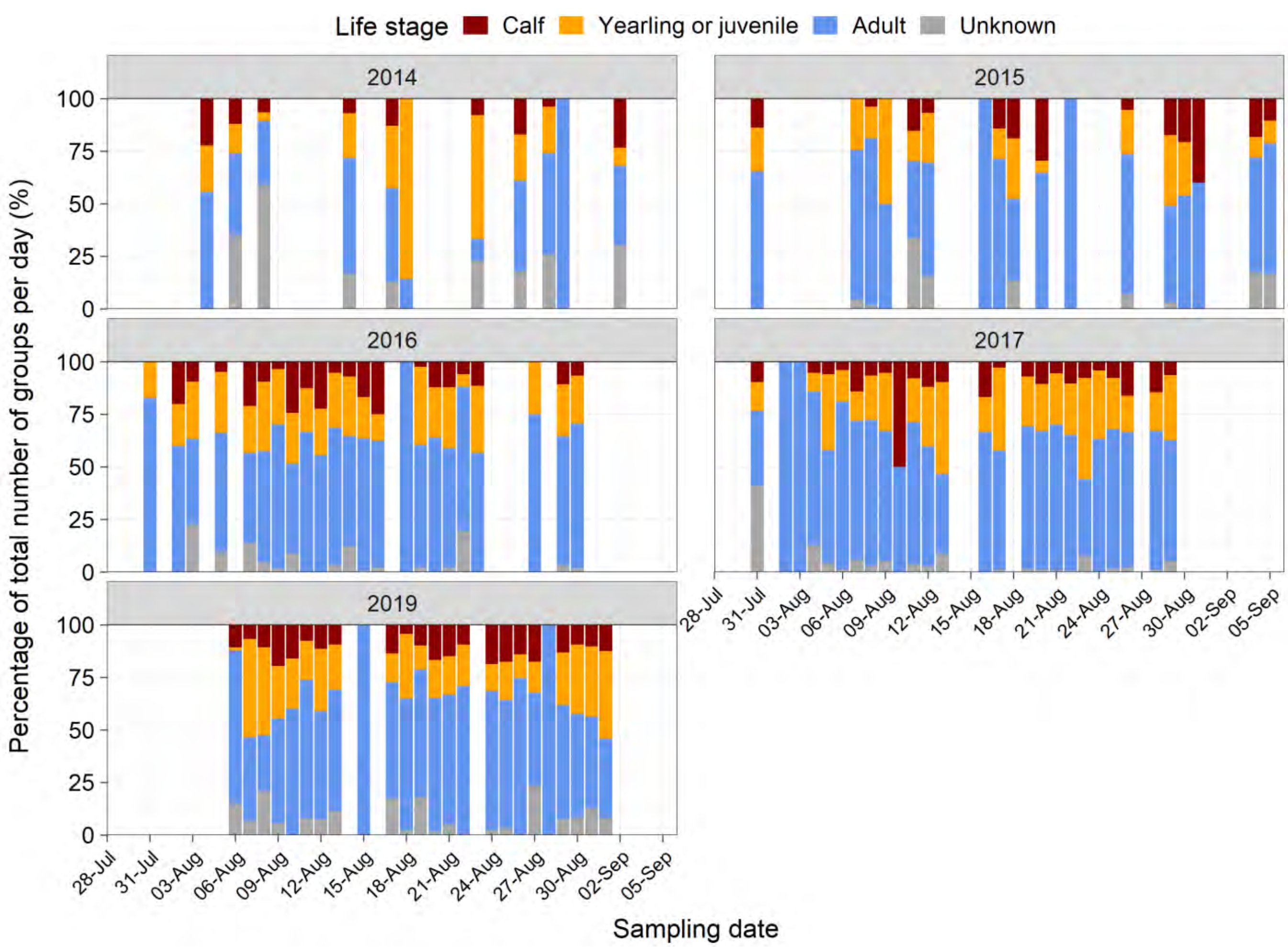


Figure 10: Daily recorded group composition during narwhal counts in BSA (2014-2019).

The following is a summary of key findings pertaining to narwhal behavioral response to vessel traffic and vessel noise based on five years of shore-based visual survey data collected at Bruce Head between 2014 and 2019:

Relative Abundance and Distribution

- The overall relative abundance of narwhal in the SSA, inferred from sighting rate (no. of narwhal per hour - corrected for effort), has remained relatively constant between 2014 and 2019 despite a gradual increase in iron ore shipping along the Northern Shipping Route during this period. Narwhal numbers in the RSA were shown to be comparable to baseline levels documented during the 2014 Bruce Head Monitoring Program, which took place prior to the start of iron ore shipping in the RSA. These findings are consistent with results from Baffinland's other narwhal monitoring programs demonstrating that the Bruce Head area continues to support high narwhal densities compared to other areas in the RSA (Elliott et al. 2015; Thomas et al. 2015; Golder 2020a; Golder 2020b).
- Within each study year, a likely but uncertain effect of vessel exposure on narwhal relative abundance in the study area (SSA) was observed. Specifically, vessel exposure was shown to result in a significant decrease in narwhal sightings in the SSA compared to when no vessels were present, but only when narwhal were exposed to vessels travelling north and away from the study area, and only at close exposure distances of 2-3 km. **These results suggest that the relative abundance of narwhal is influenced by vessel traffic at close distances, although the exact spatial extent of this effect could not be determined due to high data variability.**

Group Composition and Behavior

- Group Size: None of the effects of shipping (distance from vessel, vessel direction, vessel orientation relative to the Behavioural Study Area or BSA) on narwhal group size were shown to be statistically significant ($P>0.2$ for all effects). **These results suggest that narwhal neither congregate into larger groups nor fragment into smaller groups in response to vessel exposure.**
- Group Composition:
  - All narwhal life stage categories (adult females, adult males, yearlings/juveniles and calves) were recorded in the BSA throughout the five sampling years. The daily proportion of calves/yearlings recorded in the BSA (relative to the total number of narwhal observed per day) was higher in 2019 (annual mean of 11.2%) than all previous years (2014=10.7%, 2016=9.7%, 2017=7.7%), with the exception of 2015 (14%). This suggests that calving success at Bruce Head in 2019 is consistent with pre-shipping levels, despite year-over-year increases in shipping in the BSA.
  - Vessel traffic was shown to have a significant effect on group composition relative to calf/yearling presence (i.e., a significant interaction was observed between 'vessel distance', 'vessel direction' and 'vessel orientation relative to BSA'). Results suggest that the proportion of groups with calves/yearlings was similar between all four vessel traffic scenarios (i.e., vessel transiting toward/away BSA, vessel transiting southbound/northbound), but generally increased during close vessel encounters.
  - **Collectively, these results suggest that narwhal group composition did not significantly change between study years despite an increase in shipping activity during this period, but the proportion of groups with calves/yearlings was generally higher during close vessel encounters (although it is unknown whether this specific effect was significant).**

- Group Spread: Narwhal groups were more often observed in tight associations compared to loose associations under both vessel presence and vessel absence scenarios. In general, group spread did not significantly change during vessel-exposure events. However, loosely spread groups were less common when vessels headed away from the BSA (32% for northbound vessels and 30% for southbound vessels) than when vessels were heading toward the BSA (38% for northbound vessels and 32% for southbound vessels). **These results suggest that narwhal group spread did not significantly change during vessel exposure events.**
- Group Formation: Narwhal groups were most often observed in parallel formation under both vessel presence and vessel absence scenarios. A possible but uncertain effect of vessel distance on narwhal group formation was evident that depended on vessel direction, with the most consistent effect suggested for southbound vessels moving away from the BSA. However, none of the shipping-related variables were statistically significant. **These results suggest that narwhal group formation did not significantly change in the BSA during vessel exposure events; however, the detection power for this response variable was low.**
- Group Direction: Vessel traffic was shown to have a significant effect on travel of narwhal groups in the BSA (i.e., a significant interaction was observed between ‘vessel distance’, ‘vessel direction’ and ‘vessel orientation relative to BSA’ although the effect on travel direction was shown to be variable). Narwhal groups were predominantly observed traveling south through the BSA. Southbound travel was least common when southbound vessels were headed away from the BSA, and most common when northbound vessels were headed away from the BSA. **These findings suggest that narwhal groups may experience some level of avoidance behaviour in the wake of vessels transiting through Milne Inlet (i.e., narwhal groups appear to avoid “following” vessels) but that travel direction by narwhal groups is relatively less affected during the approach of vessels.**
- Travel Speed: The majority of the observed narwhal groups travelled at a medium speed, regardless of vessel exposure conditions. A lack of statistical significance of any of the vessel-related variables (vessel distance, vessel travel direction, vessel orientation relative to BSA) indicates that the effect of vessel exposure on narwhal travel speed was not detected. The nature of the data for fast-travelling groups was not adequate to test for the effect of vessel exposure on increased travel speed in the BSA. **These results suggest that narwhal did not decrease their travel speed or demonstrate a ‘freeze’ response during vessel exposure events.**
- Distance from Bruce Head Shore: Narwhal groups were observed more often within 300 m of the Bruce Head shore under both vessel presence and vessel absence scenarios. Offshore groups (>300 m) were detected less frequently with increasing Beaufort scale values, suggesting a decreased detection ability at distance with deteriorating sea state. Furthermore, vessel traffic was shown to result in a significant decrease in ’distance from shore’ (i.e., significant interaction was between ‘vessel distance’, ‘vessel direction’ and ‘vessel orientation). This effect appeared to be largely attributed to vessel traffic moving toward the BSA. **The results suggest that narwhal swim closer to shore when in close proximity to vessels moving toward the BSA.**

Overall, results from this five-year shore-based monitoring study support impact predictions made in the Final Environmental Impact Statement (FEIS) for the Early Revenue Phase (ERP), in that ship noise effects on narwhal will be limited to localized avoidance behaviour, consistent with low to moderate severity responses (Southall et al. 2007; Finneran et al. 2017). No evidence was observed of large-scale avoidance behaviour, displacement effects, or abandonment of the summering grounds (high severity responses), which might in turn result in a population or stock-level consequence (consistent with the definition of a non-significant effect used in the FEIS).

4.2 Inuit Researcher Feedback

Following the completion of the 2019 Bruce Head Monitoring Program, all Inuit Researcher participants were interviewed to garner feedback on the program, observations made in the field, and recommendations moving forward. Following is a summary of the feedback provided specific to this program:

- The observation location is good because the narwhal travel to Koluktoo Bay.
- Narwhal didn’t mind the ships. They are getting used to it.
- When doing RAD counts, didn’t see narwhal leaving the shipping lane when a ship would come through.
- Didn’t notice narwhal diving when shipping activity came through.
- This habituation was also seen from the Nanisivik area according to one observer’s grandfather.
- The ship would have to be closer to the narwhal by one ship length before they would change behaviour.
- Narwhal react to ships like when they are hunted, then they calm down once the ship has passed.
- Probably not seeing the effects of shipping right now but they will become more apparent later.
- Not worried that narwhal would be hit by ships.
- Narwhals move closer to shore early in the shipping season and then are less affected later.
- Narwhal would avoid the area at the point when hunters were there.
- Hunting by humans and hunting by killer whales have more of an impact of whales than shipping.
- Seals are pretty much everywhere. Saw killer whales, but not bowhead whales.
- Seals aren’t disturbed by ships, focus more on narwhal.
- The whales did not react to the helicopters or planes.

5.0 2019 PASSIVE ACOUSTIC MONITORING (PAM) PROGRAM

This section provides a summary of underwater sound levels measured during icebreaking operations during the shoulder season and shipping operations during the open-water period of 2019, to support an updated assessment of acoustic impacts (injury, disturbance and masking effects) on marine mammals relative to Baffinland’s Phase 2 Proposal (Section 7.0). These results were analyzed and interpreted relative to the scale of acoustic impacts that were predicted through acoustic modelling assessments for the ERP (Baffinland 2013) and the Phase 2 Proposal (Golder 2019b; 2019e). This section includes information prepared in response to Final Written Submission DFO Comment 3.7.2 (October 2019) and updated Final Written Submission (January 2020) DFO Comment 3.3.1, in which DFO recommended that Baffinland estimate the extent of listening range reduction (LRR) associated with the proposed increased transits, considering different areas of the RSA including Milne Inlet and Eclipse Sound.

In 2019, JASCO Applied Sciences (JASCO) deployed Autonomous Multichannel Acoustic Recorders (AMARs) (i.e., acoustic monitoring stations) at five locations in Eclipse Sound and Milne Inlet. The purpose for these recorders was to document underwater noise levels along the shipping corridor, to monitor marine mammal presence along the shipping corridor near Bruce Head and in Koluktoo Bay, and to compare measured (actual) ship noise levels to estimated ship noise levels determined through underwater noise modelling undertaken in support of the FEIS Addendum for the Phase 2 Proposal. Three AMARs (AMAR-1, AMAR-2, AMAR-3) were deployed in Milne Inlet South (Table 6; **Figure 11**) over a two-month period (August–September 2019) to collect acoustic data during the open water season, concurrently with visual observer data collected as part of the Bruce Head Shore-based Monitoring Program. An additional two AMARS were deployed along the nominal shipping route in Eclipse Sound, near Ragged Island (AMAR-RI) and south of Bylot Island (AMAR-BI) in May 2019 to record icebreaker and ore carrier noise during vessel transits in Eclipse Sound. The recorder near Bylot Island was only deployed for the spring shoulder season (28 days); the recorder near Ragged Island remained in place throughout the 2019 open water season (85 days total). Both of these recorders were redeployed at the end of the open water season to record sounds during the Fall 2019 and Spring 2020 shoulder seasons.

A description of the data collection and analytical methodology for the 2019 Passive Acoustic Monitoring Program is provided in Frouin-Mouy et al. (2020).

Table 6. AMAR acoustic recorder deployment periods, locations and depths in 2019

Station	Latitude	Longitude	Depth (m)	Deployment Date	Recording Start Date	Retrieval Date	Recording Duration (days)
AMAR−1	72.02756	-80.64772	190	5 Aug 2019	5 Aug 2019	28 Sep 2019	55
AMAR−2	72.07000	-80.75969	202.5	5 Aug 2019	5 Aug 2019	28 Sep 2019	55
AMAR−3	72.06717	-80.51808	223.5	5 Aug 2019	5 Aug 2019	28 Sep 2019	55
AMAR−RI1	72.55747	-80.20761	120	20 May 2019	7 Jul 2019	4 Aug 2019	28
AMAR−RI2	72.55803	-80.20856	121.5	4 Aug 2019	4 Aug 2019	29 Sep 2019	57
AMAR−BI	72.72328	-79.21328	330	21 May 2019	7 Jul 2019	4 Aug 2019	28

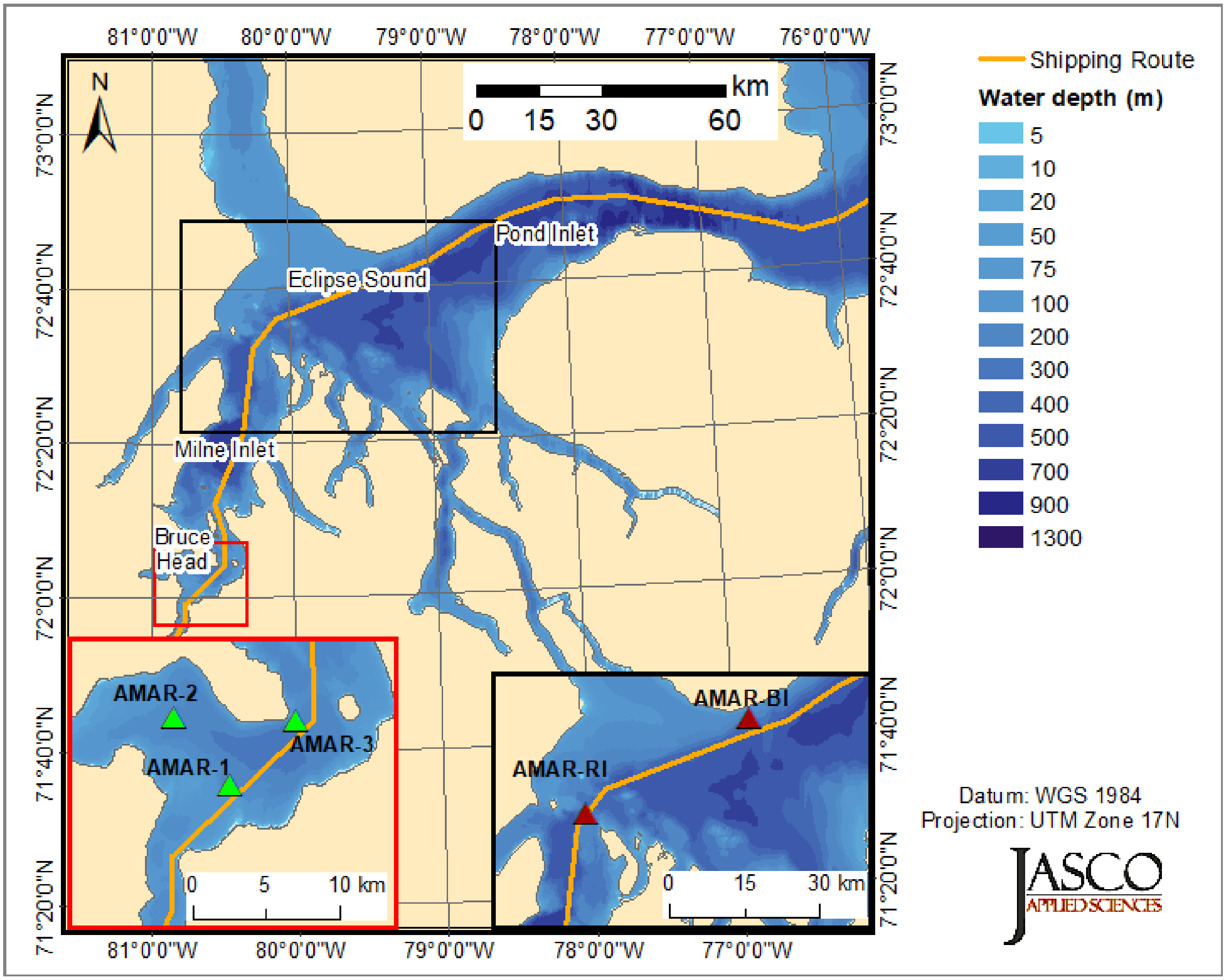


Figure 11: Acoustic monitoring area and locations of recorder stations across Milne Inlet South (red inset, AMAR-1, AMAR-2, AMAR-3), Milne Inlet North (black inset, AMAR-RI), and Eclipse Sound (black inset, AMAR-BI)

5.1 Summary of Results

5.1.1 Sound Levels during Early Shoulder Season

5.1.1.1 Sound Pressure Level (SPL)

The results of the ambient analyses for the early shoulder season (07 Jul to 04 Aug 2019) are shown in Table 7 and Figure 12 through Figure 14 for the Bylot Island (AMAR-BI) and Ragged Island (AMAR-RI) recording stations. Both AMAR stations showed an increase in Sound Pressure Level (SPL) for frequencies under 1,000 Hz over the month of recording. This increase was largely attributed to the increase in vessel traffic, weather, and wave induced noise at these locations due to decreasing ice presence and the beginning of the shipping season. The two AMAR stations were located on the nominal shipping route in Milne Inlet North and in Eclipse Sound.

AMAR-RI had overall higher sound levels than AMAR-BI, likely due to AMAR–RI's shallower deployment location (120 m at Ragged Island compared to 330 m at Bylot Island). AMAR–RI would have been exposed to a greater amount of vessel, flow, and surface sounds. Curves showing empirical distribution functions, or SPL exceedance percentages, are shown in Figure 15. These curves show that 98.1% and 98.6% of the data were below 120 dB re 1 µPa at AMAR-RI and AMAR-BI, respectively. That is, sound levels recorded AMAR-BI and AMAR-RI exceeded the 120 dB disturbance threshold (NOAA 1998[1]) for only 1.4% and 1.9% of the recording periods, respectively.

Table 7: Broadband sound pressure level (SPL) values for AMAR-RI at Ragged Island and AMAR-BI near Bylot Island during early shoulder season shipping.

Station	Min broadband SPL (dB re 1 µPa)	Max broadband SPL (dB re 1 µPa)	Mean broadband SPL (dB re 1 µPa)
AMAR-RI	80.2	151.3	102.2
AMAR-BI	83.9	141.7	99.7

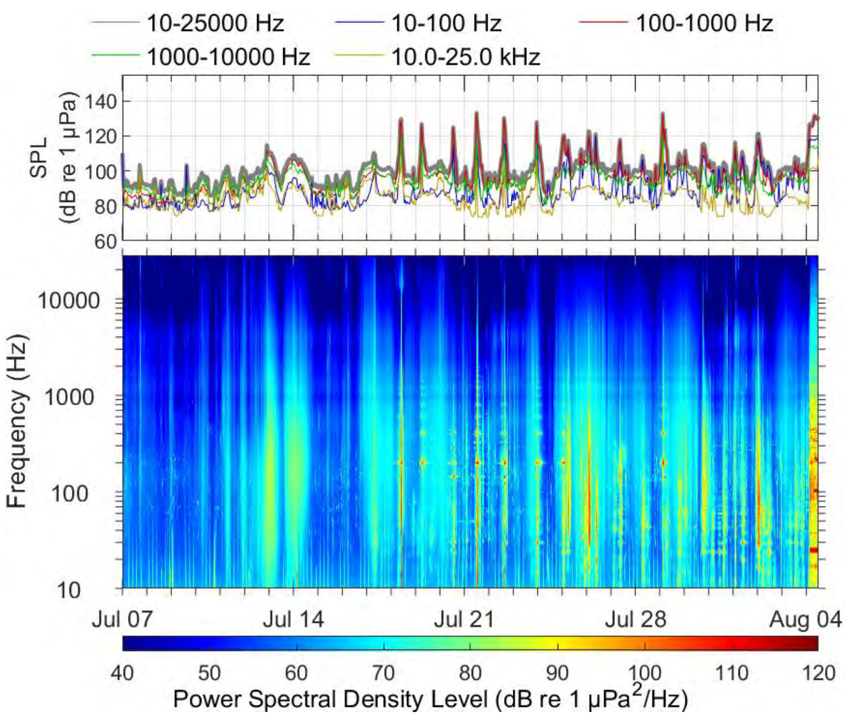


Figure 12: AMAR-BI during early shoulder season: Spectrogram (bottom) and in-band sound pressure level (SPL) (top). Vessel transits associated with the Project commenced on 17 July 2019. Sharp peaks in the SPL time series indicate vessel transits past the recorder.

[1] This criterion, defined as when broadband SPL exceeds 120 dB re 1 µPa, is the current disturbance threshold used by NOAA for assessing disturbance to marine mammals by continuous-type sounds such as vessel noise.

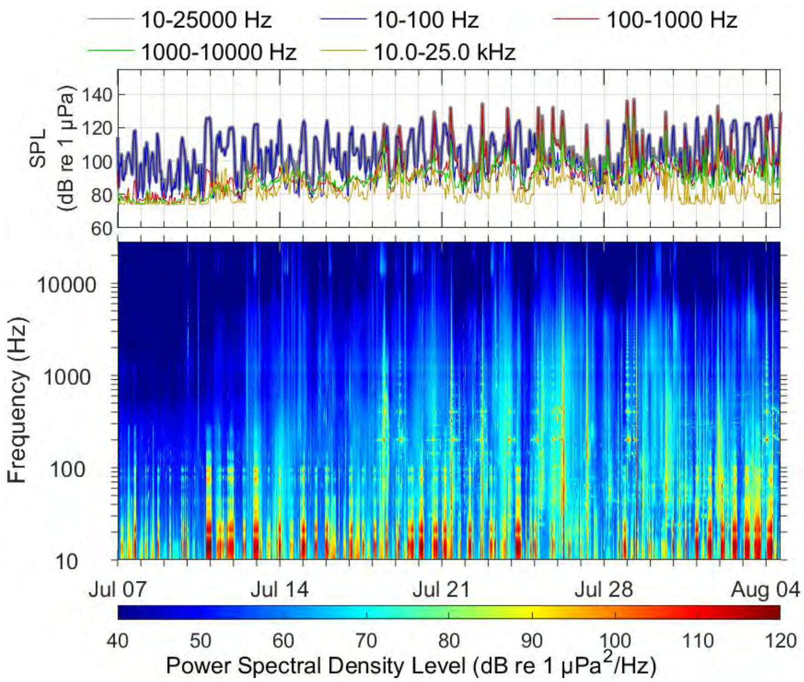


Figure 13: AMAR-RI during early shoulder season: Spectrogram (bottom) and in-band sound pressure level (SPL) (top). Vessel transits associated with the Project commenced on 17 July 2019. Sharp peaks in the SPL time series that indicate vessel transits past the recorder are most identifiable in the 1000-10000 Hz band that is less impacted by flow noise at this recorded that is dominant in the 10-100 Hz band.

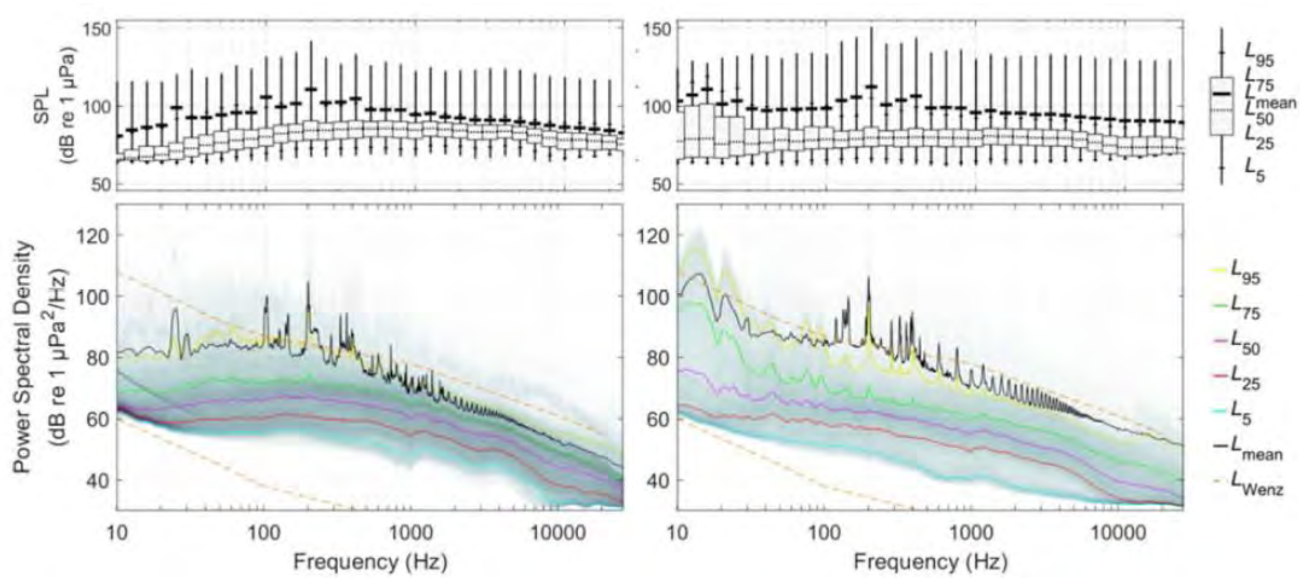


Figure 14: AMAR-BI (left) and AMAR-RI (right) during early shoulder season: Percentiles and mean of 1/3-octave-band SPL and percentiles and spectral density (grayscale) of 1-min power spectral density levels (bin width: 1 Hz) compared to limits of prevailing noise (Wenz 1962). L_{mean} = arithmetic mean (ISO 2017).

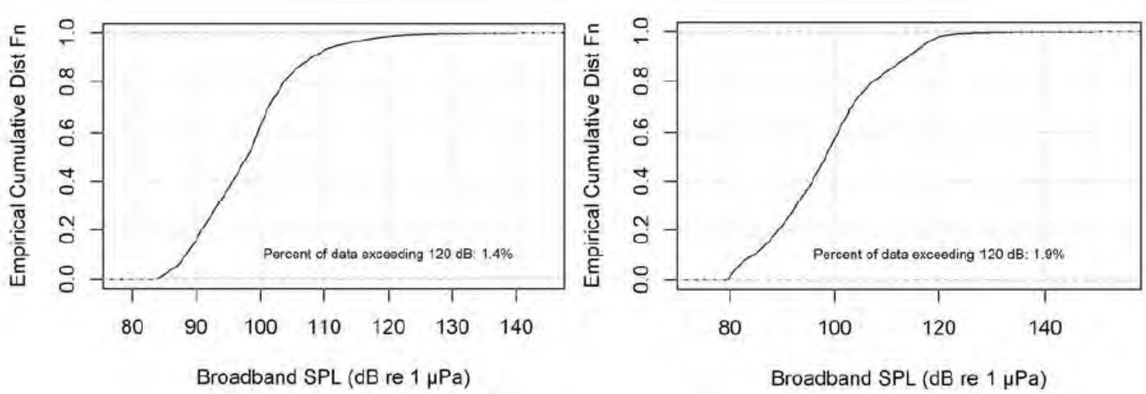


Figure 15: Empirical cumulative distribution functions for AMAR-BI (left) and AMAR-RI (right) during 2019 early shoulder season.

5.1.1.2 Daily Sound Exposure Level (SEL)

Statistical distributions of the daily unweighted SEL recorded between 07 July and 04 August 2019 on the Bylot Island (AMAR-BI) and Ragged Island (AMAR-RI) recorders are presented in Figure 16. SEL values plotted in black represent total SEL (ambient + vessel noise), while SEL data plotted in gold represent periods when only vessels were present in the recordings. Also shown is a statistical distribution of the number of hours per day in which vessels were detected on each AMAR (for any portion of that hour), and the number of vessels detected per day on each AMAR. This summary includes all vessels recorded on the AMARs and may include vessels that were not associated with Baffinland's operations. Project-related vessels did not begin shipping in the RSA in 2019 until 17 July, evident in these plots as increases in the daily SEL, and the mean SPL are noted at both AMAR-BI and AMAR-RI after this date, along with an increase of the proportional contribution of sounds from vessels after this date.

Figure 17 and Figure 18 illustrate the daily unweighted SEL and the mean sound pressure level (SPL, L_{mean}) measured each day at AMAR-BI and AMAR-RI, respectively. Levels were often higher at AMAR-RI than AMAR-BI, particularly for broadband SEL, which is attributed to enhanced sound propagation in the shallower waters near Ragged Island. There were a few days with elevated daily SEL at both stations, such as at the start of Project shipping season on 17 July. Another example occurred 26 July when there were multiple Project vessels transiting inbound along the Northern Shipping Route. Both AMAR-RI and AMAR-BI were located on the shipping route, and on 26 July an increase in hourly SPL occurred at AMAR-BI approximately one hour before a similar increase was observed at AMAR-RI. Automatic Identification System (AIS) records indicate that the icebreaker MSV Botnica escorted the fuel tanker Sarah Desgagnes to Milne Port on that day. On the same day, the ore carrier Nordic Oshima transited past both recorders on its outbound transit from Milne Port.

Frequency-weighted daily SEL values were calculated for the five marine mammal functional hearing groups using the approach described in the US National Marine Fisheries Services (NMFS 2018) guidance for assessing acoustic impacts. These levels are presented in Figure 19. None of the thresholds for either permanent or temporary hearing threshold shift (PTS and TTS) were exceeded throughout the recordings at either AMAR-RI or AMAR-BI during the early shoulder season, for any marine mammal species occurring in the Project area.

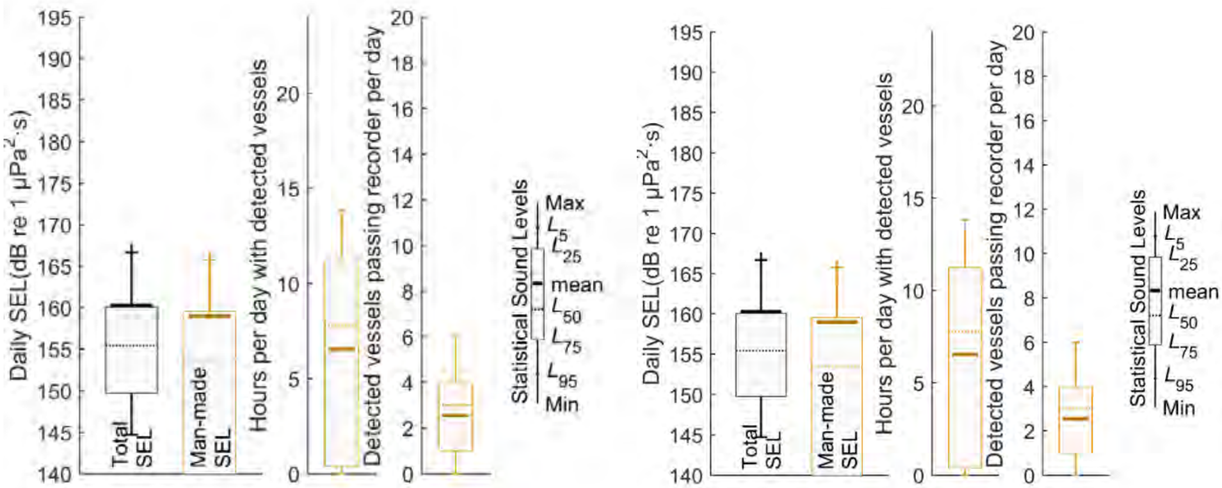


Figure 16: AMAR-BI (left) and AMAR-RI (right): Statistical distribution of the SEL, summary SEL statistics for periods when vessels were detected, hours per day that vessels were detected, and the number of vessels detected per day between 07 July and 04 August 2019.

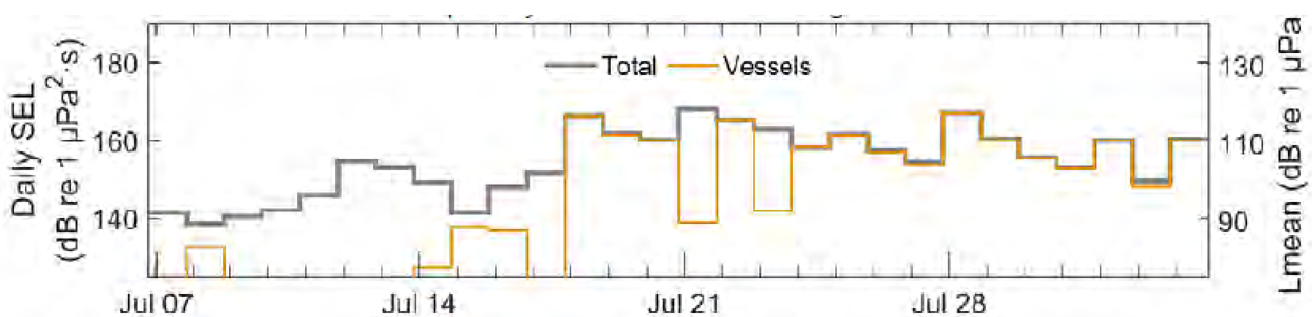


Figure 17: AMAR-BI: Daily SEL (left axis) and daily mean SPL (right axis) for data recorded between 07 July and 04 August 2019.

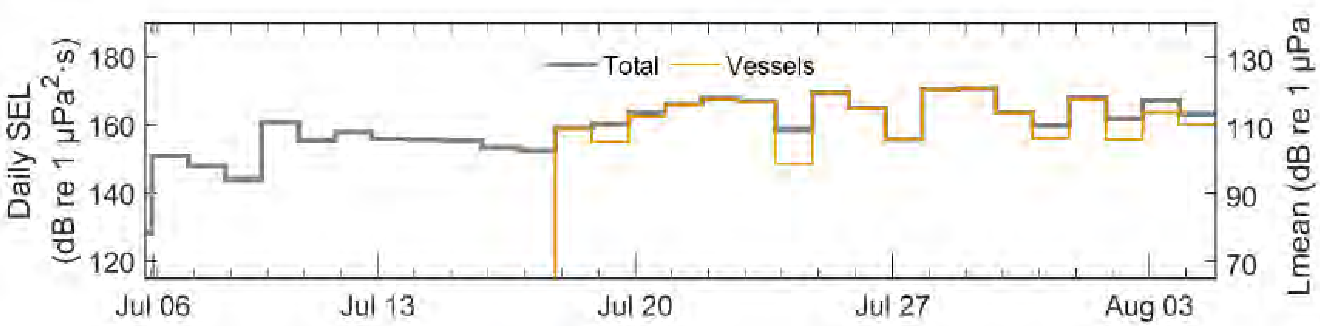


Figure 18: AMAR-RI: Daily SEL (left axis) and daily mean SPL (right axis) for data recorded between 07 July 7 and 04 August 2019.

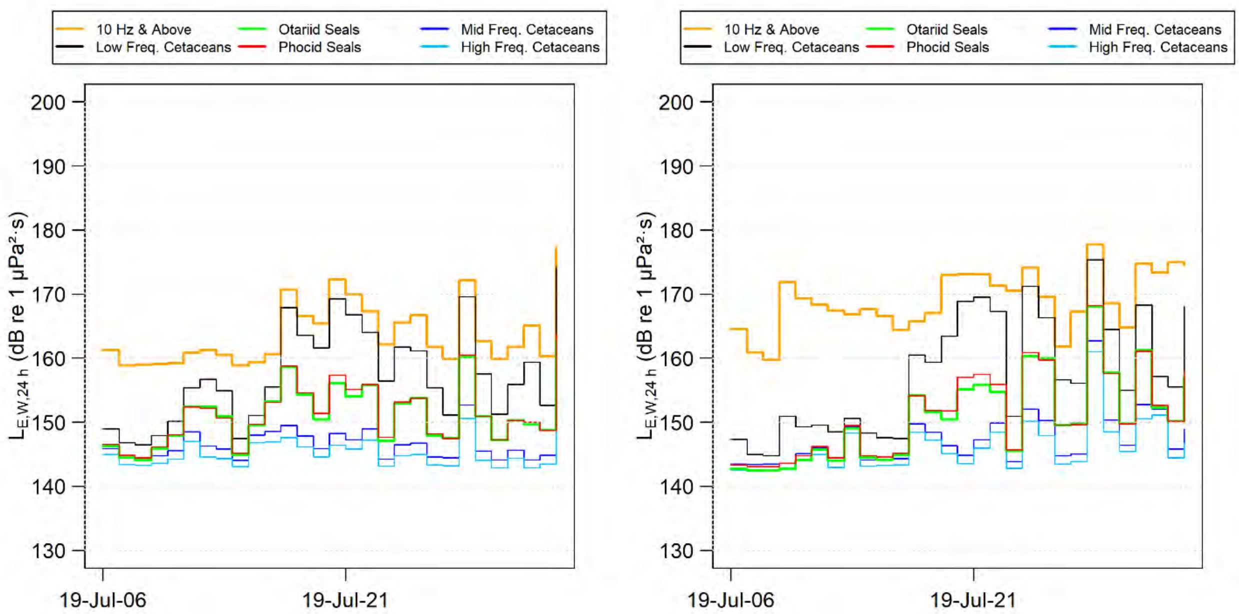


Figure 19: AMAR-BI (left) and AMAR-RI (right): The staircase plot depicts the daily SEL, weighted for marine mammal hearing using the NMFS (2018) functions.

5.1.2 Sound Levels during Open-water Season

5.1.2.1 Sound Pressure Level (SPL)

For the open-water recording period, AMAR–RI was redeployed at the same location as the early shoulder season. AMAR–BI was not redeployed during the open-water season. However, three additional AMARs were deployed in Milne Inlet South with recordings made between 5 August and 28 September 2019. AMAR-1 was located on the shipping lane at the entrance of Koluktoo Bay. AMAR-2 was located in Koluktoo Bay, approximately 6 km west of the nominal shipping lane. AMAR-3 was located on the shipping lane between Poirier Island and Bruce Head, approximately 6 km north of AMAR-1. All three recorders were deployed in approximately 200 m water depth. The Long-term Spectral Averages (LTSAs) and band-level plots for the four AMAR stations deployed during the open-water period are shown in Table 8 and Figure 20 through Figure 23.

AMAR-1 and AMAR-3 recorded higher sound levels in the 30–300 Hz range, which was attributed to their closer proximity to vessel traffic (Figure 24). AMAR-1, AMAR-2 and AMAR-3 had elevated percentile levels near 20 kHz (Figure 24) that were attributed to the presence of narwhal echolocation clicks (Figures 20, 21 and 22). AMAR-RI did not show elevated percentile levels near 20 kHz (Figure 24), clicks were not acoustically detected at this station (Figure 23). Empirical distribution function curves showing SPL exceedance percentages are shown in Figure 25. These plots illustrate that exceedances of 120 dB re 1 µPa were rare at all stations. Recorded SPL exceeded 120 dB re 1 µPa for 3% of the total recording period at AMAR-1 (the highest percentage of all AMAR recording locations) which was located on the nominal shipping route, and for only 0.8% of the total recording period at AMAR-2 which was located in Koluktoo Bay away from the nominal shipping lane.

Table 8: Broadband sound pressure level (SPL) values for recorders in Milne Inlet South (AMAR-1, AMAR-2, AMAR-3) and near Ragged Island (AMAR-RI) during open-water season shipping

Station	Min broadband SPL (dB re 1 µPa)	Max broadband SPL (dB re 1 µPa)	Mean broadband SPL (dB re 1 µPa)
AMAR-1	80.7	150.2	103.3
AMAR-2	82.1	153.9	103.6
AMAR-3	80.1	145.2	102.7
AMAR-RI	80.3	154.1	98.2

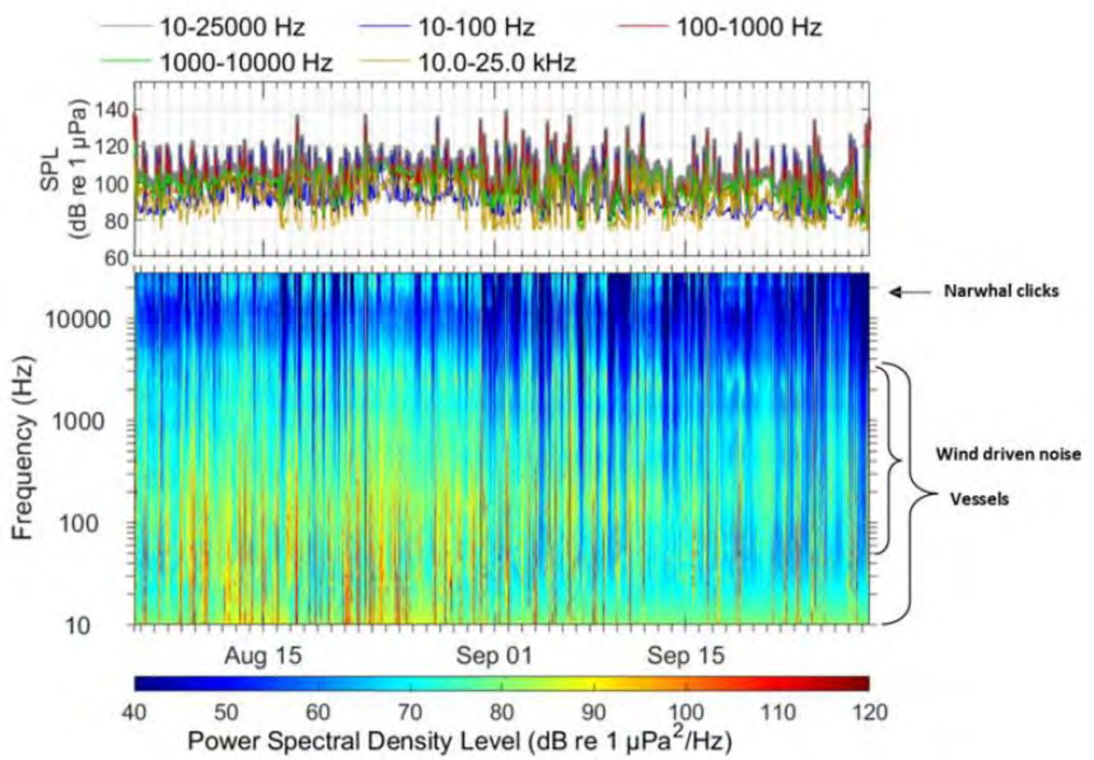


Figure 20: AMAR-1: Spectrogram (bottom) and in-band sound pressure level (SPL) (top).

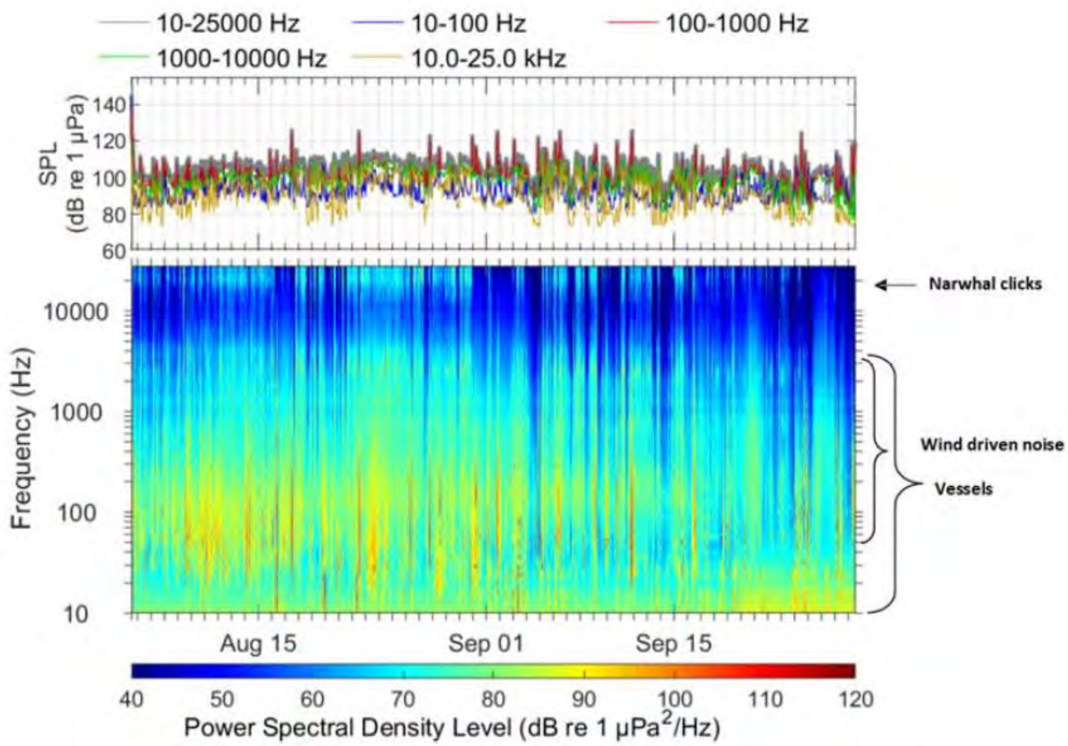


Figure 21: AMAR-2: Spectrogram (bottom) and in-band sound pressure level (SPL) (top).

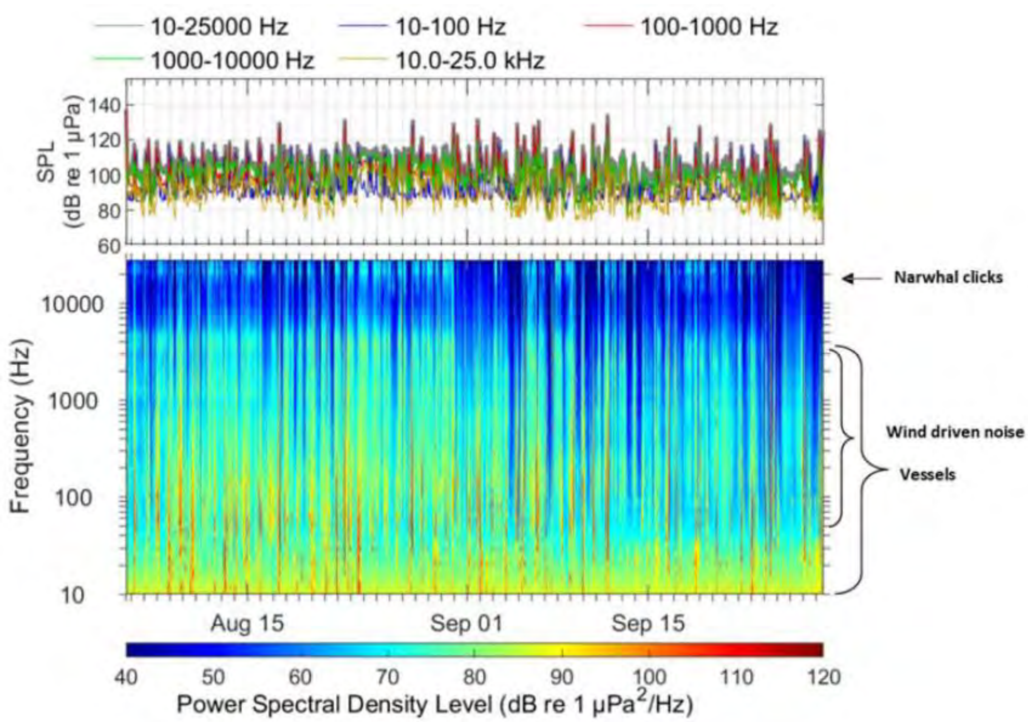


Figure 22: AMAR-3: Spectrogram (bottom) and in-band sound pressure level (SPL) (top).

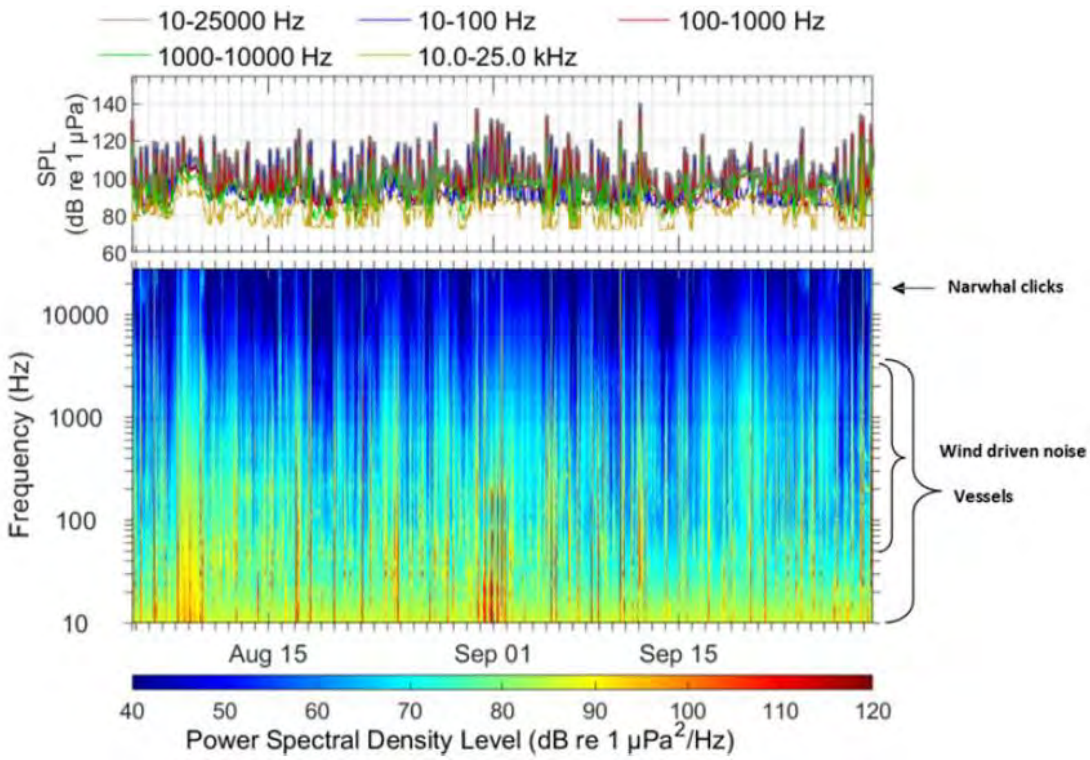


Figure 23: AMAR-RI: Spectrogram (bottom) and in-band sound pressure level (SPL) (top).

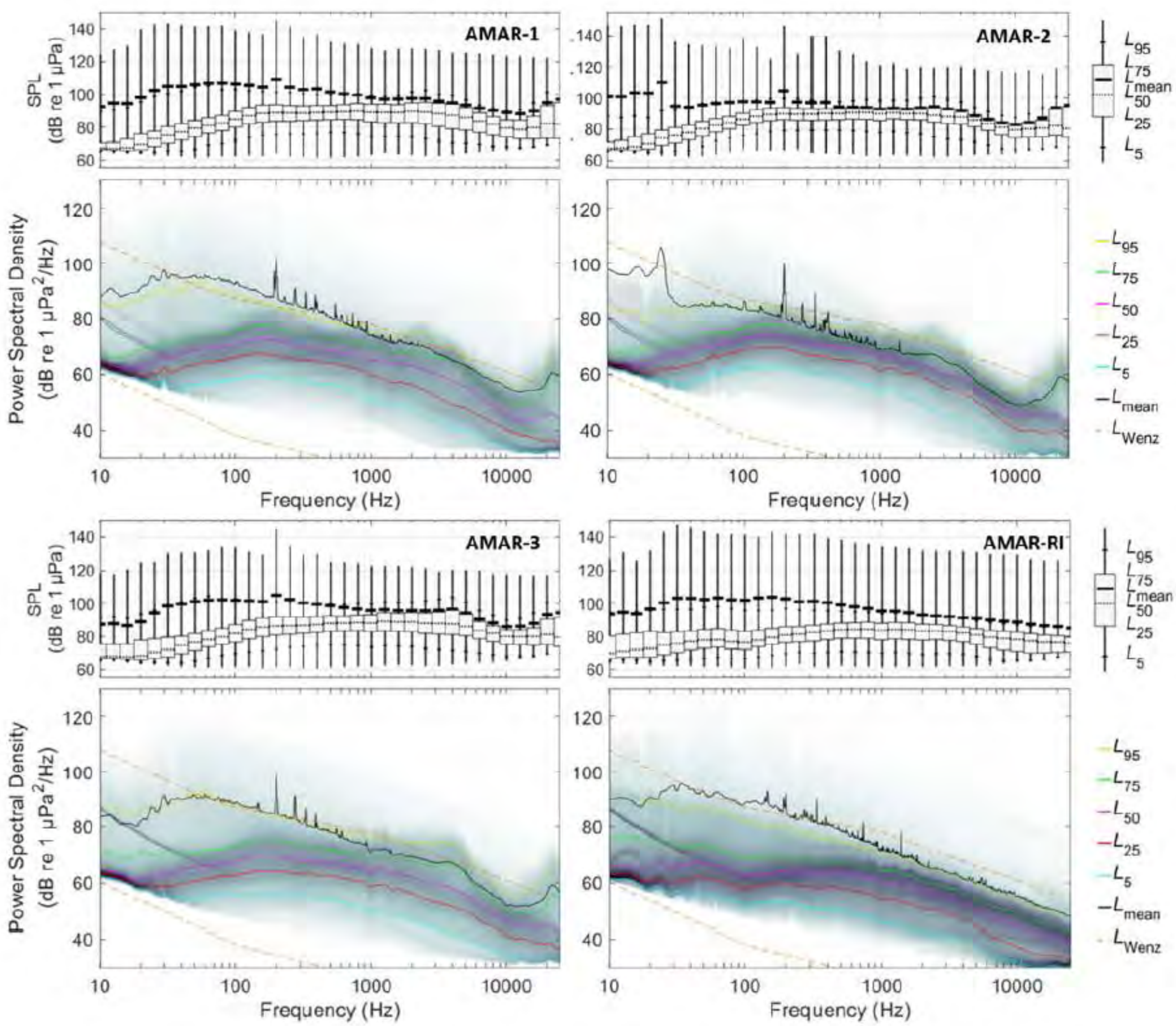


Figure 24: Percentiles and mean of 1/3-octave-band SPL and percentiles and probability density (grayscale) of 1-min power spectral density levels compared to the limits of prevailing noise (Wenz 1962). L_{mean} is the arithmetic mean (ISO 18405 2017).

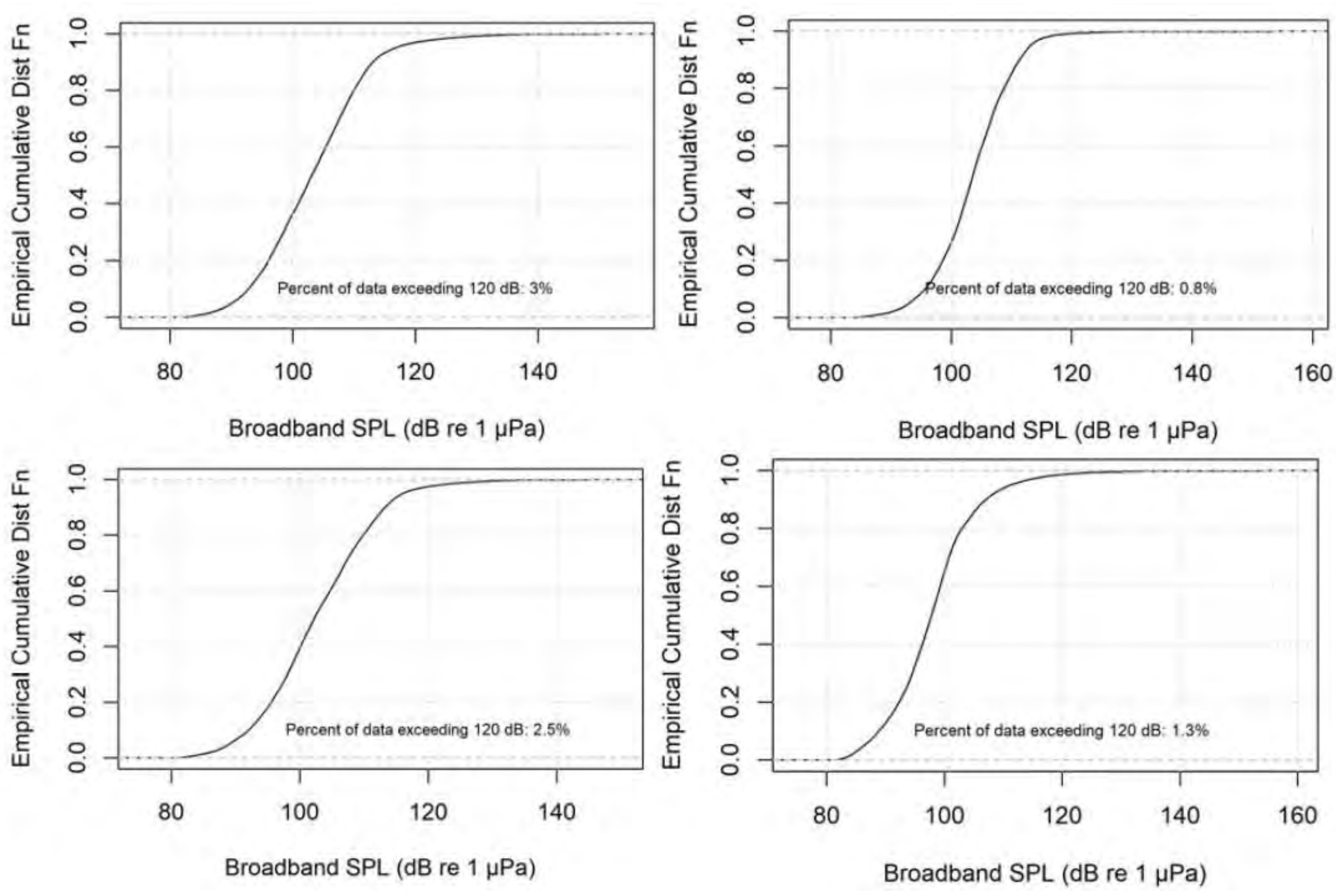


Figure 25: Empirical cumulative distribution functions for AMAR-1 (top left), AMAR-2 (top right), AMAR-3 (bottom left) and AMAR-RI (bottom right).

5.1.2.2 Daily Sound Exposure Level (SEL)

Figure 26 presents the statistical distributions of the daily unweighted SEL recorded on the Bruce Head and Ragged Island AMARs between 04 August and 28 September 2019. This summary includes all recorded data and may include sound from vessels that are not associated with Baffinland's operations. Figures 27 through 30 illustrate the daily unweighted SEL and the mean SPL (L_{mean}) per day for AMAR-1, AMAR-2, AMAR-3 and AMAR-RI, respectively.

Frequency-weighted daily SEL values were calculated for the five marine mammal functional hearing groups according to the definitions in the US National Marine Fisheries Services (NMFS 2018) guidance for assessing acoustic impacts on marine mammals; these are shown in **Figure 31**. At all recording locations, sound levels were below the acoustic thresholds for injury, for either a temporary reduction in hearing (TTS) or a permanent loss in hearing (PTS) for any marine mammal species occurring in the Project area.

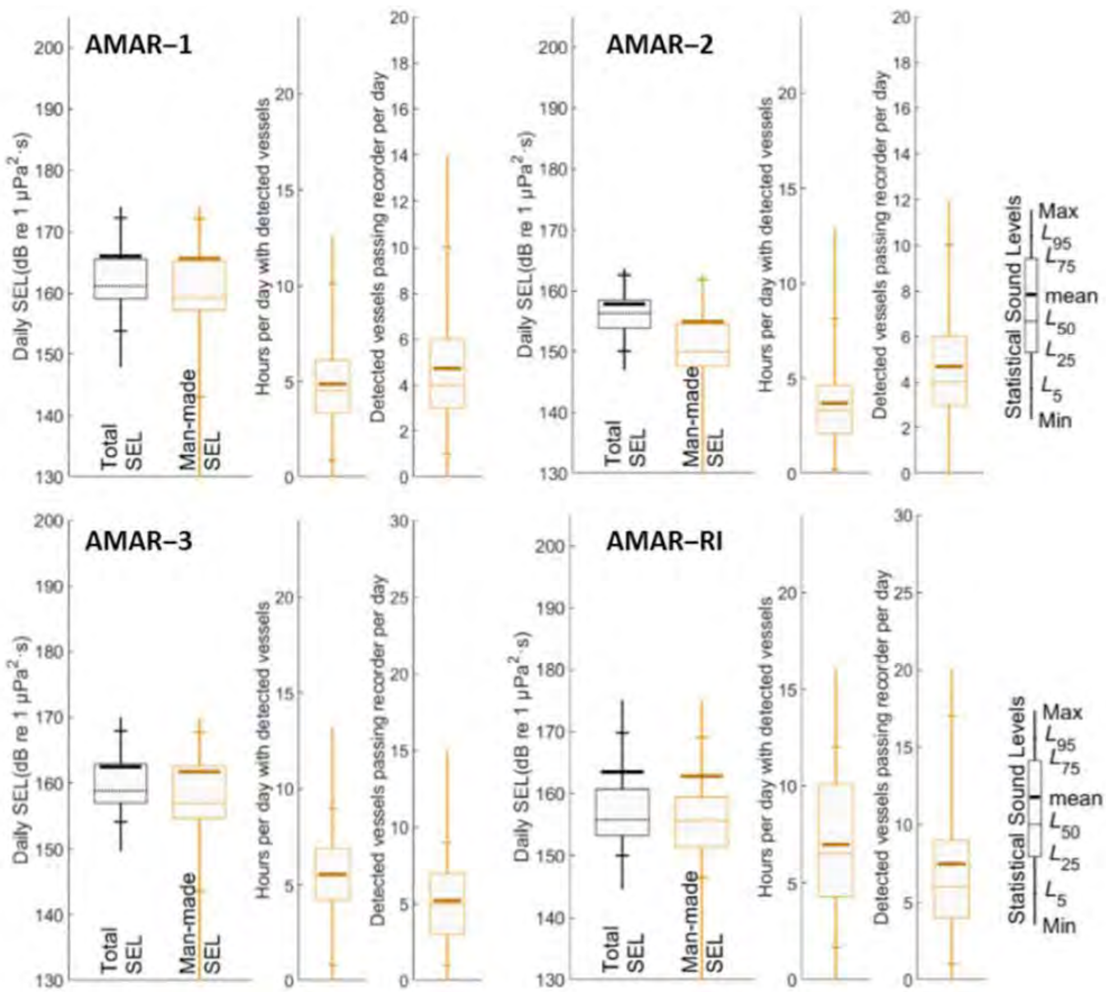


Figure 26: Statistical distribution of SEL, summary SEL statistics for periods when vessels were detected, hours per day that vessels were detected, and the number of vessels detected per day between 04 August and 28 Sept 2019.

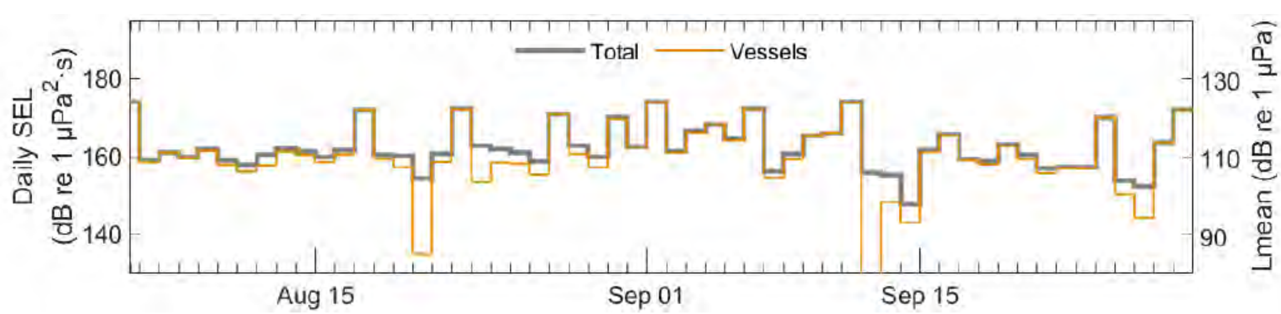


Figure 27: AMAR-1: Daily SEL (left axis) and daily mean SPL (right axis) for data recorded between 04 August and 28 Sept 2019.

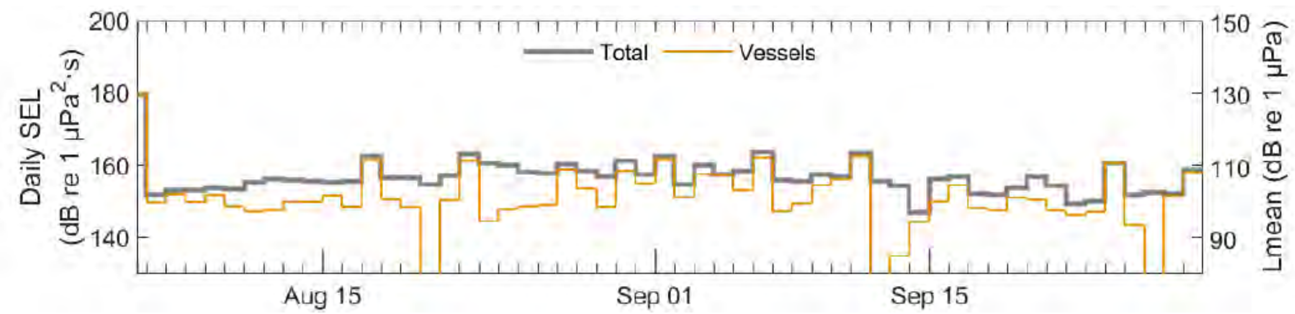


Figure 28: AMAR-2: Daily SEL (left axis) and daily mean SPL (right axis) for data recorded between 04 August and 28 Sept 2019.

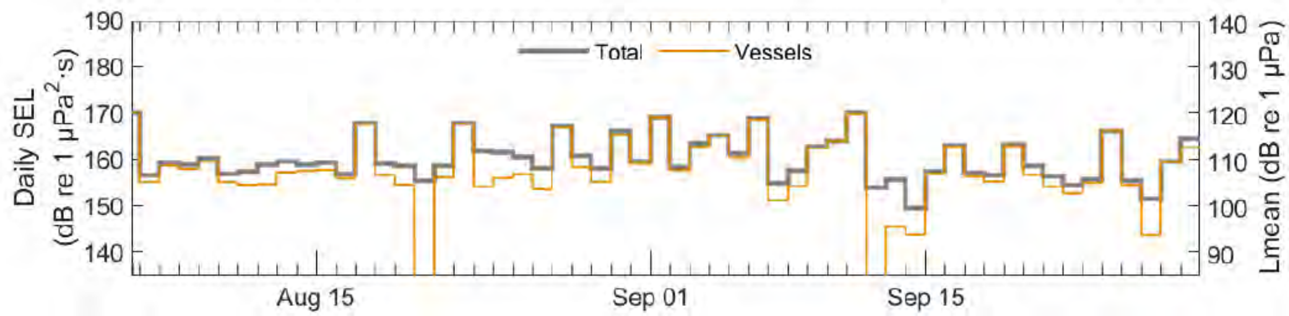


Figure 29: AMAR-3: Daily SEL (left axis) and daily mean SPL (right axis) for data recorded between 04 August and 28 Sept 2019.

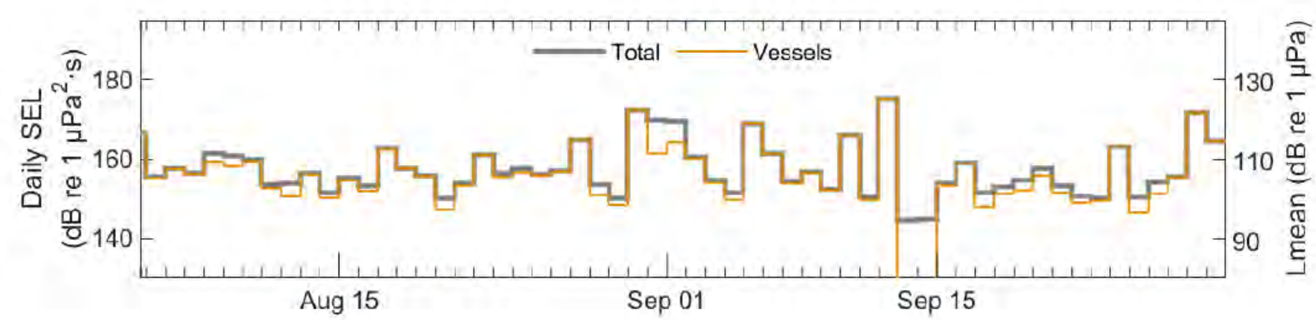


Figure 30: AMAR-RI: Daily SEL (left axis) and daily mean SPL (right axis) for data recorded between 04 August and 28 Sept 2019.

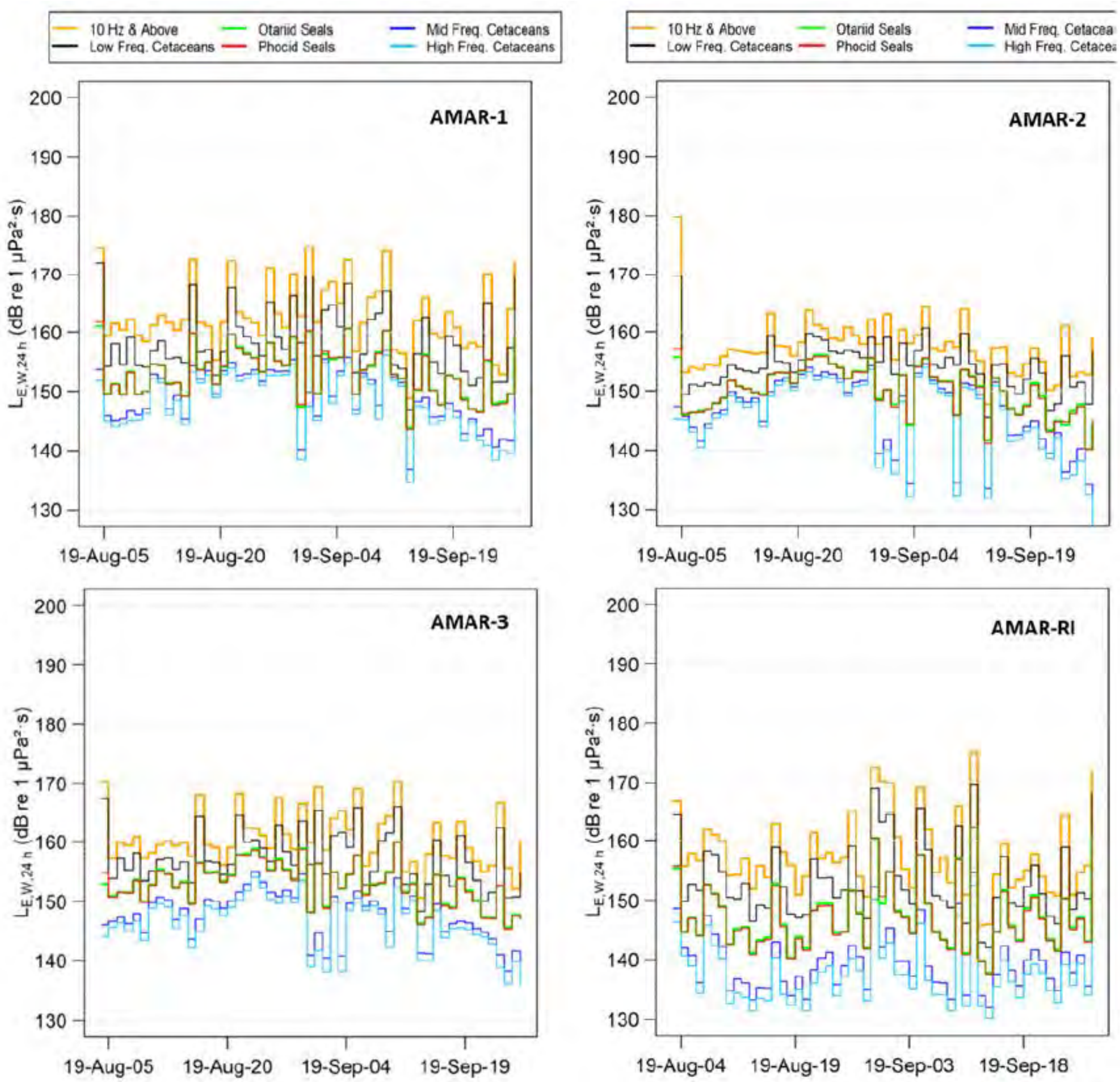


Figure 31: Staircase plots depicting daily SEL at four AMAR stations along Northern Shipping Route, weighted for marine mammal hearing using NMFS (2018) functions.

5.1.3 Exposure Duration and Quiet Time Per Day

5.1.3.1 Early Shoulder Season - Icebreaker Sound Levels

Underwater sounds levels were measured at two AMAR stations between 07 July and 04 August 2019, covering the entire duration of the spring shoulder shipping season, which included icebreaker transits to escort ore carriers. Measured sound levels for five icebreaker transits over the Bylot Island AMAR were analyzed to determine the total amount of time per transit in which sound levels exceeded both the disturbance onset threshold (120 dB re 1 µPa) and the avoidance threshold (135 dB) at Bylot Island, with results presented in Table 9 and Table 11, respectively. Measured values were subsequently compared to predicted (i.e., modelled) values for the same transiting scenario at Bylot Island (icebreaker escort + two ore carriers in 0/10 ice) to evaluate relative conservancy of the model used in the Phase 2 assessment of icebreaking activities (Golder 2019b). Results demonstrated that the measured noise fields associated with disturbance and avoidance were less than half those predicted by modelling (

Table 10 and Table 12) even when considering the loudest of the five icebreaker transits analyzed. For example, based on acoustic modelling, it was predicted that a narwhal exposed to an icebreaker accompanied by two ore carriers transiting in 0/10 ice would be subject to noise levels exceeding the disturbance threshold (≥120 dB) for a period lasting up to 3.1 h per transit. However, measured values at Bylot Island ultimately only exceeded 120 dB re 1 μPa for a maximum period of 0.5 to 1.3 h per transit (>58% lower than predicted). Similarly, for the same icebreaker transit scenario, modelling results predicted that the exposure period for avoidance (≥135 dB) would last up to 20 min per transit. Measured values at Bylot Island indicated that the avoidance exposure period was actually in the range of 0 to 10 min per transit (>50% lower than predicted). These results supported assumptions that acoustic modelling results are conservative and over-representative of measured effects.

Table 9: Exposure Period ≥ 120 dB for Icebreaker Transits over Bylot Island station AMAR-BI in July 2019

Transit #	Date	Scenario	Speed (kn)	Horizontal Range to AMAR (m)	Course Heading	Time (min) > 120 dB per transit	Time (h) > 120 dB per transit
1	18-July-2019	Botnica with 2 carriers + tug	8.7	<70	250.4	75	1.3
2	19-July-2019	Botnica with no escorts (solo)	8.3	<120	71.3	33	0.5
3	20-July-2019	Botnica with 2 carriers	8.4	<64	250	43	0.7
4	22-July-2019	Botnica with 3 carriers	8.0	<43	250.6	69	1.2
5	23-July-2019	Botnica with 2 carriers	8.2	<82	65.4	37	0.6

Table 10: Comparison of modeled vs. measured daily noise exposure periods for icebreaker transits – Disturbance$^{120\ dB}$

Scenario	Speed	Ice Cover	Noise field – R95% range (km)	R95% exposure period (h) per transit	# of transits per Day	Cum. daily exposure period (h)	"Quiet time" per day (h)**
1 icebreaker + 2 Capesize carriers - MODELLED	4.6 knots	10/10	40.3	9.5	1	9.5	14.5
	9 knots	3/10	37.3	4.5	2	9	15
	9 knots	0/10	25.9	3.1	4	12.4	11.6
1 icebreaker + 2 Capesize carriers - MEASURED (Bylot)	9 knots	0/10	N/A	1.3*	4	5.2	18.8

* 1.3 used as most conservative value (Transit 1 from Table 6) as it is associated with the highest sound levels and largest noise field of the five transit scenarios.
** "quiet time" is defined as time in which animals would not be exposed to ship noise above the disturbance threshold

Table 11: Exposure Period ≥ 135 dB for Icebreaker Transits over Bylot Island station AMAR-BI in July 2019

Transit No.	Date	Scenario	Speed (kn)	Horizontal Range to AMAR (m)	Course Heading	Time (min) > 135 dB per transit	Time (h) > 135 dB per transit
1	18-July-2019	Botnica with 2 carriers + tug	8.7	<70	250.4	10	0.2
2	19-July-2019	Botnica with no escorts (solo)	8.3	<120	71.3	4.7	0.1
3	20-July-2019	Botnica with 2 carriers	8.4	<64	250	None	None
4	22-July-2019	Botnica with 3 carriers	8.0	<43	250.6	6	0.1
5	23-July-2019	Botnica with 2 carriers	8.2	<82	65.4	3	0.1

Table 12: Comparison of modelled vs. measured daily noise exposure periods for icebreaker transits - Avoidance$^{135\ dB}$

Scenario	Speed	Ice Cover	Noise field – R95% range (km)	R95% Exposure Period (h) per transit	Average # of Transits per Day	Avg. Exposure Period (h) per day	"Quiet time" per day (h)
1 icebreaker + 2 Capesize carriers - MODELLED	4.6 knots	10/10	8.7	2	1	2	22
	9 knots	3/10	6.6	0.8	2	1.6	22.4
	9 knots	0/10	2.5	0.3	4	1.2	22.8
1 icebreaker + 2 Capesize carriers - MEASURED (Bylot)	9 knots	0/10		0.2	4	0.8	23.2

* 0.2 used as most conservative value (Transit 1 from Table 8) as it is associated with the highest sound levels and largest noise field of the five transit scenarios.

** "quiet time" is defined as time in which animals would not be exposed to ship noise above the disturbance threshold

5.1.3.2 Open-water Season

Measured underwater sound levels from the five AMAR stations were analyzed to determine the daily exposure period in which sound levels exceeded the disturbance onset threshold of 120 dB re 1 µPa (Table 13; Figure 32).These measured values from the open-water deployments were subsequently compared to predicted (i.e., modelled) daily and maximum exposure periods for each AMAR station to evaluate the relative conservancy of the model used in the Phase 2 assessment for the open-water shipping season (TSD 24, Appendix B).

Average Case

During the 2019 open-water shipping season AMAR deployment (i.e., data collected from August 05 to September 28), recorded underwater sound levels exceeded 120 dB re 1 uPa for an average daily exposure period of 0.2 h at AMAR-RI2, 0.4 h at AMAR-1, 0.1 h at AMAR-2 and 0.3 h at AMAR-3. This was equivalent to an average daily quiet time period (i.e., time in which animals would not be exposed to noise above the disturbance threshold) that ranged between 22.7 and 23.8 h per day (location dependent) during the open-water period. These values were derived from all recorded data, including periods that were not identified by JASCO's automated detector as containing vessel noise. Recordings showed that natural ambient noise sources such as wind and precipitation could also result in prolonged exceedances of the 120 dB re 1 µPa threshold.

Open-water recordings at AMAR-1 exceeded 120 dB for 0.4 h per day on average, which was the highest average daily exposure period of all the open-water AMAR recordings (Table 13). These results were representative of existing conditions under the Early Revenue Phase, with an expected average of two transits per day of Postpanamax sized ore carriers. It can therefore be assumed, based on the measured data, that a single transit of a Postpanamax sized ore carrier would result in a 120 dB exposure period of at most 0.2 h (highest daily average of 0.4 h, divided by two transits). During Phase 2, it is anticipated that there would be two Postpanamax and three Capesize ore carrier transits in the RSA on an average shipping day. Acoustic modelling indicated that the per-transit 120 dB exposure duration for a Capesize ore carrier (modelled at 2.2 h) was 1.7 times longer than that for a Postpanamax ore carrier (modelled at 1.3 h). To account for cumulative effects, one additional transit per day by a non-Project vessel is anticipated in the RSA, conservatively assumed to emit sound that is equivalent to or less than a Capesize ore carrier. Using exposure durations based on the 2019 measurements, and a scaling factor of 1.7 for transits of Capesize ore carriers, we estimate that under a cumulative effects scenario, a stationary animal near the shipping lane would be exposed to underwater sound levels ≥120 dB re 1 µPa for 1.7 hours on an average day in Phase 2 (Table 14), providing 22.3 h of quiet time per day.

Table 13: Average and maximum daily exposure durations for disturbance (120 dB) for each recorder during the 2019 early shoulder and open-water shipping seasons

Recorder	Average Hours [Minutes] per Day with SPL > 120 dB	Maximum Hours [Minutes] per Day with SPL > 120 dB	% of Total Recording with SPL >120 dB
Early Shoulder Season Deployment (July 07 to August 04)			
AMAR-BI (all recorded data)	0.2 [12.6]	8.6 [516.0]	1.4%
AMAR-BI (only data with vessels detected)	0.2 [12.6]	8.6 [516.0]	0.4%
AMAR-RI1 (all recorded data)	1.3 [77.3]	10.6 [637.0]	1.9%
AMAR-RI1 (only data with vessels detected)	0.7 [41.1]	7.1 [427.0]	0.5%
Open-water Season Deployment (August 05 to September 28)			
AMAR-RI2 (all recorded data)	0.2 [10.9]	3.1 [184.0]	1.3%
AMAR-RI2 (only data with vessels detected)	0.1 [3.1]	0.7 [43.0]	0.4%
AMAR-1 (all recorded data)	0.4 [23.6]	2.3 [136.0]	3%
AMAR-1 (only data with vessels detected)	0.1 [8.1]	0.8 [47.0]	1%
AMAR-2 (all recorded data)	0.1 [6.3]	1.4 [82.0]	0.8%
AMAR-2 (only data with vessels detected)	0.0 [2.1]	0.5 [28.0]	0.3%
AMAR-3 (all recorded data)	0.3 [19.4]	2.4 [145.0]	2.5%
AMAR-3 (only data with vessels detected)	0.1 [6.8]	0.9 [52.0]	0.9%

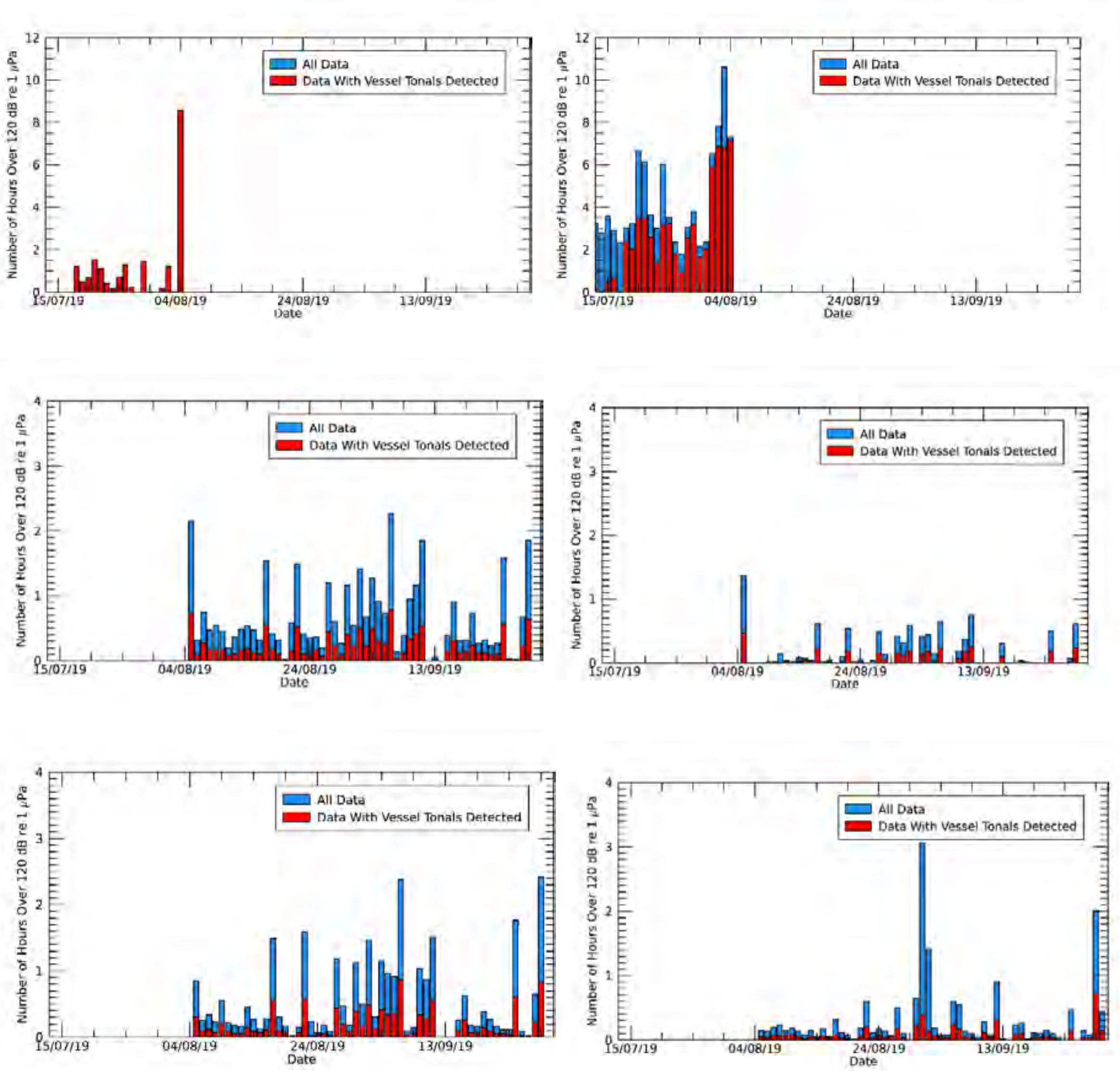


Figure 32: Hours per day with recorded SPL exceeding 120 dB re 1 µPa at (top left) AMAR-BI, (top right) AMAR-RI1, (middle left) AMAR-1, (middle right) AMAR-2, (bottom left) AMAR-3, and (bottom right) AMAR-RI2.

Table 14: Estimates of daily exposure duration and daily quiet time for Phase 2 Shipping based on modelled and measured sound levels - Average Case

Vessel Type	Exposure period (h) per transit	Average # of Transits per Day	Daily Exposure Period (h)	Daily Quiet Time Period (h)
MODELLED				
1 Postpanamax	1.3	2	2.6	21.4
1 Capesize	2.2	3*	6.6	17.4
1 Non-project vessel**	2.2	1	2.2	21.8
Combined		6	11.4	12.6
MEASURED				
1 Postpanamax	0.2	2	0.4	23.6
1 Capesize	0.34	3*	1.0	23.0
1 Non-project vessel**	0.34	1	0.3	23.7
Combined		6	**1.7**	**22.3**

*One of the daily Capesize transits represents a fuel or cargo ship transit. As no source levels were available for fuel or cargo ships, the conservative approach was to use the louder sound footprint of the Capesize carrier. **The non-Project vessel transit was assumed to have the same acoustic footprint as a Capesize carrier.

Maximum Case

During the 2019 shipping season, recorded underwater sound levels exceeded 120 dB re 1 µPa for a maximum daily exposure period of 10.6 h (Figure 32; Table 13), which was equivalent to a minimum daily quiet time period of 13.4 h. This maximum exposure event occurred on 3 August 2019 at the Ragged Island recorder (AMAR-RI1), a day during which four ore carriers transited past this recorder in open water conditions. The calculation considered all recorded data, including periods when JASCO's automated vessel detector did not identify vessel sounds in the acoustic recordings; during these times ambient noise sources such as wind and precipitation can result in prolonged exceedances of the 120 dB re 1 µPa threshold. Considering only periods when the automated detector noted vessel presence, the recorded SPL exceeded 120 dB re 1 µPa for a maximum daily exposure period of 7.1 h on that day (equivalent to a minimum daily quiet time of 16.9 h).

The days with the longest durations of exposure at or above 120 dB occurred during the shoulder season AMAR deployment, in the early portion of the open water season (25 July to 4 August). During this time, atypically high numbers of vessels transited past the recorder in the form of convoys with the icebreaker, the initial arrival of cargo and fuel, and the initial arrival of Project tugs. During the remainder of the open water shipping season (5 August to 28 September), with more typical daily transit numbers, the maximum exposure duration at 120 dB was 3 h in one day (equivalent to 21 h of quiet time) near Ragged Island (AMAR-RI2). It is possible that ambient levels resulted in a prolonged exposure duration at this location; considering only the periods identified by the automated detector as containing vessel noise, the maximum exposure duration was 0.7 h.

Under a maximum case scenario for ship traffic needed for Phase 2 operations, it is anticipated that there would be up to four Postpanamax and four Capesize ore carrier transits per day in the RSA. Furthermore, one additional transit per day by a non-Project vessel is anticipated to occur in the RSA (conservatively assumed to be equivalent in size to a Capesize ore carrier). Using the scaling factor for Capesize vessels (1.7x), and based on exposure durations calculated using 2019 acoustic measurements, it is estimated that a stationary animal near the shipping lane would be exposed to a cumulative (Project and non-Project) noise exposure period (≥ 120 dB) of up to 2.5 h per day under a maximum daily transit scenario (nine transits in total) during the Phase 2 open-water season, equivalent to 21.5 h of quiet time per day (Table 15).

Table 15: Estimates of exposure duration and quiet time for Phase 2 Shipping based on measured exposure durations - Maximum Case

	Exposure period (h) per transit	Average # of Transits per Day	Daily Exposure Period (h)	Daily Quiet Time Period (h)
MODELLED				
1 Postpanamax carrier	1.3	4	5.2	18.8
1 Capesize carrier	2.2	4*	8.8	15.2
1 Non-project vessel**	2.2	1	2.2	21.8
Combined		9	16.2	7.8
MEASURED				
1 Postpanamax carrier	0.2	4	0.8	23.2
1 Capesize carrier	0.34	4*	1.4	22.6
1 Non-project vessel**	0.34	1	0.3	23.7
Combined		9	**2.5**	**21.5**

*Two of the daily Capesize transits represents a fuel or cargo ship transit. As no source levels were available for fuel or cargo ships, the conservative approach was to use the louder sound footprint of the Capesize carrier. **The non-Project vessel transit was assumed to have the same acoustic footprint as a Capesize carrier.

For the most common marine mammals occurring in the RSA (i.e., narwhal and ringed seal), it is important to note that the daily noise exposure periods presented above were considered to be conservative estimates for assessing disturbance effects, as the 120 dB threshold does not account for the frequency of the ship noise source relative to narwhal and ringed seal hearing sensitivity. Shipping noise generally dominates ambient noise at low frequencies, with most energy occurring between 20 to 300 Hz and some components extending into the 1 to 5 kHz range (Richardson et al. 1995). Narwhal are considered high-frequency cetaceans (Southall et al. 2019) (previously recognized as mid-frequency cetaceans; NMFS 2018) with their most sensitive hearing occurring in the 20 to 100 kHz range (Richardson et al. 1995). Narwhal vocalization studies indicate that this species primarily vocalizes in the 300 Hz to 24 kHz range (Ford and Fisher 1978; Marcoux et al. 2011; Marcoux et al. 2012). Ringed seal vocalizations occur in the 400 Hz to 16 kHz frequency range, with dominant frequencies concentrated above 5 kHz

(Stirling 1973; Cummings et al. 1984). Ship noise is therefore unlikely to result in major disturbance effects in narwhal or ringed seal given it is primarily emitted in the frequency band in which both species have lower hearing sensitivity. The maximum disturbance ranges presented herewith should therefore be considered as conservative estimates.

Based on these updated calculations of daily noise exposure periods based on empirical acoustic data collected from several representative locations in the RSA in 2019, and in light of the updated assessment of acoustic disturbance effects presented above, there is even greater confidence in the Phase 2 effects assessment that the proposed number of ore carrier voyages (n=176) will not result in significant residual impacts on marine mammals in the RSA (i.e., those resulting in potential population-level effects).

5.1.4 Listening Range Reduction (LRR)

The term ‘listening space’ refers to the area over which sources of sound can be detected by an animal at the center of the space. An assessment of lost listening space (or area) has been traditionally applied to in-air sounds for assessing noise effects on birds; only in recent years has it been applied to the assessment of underwater noise effects on marine mammals (Pine et al. 2018). In support of the conclusions made in Phase 2 assessment, listening range reductions (LRR) for narwhal were calculated to evaluate the effects of shipping noise on the listening space of marine mammals during the shoulder and open-water seasons. The LRR method assesses how sound travels through the water from a ship and compares this information to the basic hearing capabilities of an animal of interest; in this case narwhal. LRR calculates a fractional reduction in an animal’s listening range when exposed to a combination of anthropogenic and natural ambient noise sources compared to that under natural ambient conditions (i.e., representing the proportional reduction in distance at which a signal of interest can be heard at a frequency, in the presence of noise). LRR does not provide absolute areas or volumes of space. However, a benefit of the LRR method is that it does not rely on source levels of the sounds of interest. Instead, the method depends only on the rate of sound transmission loss.

LRR was calculated for three representative frequencies (corresponding with different narwhal vocalization types) for all five AMAR locations in the RSA, three near Bruce Head (AMAR-1, AMAR-2 and AMAR-3), one near Ragged Island (AMAR-RI) and one near Bylot Island (AMAR-BI). Calculation of the LRR at each AMAR location was carried out using the same methodology outlined in the 2018 Bruce Head Passive Acoustic Monitoring report (Frouin-Mouy et al. 2019). At each location, the LRR was determined for 1 kHz (representative of narwhal burst pulses), 5 kHz (representative of whistles and knock trains) and 25 kHz (representative of clicks and high frequency buzzes). The recording data were divided into periods with and without vessel detections. The normal listening range was determined using the maximum of the mid-frequency cetacean audiogram (see Table A-9 in Finneran 2015) or the median 1-minute sound pressure level without vessels in each of the 1/3-octave-bands of interest as the baseline hearing threshold. The geometric spreading coefficient was set to a nominal value of 15. The analysis was performed for each 1 dB of increased 1/3-octave-band SPL above the normal condition.

LRR calculations are presented in Table 16 for both a >50% and >90 % reduction in listening range (>50% LRR and >90% LRR), for all five recorder locations and the three representative frequencies. Figure 33 presents results for the AMARs deployed during the early shoulder season and Figure 34 presents results for the AMARs deployed during the open-water season. During the 2019 open-water shipping season, vessels (Project and non-Project related) were detected in the acoustic recordings for between 15% (at AMAR-2) and 29% (AMAR-RI – open-water deployment) of the total acoustic recording durations (1,297 hours at AMAR-2 and 1,345 hours at AMAR-RI – open-water redeployment), with vessel detections most common at AMAR-RI. Additional information is presented below for three representative recorder locations; AMAR-RI which is located directly on the nominal shipping lane near Ragged Island, AMAR-1 which is located directly on the shipping lane in Milne Inlet South, and AMAR-2 which is located in Koluktoo Bay, approximately 6 km away from the nominal shipping lane.

Table 16: Percentage of time associated with >50% and >90% LRR at each acoustic recorder location

Recorder	1 kHz		5 kHz		25 kHz	
	>50% LRR	>90% LRR	>50% LRR	>90% LRR	>50% LRR	>90% LRR
Early Shoulder Season Deployments						
AMAR-BI (ambient noise data)	0.2	0	21.0	0.3	30.5	8.4
AMAR-BI (data with vessels detected)	1.8	0.3	22.4	1.3	30.4	6.3
AMAR-RI (ambient noise data)	0	0	24.5	0.8	36.7	16.9
AMAR-RI (data with vessels detected)	4.1	0.9	48.7	5.1	50.8	26.3
Open-water Season Deployments						
AMAR-1 (ambient noise data)	0.9	0	29.3	0.1	45.9	36.4
AMAR-1 (data with vessels detected)	10.1	2.1	27	3.0	32.6	22.9
AMAR-2 (ambient noise data)	0.2	0	14.7	0	45.6	37.7
AMAR-2 (data with vessels detected)	3.3	0.1	9.6	0.2	33.0	26.3
AMAR-3 (ambient noise data)	0.8	0	33.0	3.1	42.0	33.2
AMAR-3 (data with vessels detected)	8.1	1.2	34.0	4.6	37.0	25.7
AMAR-RI (ambient noise data)	0.1	0	15.5	0.2	31.7	6.2
AMAR-RI (data with vessels detected)	3.3	0.8	14.7	2.0	24.4	6.2

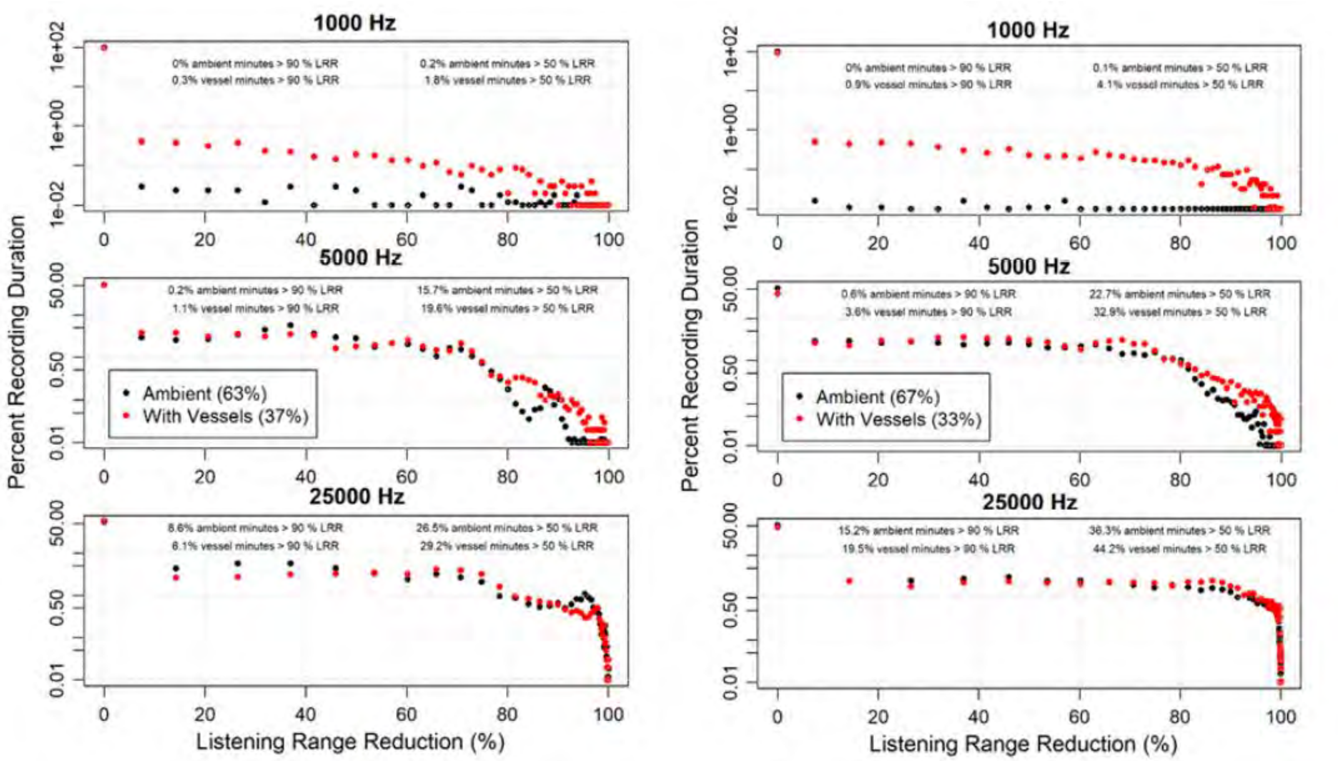


Figure 33: Listening range reduction (LRR) during the early shoulder season for the three considered frequencies at AMAR-BI (left) AMAR-RI (right). For each station, the top figure shows LRR for the 1 kHz 1/3-octave-band, which is representative of burst pulses, the middle figure shows LRR for the 5 kHz 1/3-octave-band, which is representative of listening for whistles and knocks, and the bottom figure shows LRR for 25 kHz which is representative of clicks and high-frequency buzzes. The black dots show the distribution of LRR for ambient data only, while the red dots show the distribution of LRR for minutes with vessel detections. The black dots show the distribution of LRR for ambient noise data only (no vessels), while the red dots show the distribution of LRR for recordings with vessels detected (vessels + ambient noise). The y-axis is logarithmic to better illustrate the rare high LRR events.

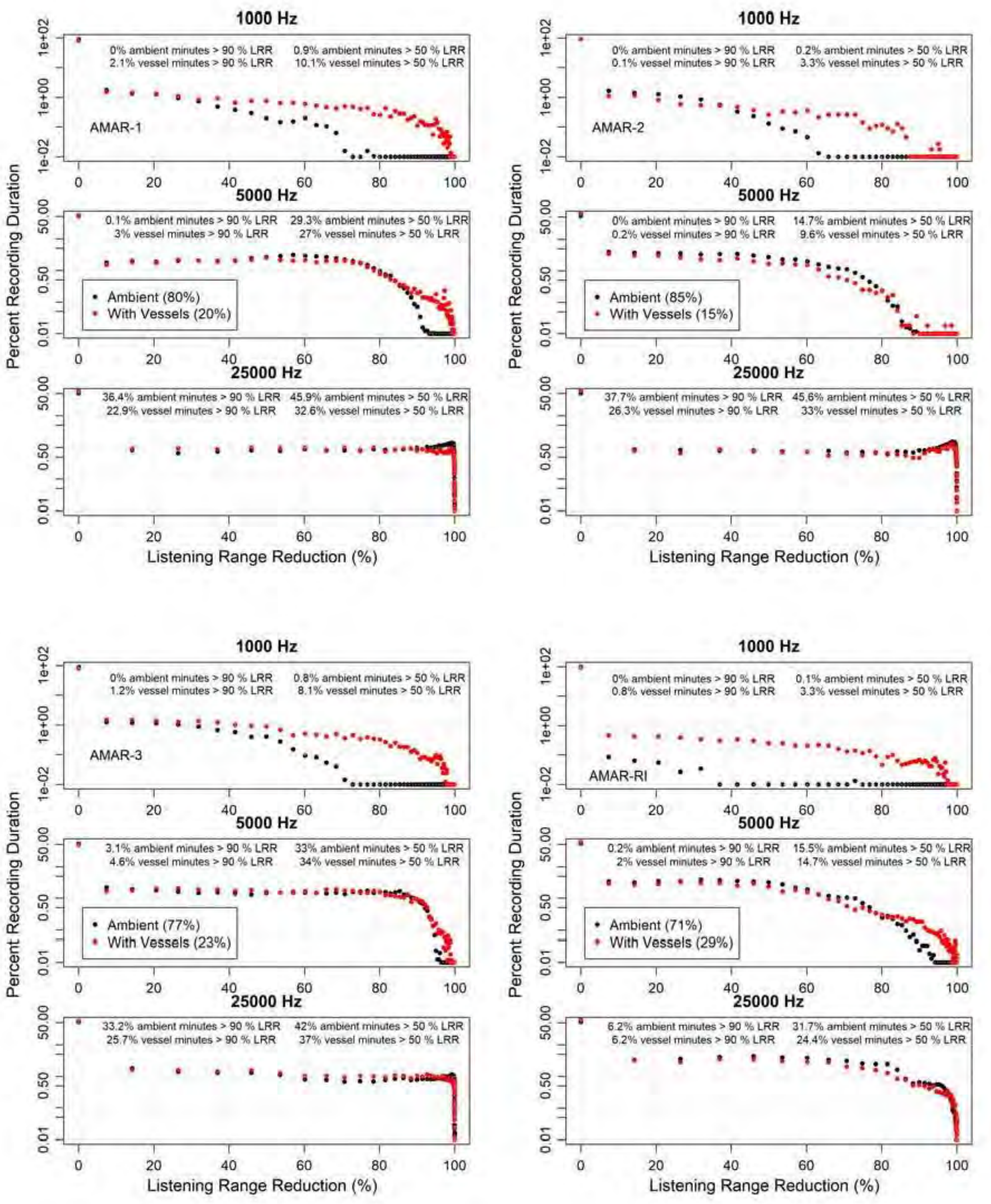


Figure 34: Listening range reduction (LRR) during the open-water season for the three considered frequencies at each station. For each station, the top figure shows LRR for the 1 kHz 1/3-octave-band, which is representative of burst pulses, the middle figure shows LRR for the 5 kHz 1/3-octave-band, which is representative of listening for whistles and knocks, and the bottom figure shows LRR for 25 kHz which is representative for clicks and high-frequency buzzes. The black dots show the distribution of LRR for ambient data only, while the red dots show the distribution of LRR for minutes with vessel detections. The black dots show the distribution of LRR for ambient noise data only (no vessels), while the red dots show the distribution of LRR for recordings with vessels detected (vessels + ambient noise). The y-axis is logarithmic to better illustrate the rare high LRR events.

AMAR-RI (Ragged Island)

AMAR-RI was located directly on the nominal shipping route adjacent to the Ragged Island anchorage locations. Vessel noise was most common at this recorder location, with vessels acoustically detected on 33% of the early shoulder season recording (163 out of 493 h) and on 29% of the open water season recording (390 out of 1,345 h). Greater than 50% LRR occurred most frequently at AMAR-RI during the early shoulder season. A summary of the LRR calculations for each of the three considered frequencies, with a relative comparison to ambient noise (i.e., data with no vessels present) is as follows.

<u>1 kHz (burst pulses):</u>

During the early shoulder season, >50% LRR occurred for sound at 1 kHz (a frequency component of narwhal burst pulses) during 4.1% of the time vessels were detected on the recording (7 of 163 h). This means that 96% of the time when vessel noise was detectable in the shoulder season at AMAR-RI, a stationary narwhal would be able to detect a sound at 1 kHz to distances over half of their full detection range, and 4% of the time when vessel noise was detectable in the shoulder season at this location, their detection range at this frequency would be reduced by at least half. Because the hearing threshold for narwhal at 1 kHz is higher than the median ambient sound level at this frequency, ambient noise did not cause appreciable LRR for this vocalization type during any of the early shoulder season recording (0 of 521 h without vessels detected). **Overall, vessel noise resulted in greater than 50% LRR for sound at 1kHz for 1% of the total recording period during the early shoulder season (7 of 493 h).**

During the open-water season, >50% LRR occurred for sound at 1 kHz during 3.3% of the time vessels were detected on the recording (13 of 390 h). Ambient noise caused >50% LRR for sound at 1 kHz during 0.1% of the recordings when no vessels were detected acoustically (1 of 955 h). **Overall, ambient noise caused >50% LRR for sound at 1 kHz for 0.07% of the total open water recording period (1 of 1,345 h), while vessel noise caused >50% LRR for sound at 1 kHz for 1% of the open water recording period (13 of 1,345 h).**

<u>5 kHz (whistles and knock trains):</u>

During the early shoulder season, >50% LRR occurred for sound at 5 kHz (a frequency component of narwhal whistles and knock trains) during 48.7% of the time vessels were detected acoustically on the recording at AMAR-RI (79 of 163 h). In comparison, ambient noise during the early shoulder season resulted in >50% LRR for sound at 5 kHz during 24.5% of the recordings when no vessels were detected (80 of 330 h). **Overall, both ambient noise and vessels resulted in >50% LRR for sound at 5 kHz for 16% of the total shoulder season recording period (80 of 493 h from ambient noise and 79 of 493 h from vessel noise).**

During the open water season, >50% LRR occurred for sound at 5 kHz during 14.7% of the time vessels were detected on the recording at AMAR-RI (57 of 390 h). Ambient noise resulted in >50% LRR for sound at 5 kHz during 15.5% of the recordings when no vessels were detected acoustically (148 of 955 h). **Overall, ambient noise resulted in >50% LRR for sound at 5 kHz for 11% of the total open water recording period (148 of 1,345 h), while vessel noise resulted in >50% LRR for sound at 5 kHz for 4.2% of the total open water recording period (57 of 1,345 h).**

<u>25 kHz (clicks and high-frequency buzzes):</u>

During the early shoulder season, >50% LRR occurred for sound at 25 kHz (a frequency component of narwhal clicks and high-frequency buzzes) during 50.8% of the time vessels were detected acoustically on the recording at AMAR-RI (83 of 163 h). During this same period, ambient noise resulted in >50% LRR for sound at 25 kHz during

36.7% of the recordings when no vessels were detected (121 of 330 h). **Overall, >50% LRR occurred for sound at 25 kHz for 41% of the total recording period during the early shoulder season; 25% of this was related to ambient noise (121 of 493 h) and 12% of this was related to vessel noise (83 of 493 h).**

During the open water season, >50% LRR occurred for sound at 25 kHz during 24% of the time vessels were detected on the recording (94 of 390 h). Ambient noise resulted in >50% LRR for sound at 25 kHz during 32% of the recordings when no vessels were detected acoustically (306 of 955 h). **Overall, >50% LRR occurred for sound at 25 kHz for 37% of the total recording period during the open water season; 23% of this was related to ambient noise (306 of 1,345 h) and 14% of this was related to vessel noise (191 of 1,345 h).**

AMAR-1 (Milne Inlet Shipping Lane)

AMAR–1 was located directly on the nominal shipping route in Milne Inlet South, adjacent to the entrance to Koluktoo Bay. It was only deployed during the open water season. Vessels were acoustically detected on 20% of the recording (259 out of 1,297 h). A summary of the LRR for each of the three considered frequencies, with a relative comparison to ambient noise (i.e., no vessels present) is as follows.

<u>1 kHz (burst pulses):</u>

During the open water season, greater than 50% LRR for sound for 1 kHz (a frequency component of narwhal burst pulses) occurred during 10.1% of the time vessels were detected on the recording (26 of 259 h). Ambient noise resulted in greater than 50% LRR for sound at 1 kHz during 0.9% of the recordings when no vessels were detected acoustically (9 of 1,038 h). **Overall, ambient noise resulted in greater than 50% LRR for sound at 1 kHz for 0.7% of the total open water recording period (9 of 1,297 h), while vessel noise resulted in greater than 50% LRR for sound at 1 kHz for 2% of the open water recording period (26 of 1,297 h).**

<u>5 kHz (whistles and knock trains):</u>

During the open water season, greater than 50% LRR for sound at 5 kHz (a frequency component of narwhal whistles and knock trains) occurred during 27% of the time vessels were detected on the recording (70 of 259 h). Ambient noise resulted in greater than 50% LRR for sound at 5 kHz during 29% of the recordings when no vessels were detected acoustically (301 of 1,038 h). **Overall, ambient noise resulted in greater than 50% LRR for sound at 5 kHz for 23% of the total open water recording period (301 of 1,297 h), while vessel noise resulted in greater than 50% LRR for sound at 5 kHz for 5% of the total open water recording period (70 of 1,297 h).**

<u>25 kHz (clicks and high-frequency buzzes):</u>

During the open water season, greater than 50% LRR for sound at 25 kHz (a frequency component of narwhal clicks and high-frequency buzzes) occurred during 32.6% of the time vessels were detected on the recording (85 of 259 h). Ambient noise resulted in greater than 50% LRR for sound at 25 kHz during 45.9% of the recordings when no vessels were detected acoustically (476 of 1,038 h). **Overall, ambient noise resulted in greater than 50% LRR for sound at 25 kHz for 37% of the total open water recording period (476 of 1,297 h), while vessel noise resulted in a 50% LRR for clicks for 7% of the total open water recording period (85 of 1,297 h).**

AMAR-2 (Koluktoo Bay)

AMAR–2 was located in Koluktoo Bay, approximately 6 km west of the nominal shipping route in Milne Inlet South. AMAR–2 was only deployed during the open water season. Vessels were acoustically detected in 15% of the recording (195 out of 1,297 h). A summary of the LRR for each of the three considered frequencies, with a relative comparison to ambient noise (i.e., no vessels present) is as follows.

1 kHz (burst pulses):

During the open water season, >50% LRR for sound at 1 kHz occurred during 3.3% of the time vessels were detected on the recording (6 of 195 h). Ambient noise resulted in >50% LRR for sound at 1 kHz during 0.2% of the recordings when no vessels were detected acoustically (2 of 1,102 h). **Overall, ambient noise resulted in >50% LRR for sound at 1 kHz for 0.1% of the total open water recording period (2 of 1,297 h), while vessel noise resulted in >50% LRR for sound at 1 kHz for 0.4% of the open water recording period (6 of 1,297 h).**

5 kHz (whistles and knock trains):

During the open water season, >50% LRR occurred for sound at 5 kHz (a frequency component of narwhal whistles and knock trains) during 9.6% of the time vessels were detected on the recording (19 of 195 h). Ambient noise resulted in >50% LRR for sound at 5 kHz during 14.7% of the recordings when no vessels were detected acoustically (162 of 1,102 h). **Overall, ambient noise resulted in >50% LRR for sound at 5 kHz for 12% of the total open water recording period (162 of 1,297 h), while vessel noise resulted in >50% LRR for sound at 5 kHz for 1% of the total open water recording period (19 of 1,297 h).**

25 kHz (clicks and high-frequency buzzes):

During the open water season, >50% LRR for sound at 25 kHz (a frequency component of narwhal clicks and high-frequency buzzes) occurred during 33% of the time vessels were detected on the recording (64 of 195 h). Ambient noise resulted in >50% LRR for sound at 25 kHz during 45.6% of the recordings when no vessels were detected acoustically (502 of 1,102 h). **Overall, ambient noise resulted in >50% LRR for sound at 25 kHz for 39% of the total open water recording period (502 of 1,297 h), while vessel noise resulted in >50% LRR for sound at 25 kHz for 5% of the total open water recording period (64 of 1,297 h).**

LRR for Phase 2 Shipping Operations

The results above were reflective of present shipping operation conditions under the 6 MTPA shipping operations, derived from 2019 measurements of approximately 166 transits of Postpanamax sized ore carriers from 28 days during the early shoulder season days and 55 days during the open-water season.

Under Phase 2 operations, a total of 324 Postpanamax carrier transits and 28 Capesize carrier transits are anticipated per shipping season. Postpanamax vessels can therefore be assumed to be detectable twice as often under a Phase 2 setting compared to the ERP setting (324 expected transits compared to 166 measured transits), meaning that Postpanamax vessels would be detectable between 30% and 60% of the time under Phase 2 operations (location dependent), with the same expected probability of LRR during those times as presented above. Capesize vessels would be detectable for approximately 15% of that time. This estimate is based on the fact that Capesize vessels would occur less often compared to Postpanamax vessels (the expected 28 Capesize transits is 8% of the expected 324 Postpanamax transits), but would be detectable for longer periods of time per transit owing to the higher sound levels from these larger vessels (the exposure duration of a Capsize transit is predicted to be

1.7 times that for a Postpanamax vessel). Scaling 8% up by a factor of 1.7 yields 15%. Based on this approach, it is estimated that Capesize vessels would be detectable between approximately 4.5% (15% of 30%) and 9% (15% of 60%) of the shipping season under Phase 2 operations.

Since the noise footprint for a Capesize vessel is larger than that for a Postpanamax vessel, there would be a higher occurrence of LRR on narwhal vocalizations when Capesize vessels transit past a stationary narwhal compared to that elicited by a Postpanamax vessel. There are no data that can be used to quantify this effect and this effect is not straightforward to model. To estimate the increased occurrence of LRR in the presence of a Capesize vessel, an increase of 3 dB was applied to the sound levels recorded at each AMAR during periods when vessels were detected to estimate the occurrence of LRR for Capesize vessels. The value of 3 dB was based on the modelling undertaken for Phase 2 which assumed a 3 dB difference in source levels between a Capesize and Postpanamax vessel. The resulting LRR occurrences for these simulated received levels are presented in Table 17. On average, the values are approximately 1.7 times those of the values in Table 16, a value which also corresponds with the exposure duration scaling factor applied in Section 4.1.3. Therefore, scaling the LRR probabilities in Table 16 by a factor of 1.7 (as shown in Table 17) is assumed to provide a reasonable estimate of the amount of time that the listening range for narwhal vocalizations would be reduced by >50% and >90% during periods when Capesize vessels would be detectable on the recordings.

Table 17: Estimate percent of time with >50% and >90% Listening Range Reduction (LRR) that would occur at each acoustic recorder location if received levels were 3 dB higher at times when vessels were detected (reflective of what conditions would be for Capeseize carriers).

Recorder	1 kHz		5 kHz		25 kHz	
	>50% LRR	>90% LRR	>50% LRR	>90% LRR	>50% LRR	>90% LRR
AMAR-1 (ambient noise data)	0.9	0	29.3	0.1	45.9	36.4
AMAR-1 (data with vessels detected)	15.2	3.4	40	4.6	38.4	28.1
AMAR-2 (ambient noise data)	0.2	0	14.7	0	45.6	37.7
AMAR-2 (data with vessels detected)	6.1	0.3	22.9	0.3	37.9	29.8
AMAR-3 (ambient noise data)	0.8	0	33.0	3.1	42.0	33.2
AMAR-3 (data with vessels detected)	14.9	2.1	44.9	10.7	47.7	31.7
AMAR-RI (ambient noise data)	0.1	0	15.5	0.2	31.7	6.2
AMAR-RI (data with vessels detected)	5.3	1.2	31.9	3.2	43	11.8

5.1.4.1 Potential Effects of LRR on Acoustic Masking

Although DFO Science has expressed concern that the acceptable risk threshold for LRR for narwhal has not been scientifically demonstrated by Baffinland, it is well known that currently there are no established regulatory thresholds under any jurisdiction that would aid in the determination of significance of acoustic masking effects on narwhal. As described in Hemerra (2019), Erbe et al. (2016) characterize acoustic masking as a complex phenomenon. Masking levels can be variable and dependent on the physiological and anatomical characteristics and activity of the sender and receiver, the levels of ambient noise and the degree of habituation of the individuals, as well as any anti-masking strategies employed. There is no vocalization masking model developed in the literature that is narwhal-specific and no research is available on the hearing ability (i.e., audiogram) of narwhal (Erbe et al. 2016). More research is needed to understand the process and biological significance of masking, as well as the risk of masking by various anthropogenic activities, before masking can be incorporated into regulation strategies or approaches for mitigation (Erbe et al. 2016).

Updated calculations for LRR based on 2019 measured data confirm assumptions made in the Phase 2 effects assessment that Project shipping has the potential to result in acoustic masking effects on narwhal that are measurable. However, based on monitoring results from 2019 which provide further insights into the magnitude and frequency at which this will occur, there is even greater confidence in the assessment that Project shipping is unlikely to compromise stock or population integrity. Mitigation measures, such as reduced ship speeds in the RSA and limited icebreaker transits during the early shoulder season, are expected to reduce potential effects of acoustic masking on narwhal and proposed marine mammal monitoring programs supportive of the Phase 2 Proposal will help address uncertainty and fill outstanding data gaps.

6.0 2019 SHIP-BASED OBSERVER PROGRAM

This section presents a summary of the results of the 2019 Ship-based Observer (SBO) Program to support an updated assessment of Project effects on marine mammals relative to Baffinland's Phase 2 Proposal (Section 7.0). The 2019 SBO Program took place onboard the icebreaker MSV Botnica during the early summer (Leg 1: 19–29 July) and fall shoulder season (Leg 2: 5-28 October). A detailed description of data collection and analytical methodology for the 2019 Marine Mammal Aerial Survey Program is provided in Golder (2019a; 2020d).

6.1 Summary of Results

Total monitoring effort for both survey legs was 268.7 h covering 3,089 km. Total monitoring effort during Leg 1 was 100.4 h covering 1,119 km. Total monitoring effort during Leg 2 was 168.3 h travelling 1,970 km. Although there were nearly twice as many observation days in Leg 2 compared to Leg 1 (24 vs. 11 days), this was not reflected in overall survey effort given the longer daylight hours during Leg 1 (mean daily effort= 11 h) compared to Leg 2 (mean daily effort = 7 h).

Seven different species of marine mammals were observed during the 2019 SBO Program: narwhal, beluga whale, bowhead whale, ringed seal, harp seal, bearded seal and polar bear. A total of 304 marine mammal sightings comprising 2,785 individuals were recorded (Table 18). Killer whale and walrus were not recorded in the RSA during either survey leg in 2019; however both species are known to occur in the region.

During Leg 1, a total of 152 marine mammal sightings comprising 2,453 individuals were recorded (Table 18). Species identified included ringed seal (61 sightings of 722 individuals), narwhal (27 sightings of 385 individuals), harp seal (24 sightings of 136 individuals), bowhead whale (22 sightings of 24 individuals), bearded seal (four sightings of four individuals), polar bear (two sightings of two individuals) and beluga (one sighting of one individual). There were also nine sightings of unconfirmed pinniped species (comprising 1,176 individuals) and two sightings of unconfirmed cetacean species (comprising three individuals).

During Leg 2, a total of 152 marine mammal sightings comprising 332 individuals were recorded (Table 18). Species identified included ringed seal (53 sightings of 58 individuals), narwhal (27 sightings of 103 individuals), harp seal (25 sightings of 117 individuals), bearded seal (one sighting of one individual) and bowhead whale (one sighting of one individual). There were also 44 sightings of unconfirmed pinniped species (49 individuals) and one sighting of an unconfirmed cetacean species (comprising three individuals). No polar bear or beluga were observed during the fall surveys.

Table 18. Marine mammal sightings recorded during the 2019 Ship-based Observer Program

Species	Early Summer (July 19-29)				Fall (0ct 05-28)			
	In Water		On Ice		In Water		On Ice	
	No. of Sightings	No. of Animals	No. of Sightings	No. of Animals	No. of Sightings	No. of Animals	No. of Sightings	No. of Animals
Narwhal	27	385	0	0	27	103	0	0
Beluga	1	1	0	0	0	0	0	0
Bowhead	22	24	0	0	1	1	0	0
Unknown Whale	2	3	0	0	1	3	0	0
Ringed Seal	48	49	13	673	52	56	1	2
Harp Seal	24	136	0	0	25	117	0	0
Bearded Seal	1	1	3	3	1	1	0	0
Unknown Seal	4	4	5	1,172	36	37	8	12
Polar Bear	0	0	2	2	0	0	0	0
Total	**129**	**603**	**23**	**1,850**	**143**	**318**	**9**	**14**

Narwhal

A total of 54 narwhal sightings comprising 488 individuals were recorded in the RSA in 2019, with a higher number of animals observed during Leg 1 (n=385) than Leg 2 (n=103) (Table 18). Narwhal were observed from the vessel as early as 19 July and as late as 28 October. During Leg 1, sightings were concentrated in eastern Eclipse Sound near Pond Inlet and near Bruce Head in southern Milne Inlet (Figure 35). During Leg 2, sightings were concentrated in Eclipse Sound near the southwest tip of Bylot Island and in Milne Inlet North near Ragged Island (Figure 36). Mean narwhal group size in 2019 was nine (ranging from 1 to 100 animals). No mothers with calves were observed during the 2019 SBO Program.

Beluga Whale

There was one sighting of a single beluga whale in Milne Inlet South during Leg 1, observed near the entrance to Koluktoo Bay (Table 18; Figure 35).

Bowhead Whale

A total of 22 bowhead sightings comprising 24 individuals were recorded in the RSA in 2019 (Table 18). All of the sightings occurred during Leg 1 (Figure 35), with the exception of one solitary bowhead observed during Leg 2 north of Ragged Island (Figure 36). Bowhead sightings during Leg 1 were primarily concentrated in Eclipse Sound with several individuals also observed in Milne Inlet South and Milne Inlet North near Ragged Island. All sightings consisted of solitary animals with the exception of two separate sightings of a pair of bowheads during Leg 1.

Ringed Seal

A total of 114 ringed seal sightings comprising 780 individuals were recorded in the RSA in 2019 (Table 18). During Leg 1, ringed seal were distributed along the entire shipping corridor, with multiple large group sightings (>10 animals) recorded in Milne Inlet North (Figure 37). During Leg 2, ringed seal were observed primarily in Eclipse Sound with only a few sightings recorded in Milne Inlet and Baffin Bay (Figure 38). In-water sightings consisted primarily of solitary animals (95 out of 100 sightings). On-ice sightings consisted of solitary animals or in groups ranging in size from 2 to 300 animals, with a median group size of 7.5.

Harp Seal

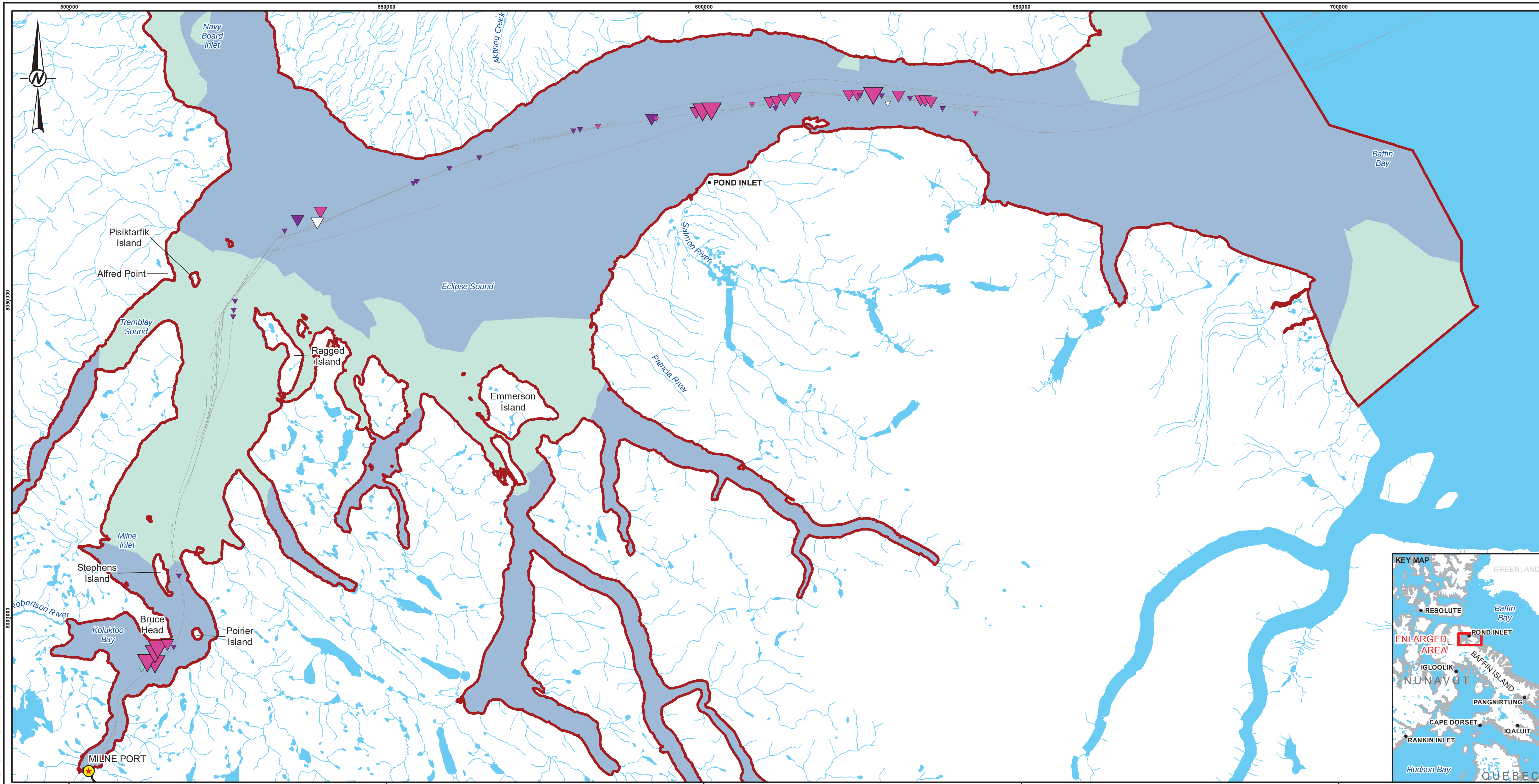
A total of 49 harp seal sightings comprising 253 individuals were recorded in the RSA in 2019 (Table 18). During both Leg 1 and Leg 2, harp seal were observed primarily in Eclipse Sound and eastward towards the entrance to Eclipse Sound (Tuqsukatta) (Figure 37 and Figure 38). All in-water sightings consisted of solitary animals or in groups ranging in size from two to 25 animals, with a median group size of two. No harp seals were observed on ice during either survey leg.

Bearded Seal

A total of five bearded seal sightings (all solitary animals) were recorded in the RSA in 2019 (Table 18). Four of the sightings occurred during Leg 1, three of which were on-ice (Figure 37). The lone sighting recorded during Leg 2 consisted of a solitary animal observed in-water at the entrance to Baffin Bay (Figure 38).

Polar Bear

Only two polar bear sightings were recorded in the RSA in 2019, both on the same day (20 July), with each sighting consisting of a solitary polar bear walking on the sea ice in Milne Inlet North (Table 18; Figure 37). The first polar bear was observed approximately 1 km from the vessel. The second polar bear was observed 12 minutes later, approximately 3 km from the vessel. There was also one incidental polar bear sighting made by the ship crew on July 21 at 02:00 when the MWOs were not on watch. The bear was observed in Milne Inlet North (near Ragged Island) where it was resting on the ice ahead of the vessel at an unknown distance before running away.



LEGEND

- COMMUNITY
- MILNE PORT

CETACEAN SPECIES OBSERVATIONS (GROUP SIZE)

BELUGA
- 1

BOWHEAD WHALE
- 1
- 2 - 10

NARWHAL
- 1
- 2 - 10
- 10+

UNIDENTIFIED WHALE
- 1
- 2 - 10

- MILNE INLET TOTE ROAD
- SURVEY TRACK (JULY 19 - 29, 2018)
- WATERCOURSE
- MARINE MAMMAL REGIONAL STUDY AREA
- WATERBODY

SUMMER MEAN PERCENT ICE CONCENTRATION (JULY 19 TO 29, 2018)
- ICE FREE
- 0-10%
- 10-30%
- 40-60%
- 70-80%
- 90-100%

0 10 20
1:600,000 KILOMETRES

REFERENCE(S)
ICE CONCENTRATION OBTAINED FROM CANADIAN ICE SERVICE, GOVERNMENT OF CANADA. DAILY ICE CHARTS – APPROACHES TO RESOLUTE BAY. ACCESSED SEPTEMBER 19, 2019 AND DECEMBER 13, 2019. GEOGRAPHIC NAMES, HYDROGRAPHY, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

PROJECT
MARY RIVER PROJECT – 2019 SHIP-BASED OBSERVER PROGRAM

CONSULTANT
GOLDER

YYYY-MM-DD	2020-05-08
DESIGNED	KG
PREPARED	AA
REVIEWED	PR
APPROVED	PR

TITLE
DISTRIBUTION OF CETACEAN OBSERVATIONS FROM 19-29 JULY 2019

PROJECT NO.	CONTROL	REV.	FIGURE
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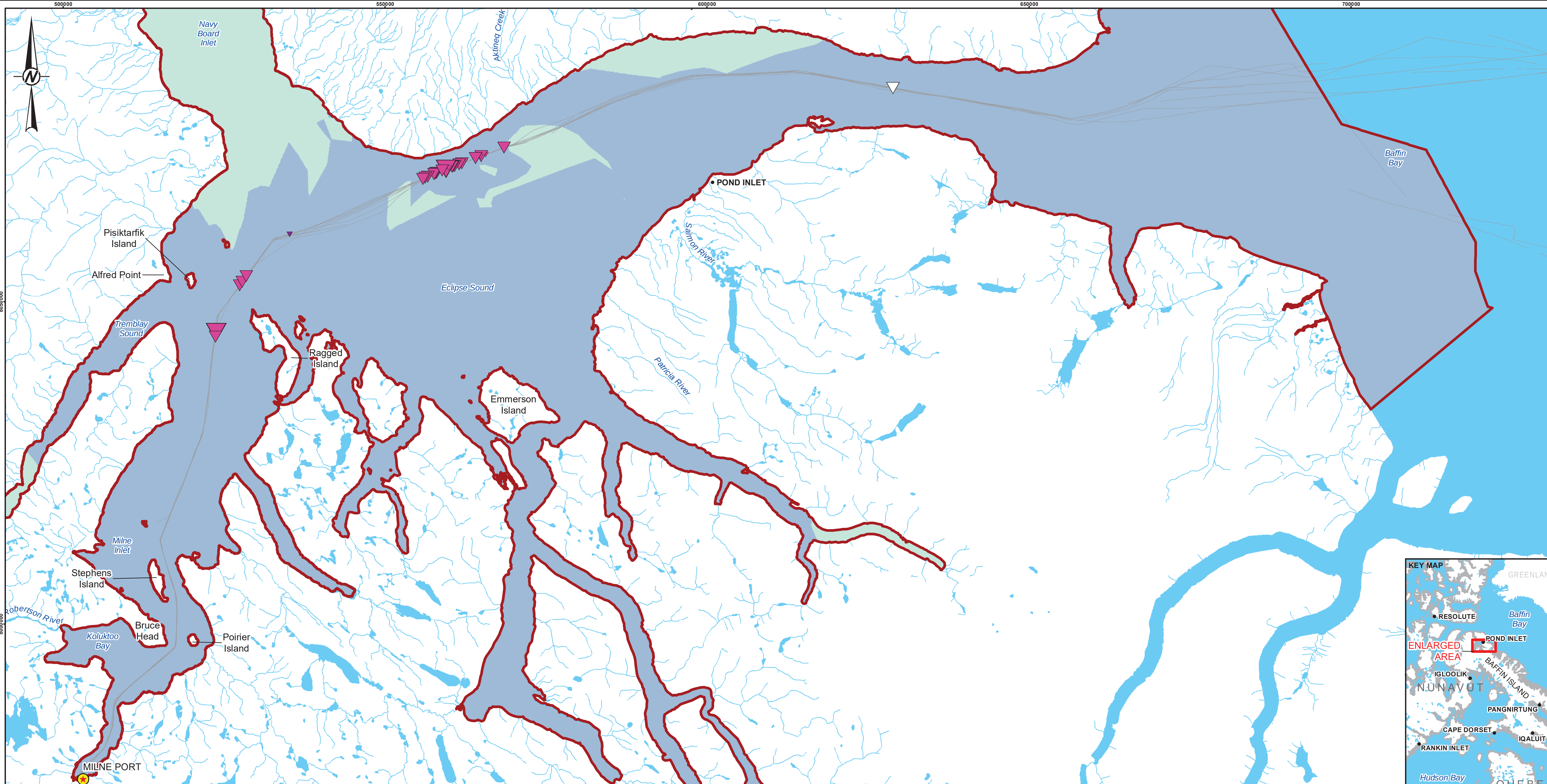

LEGEND

- COMMUNITY
- MILNE PORT

CETACEAN SPECIES OBSERVATIONS (GROUP SIZE)

BOWHEAD WHALE

- 1

NARWHAL

- 1
- 2 - 10
- 10+

UNIDENTIFIED WHALE

- 2 - 10

- MILNE INLET TOTE ROAD
- SURVEY TRACK (OCTOBER 5-28, 2019)
- WATERCOURSE
- MARINE MAMMAL REGIONAL STUDY AREA
- WATERBODY

FALL MEAN PERCENT ICE CONCENTRATION (OCTOBER 5 TO 28, 2019)

- ICE FREE
- 0-10%
- 10-30%
- 40-60%
- 70-80%
- 90-100%

0 10 20

1:600,000 KILOMETRES

REFERENCE(S)

ICE CONCENTRATION OBTAINED FROM CANADIAN ICE SERVICE, GOVERNMENT OF CANADA. DAILY ICE CHARTS – APPROACHES TO RESOLUTE BAY. ACCESSED SEPTEMBER 19, 2019 AND DECEMBER 13, 2019. GEOGRAPHIC NAMES, HYDROGRAPHY, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

PROJECT
MARY RIVER PROJECT – 2019 SHIP-BASED OBSERVER PROGRAM

CONSULTANT

GOLDER

YYYY-MM-DD	2020-05-08
DESIGNED	KG
PREPARED	AA
REVIEWED	PR
APPROVED	PR

TITLE
DISTRIBUTION OF CETACEAN OBSERVATIONS FROM 5-28 OCTOBER 2019

PROJECT NO.	CONTROL	REV.	FIGURE
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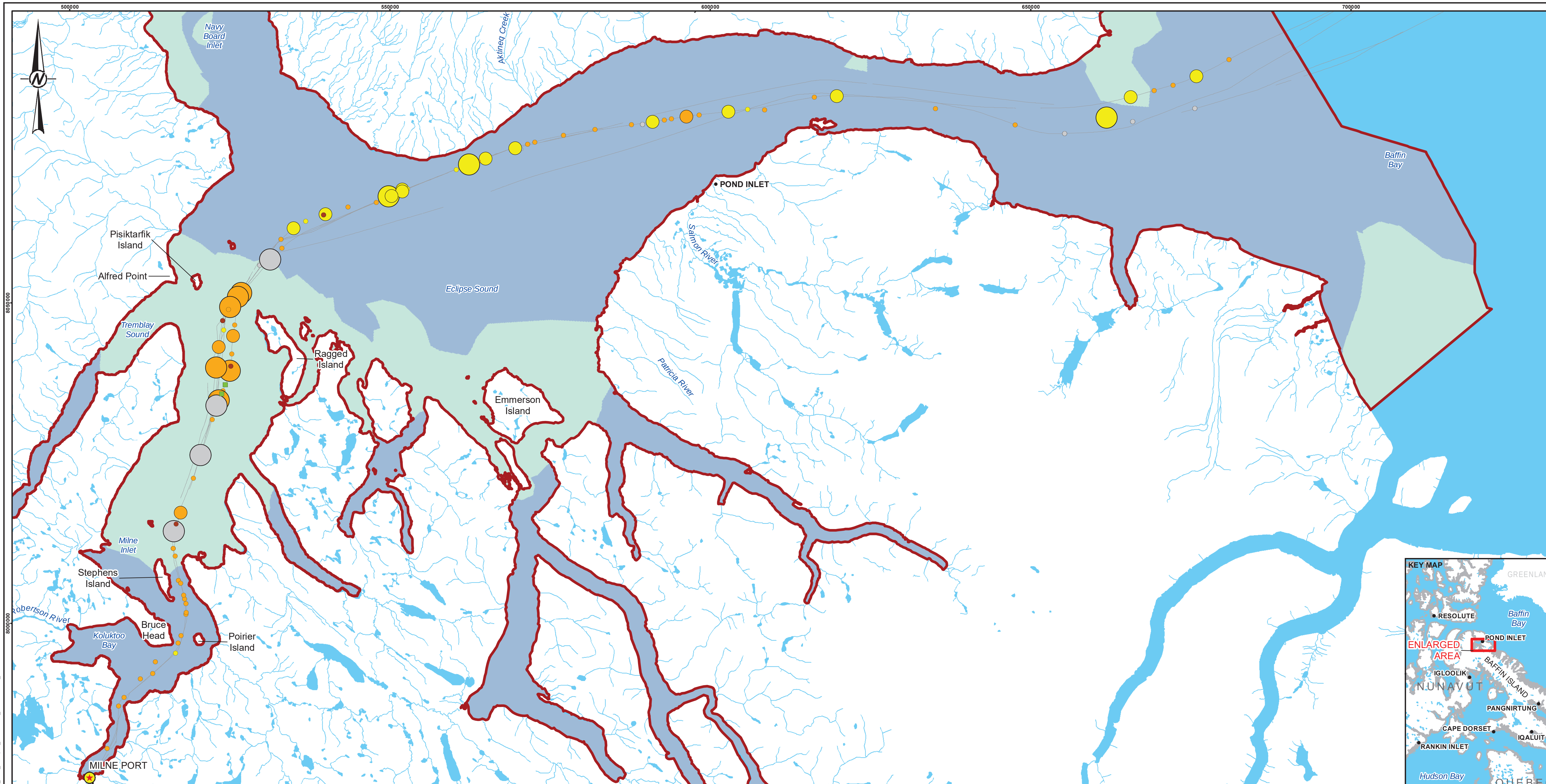

LEGEND

- COMMUNITY
- MILNE PORT

MARINE MAMMAL SPECIES OBSERVATIONS (GROUP SIZE)

BEARDED SEAL
- 1

HARP SEAL
- 1
- 2 - 10
- 10+

POLAR BEAR
- 1

RINGED SEAL
- 1
- 2 - 10
- 10+

UNIDENTIFIED SEAL
- 1
- 10+

- MILNE INLET TOTE ROAD
- SURVEY TRACK (JULY 19 - 29, 2018)
- WATERCOURSE
- MARINE MAMMAL REGIONAL STUDY AREA
- WATERBODY

SUMMER MEAN PERCENT ICE CONCENTRATION (JULY 19 TO 29, 2019)
- ICE FREE
- 0-10%
- 10-30%
- 40-60%
- 70-80%
- 90-100%

0 10 20
1:600,000 KILOMETRES

REFERENCE(S)
ICE CONCENTRATION OBTAINED FROM CANADIAN ICE SERVICE, GOVERNMENT OF CANADA. DAILY ICE CHARTS – APPROACHES TO RESOLUTE BAY. ACCESSED SEPTEMBER 19, 2019 AND DECEMBER 13, 2019. GEOGRAPHIC NAMES, HYDROGRAPHY, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

PROJECT
MARY RIVER PROJECT – 2019 SHIP-BASED OBSERVER PROGRAM

CONSULTANT
GOLDER

YYYY-MM-DD	2020-05-08
DESIGNED	KG
PREPARED	AA
REVIEWED	PR
APPROVED	PR

TITLE
DISTRIBUTION OF PINNIPED AND POLAR BEAR OBSERVATIONS FROM JULY 19-29, 2019

PROJECT NO.	CONTROL	REV.	FIGURE
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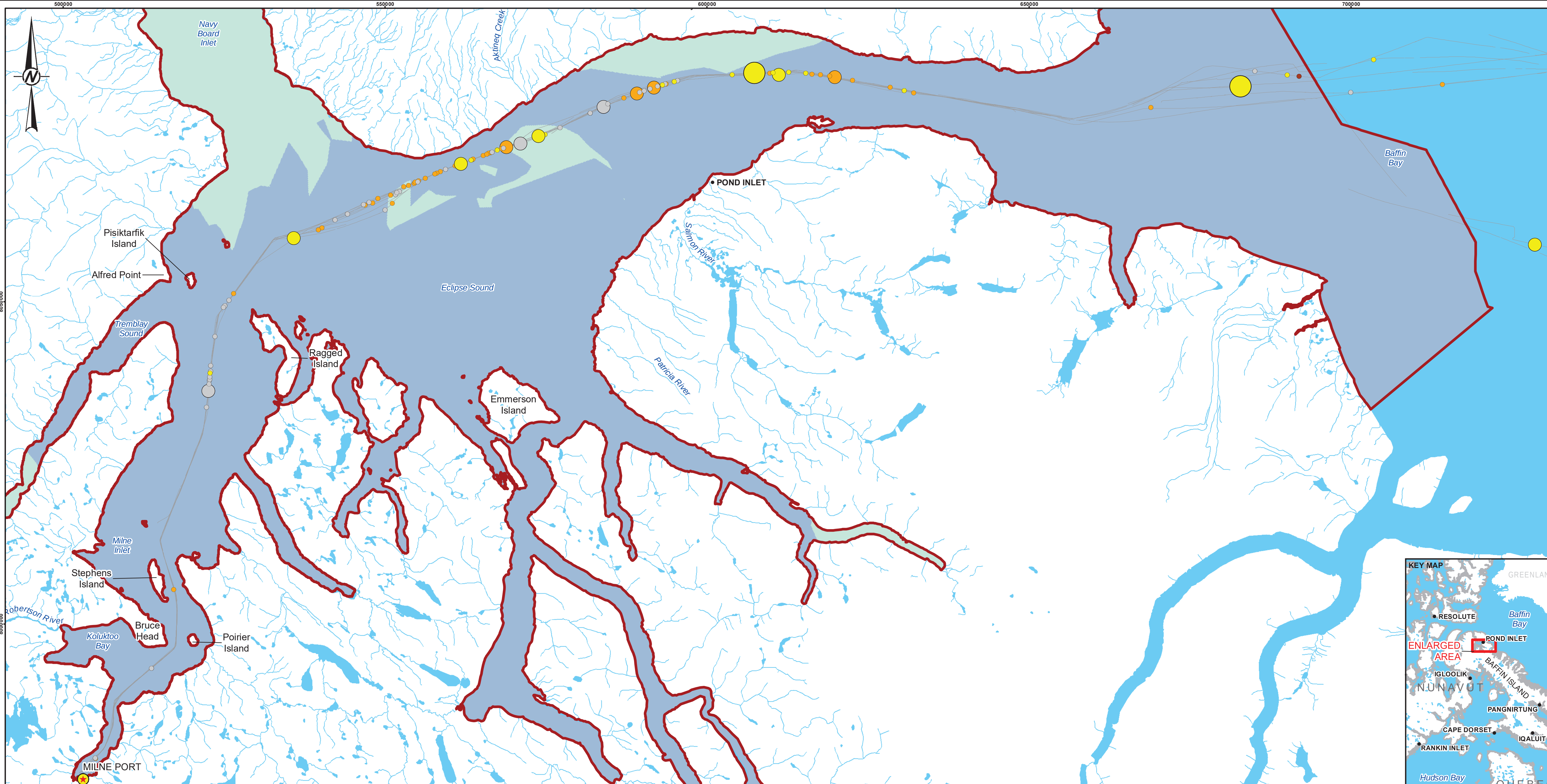

LEGEND

- • COMMUNITY
- MILNE PORT

MARINE MAMMAL SPECIES OBSERVATIONS (GROUP SIZE)

BEARDED SEAL
- 1

HARP SEAL
- 1
- 2 - 10
- 10+

RINGED SEAL
- 1
- 2 - 10

UNIDENTIFIED SEAL
- 1
- 2 - 10

- MILNE INLET TOTE ROAD
- SURVEY TRACK (OCTOBER 5-28, 2019)
- WATERCOURSE
- MARINE MAMMAL REGIONAL STUDY AREA
- WATERBODY

FALL MEAN PERCENT ICE CONCENTRATION (OCTOBER 5 TO 28, 2019)
- ICE FREE
- 0-10%
- 10-30%
- 40-60%
- 70-80%
- 90-100%

0 10 20
1:600,000 KILOMETRES

REFERENCE(S)
MILNE PORT INFRASTRUCTURE DATA OBTAINED FROM CLIENT MAY 28, 2018 AND BY HATCH, JANUARY 25, 2017, RETRIEVED FROM KNIGHT PIESOLD LTD. FULCRUM DATA MANAGEMENT SITE MAY 19, 2017. GEOGRAPHIC NAMES, HYDROGRAPHY, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

PROJECT
MARY RIVER PROJECT – 2019 SHIP-BASED OBSERVER PROGRAM

CONSULTANT
GOLDER

YYYY-MM-DD	2020-05-08
DESIGNED	KG
PREPARED	AA
REVIEWED	PR
APPROVED	PR

TITLE
DISTRIBUTION OF PINNIPED OBSERVATIONS FROM OCTOBER 5-28, 2019

PROJECT NO.	CONTROL	REV.	FIGURE
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Relative Abundance of Marine Mammals in the RSA

The relative abundance of marine mammals in the RSA, expressed as the animal detection rate (no. of animals relative to survey effort in km) in Table 19 below, was 0.90 animals/km (0.10 sightings per km). More animals were observed during Leg 1 (2.19 animals/km) than during Leg 2 (0.17 animals/km). Table 19 provides a summary of sighting rates and animal detection rates by species and between survey legs. All marine mammal species, including narwhal, occurred in higher relative abundance in the RSA during Leg 1 than during Leg 2.

Table 19: Sighting and animal detection rate (relative abundance) of marine mammals in RSA

Species	Early Summer (July 19-29)		Fall (0ct 05-28)		Combined	
	No. of Sightings (No. of Individuals)	Relative Detection Rate*	No. of Sightings (No. of Individuals)	Relative Detection Rate	No. of Sightings (No. of Individuals)	Relative Detection Rate
Narwhal	27 (385)	0.0241 (0.3441)	27 (103)	0.0137 (0.0523)	54 (488)	0.0175 (0.1580)
Beluga whale	1 (1)	0.0009 (0.0009)	0 (0)	0 (0)	1 (1)	0.0003 (0.0003)
Bowhead	22 (24)	0.0197 (0.0214)	1 (1)	0.0005 (0.0005)	23 (25)	0.0074 (0.0081)
Unknown whale	2 (3)	0.0018 (0.0027)	1 (3)	0.0005 (0.0015)	3 (6)	0.0010 (0.0019)
Ringed seal	61 (722)	0.0545 (0.6452)	53 (58)	0.0269 (0.0294)	114 (780)	0.0369 (0.2525)
Harp seal	24 (136)	0.0214 (0.1215)	25 (117)	0.0127 (0.0594)	49 (253)	0.0159 (0.0819)
Bearded seal	4 (4)	0.0036 (0.0036)	1 (1)	0.0005 (0.0005)	5 (5)	0.0016 (0.0016)
Unknown seal	9 (1,176)	0.0080 (1.0509)	44 (49)	0.0223 (0.0249)	53 (1,225)	0.0172 (0.3965)
Polar bear	2 (2)	0.0018 (0.0018)	0 (0)	0(0)	2 (2)	0.0006 (0.0006)
Total	152 (2,453)	0.1358 (2.1921)	253 (332)	0.0771 (0.1685)	304 (2,785)	0.0984 (0.9015)

Note: * sightings/km (individuals/km)

6.2 Comparison to 2018 SBO Program

The relative abundance of marine mammals in the RSA was similar in 2019 (0.90 individuals/km) to that observed in 2018 (0.88 individuals/km) (Table 20). Species observed in greater relative abundance in 2019 included narwhal, beluga, and bowhead whale. For these species, the increase was reflective of more animals observed during Leg 1 (similar numbers were seen during Leg 2 in both years). Less ringed seal and harp seal were observed in 2019 compared to 2018, although this was likely associated with the large number of unconfirmed seal species recorded in 2019 (n=1,225) compared to 2018 (n=760) (Table 20). When considering all seal categories (confirmed and unconfirmed species), a similar number of seals were observed in both years.

The observed increase in narwhal relative abundance in 2019 may have been reflective of abnormally low numbers of narwhal in the RSA in 2018, as reported by community members and as supported by low catch rates that year. Hunters found the opposite to be true in 2019 when narwhal were regularly observed throughout the RSA and in large groups (R. Arnakallak, Pers. Comm. 2020). The increase in relative abundance observed in 2019 may have also been a result of new adaptive management measures implemented during the early 2019 shoulder season to specifically reduce icebreaker noise impacts on narwhal, such as the 40 km floe edge buffer zone and a reduced number of icebreaker transits per day in the RSA in heavy ice conditions.

Overall, 2018 and 2019 results suggest that marine mammals in the RSA are not demonstrating large-scale displacement or abandonment from the RSA during or following icebreaking operations, and that mitigation measures implemented during the 2019 early shoulder season (e.g., limited number of transits, 40 km buffer area, etc.) are demonstrating to be effective.

6.3 2013-2015 SBO Programs

The main species observed during the initial SBO programs in 2013, 2014 and 2015, prior to the 2018 and 2019 SBO Programs, were narwhal, ringed seal and harp seal (SEM 2016). Less observation effort during earlier SBO programs (5.5 h in 2013, 9 h in 2014 and 9 h in 2015) resulted in a lower number of sightings compared to the 2018 and 2019 programs. In 2013, a total of five narwhal, 453 ringed seal, 10–15 harp seal and one unidentified seal were observed (SEM 2016). In 2014, a total of 7–9 narwhal, two ringed seal and one unidentified seal were observed (SEM 2016). In 2015, a total of 5–10 narwhal and one ringed seal were observed (SEM 2016). Results from the 2013-2015 SBO Programs were not directly comparable to results from 2018 and 2019.

Table 20: Relative abundance of marine mammals in RSA – A comparison between 2018 and 2019 SBO Programs

Species	Combined 2018		Combined 2019	
	No. of Individuals	Relative Abundance*	No. of Individuals	Relative Abundance*
Narwhal	175	0.0555	488	0.1580
Beluga whale	0	0.0000	1	0.0003
Bowhead whale	0	0.0000	25	0.0081
Unidentified Whale	1	0.0003	6	0.0019
Ringed Seal	1,069	0.3389	780	0.2525
Harp Seal	754	0.2391	253	0.0819
Bearded Seal	5	0.0016	5	0.0016
Unidentified Seal	760	0.2410	1,225	0.3965
Polar Bear	2	0.0006	2	0.0006
Total	**2,766**	**0.8770**	**2,785**	**0.9015**

Note: *individuals/km

6.4 Closest Point of Approach to Vessel

During each recorded marine mammal sighting, the distance between the detected marine mammal and the ship was estimated. The initial distance at which a marine mammal was observed by the MWO was noted and if the animal was subsequently observed again at a closer distance to the ship, the Closest Point of Approach (CPA) was updated. Table 21 presents a summary of CPAs recorded for sightings during all scheduled marine mammal watches in 2019. CPAs for pinnipeds 'on ice' and 'in-water' were calculated separately given differences in animal detectability and animal behaviours between the two environments (i.e., as pinnipeds are more easily detected on ice than in-water).

Table 21: Closest Point of Approach (CPA) distances recorded during the 2019 SBO Program

	Narwhal	Beluga	Bowhead Whale	Unidentified Whale	Ringed Seal	Harp Seal	Bearded Seal	Unidentified Seal	Polar Bear
Leg 1: Early Summer (July 19-29)									
In-water									
Mean CPA (m)	792.6	1000.0	729.5	550.0	223.8	330.8	600.0	237.5	n/a
Range (m)	200-2500	1000	200-1500	200-900	50-900	60-800	600	100-400	n/a
# Sightings	27	1	24	2	48	24	1	4	0
On ice									
Mean CPA (m)	n/a	n/a	n/a	n/a	830.8	n/a	233.3	1180.0	2000.0
Range (m)	n/a	n/a	n/a	n/a	100-2000	n/a	100-300	100-2000	1000-3000
# Sightings	0	0	0	0	13	0	3	5	2
Leg 2: Fall (0ct 05-28)									
In-water									
Mean CPA (m)	1175.9	n/a	3700.0	n/a	415.8	315.4	800.0	824.7	n/a
Range (m)	250-5000	n/a	3700	n/a	30-1500	10-900	800	10-5000	n/a
# Sightings	28	0	1	0	54	27	1	36	0
On ice									
Mean CPA (m)	n/a	n/a	n/a	n/a	400.0	n/a	n/a	5062.5	n/a
Range (m)	n/a	n/a	n/a	n/a	400	n/a	n/a	500-8000	n/a
# Sightings	0	0	0	0	1	0	0	8	0

Narwhal

The CPA for narwhal ranged from 200 to 2,500 m (mean = 792.6 m) during Leg 1, and from 250 to 5,000 m (mean = 1,175.9 m) during Leg 2 (Table 21). Mean CPA distances were significantly larger in Leg 2 than during Leg 1 (Mann-Whitney U = 191, p = 0.003).

Beluga Whale

The single observation of a beluga whale during Leg 1 corresponded with a CPA of 1,000 m (Table 21).

Bowhead Whale

The CPA for bowhead whale during Leg 1 ranged from 200 to 1,500 m (mean = 729.5 m; Table 21). The single bowhead whale sighting during Leg 2 corresponded with a CPA of 3,700 m.

Ringed Seal

The CPA for ringed seal in-water ranged from 50 to 900 m (mean = 223.8 m) during Leg 1, and from 30 to 1,500 m (mean = 415.8 m) during Leg 2 (Table 21). The mean CPA distances were significantly larger in Leg 2 than during Leg 1 (Mann-Whitney U = 901.0, p = 0.016). The CPA for ringed seal on ice ranged from 100 to 2,000 m (mean = 830.8 m) during Leg 1. The only sighting of a pair of ringed seal on ice during Leg 2 corresponded with a CPA of 400 m.

Harp Seal

The CPA for harp seals in-water ranged from 60 to 800 m (mean = 330.8 m) during Leg 1, and from 10 to 900 m (mean = 315.4 m) during Leg 2 (Table 21), with no significant difference between seasons (Mann-Whitney U = 308, p = 0.880). Harp seals were not observed on ice during the 2019 SBO Program.

Bearded Seal

The single bearded seal in-water sighting during Leg 1 corresponded with a CPA of 600 m (Table 21) and the single bearded seal in-water sighting during Leg 2 corresponded with a CPA of 800 m (Table 21). The CPA for ringed seal on-ice ranged from 100 to 300 m during Leg 1 (mean = 233.3 m; Table 21). No on-ice sightings of bearded seal occurred during Leg 2.

Polar Bear

Two polar bears were observed during Leg 1; the first was observed on the ice with a CPA of 1,000 m and the second was observed on the ice with a CPA of 3,000 m.

Overall, the 2019 CPA results supported impact predictions that animals demonstrate localized avoidance of the ship. This provides further confidence that a vessel strike on a marine mammal is unlikely to occur based on current vessel speeds in the RSA (9 knot speed restriction). These results also further support impact predictions made in the FEIS Addendum for the Early Revenue Phase (ERP), that the Project is unlikely to result in significant residual adverse effects on narwhal in the RSA, defined as effects that compromise the integrity of the population either through mortality (i.e., ship strikes) or via large-scale displacement or abandonment of the RSA.

6.5 Inuit Researcher Feedback

Following the completion of the 2019 SBO Program, two Inuit Researchers that participated in the program in 2019 and in past years were interviewed to garner feedback on the program, observations made in the field, and recommendations moving forward. The following is a summary of the feedback provided specific to this program:

- Once the ice breaks up, narwhal are everywhere.
- Narwhal swim away from ship if it is coming at them. Some may be curious around this ship.
- Did not notice narwhal swimming behind the ship’s ice tracks.
- When the ship is closer, the narwhal travel faster than when the ship is farther away.

- Marine mammals usually keep their distance from ships.
- Seals move out of the way.
- Bowhead whales have not been observed near the ship. They are normally to the side and swim fast.

7.0 2017/2018 INTEGRATED NARWHAL TAGGING STUDY

This section provides a summary of narwhal behavioural responses to shipping operations during the 2017 and 2018 shipping seasons in the RSA, to support an updated assessment of potential ship strikes and disturbance effects on marine mammals relative to Baffinland's Phase 2 Proposal (Section 7.0). These results have been analyzed and interpreted relative to the scale of impacts that were predicted through a comprehensive review of scientific literature, available empirical data, and through acoustic modelling undertaken for Phase 2.

To investigate behavioural response of narwhal to vessels transiting the Northern Shipping Route, Golder partnered with Fisheries and Oceans Canada (DFO) to undertake a narwhal tagging study during 2017 and 2018 based out of Tremblay Sound, Nunavut. The collaborative research program involved Golder expanding on DFO's existing tagging program by supplying additional biologging tags that were customized to address Baffinland's Project-specific study objectives related to understanding behavioural response of narwhal to vessel traffic. A total of 24 narwhal were live-captured in Tremblay Sound during summer of 2017 and 2018 (20 narwhal in 2017 and four narwhal in 2018) and instrumented with a combination of biologging tags. Biologging tags monitored the fine-scale lateral movements of narwhal, their dive behaviour, and habitat use throughout their summering grounds in the coastal fjord system of northern Baffin Island.

Behavioural response of narwhal to Project ore carriers and other non-Project related vessel traffic present within the Project's RSA was investigated by comparing animal-borne tag data with AIS vessel-tracking data collected during the 2017 and 2018 shipping seasons. Behavioural responses considered in this study included changes in narwhal surface movement (e.g., horizontal displacement, travel speed, habitat re-occupation) and changes in dive behaviour; with the latter component assessing potential changes in surface time, dive rate, bottom dive depth, time at depth, dive duration, and descent speed during encounters with large- (≥100 m in length) and medium-sized vessels (50–99 m in length).

For analysis of narwhal dive behaviour, the dataset included high-resolution dive data obtained for six narwhal, each fitted with a backpack tag possessing Fastloc GPS capability and a MiniPAT tow tag (Wildlife Computers). A total of 92 vessel-narwhal interactions were identified in which the closest point of approach (CPA) between individual narwhal and a given vessel was within 3 km. Subsurface movements of each animal were then analyzed as a function of distance from transiting vessels (CPA to 10 km) in relation to vessel non-exposure (>10 km) periods.

A larger subset of narwhal associated with GPS tag data was incorporated into the surface behaviour analysis as this component was not limited by the small sample size of individuals that were successfully fitted with high resolution dive tags. The dataset used for analysis of surface movement relative to vessel traffic included 14 narwhal fitted with GPS Fastloc location tags (ten SPLASH10 tags and four CTD-SRDL tags). Potential changes in narwhal surface behaviour were also examined as a function of distance from transiting vessels within the 10 km exposure zone and compared against periods of non exposure (> 10 km).

A description of the data collection and analytical methodology for the 2017 and 2018 Integrated Narwhal Tagging study is provided in Golder (2020).

7.1 Summary of Results

The following is a summary of key findings pertaining to narwhal behavioural response to vessel traffic based on a comparison of animal-borne tag data with AIS ship-tracking data during the 2017 and 2018 shipping seasons:

- Narwhal positional data from 2017 and 2018 demonstrated that tagged narwhal occurred in all strata during the summer period but were more common in certain areas of the RSA, namely Milne Inlet South, Koluktoo Bay, Milne Inlet North and Tremblay Sound. High use areas in the RSA included the central portion of Tremblay Sound, the western shore of Milne Inlet North, and most of Koluktoo Bay and Milne Inlet South, particularly in areas south of Bruce Head (i.e., entrance to Koluktoo Bay) and in Assomption Harbour (i.e., Milne Port site). These results were consistent with areas of high narwhal concentrations identified during baseline aerial surveys conducted in the RSA during 2007, 2008, 2013 and 2014 (Elliott et al. 2015; Thomas et al. 2015) prior to the commencement of iron ore shipping along the Northern Shipping Route.
- With respect to interactions between tagged narwhal and existing shipping in the RSA, the majority of the GPS data collected during 2017 and 2018 occurred when narwhal were >10 km from medium- and large-sized vessels (Project and non-Project related). Vessel exposure events (<10 km) occurred throughout the RSA but were more common in the Milne Inlet South and Koluktoo Bay strata due to the confined nature of the channel along this part of the Northern Shipping Route.
- Satellite tag data from 2017 indicated that several of the tagged narwhal moved between Eclipse Sound and Admiralty Inlet during their deployment period. These results supported the notion that some degree of mixing occurs between the Eclipse Sound and Admiralty Inlet stocks during the shipping season.
- Narwhal dive behavioural responses that were shown to be significantly influenced by ship noise and/or close ship encounters included surface time, dive duration, and bottom dives; the latter only during periods when narwhal were engaged in bottom diving at the initial time of vessel exposure. No significant effects were observed for dive rate, time at depth, descent speed, or bottom dives (during periods when narwhal were not actively diving to the bottom at the initial time of exposure). The distance at which significant changes were observed in dive behaviour ranged from 1 to 5 km dependent on the response variable. This corresponded with an exposure period ranging from 7 to 36 min per vessel transit (based on a 9-knot travel speed), with animals returning to their pre-response behaviour following the exposure period (temporary effect). The frequency of this effect was considered intermittent given that vessels were within 5 km of a tagged narwhal for <1% of the GPS datapoints collected in the RSA during 2017 and 2018.
- Narwhal surface movement responses that were shown to be significantly influenced by ship-generated noise included turning angle and orientation relative to vessel (low level severity responses). No significant effects were observed for travel speed, horizontal displacement or habitat re-occupation. The distance at which significant changes were observed in surface movement behaviour ranged from 4 to 10 km dependant on the response variable. This corresponded with an exposure period ranging from 29 to 54 min per vessel transit (based on a 9 knot travel speed), with animals returning to their pre-response behaviour following the exposure period (temporary effect). The frequency of this effect was considered intermittent given that vessels were within 10 km of a tagged narwhal for <7% of the GPS datapoints collected in the RSA during 2017 and 2018. Although no significant effect was observed for horizontal displacement, a clear spatial gap in narwhal positional data was evident in the immediate proximity of the vessel (within 0.5 km of the vessel's port and starboard beam and within 1 km of its bow and stern). This gap may reflect close-range avoidance behaviour but may also be a function of the low-resolution GPS location data available.

Overall, results from the 2017 and 2018 narwhal tagging study supported predictions made in the FEIS for the ERP, in that ship noise effects on narwhal will be limited to temporary, short-term avoidance behaviour, consistent with low to moderate severity responses (Southall et al. 2007; Finneran et al. 2017). No evidence was observed of large-scale avoidance behaviour, displacement effects, or abandonment of the summering grounds (high severity responses), which might in turn result in a population or stock-level consequence (consistent with the definition of a non-significant effect used in the FEIS).

8.0 COMBINED EFFECTS ASSESSSMENT

In their Final Written Submissions (DFO 3.11 (October 2019) and DFO 3.7 (January 2020)), DFO requested that Baffinland conduct an assessment examining all combined effects of the Project. Table 22 addresses this request, and considers both Project incremental and Project combined effects for each marine mammal VEC based on the five key effect pathways identified: vessel strikes, entrapment in ice, acoustic injury, acoustic behavioural disturbance and acoustic masking from shipping operations, along with a determination of significance. A detailed description of the assessment methodology is provided in FEIS Volume 2, Section 3, including the approach used for characterizing residual effects and determining significance.

The previous effects assessment submissions have demonstrated that, following implementation of known and effective mitigation measures, three of these effect pathways (vessel strikes, entrapment and acoustic injury) are not predicted to occur and hence are not predicted to act in combination with the two remaining effect pathways (acoustic disturbance and acoustic masking).

Regarding the combined effect of behavioral disturbance and acoustic masking, it is important to note that acoustic masking is actually a form of behavioural disturbance, with masking effects occurring at the lower level of behavioural impacts in marine mammals (Pine et al. 2018). In essence, these two pathways are already inherently combined, as shown by the identical effect ratings and significance determinations in Table 22. While limited masking from ship noise is predicted to occur for marine mammals in the RSA as demonstrated through acoustic modelling, the levels are comparable to those animals in the RSA already regularly experience from ambient noise sources (i.e., natural weather events), and it is not presently possible to determine or calculate the biological consequence of this effect, if one exists.

Table 22: Updated residual effect ratings and significance determinations for Marine Mammal VECs - Phase 2

Residual Effect	Residual Effect Evaluation Criteria					Significance	Qualifiers**	
	Magnitude	Extent	Frequency	Duration	Reversibility		Probability (Likelihood of Effect Occurring)	Certainty (Confidence in Effects Prediction)
Narwhal (BB and ES*)								
Hearing impairment	-	-	-	-	-	-	I (Unlikely)	III (High)
Disturbance	Level II	Level II	Level II	Level II	Level I	N	II (Moderate)	II (Medium)
Acoustic masking	Level II	Level II	Level II	Level II	Level I	N	II (Moderate)	II (Medium)
Ice entrapment	Level I	Level I	Level I	Level II	Level I	N	I (Unlikely)	III (High)
Ship strikes	Level I	Level I	Level I	Level II	Level I	N	I (Unlikely)	III (High)

Residual Effect	Residual Effect Evaluation Criteria					Significance	Qualifiers**	
	Magnitude	Extent	Frequency	Duration	Reversibility		Probability (Likelihood of Effect Occurring)	Certainty (Confidence in Effects Prediction)
Combined Project Effects	Level II	Level II	Level II	Level II	Level I	N		II (Medium)
Beluga								
Hearing impairment	-	-	-	-	-	-	I (Unlikely)	III (High)
Disturbance	Level II	Level II	Level II	Level II	Level I	N	II (Moderate)	II (Medium)
Acoustic masking	Level II	Level II	Level II	Level II	Level I	N	II (Moderate)	II (Medium)
Ice entrapment	Level I	Level I	Level I	Level II	Level I	N	I (Unlikely)	III (High)
Ship strikes	Level I	Level I	Level I	Level II	Level I	N	I (Unlikely)	III (High)
Combined Project Effects	Level II	Level II	Level II	Level II	Level I	N		II (Medium)
Bowhead whale								
Hearing impairment	-	-	-	-	-	-	I (Unlikely)	III (High)
Disturbance	Level II	Level II	Level II	Level II	Level I	N	II (Moderate)	II (Medium)
Acoustic masking	Level II	Level II	Level II	Level II	Level I	N	II (Moderate)	II (Medium)
Ship strikes	Level I	Level I	Level I	Level II	Level I	N	I (Unlikely)	III (High)
Combined Project Effects	Level II	Level II	Level II	Level II	Level I	N		II (Medium)
Ringed seal								
Hearing impairment	-	-	-	-	-	-	I (Unlikely)	III (High)
Disturbance	Level II	Level II	Level II	Level II	Level I	N	II (Moderate)	II (Medium)
Acoustic masking	Level II	Level II	Level II	Level II	Level I	N	II (Moderate)	II (Medium)
Ship strikes	Level I	Level I	Level I	Level II	Level I	N	I (Unlikely)	III (High)
Change in habitat	Level I	Level I	Level II	Level II	Level I	N	I (Unlikely)	III (High)
Combined Project Effects	Level II	Level II	Level II	Level II	Level I	N		II (Medium)
Polar bear								
Ship strikes	Level I	Level I	Level I	Level II	Level I	N	I (Unlikely)	III (High)
Combined Project Effects	Level 1	Level1	Level 1	Level II	Level I	N		III (High)

Notes:
Magnitude: 1 (Level I) = an effect on the exposed indicator/VEC that results in a change that is not distinguishable from natural variation and is within regulated values; 2 (Level II) = an effect that results in some exceedance of regulated values and/or results in a change that is measurable but allows recovery within one to two generations; 3 (Level III) = an effect predicted to exceed regulated values and/or result in a reduced population size or other long-lasting effect on the subject of the assessment.
Extent: 1 (Level I) = confined to the LSA; 2 (Level II) = beyond the LSA and within the RSA; 3 (Level III) = beyond the RSA
Frequency: 1 (Level I) = infrequent (rarely occurring); 2 (Level II) = frequent (intermittently occurring); 3 (Level III) = continuous
Duration: 1 (Level I) = short-term (<5 years); 2 (Level II) = medium-term (life of Project); 3 (Level III) = long-term (beyond the life of the project) or permanent
Reversibility: 1 (Level I) = fully reversible after activity is complete; 2 (Level II) = partially reversible after activity is complete; 3 (Level III) = non-reversible after the activity is complete. Note: Reversibility is considered for biological VECs at the population level. Therefore, although an effect like mortality is irreversible, the effect at the population level might be reversible.
Significance Rating: S=Significant, N=Not Significant, P=Positive
Qualifiers- only applicable to significant effects**
Probability: 1 (Level I) = unlikely; 2 (Level II) = moderate; 3 (Level III) = likely
Certainty: 1 (Level I) = low; 2 (Level II) = medium; 3 (Level III) = high
*BB: Baffin Bay population; ES: Eclipse Sound summer stock (sub-population)
**Qualifiers provided for at the request of DFO. Inclusion is not consistent with FEIS methodology that indicates qualifiers are only applicable to significant effects.

With the effective implementation of mitigation measures currently in place (e.g., 9 knot speed restriction, 40-km buffer zone, limited icebreaker transits during shoulder season, etc.), it is predicted that the residual combined effects of the Project on marine mammals in the RSA will be limited to temporary and localized avoidance behavior. In summary, when all potential effects on marine mammals are combined, no significant residual effects are predicted for any of the marine mammal VECs in the RSA, that is no effects at the population or stock level, either through mortality or from large-scale displacement or abandonment from the RSA, are anticipated.

9.0 SUMMARY

Baffinland's marine mammal monitoring programs were based on a comprehensive 'multiple lines of evidence' approach for detection of potential Project effects, using an integrated combination of remote sensing and shore-based, vessel-based, aerial-based and acoustic-based monitoring methods. Collectively, these multi-year monitoring programs provided a comprehensive evaluation of potential shipping effects on marine mammals during the shipping period. Potential effects on marine mammals detected as part of this process were evaluated against impact predictions made in the FEIS, and in light of the various mitigation measures presently implemented as part of Baffinland's current shipping operations.

Overall, monitoring results collected to date, in concert with available modelling data, supported impact predictions made in the FEIS Addendum for ERP shipping operations, in that no marine mammal mortalities are anticipated to occur in the RSA from ship strikes, and that acoustic impacts from shipping on marine mammals will be limited to temporary, short-term avoidance behaviour, consistent with low to moderate severity responses (Southall et al. 2007; Finneran et al. 2017). Through the monitoring programs, no evidence has been observed of large-scale avoidance behaviour, displacement effects, or abandonment of the summering grounds (consistent with high severity responses), which might in turn result in a population or stock-level consequence (consistent with the definition of a non-significant effect used in the FEIS).

10.0 CLOSURE

We trust the above meets your present requirements. If you have any questions or require additional information, please contact the undersigned.

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Appendix 4

2018 Tagged Narwhal During Icebreaking

TECHNICAL MEMORANDUM

DATE 15 October 2019 **Reference No.** 1663724-162-TM-Rev0-12000

TO Megan Lord-Hoyle
Baffinland Iron Mines Corporation

CC

FROM Phil Rouget **EMAIL prouget@golder.com**

MOVEMENT OF TAGGED NARWHAL (MONODON MONOCEROS) IN RELATION TO ICEBREAKING OPERATIONS AND ASSOCIATED VESSEL TRAFFIC DURING THE 2018 FALL SHOULDER SEASON

Golder Associates (Golder) partnered with Fisheries and Oceans Canada (DFO) in 2017 and 2018 to undertake a narwhal tagging study based out of Tremblay Sound in the North Baffin Region of Nunavut. The collaborative research program involved Golder expanding on DFO's existing tagging program by supplying additional biologging tags that were customized to address Baffinland's Project-specific study objectives related to understanding behavioural response of narwhal to vessel traffic.

This technical memorandum presents a limited scope relative to this program and has been prepared in response to commitments made by Baffinland Iron Mines Corporation (Baffinland) to assess narwhal (*Monodon monoceros*) behavioral response to Project-related icebreaking operations in support of the Mary River Project (the Project) Phase 2 proposal.

1.0 BACKGROUND

Two narwhal were tagged with a combination of GPS Fastloc location tags (CTD-SRDL; SMRU), pop-up archival dive tow tags (MiniPAT/Mk10PAT; Wildlife Computers), and passive acoustic recording tags (Acousonde 3MB; Greenridge Sciences) during the 2018 Tremblay Sound Narwhal Tagging Program. Both individuals were tagged on 17 August 2018, with narwhal NW21 transmitting ARGOS location data until 08 October 2018 (53 days) and narwhal NW22 transmitting GPS Fastloc location data until 02 November 2018 (76 days). Dive and acoustic data collected for NW21 (24 and 3 days, respectively) and NW22 (20 and 7 days, respectively) did not extend into the fall shoulder season. Therefore, to assess narwhal behavioral response to icebreaking operations and associated vessel traffic, this technical memorandum is focused solely on narwhal positional data collected between 29 September and 17 October 2018, coincident with the period the MSV *Botnica* (97-m icebreaker) was conducting Project-related icebreaking operations along the Northern Shipping Route in the Regional Study Area (RSA) (Figure 1).

Given the limited data presented in this report, the sample size is insufficient for a comprehensive statistical analysis to be undertaken. Instead, narwhal interactions with icebreaking operations and associated vessel traffic are presented for the purpose of visualizing and qualitatively discussing potential behavioral responses of narwhal to icebreaker transits in the RSA during the 2018 fall shoulder season. Statistical analysis of the full extent of the tagging data (i.e., all tags) will be undertaken as part of the 2017/2018 integrated tagging report, which will build on information presented in the 2017 Narwhal Tagging Study – Technical Data Report (Golder 2018). The integrated tagging report will be provided in draft form to the Marine Environmental Working Group (MEWG) in Q1 of 2020.

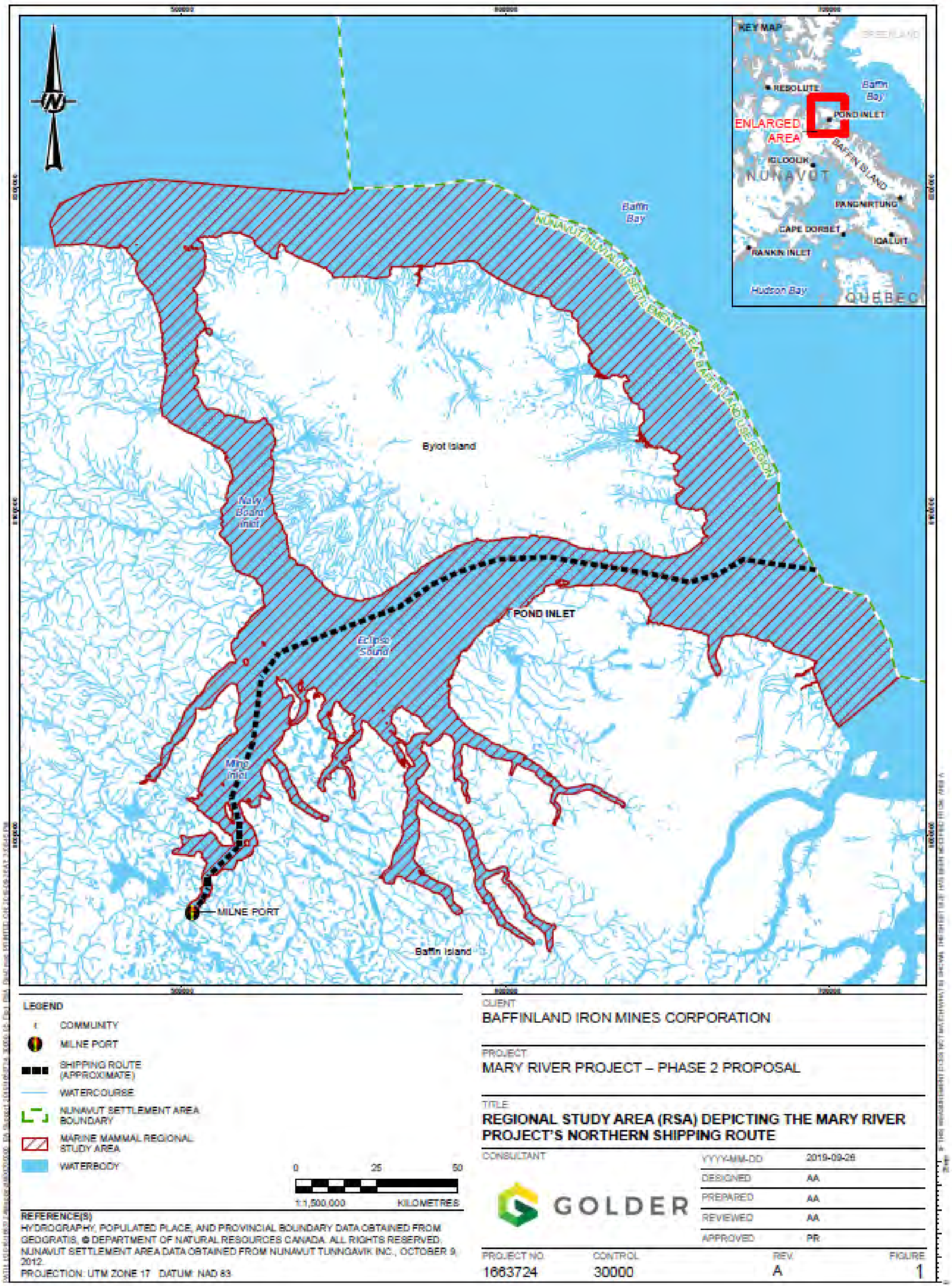

Figure 1: Regional Study Area (RSA) depicting the Mary River Project's Northern Shipping Route

2.0 METHODS

2.1 Narwhal GPS Data Management

Narwhal positional data presented in this technical memorandum were obtained from CTD-SRDL GPS location tags. The CTD-SRDL tag is an ARGOS satellite tag manufactured by Sea Mammal Research Unit (SMRU) Instrumentation that includes sensors to measure horizontal and vertical movement, as well as record water temperature, conductivity, and wet/dry periods to decipher surfacing events. Data collected by the CTD-SRDL tags are summarized and compressed for transmission each time the animal surfaces. Depth data collected by the CTD-SRDL is associated with individual dives and pre-determined depth intervals, not recorded at specific time intervals as in the MiniPAT, Mk10-Pat and Splash-10 tags (Wildlife Computers). Both CTD-SRDL tags were attached to narwhal using a 'backpack' style design with three nylon pins inserted subdermally on the back of the animal.

To reduce erroneous locations, GPS data were filtered to remove all narwhal positions calculated from less than six satellite positions and for which the residual value was ≤30 (Dujon et al. 2014). Where gaps in GPS locations were evident, narwhal positional data were interpolated at 1-min intervals and only raw GPS data or interpolated data within 20 min from a raw GPS point were used for this study. Further details on the approach undertaken to manage narwhal positional data is presented in Golder (2018).

Although both tags deployed on NW21 and NW22 included Fastloc GPS capability, only lower-resolution ARGOS location data were available for NW21 during the fall shoulder season (Fastloc data stopped transmitting several weeks earlier). As such, daily movements of both animals in relation to icebreaking operations and associated vessels are presented for visualization purposes (Appendix A) but location data associated with NW21 is of insufficient resolution to assess behavioral responses during the animal's closest point of approach (CPA) with icebreaking vessels (see Section 2.3).

2.2 Vessel AIS Data Management

Vessel GPS data used in this study were a combination of shore-based and satellite-based Automated Identification System (AIS) data, which provided accurate real-time data on all large vessel passages along the Northern Shipping Route during the 2018 shipping season. AIS is mandatory for all commercial vessels >300 gross tonnage and passenger ships. A shore-based AIS station was installed on a high cliff near Bruce Head, which provided a continuous record of ship positions within line-of-sight of the station, inclusive of Milne Inlet (north and south) and portions of Eclipse Sound and Navy Board Inlet. A second shore-based AIS station in Pond Inlet provided a continuous record of ship positions for the eastern portion of Eclipse Sound and Pond Inlet. Satellite-based AIS data, acquired from exactEarth Ltd[1], was used to supplement vessel position information during periods when there were gaps in the shore-based data. The temporal resolution of the shore-based AIS data was approximately five seconds, whereas the satellite-based AIS data exhibited longer interposition times (ten minutes on average), resulting in a comparatively lower spatial and temporal resolution with respect to vessel position. To best represent vessel movement in the along the Northern Shipping Route during periods when only satellite-based AIS was available, vessel position was interpolated at one-minute intervals.

[1] exactEarth Ltd. Is a data services company that leverages advanced microsatellite technology and globally deployed ground systems to deliver exactAIS™, a global vessel tracking and monitoring system based on world leading space-based advanced AIS detection technology.

Vessels were classified into three categories – small vessels (<50 m in length), medium vessels (≥50 m but <100 m in length), and large vessels (≥100 m in length). For non-icebreaking vessels present in the RSA, only large vessels (≥100 m in length) were used in subsequent analyses. Two icebreaking vessels were present in the RSA during the 2018 fall shoulder season, one procured by Baffinland to provide escort to ore carriers (the MSV Botnica), and another 88-m icebreaker that was not Project-related (Canadian Coast Guard Service (CCGS) Terry Fox). AIS data were filtered to retain only transiting vessels (speed ≥1 knot), to avoid representing interactions between narwhal and stationary vessels.

2.3 Identification of Closest Point of Approach (CPA) Events

Horizontal movements of the single narwhal (NW22) outfitted with a GPS Fastloc tag were analyzed in relation to AIS vessel track data to determine the location and time of narwhal-vessel interactions. Using customized functions in R v. 3.6.1 (R Core Team 2019), the closest point of approach (CPA) was identified for all 'events[2]' in which vessels transiting along the Northern Shipping Route were within 54.4 km of the animal. This distance (54.4 km) was selected based on acoustic modeling results by JASCO Applied Sciences (Quijano et al. 2019) which predicted icebreaker noise would extend above the 120 dB re: 1µPa (SPL_{rms}) disturbance threshold for distances up to 54.4 km (R_{max}), based on a modelled scenario of an icebreaker escorting two Capesize ore carriers through Eclipse Sound in 10/10 ice concentration.

For each narwhal GPS position, all vessel AIS positions recorded within the preceding or following 30 minutes of the timestamp were retrieved and the nearest AIS position to a given narwhal location was identified. Of these, the points in time when the distance between the narwhal and the vessel decreased and then increased were retrieved as potential CPA points. These "potential" CPA points were further assessed in a second step, so that only a single CPA point within each 6-h time period was retained. A CPA event was then defined as the ±3 h time window around each CPA timestamp. As a quality control measure, animations were created depicting real-time movements of NW22 in relation to transiting ships over the period of interest (29 September– 17 October 2018). Visual examination of the animations allowed the analyst to confirm individual CPA events and qualitatively assess the movements of NW22 in relation to icebreaking operations and associated vessel traffic in greater detail. For each CPA event (i.e., each narwhal-vessel interaction within ±3 h from a CPA point), two plots were then generated. The first plot included a zoomed-out map depicting the horizontal relocations of individual narwhal in relation to the vessel in the ±3 h from the CPA timestamp. The second plot included a zoomed-in map showing the finer resolution movements for the same narwhal during the same time period. All analyses and plotting were performed in R v.3.6.1 (R Core Team 2019).

3.0 RESULTS

3.1 Narwhal Interactions with All Vessel Types

Both NW21 and NW22 remained in the vicinity of the Northern Shipping Route for extended periods during the 2018 fall shoulder season, despite being exposed to thickening ice conditions, icebreaking operations and associated vessel traffic. Although the ARGOS location data associated with NW21 were not of sufficient resolution to assess fine scale movements of this animal in relation to icebreaker movements, it is evident from

[2] Event = the 6 h time period associated with each CPA (3 h before and 3 h after CPA), where the whale-vessel distance was ≤54.4 km along the Northern Shipping Route. Events more than 3 h apart, even of the same narwhal with the same vessel, are considered different events.

the daily narwhal tracks presented in Figures A-1 to A-19 (Appendix A) that exposure to icebreaker and ship traffic during this time did not result in displacement of either narwhal from the RSA.

In general, NW22 had multiple close encounters with all vessel types throughout the fall shoulder season and did not appear to actively avoid icebreaking operations and associated vessel traffic as the season progressed (Figure 2). A total of 84 CPA events were identified in which NW22 was within 54.4 km of active vessel transits. Of these, 26 events were with icebreakers, 47 with ore carriers, 6 with fuel tankers, and 5 with cargo vessels. NW22's closest encounters with the different types of Project vessels were as follows:

- Icebreaker: 0.84 km (15 October 2018; MSV *Botnica*)
- Ore carrier: 1.66 km (02 October 2018; *Nordic Orion*),
- Fuel tanker: 4.25 km (14 October 2018; *Sarah Desgagnés*)
- Cargo vessel: 1.32 km (10 October 2018; *Zelada Desgagnés*).

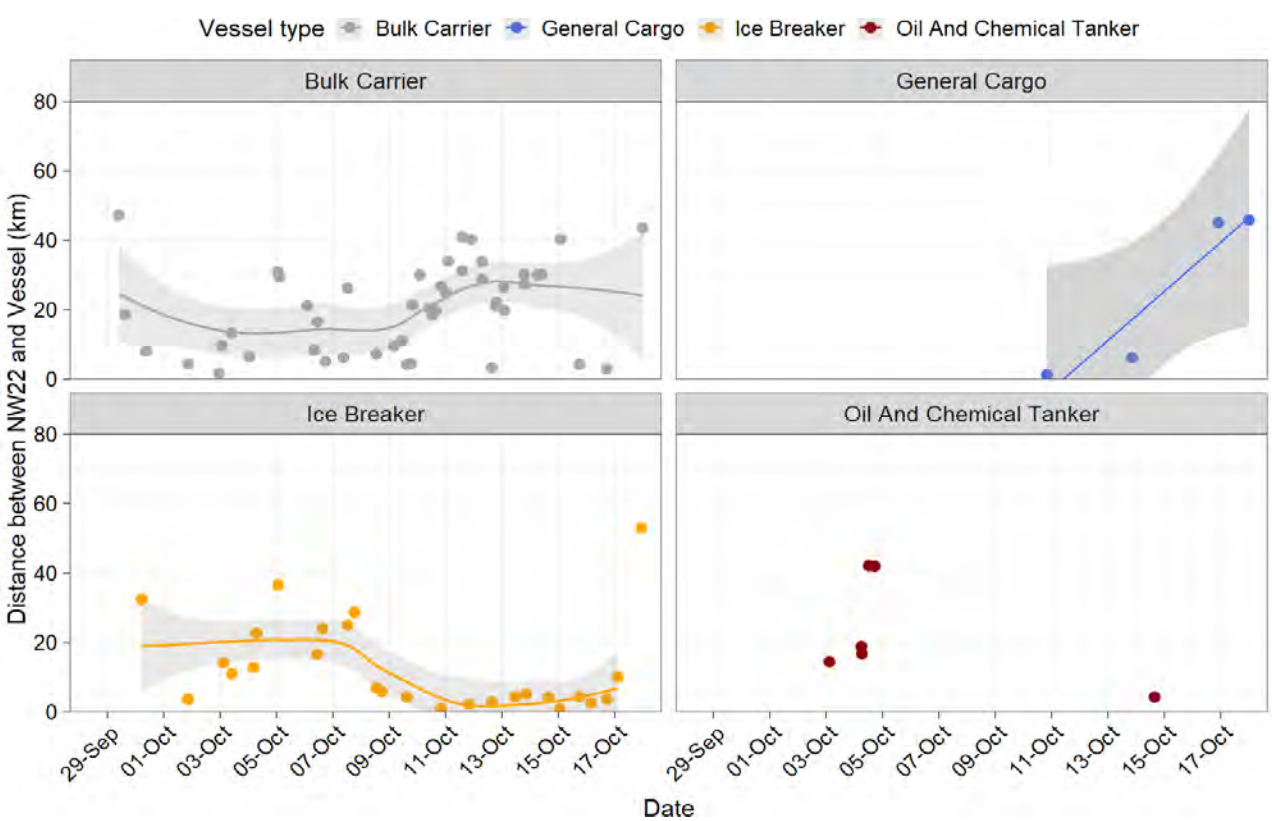

Figure 2: Closest points of approach (CPAs) of NW22 with different vessel classes during the 2018 Fall shoulder season (29 September - 17 October 2018)

3.2 Narwhal Interactions with Icebreaking Operations

Of the total 84 CPA events identified for NW22 within 54.4 km from active vessel transits, 25 events occurred in relation to icebreaking transits undertaken by the MSV *Botnica* and one event occurred in relation to icebreaking transits by the CCGS *Terry Fox* (Table 1; Figure 3 through Figure 11. Other Project-related vessels present during close encounters of NW22 with icebreaker transits are noted in Table 1 and presented as black hatched tracks in Figure 3 through Figure 11. In general, each of the 26 CPA events identified represents the closest encounter of NW22 with icebreaking operations during one active vessel transit in/out of Eclipse Sound, although transits by the icebreaker and associated vessel traffic did not always extend the full extent of the route between Milne Port and the eastern edge of the RSA (e.g. CPA events 1 and 7). The distance between NW22 and an icebreaker during active transits (CPA < 54.4 km) ranged between 0.84 km and 52.97 km.

Table 1: Closest point of approach (CPA) events of NW22 within 54.4 km of icebreaking vessels. All CPA events presented are interactions of NW22 with the MSV *Botnica*, except for CPA event #6 which is an interaction of NW22 with the CCGS *Terry Fox*

CPA Event	Date	Time (UTC)	Average Vessel Speed (kts)	CPA Distance (km)	Ice Concentration @ CPA	Escort / Other Vessels Present
1	30 September 2018	5:16:24	8.1	32.47	< 1/10	Eastward with *Golden Ice* until CPA, then turned back westward while *Golden Ice* continued out of RSA.
2	1 October 2018	20:29:31	8.3	3.60	7-8/10	Eastward with NS *Yakutia*.
3	3 October 2018	02:43:24	8.8	14.21	< 1/10	Westward with *Sarah Desgagnés*; *Golden Opportunity also* nearby, heading westward; *Nordic Orion* also nearby, heading eastward.
4	3 October 2018	09:59:24	8.6	11.06	9-10/10	Eastward without escort; *Golden Pearl* also nearby, heading westward.
5	4 October 2018	04:27:24	8.7	12.78	9-10/10	Westward without escort. CCGS *Terry Fox* with *Kitikmeot W* and *Qikiqtaaluk W* also nearby, heading south from Navy Board Inlet; *Nordpol* also nearby.

CPA Event	Date	Time (UTC)	Average Vessel Speed (kts)	CPA Distance (km)	Ice Concentration @ CPA	Escort / Other Vessels Present
6	4 October 2018	06:46:24	6.2	22.69	9-10/10	South and then eastward with *Kitikmeot W* and *Qikiqtaaluk W*; *Botnica* also nearby, heading westward; *Nordpol* also nearby.
7	5 October 2018	1:30:24	7.9	36.58	9-10/10	Eastward with *Golden Opportunity* until CPA and then westward with *Golden Amber*.
8	6 October 2018	10:32:24	8.3	16.54	9-10/10	Eastward with *Golden Pearl*; *Nordic Odin* also nearby.
9	6 October 2018	15:04:24	8.4	23.99	9-10/10	Westward[3] without escort (departed *Golden Pearl* in middle of Eclipse Sound to return west). *Nordic Odin* also nearby.
10	7 October 2018	12:34:24	8.1	25.01	9-10/10	Eastward with *Nordpol*; *Nordic Odin* also nearby.
11	7 October 2018	18:26:24	8.3	28.61	9-10/10	Westward without escort (departed *Nordpol* in middle of Eclipse Sound to return west).
12	8 October 2018	12:56:24	8.4	6.96	9-10/10	Eastward with *Golden Amber*
13	8 October 2018	17:48:36	8.5	5.78	9-10/10	Westward without escort; *Golden Amber* moving eastward.
14	9 October 2018	14:51:24	6.9	4.23	9-10/10	Eastward with *Nordic Olympic*; *Nordic Odyssey* and *Arkadia* also nearby.

[3] Note that the arrow showing vessel direction of travel in Figure 5 does not point west due to the initial part of the track being oriented eastward.

CPA Event	Date	Time (UTC)	Average Vessel Speed (kts)	CPA Distance (km)	Ice Concentration @ CPA	Escort / Other Vessels Present
15	10 October 2018	20:02:24	7.0	0.95	9-10/10	Westward with *Zelada Desgagnés*; Nordic Odyssey and *Arkadia* also nearby.
16	11 October 2018	19:51:24	6.7	2.11	9-10/10	Eastward without escort; *Nordic Odyssey* and *Arkadia* also nearby.
17	12 October 2018	15:23:29	7.1	2.74	9-10/10	Westward with *Nordic Oshima*; *Nordic Odyssey* and *Arkadia* also nearby.
18	13 October 2018	11:10:24	7.7	4.37	9-10/10	Eastward without escort.
19	13 October 2018	20:34:24	7.8	5.14	9-10/10	Westward with *Qamutik*; *Nordic Odyssey* and *Arkadia* also nearby.
20	14 October 2018	15:39:24	8.3	4.11	9-10/10	Eastward with *Sarah Desgagnés*. *Nordic Odyssey* also nearby.
21	15 October 2018	1:12:24	8.1	0.84	9-10/10	Westward without escort. *Nordic Odyssey* also nearby.
22	15 October 2018	17:55:24	6.4	4.30	9-10/10	Eastward with *Nordic Odin*.
23	16 October 2018	04:02:24	7.9	2.53	9-10/10	Westward without escort.
24	16 October 2018	17:30:24	6.5	3.64	9-10/10	Eastward with *Nordic Oshima*
25	17 October 2018	02:39:24	8.2	10.02	9-10/10	Westward without escort; *Zelada Desgagnés* also nearby.
26	17 October 2018	22:36:24	7.6	52.97	7-8/10	Eastward with *Arkadia* and *Zelada Desgagnés*

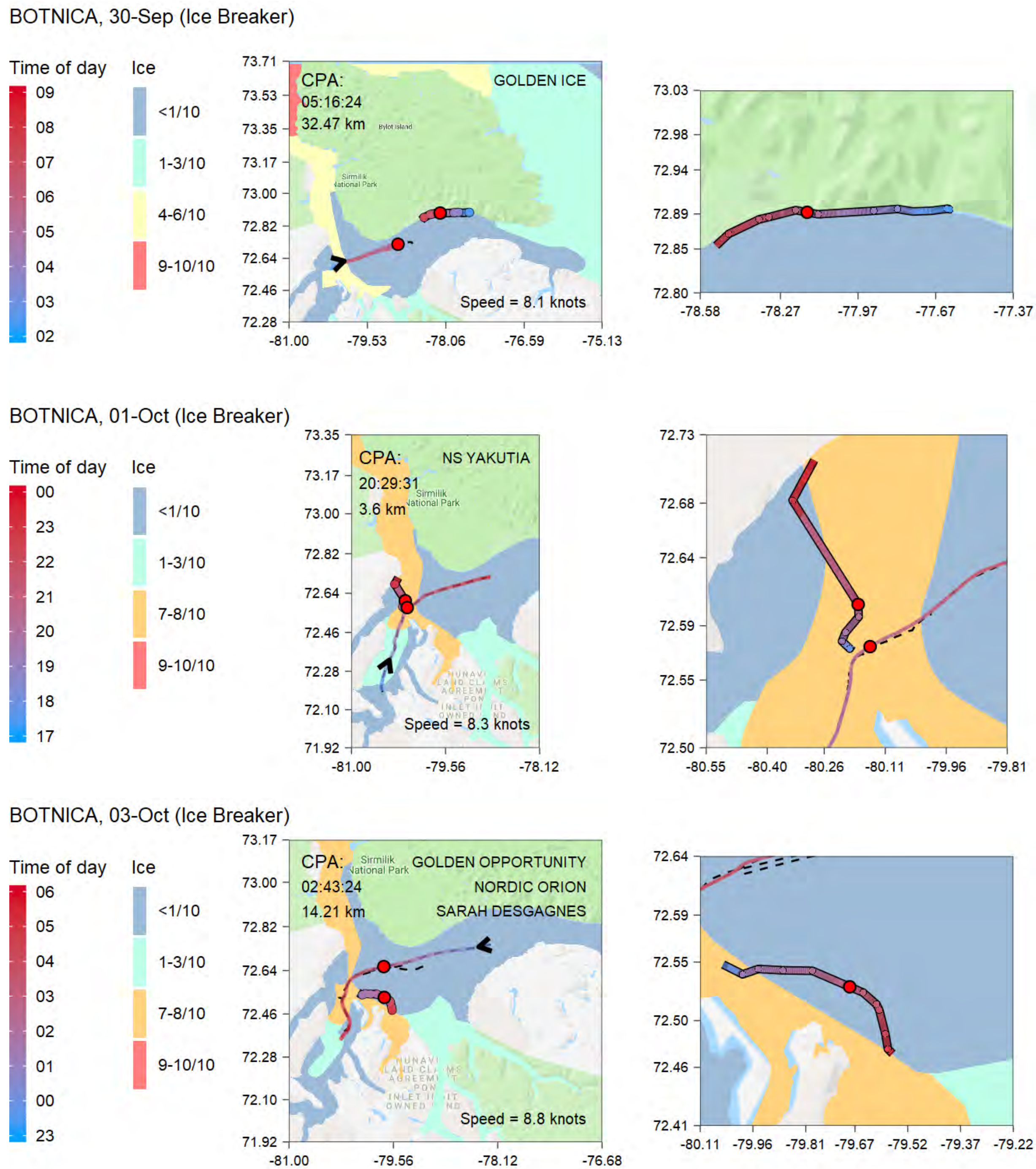

Figure 3: Closest point of approach (CPA) events of NW22 within 54.4 km of icebreaking operations and associated vessel traffic during the 2018 fall shoulder season (29 September - 17 October 2018; CPA events 1 through 3). The left panel shows the track of NW22 (thick line, color-coded for time) in relation to the icebreaker track (thin line, color-coded for time; average speed specified) and associated vessel tracks (black hatched lines; vessel names specified). The right panel is zoomed in to better illustrate the fine-scale movements of NW22. The CPA between NW22 and the icebreaking vessel is represented by a red dot on both the narwhal and the vessel tracks. Daily ice concentrations are also provided.

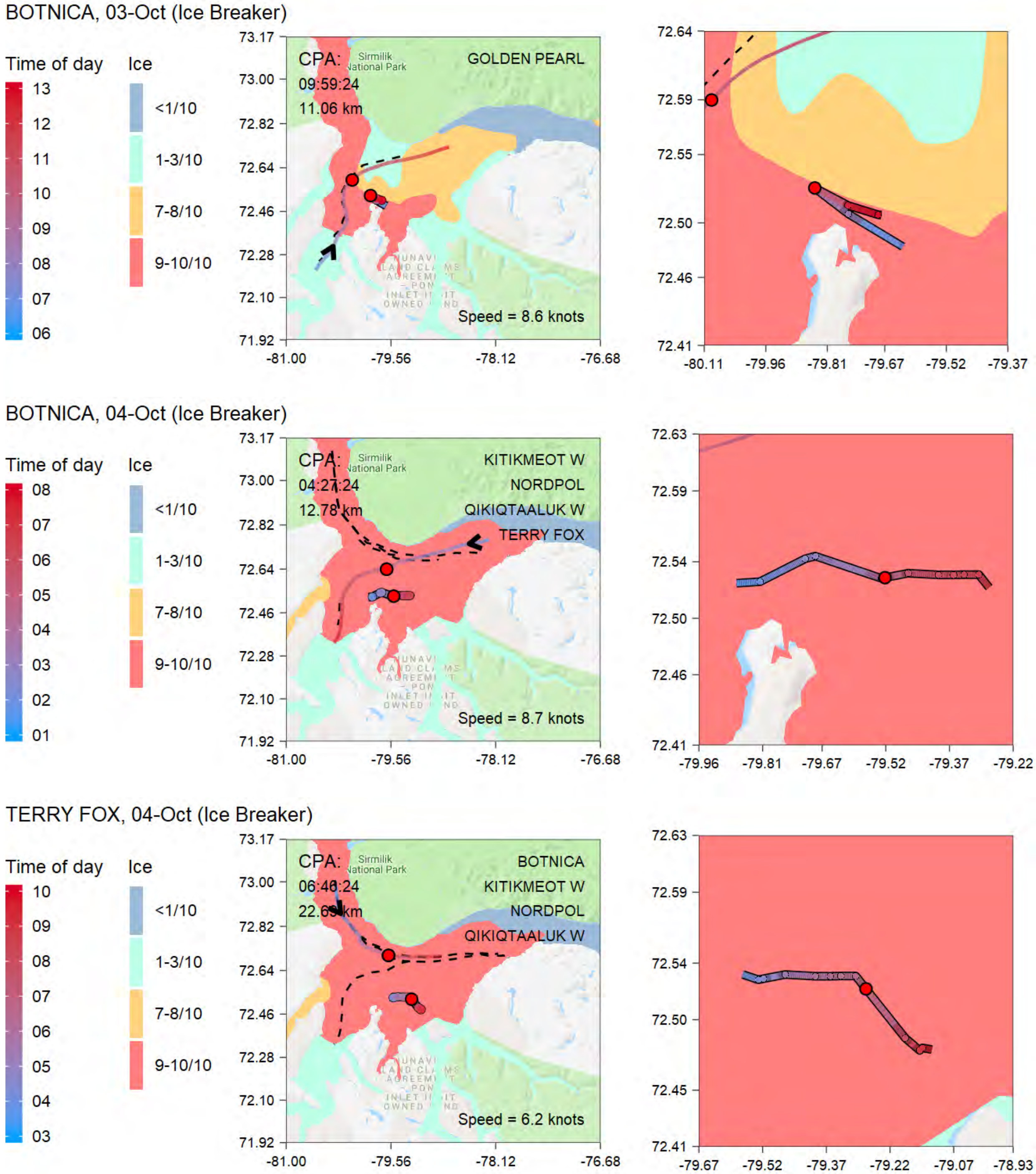

Figure 4: Closest point of approach (CPA) events of NW22 within 54.4 km of icebreaking operations and associated vessel traffic during the 2018 fall shoulder season (29 September - 17 October 2018; CPA events 4 through 6). The left panel shows the track of NW22 (thick line, color-coded for time) in relation to the icebreaker track (thin line, color-coded for time; average speed specified) and associated vessel tracks (black hatched lines; vessel names specified). The right panel is zoomed in to better illustrate the fine-scale movements of NW22. The CPA between NW22 and the icebreaking vessel is represented by a red dot on both the narwhal and the vessel tracks. Daily ice concentrations are also provided.

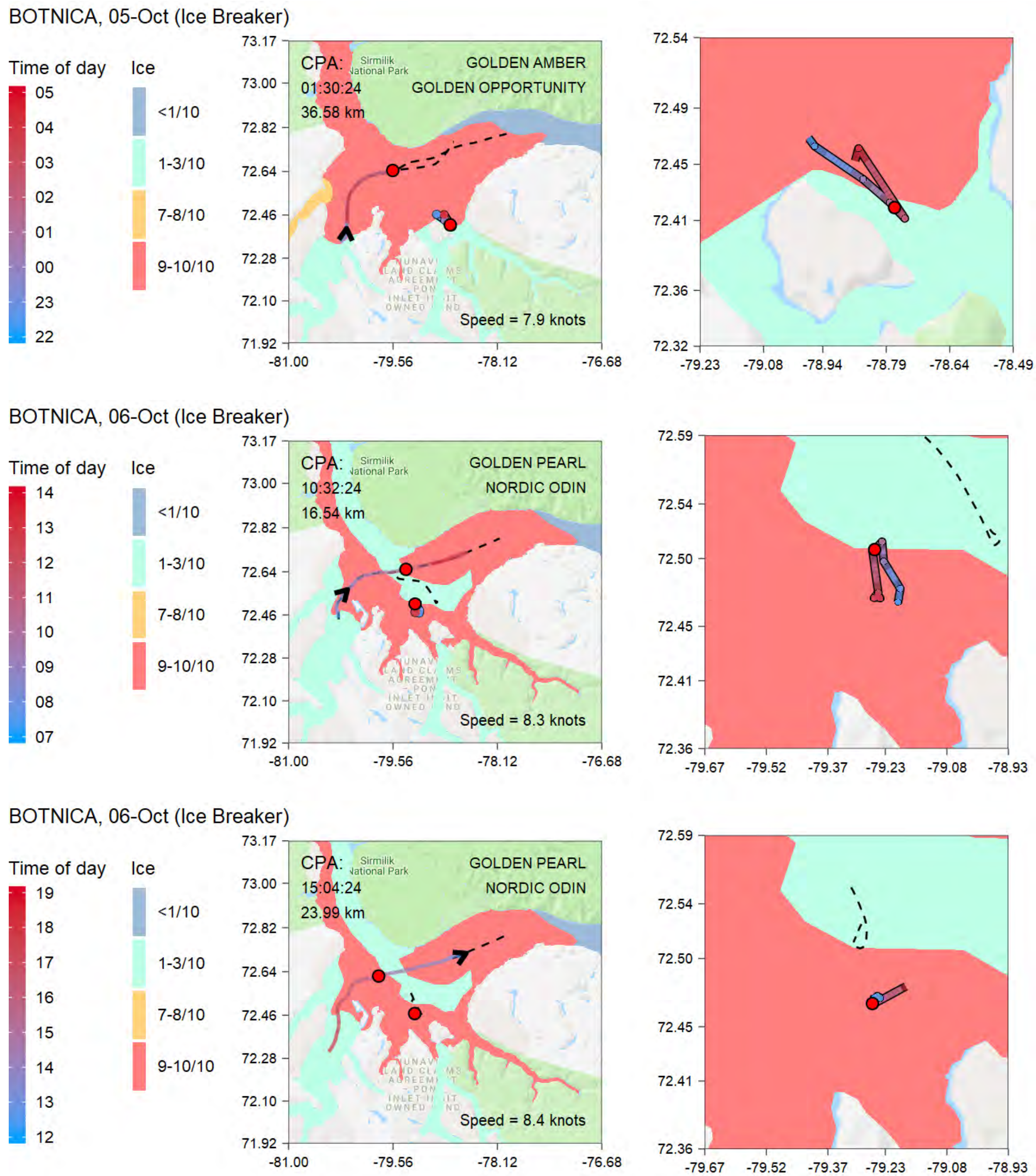

Figure 5: Closest point of approach (CPA) events of NW22 within 54.4 km of icebreaking operations and associated vessel traffic during the 2018 fall shoulder season (29 September - 17 October 2018; CPA events 7 through 9). The left panel shows the track of NW22 (thick line, color-coded for time) in relation to the icebreaker track (thin line, color-coded for time; average speed specified) and associated vessel tracks (black hatched lines; vessel names specified). The right panel is zoomed in to better illustrate the fine-scale movements of NW22. The CPA between NW22 and the icebreaking vessel is represented by a red dot on both the narwhal and the vessel tracks. Daily ice concentrations are also provided.

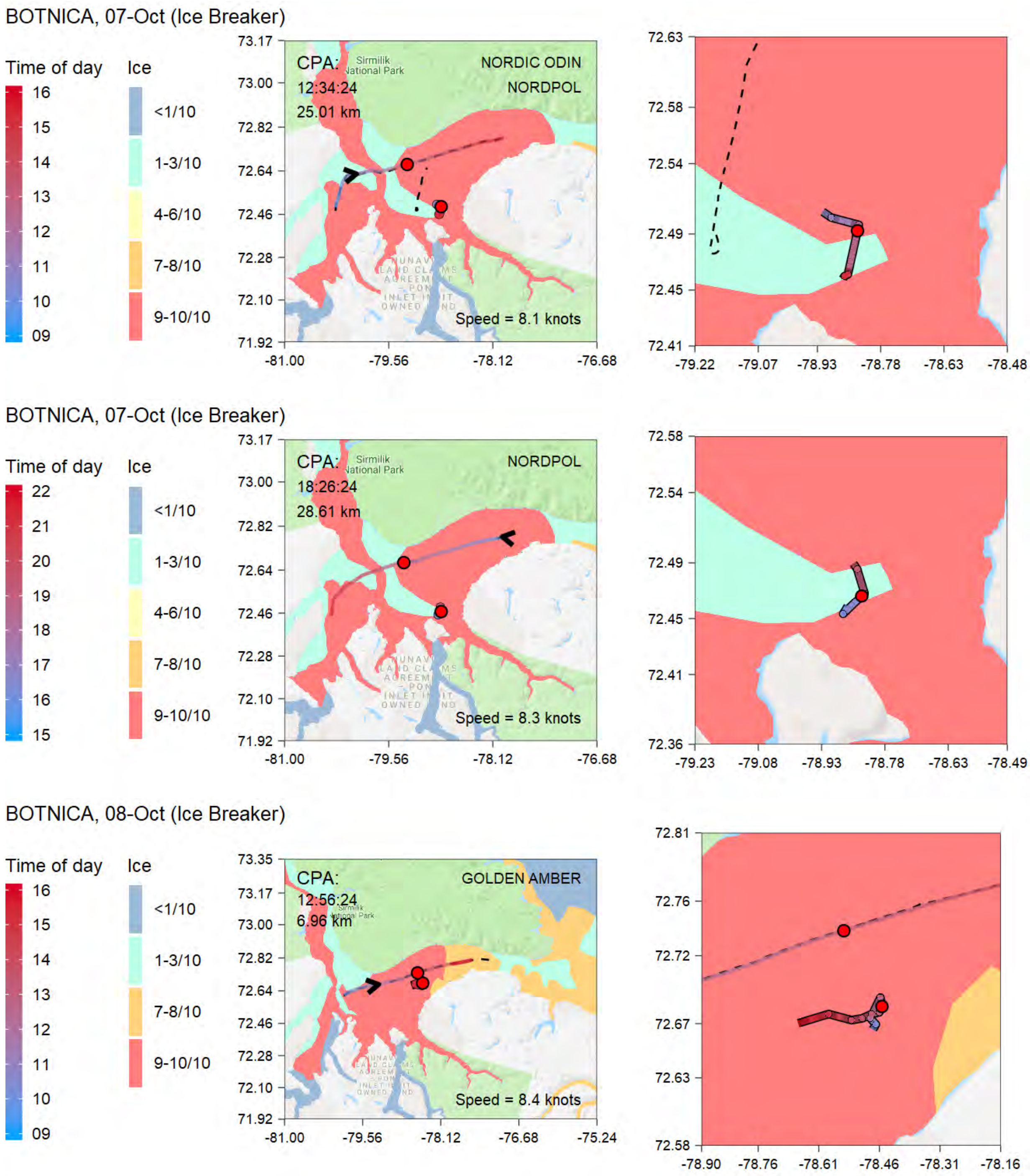

Figure 6: Closest point of approach (CPA) events of NW22 within 54.4 km of icebreaking operations and associated vessel traffic during the 2018 fall shoulder season (29 September - 17 October 2018; CPA events 10 through 12). The left panel shows the track of NW22 (thick line, color-coded for time) in relation to the icebreaker track (thin line, color-coded for time; average speed specified) and associated vessel tracks (black hatched lines; vessel names specified). The right panel is zoomed in to better illustrate the fine-scale movements of NW22. The CPA between NW22 and the icebreaking vessel is represented by a red dot on both the narwhal and the vessel tracks. Daily ice concentrations are also provided.

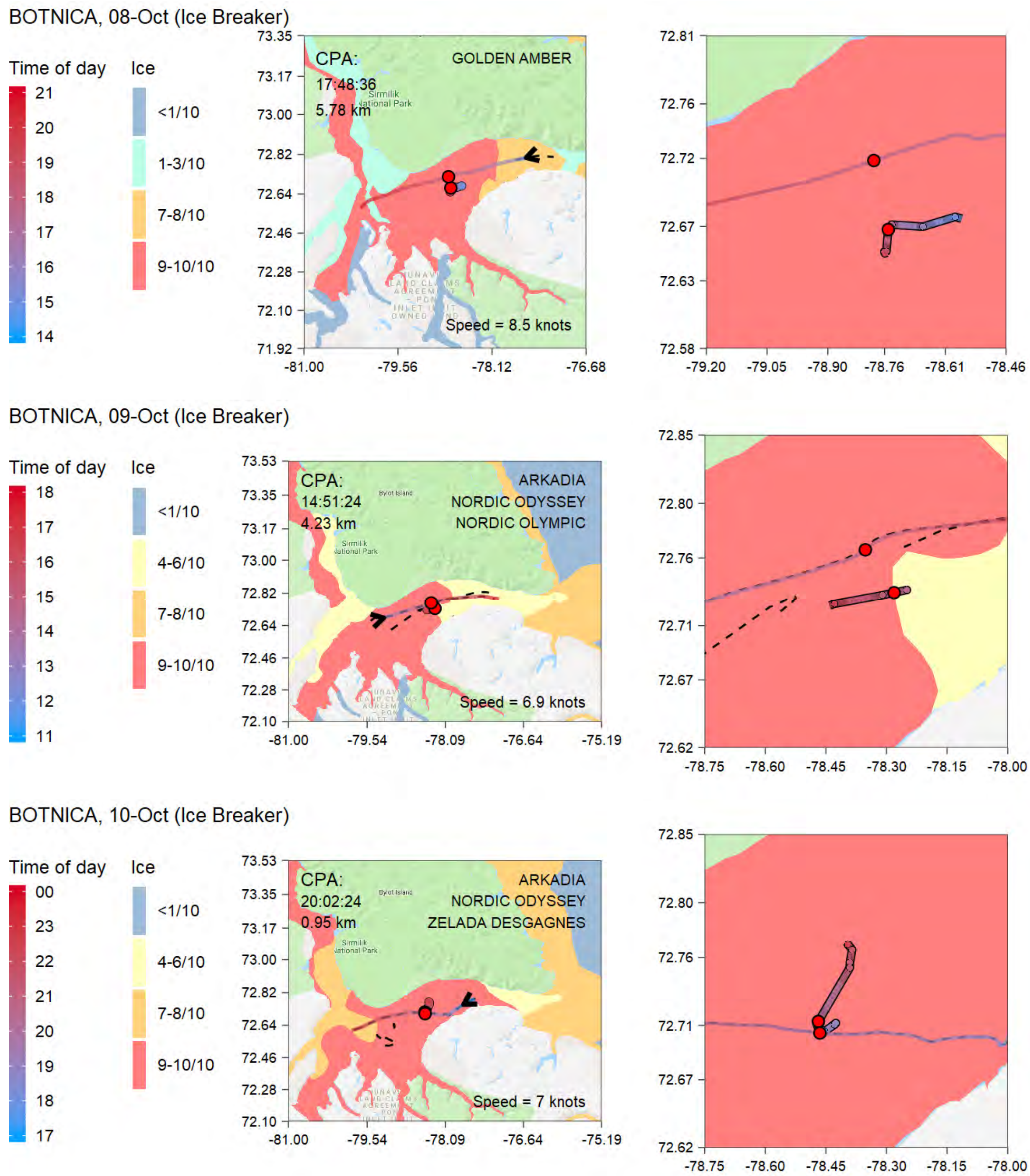

Figure 7: Closest point of approach (CPA) events of NW22 within 54.4 km of icebreaking operations and associated vessel traffic during the 2018 fall shoulder season (29 September - 17 October 2018; CPA events 13 through 15). The left panel shows the track of NW22 (thick line, color-coded for time) in relation to the icebreaker track (thin line, color-coded for time; average speed specified) and associated vessel tracks (black hatched lines; vessel names specified). The right panel is zoomed in to better illustrate the fine-scale movements of NW22. The CPA between NW22 and the icebreaking vessel is represented by a red dot on both the narwhal and the vessel tracks. Daily ice concentrations are also provided.

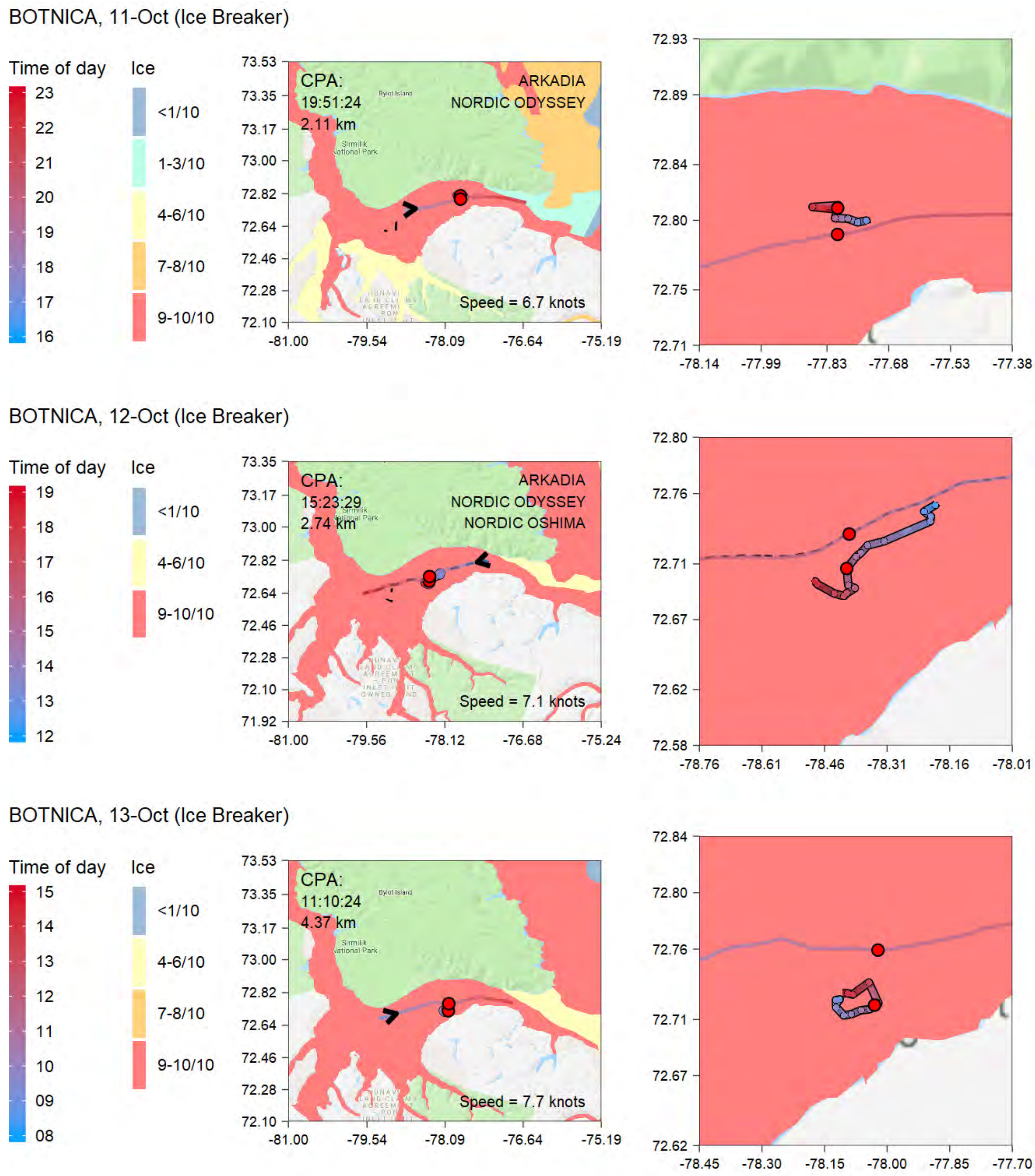

Figure 8: Closest point of approach (CPA) events of NW22 within 54.4 km of icebreaking operations and associated vessel traffic during the 2018 fall shoulder season (29 September - 17 October 2018; CPA events 16 through 18). The left panel shows the track of NW22 (thick line, color-coded for time) in relation to the icebreaker track (thin line, color-coded for time; average speed specified) and associated vessel tracks (black hatched lines; vessel names specified). The right panel is zoomed in to better illustrate the fine-scale movements of NW22. The CPA between NW22 and the icebreaking vessel is represented by a red dot on both the narwhal and the vessel tracks. Daily ice concentrations are also provided.

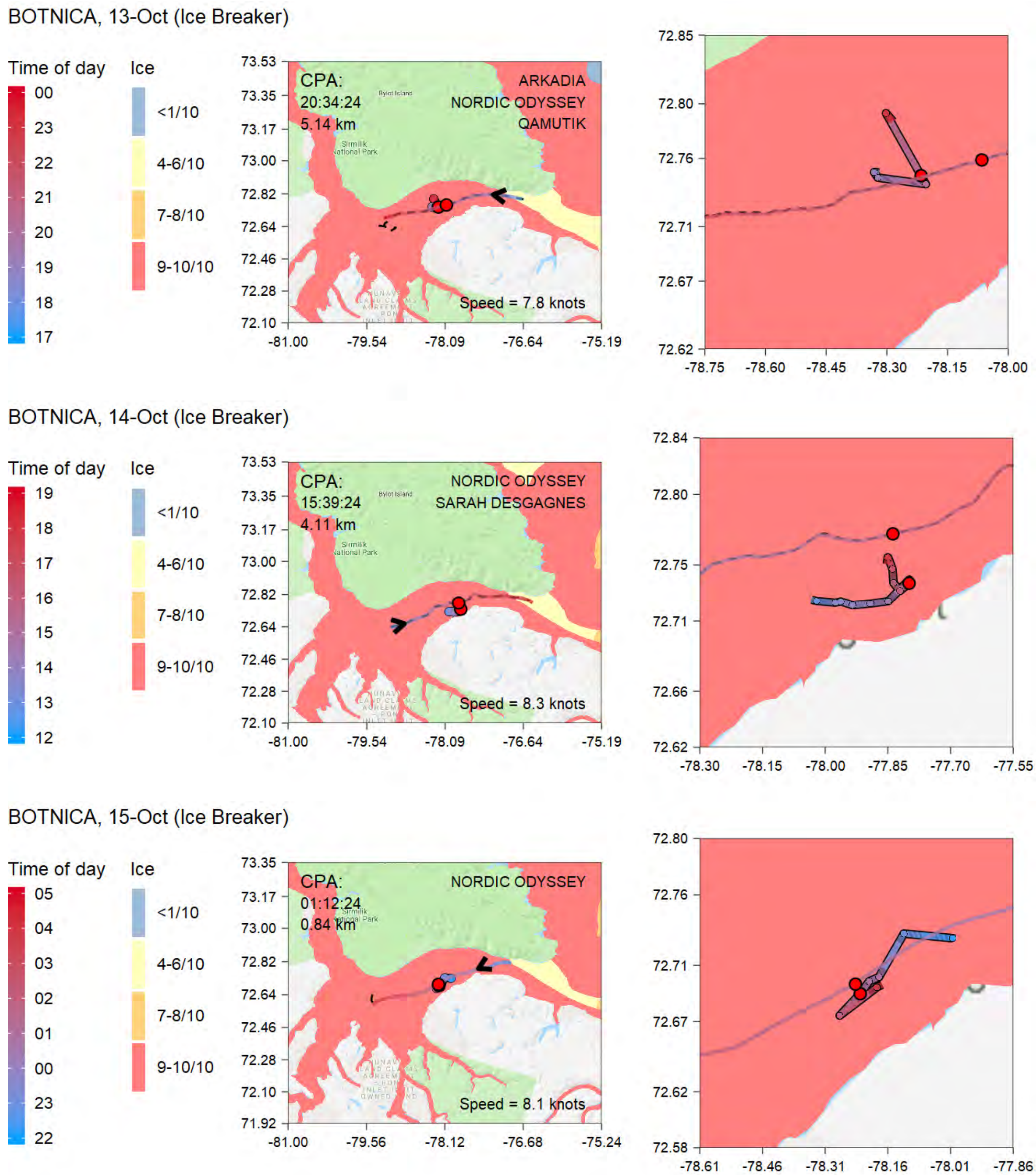

Figure 9: Closest point of approach (CPA) events of NW22 within 54.4 km of icebreaking operations and associated vessel traffic during the 2018 fall shoulder season (29 September - 17 October 2018; CPA events 19 through 21). The left panel shows the track of NW22 (thick line, color-coded for time) in relation to the icebreaker track (thin line, color-coded for time; average speed specified) and associated vessel tracks (black hatched lines; vessel names specified). The right panel is zoomed in to better illustrate the fine-scale movements of NW22. The CPA between NW22 and the icebreaking vessel is represented by a red dot on both the narwhal and the vessel tracks. Daily ice concentrations are also provided.

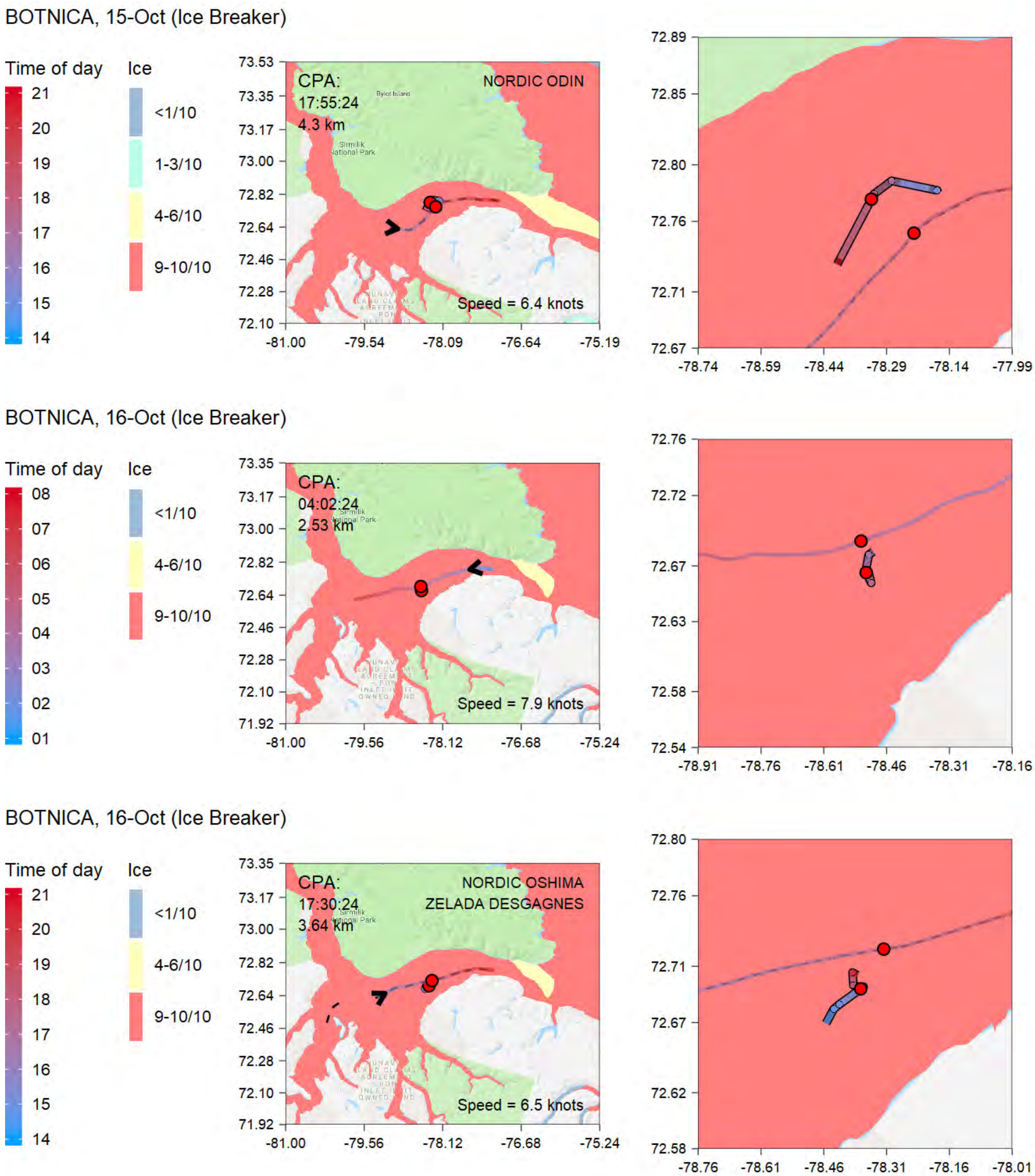

Figure 10: Closest point of approach (CPA) events of NW22 within 54.4 km of icebreaking operations and associated vessel traffic during the 2018 fall shoulder season (29 September - 17 October 2018; CPA events 22 through 24). The left panel shows the track of NW22 (thick line, color-coded for time) in relation to the icebreaker track (thin line, color-coded for time; average speed specified) and associated vessel tracks (black hatched lines; vessel names specified). The right panel is zoomed in to better illustrate the fine-scale movements of NW22. The CPA between NW22 and the icebreaking vessel is represented by a red dot on both the narwhal and the vessel tracks. Daily ice concentrations are also provided.

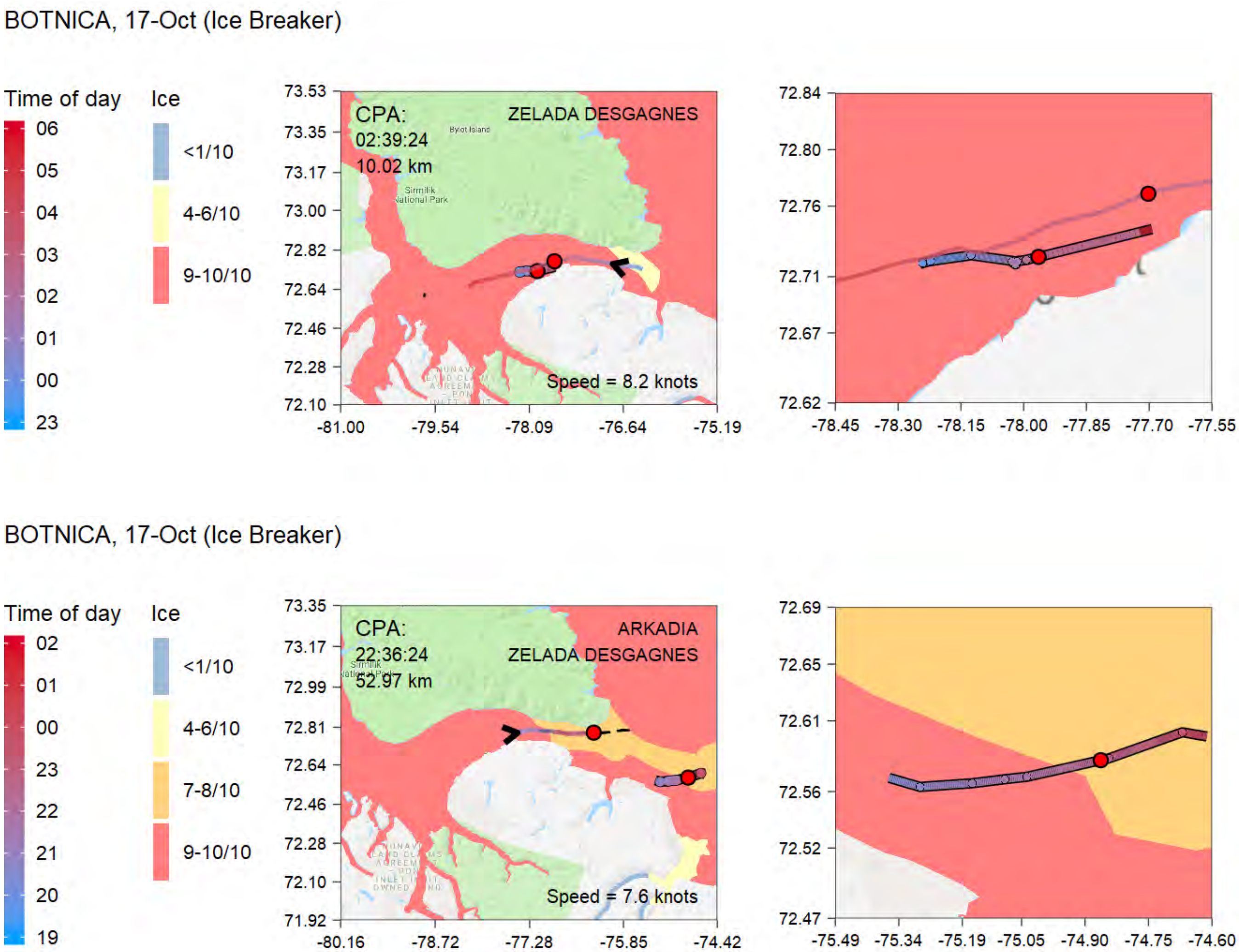

Figure 11: Closest point of approach (CPA) events of NW22 within 54.4 km of icebreaking operations and associated vessel traffic during the 2018 fall shoulder season (29 September - 17 October 2018; CPA events 25 and 26). The left panel shows the track of NW22 (thick line, color-coded for time) in relation to the icebreaker track (thin line, color-coded for time; average speed specified) and associated vessel tracks (black hatched lines; vessel names specified). The right panel is zoomed in to better illustrate the fine-scale movements of NW22. The CPA between NW22 and the icebreaking vessel is represented by a red dot on both the narwhal and the vessel tracks. Daily ice concentrations are also provided.

3.3 Percent Time in Disturbance and Avoidance Zones

Throughout the 19 day study period, NW22 remained within 54.4 km of a transiting icebreaker 47.4% of the time[4] (Figure 12), corresponding with the range associated with acoustic disturbance (i.e., 120 dB) based on acoustic modeling (Figure 12). During the same period, NW22 remained within 13.4 km of a transiting icebreaker 8.7% of the time[5], corresponding with the range associated with narwhal avoidance behaviour (i.e., 135 dB) as modeled for the same scenario (Richardson et al. 1995; Golder 2019a). NW22 interacted more closely with icebreaking operations toward the latter part of the fall shoulder season (Figure 13). Of note, NW22 became increasingly associated with transiting icebreakers and associated vessel traffic beginning on 08 October 2018, consistently spending approximately 12-24% of its total time within 13.4 km of the icebreaker which is the range associated with potential avoidance (i.e., 135 dB), as modeled by JASCO Applied Sciences (Quijano et al. 2019). Time reported within the modeled disturbance and avoidance zones is based on total data available within 100 km of the animal, as breaks in both the AIS and the GPS location data prevent analysis of the full extent of movements by NW22 in relation to transiting vessels.

[4] Based on available data within 100 km from whale.

[5] Based on available data within 100 km from whale.

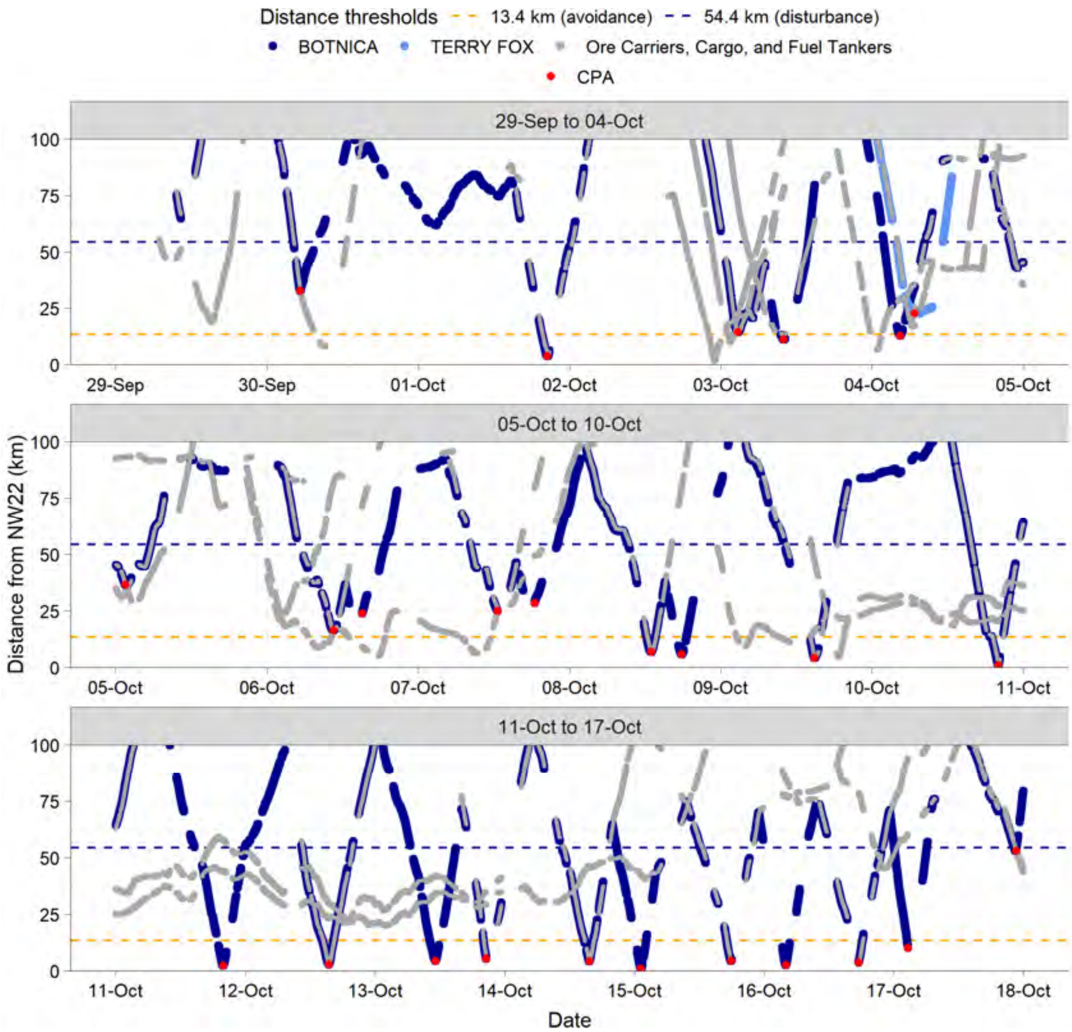

Figure 12: Distance (km) of NW22 from icebreaking operations and associated vessel traffic between 29 September – 17 October 2018. The 54.4 km distance associated with acoustic disturbance (i.e. 120 dB re: 1 μPa) is represented by the blue hatched line and the 13.4 km distance associated with avoidance (i.e. 135 dB re: 1 μPa) is represented by the orange hatched line.

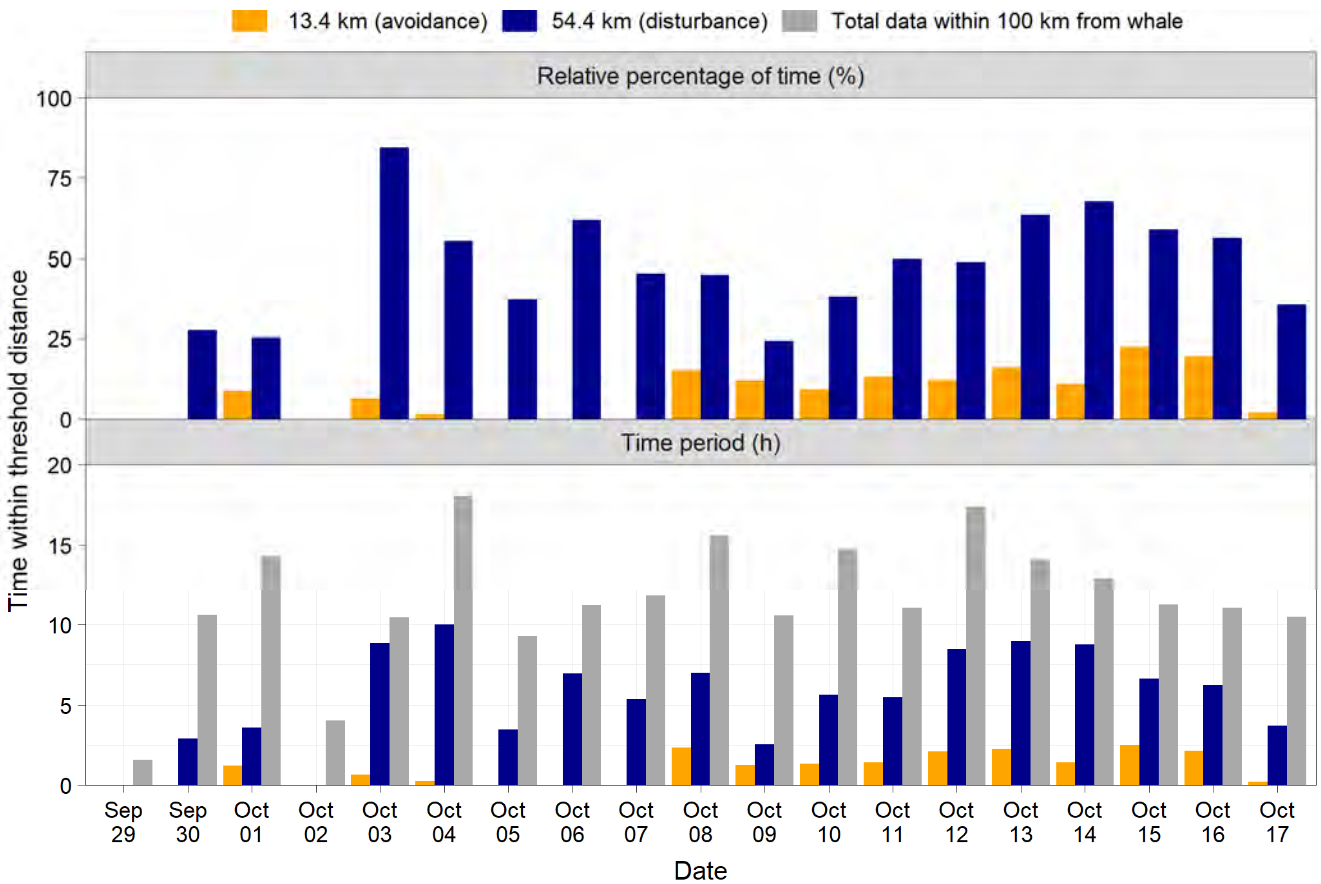

Figure 13: Relative percentage of time (%) that NW22 spent in the disturbance and avoidance zones of icebreaking operations (top plot). Number of hours that NW22 spent in the disturbance and avoidance zones of icebreaking operations, and total number of hours where data within 100 km from whale were available (bottom plot).

3.4 Distance and Time Since Crossing of NW22 over Vessel Tracks

NW22 made regular crossings to the bow and the stern of all vessel types during the 2018 fall shoulder season (Figure 14). However, NW22 did not cross behind the stern of icebreaking vessels or associated vessel traffic for a period of 4.5 hours following an active transit. This 4.5 h lag in entering a ship's sternward track was not evident in relation to any other vessel type when reviewing the track crossings of all narwhal tagged during the full extent of the 2017 and 2018 shipping seasons (Figure 15).

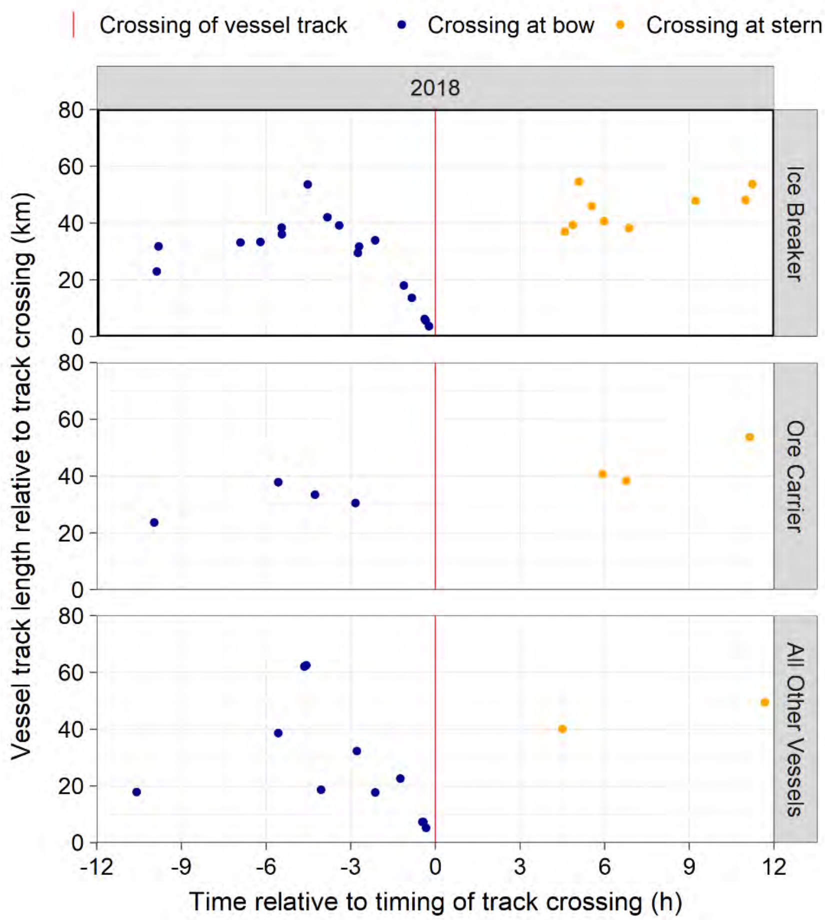

Figure 14: Distance (km) and time since crossing (h) of NW22 over vessel tracks during the 2018 fall shoulder season (29 September - 17 October 2018).

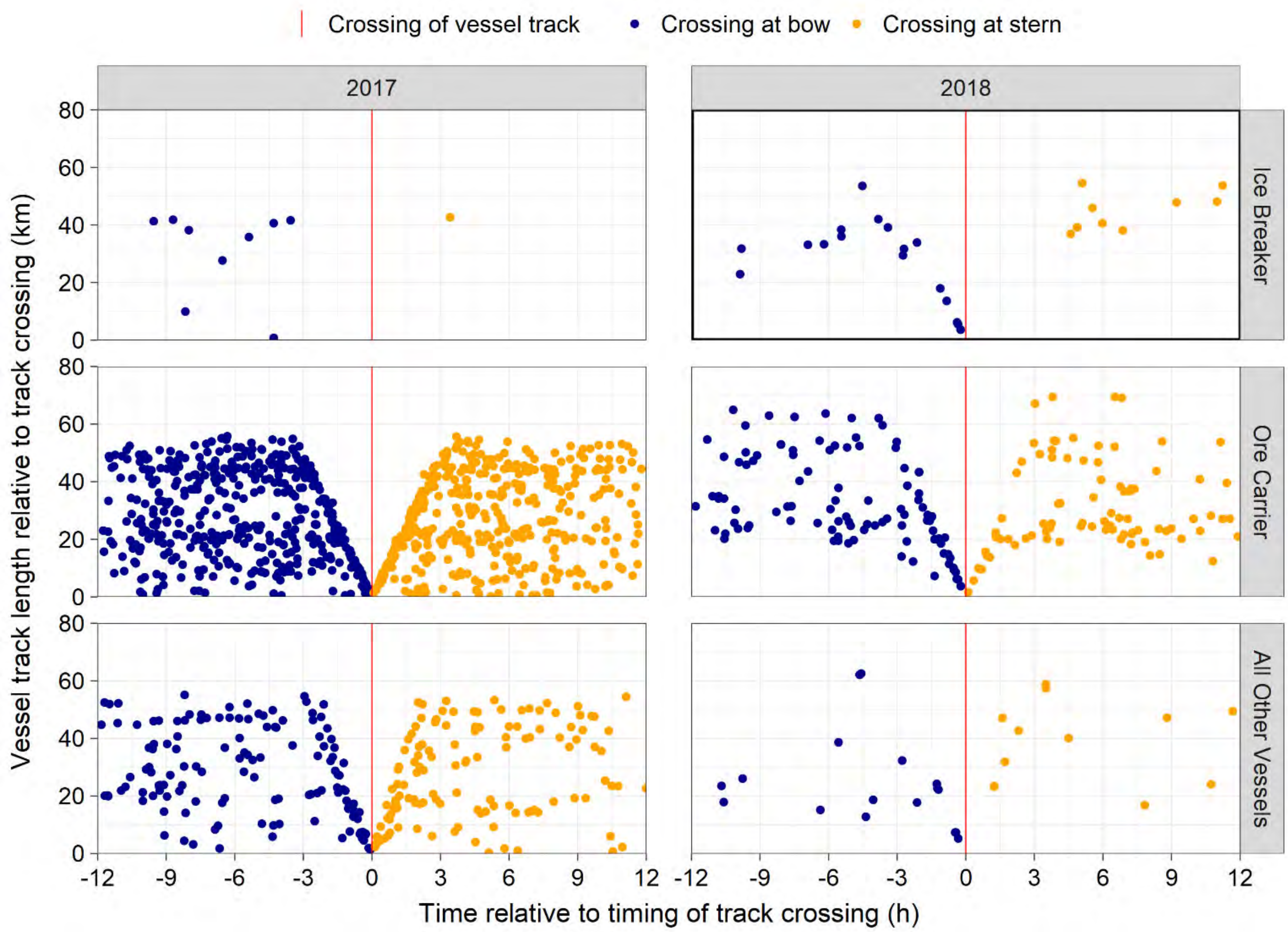

Figure 15: Distance (km) and time since crossing (h) over vessel tracks of all narwhal tagged during the full extent of the 2017 and 2018 shipping seasons.

4.0 DISCUSSION

Following is a high-level summary of key findings pertaining to narwhal behavioral responses to icebreaking operations and associated vessel traffic during the 2018 fall shoulder season based on the analysis of animal-borne tag data in relation to AIS ship-tracking data:

- Exposure to icebreaking operations and associated vessel traffic did not cause either NW21 or NW22 to be immediately displaced from the RSA during the 2018 fall shoulder season. Both animals remained in the vicinity of icebreaking operations for multiple days before the MSV *Botnica* departed the RSA on 21 October 2018. Of note, the tag associated with NW21 ceased transmitting location data on 08 October 2018, at which point it is not known whether the animal remained in the RSA or departed. NW22 departed the RSA on 17 October 2018, after spending 19 days in the vicinity of icebreaking operations.

- NW22 did not actively avoid icebreaking operations but rather appeared to interact more closely with the MSV *Botnica* and associated vessels as the 2018 fall shoulder season progressed. This finding may indicate possible habituation of the animal to icebreaking operations. It may also indicate that both the icebreaking vessel and animal were utilizing the path of least resistance (i.e. area with the least ice present) as the ice becomes increasingly dense later in the fall shoulder season. It is also possible that increasing ice concentration restricts movements by the animal, causing it to rely more heavily on the path created by icebreaking operations. However, this last scenario is not supported by the finding outlined in the following bullet point regarding narwhal use of vessel tracks. Further analysis is needed to adequately assess fine-scale movements of NW22 in relation to icebreaking operations and may be made available as part of the 2017/2018 integrated tag report, which will be released in Q1 of 2020.

- NW22 did not cross behind the stern of icebreaking vessels or associated vessel traffic for a period of 4.5 hours following an active transit. As sound generated from vessels in open water is known to radiate asymmetrically, with sound levels from the stern aspect typically being highest (Arveson and Vendittis 2000; McKenna et al. 2012), this finding may signify the animal's attempt to avoid the noisiest aspect of the vessel. However, the gap may also be due to data scarcity during the 2018 fall shoulder season (limited to one tagged animal). In addition, given the characteristics of sound that are generated from icebreaking operations and the way in which sound propagates under ice, the interpretation of the 4.5 h gap of crossing behind the stern of the vessel is not straightforward. Continued acoustic monitoring of Project-related icebreaking operations is therefore warranted to assess the sound levels radiated from the stern of individual vessels, including icebreakers.

- No obvious "freeze" response by narwhal to icebreaking operations as reported by Finley et al. (1990) was observed by NW22 during the 2018 fall shoulder season. However, it is acknowledged that brief, fine scale behavioral changes by narwhal may not be captured at the resolution provided by the animal-borne GPS tags.

- Distances selected to assess the time that NW22 resided within the zones associated with acoustic disturbance (i.e., 54.4 km) and avoidance (i.e., 13.4 km) of icebreaking operations and associated vessel traffic are based on the most conservative modeling scenarios presented by JASCO Applied Sciences (i.e., vessels transiting through 10/10 ice concentration, actively breaking ice; Quijano et al. 2019). It is evident from the daily satellite imagery, however, that ice conditions throughout the RSA were not 10/10 concentration for the full extent of the 2018 fall shoulder season (see Figures A-1 to A-19 in Appendix A).

Furthermore, a preliminary review of acoustic data collected during the 2019 spring shipping season in Eclipse Sound (Golder 2019b) suggests that estimated exposure periods incorporated into acoustic modeling were overly conservative by a factor of approximately two to three when compared to measured exposure periods for both disturbance and avoidance onset. Therefore, the percentage of time reported that NW22 was exposed to sound levels associated with disturbance (i.e., 120 dB re: 1 µPa 47.4% of the time) and avoidance (i.e., 135 dB re: 1 µPa 8.7% of the time) is likely an overestimate.

In summary, the narwhal-vessel interactions presented above suggest that Project-related icebreaking operations do not cause narwhal to be immediately displaced from the area, but that narwhal may actively avoid the sternward track of icebreaking vessels for a period of 4.5 hours. These results are based on a very limited dataset (a single animal over the course of 19 days), and further data collection and analysis is required to assess whether this trend is due to chance alone or whether it represents a real avoidance behaviour. NW22 interacted more closely with Project-related icebreaking operations as the 2018 fall shoulder season progressed and did not demonstrate any “freeze” response as reported by Finley et al. (1990). NW22 was exposed to sound levels associated with disturbance (i.e., 120 dB re: 1 µPa) for 47.4% of the fall shoulder season and to sound levels associated with avoidance (i.e., 135 dB re: 1 µPa) for 8.7% of the fall shoulder season, though a preliminary comparison of modeled vs. actual acoustic data collected during the 2019 spring shipping season (Golder 2019b) suggests that this is likely an overestimate. This technical memorandum presents the preliminary results of a more comprehensive analysis that will be made available as part of the 2017/2018 integrated tagging report. The integrated tagging report will be provided in draft form to the Marine Environmental Working Group in Q1 of 2020.

5.0 CLOSURE

We trust the above meets your present requirements. If you have any questions or require additional information, please contact the undersigned.

Golder Associates Ltd.

Ainsley Allen, MSc
Marine Biologist

Phil Rouget, MSc, RPBio
Senior Marine Biologist

Evan Jones, MASc, PEng
Associate

AA/PR/asd

Attachment 1: Daily Locations of Narwhal in relation to Vessel Traffic and Ice Conditions (29 September - 17 October 2018)

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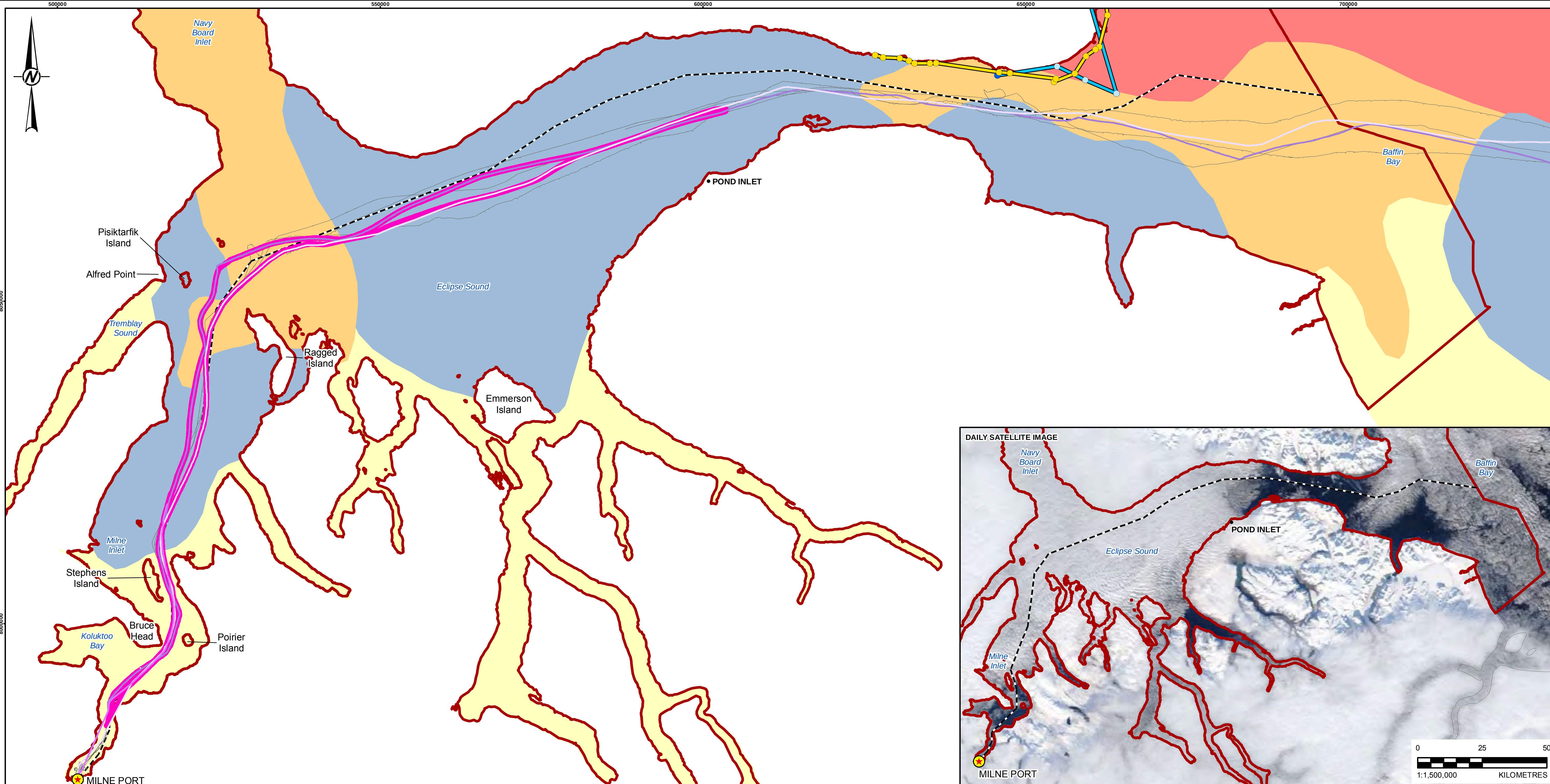
ATTACHMENT 1

Daily Locations of Narwhal in relation to Vessel Traffic and Ice Conditions (29 September - 17 October 2018)



LEGEND

- COMMUNITY
- MILNE PORT

NARWHAL GPS LOCATIONS

- NW22 (MM02-760) FASTLOC GPS LOCATION

NW21 (MM02-763) ARGOS LOCATIONS

- CLASS 1 (~ERROR 500 m < < 1500 m)
- CLASS 2 (~ERROR 250 m < < 500 m)

NARWHAL TRACKS

- NW22 (MM02-760) FASTLOC GPS LOCATION
- NW21 (MM02-763) ARGOS LOCATIONS (CLASSES 3, 2, AND 1)
- BOTNICA SHIP TRACK
- MILNE INLET TOTE ROAD
- NOMINAL SHIPPING ROUTE

PROJECT VESSEL SHIP TRACKS

BULK (ORE) CARRIERS

- GOLDEN ICE
- NORDIC ORION
- NORDKAP
- NS YAKUTIA

GENERAL CARGO VESSELS

- ATLANTIC RAVEN
- MARINE MAMMAL REGIONAL STUDY AREA

ICE CONCENTRATION

- < 1/10
- 1-3/10
- 4-6/10
- 7-8/10
- 9-10/10

0 10 20
1:600,000 KILOMETRES

REFERENCE(S)
ICE CONCENTRATION OBTAINED FROM CANADIAN ICE SERVICE, GOVERNMENT OF CANADA. DAILY ICE CHARTS – APPROACHES TO RESOLUTE BAY. ACCESSED NOVEMBER 23, 2018. GEOGRAPHIC NAMES, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. WE ACKNOWLEDGE THE USE OF IMAGERY PROVIDED BY SERVICES FROM NASA'S GLOBAL IMAGERY BROWSE SERVICES (GIBS), PART OF NASA'S EARTH OBSERVING SYSTEM DATA AND INFORMATION SYSTEM (EOSDIS).
PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

PROJECT
MARY RIVER PROJECT - PHASE 2 PROPOSAL

CONSULTANT
GOLDER

YYYY-MM-DD	2019-09-26
DESIGNED	MF
PREPARED	AA
REVIEWED	AA
APPROVED	PR

TITLE
DAILY LOCATIONS OF NARWHAL IN RELATION TO VESSEL TRAFFIC AND ICE CONDITIONS - FALL - SEPTEMBER 29, 2018 (UTC)

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	30000-05	A	A-1

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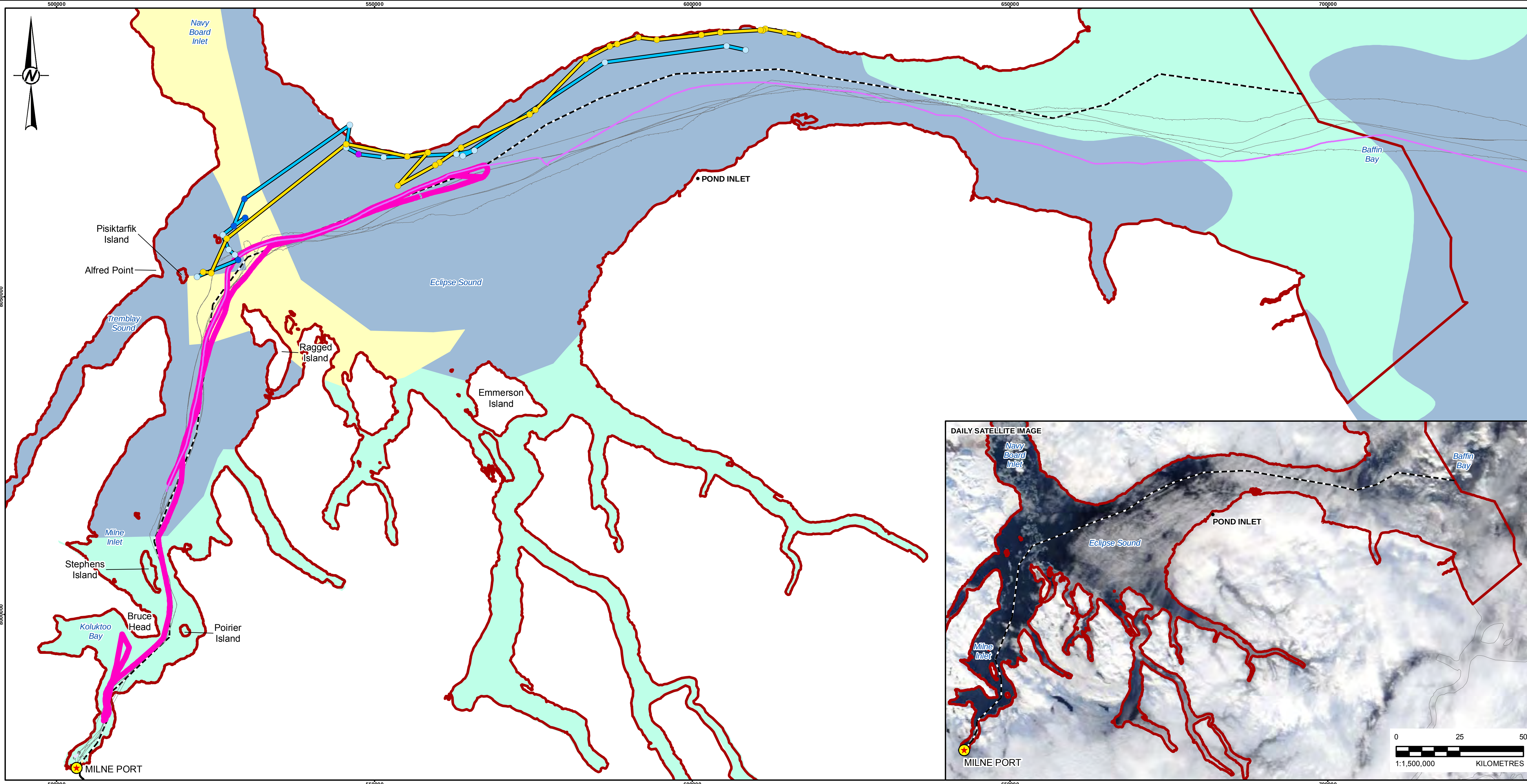

LEGEND

- COMMUNITY
- MILNE PORT

NARWHAL GPS LOCATIONS

- NW22 (MM02-760) FASTLOC GPS LOCATION

NW21 (MM02-763) ARGOS LOCATIONS

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- CLASS 2 (~ERROR 250 m < < 500 m)
- CLASS 3 (~ERROR < 250 m)

NARWHAL TRACKS

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- NW21 (MM02-763) ARGOS LOCATIONS (CLASSES 3, 2, AND 1)
- BOTNICA SHIP TRACK
- MILNE INLET TOTE ROAD

- NOMINAL SHIPPING ROUTE
- PROJECT VESSEL SHIP TRACK - PREVIOUS 2 DAYS

PROJECT VESSEL SHIP TRACKS

BULK (ORE) CARRIERS

- GOLDEN ICE
- NORDIC ORION
- NS YAKUTIA

GENERAL CARGO VESSELS

- ATLANTIC RAVEN
- MARINE MAMMAL REGIONAL STUDY AREA

ICE CONCENTRATION

- < 1/10
- 1-3/10
- 4-6/10
- 7-8/10
- 9-10/10

0 10 20
1:600,000 KILOMETRES

REFERENCE(S)

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PROJECTION: UTM ZONE 17 DATUM: NAD 83

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BAFFINLAND IRON MINES CORPORATION

PROJECT
MARY RIVER PROJECT - PHASE 2 PROPOSAL

CONSULTANT

GOLDER

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DESIGNED	MF
PREPARED	AA
REVIEWED	AA
APPROVED	PR

TITLE
DAILY LOCATIONS OF NARWHAL IN RELATION TO VESSEL TRAFFIC AND ICE CONDITIONS - FALL - SEPTEMBER 30, 2018 (UTC)

PROJECT NO.	CONTROL	REV.	FIGURE
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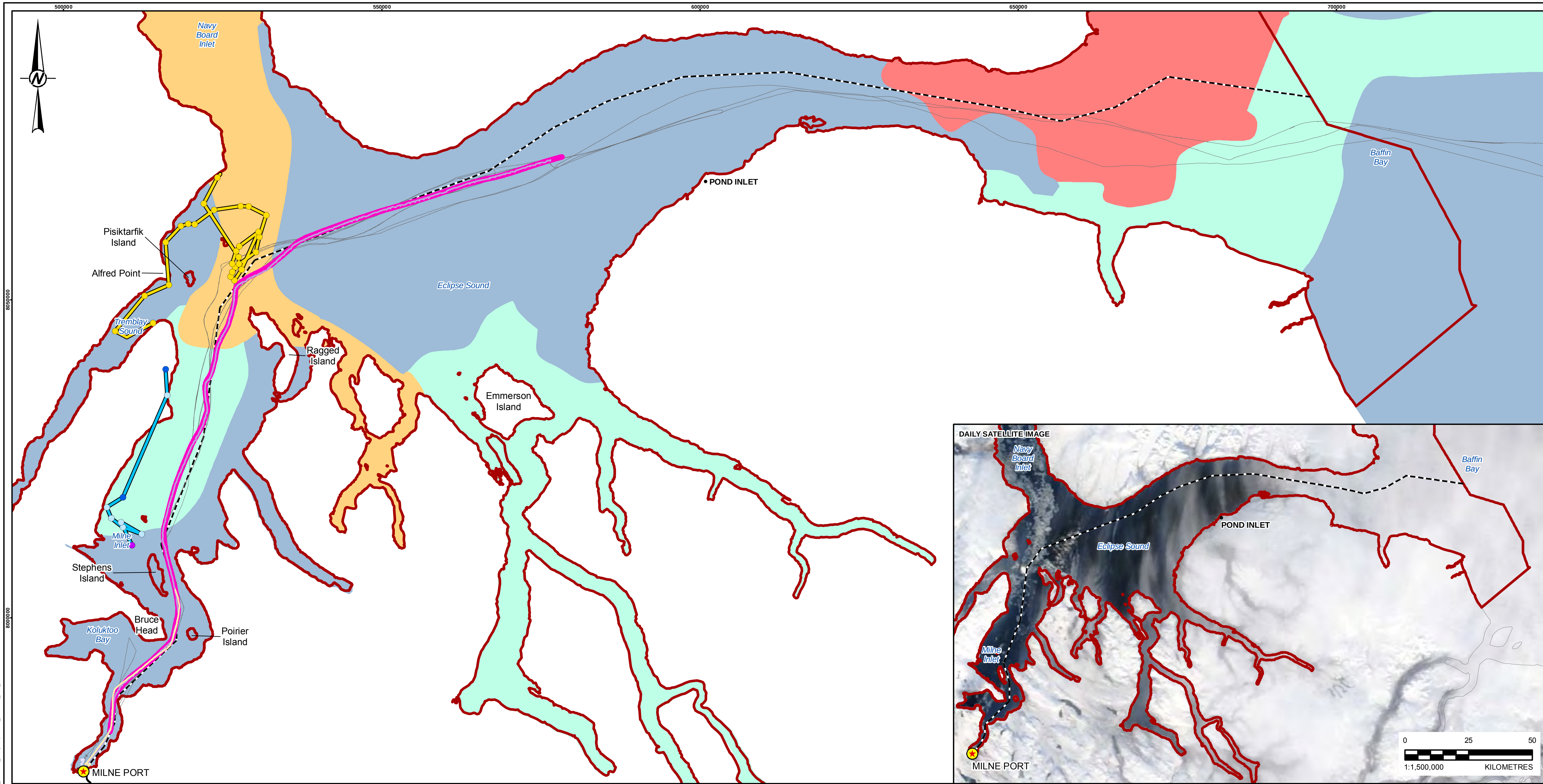

LEGEND

- COMMUNITY
- MILNE PORT

NARWHAL GPS LOCATIONS

- NW22 (MM02-760) FASTLOC GPS LOCATION

NW21 (MM02-763) ARGOS LOCATIONS

- CLASS 1 (~ERROR 500 m < < 1500 m)
- CLASS 2 (~ERROR 250 m < < 500 m)
- CLASS 3 (~ERROR < 250 m)

NARWHAL TRACKS

- NW22 (MM02-760) FASTLOC GPS LOCATION
- NW21 (MM02-763) ARGOS LOCATIONS (CLASSES 3, 2, AND 1)
- BOTNICA SHIP TRACK
- MILNE INLET TOTE ROAD

- NOMINAL SHIPPING ROUTE
- PROJECT VESSEL SHIP TRACK - PREVIOUS 2 DAYS

PROJECT VESSEL SHIP TRACKS

BULK (ORE) CARRIERS

- NORDIC ORION
- NS YAKUTIA

GENERAL CARGO VESSELS

- ATLANTIC RAVEN
- MARINE MAMMAL REGIONAL STUDY AREA

ICE CONCENTRATION

- < 1/10
- 1-3/10
- 4-6/10
- 7-8/10
- 9-10/10

0 10 20
1:600,000 KILOMETRES

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CONSULTANT
GOLDER

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DESIGNED	MF
PREPARED	AA
REVIEWED	AA
APPROVED	PR

TITLE
DAILY LOCATIONS OF NARWHAL IN RELATION TO VESSEL TRAFFIC AND ICE CONDITIONS - FALL - OCTOBER 01, 2018 (UTC)

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	30000-05	A	A-3

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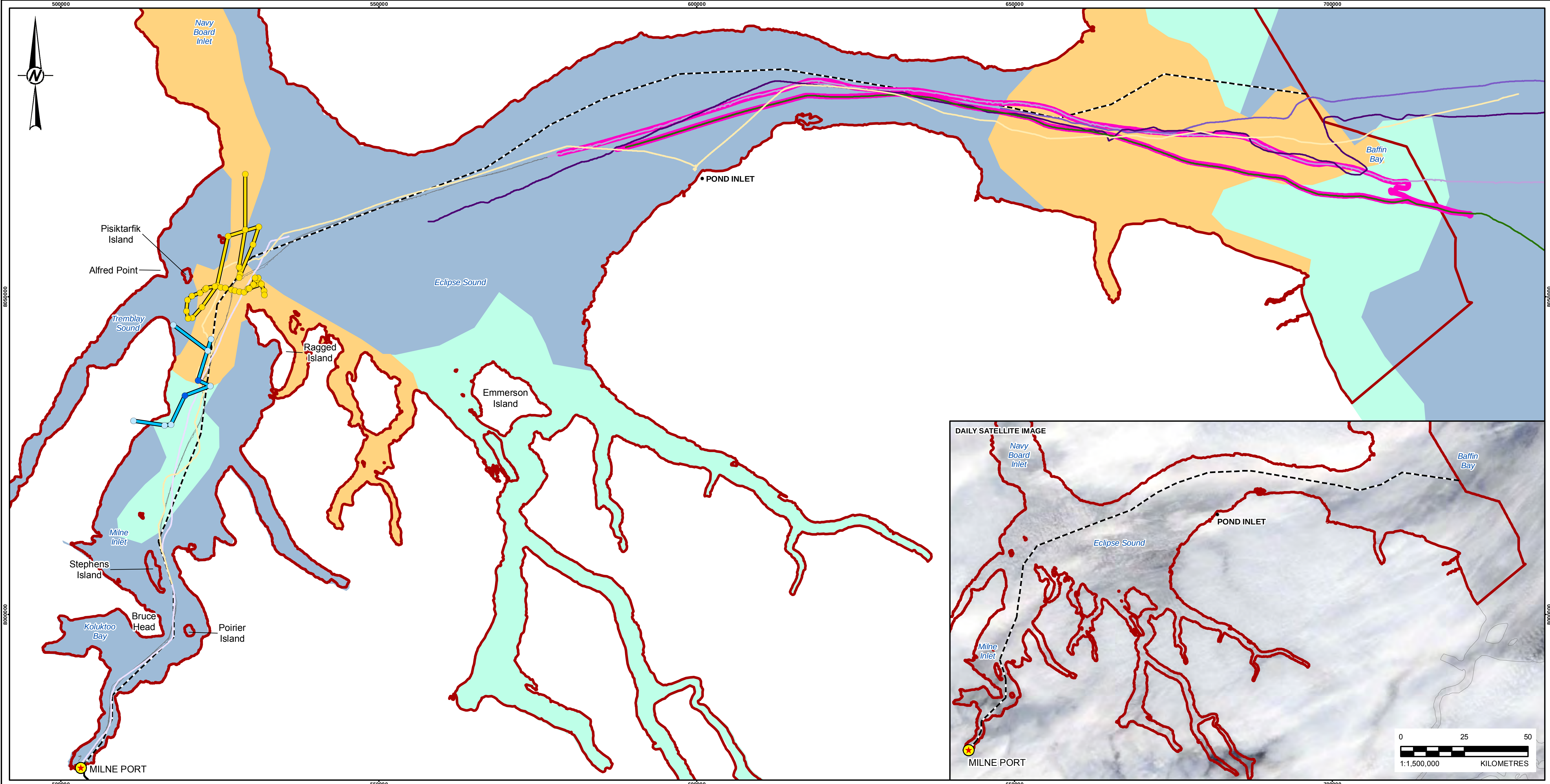

LEGEND

- COMMUNITY
- MILNE PORT

NARWHAL GPS LOCATIONS

- NW22 (MM02-760) FASTLOC GPS LOCATION

NW21 (MM02-763) ARGOS LOCATIONS

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- CLASS 2 (~ERROR 250 m < < 500 m)

NARWHAL TRACKS

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- NW21 (MM02-763) ARGOS LOCATIONS (CLASSES 3, 2, AND 1)
- BOTNICA SHIP TRACK
- MILNE INLET TOTE ROAD
- NOMINAL SHIPPING ROUTE

- PROJECT VESSEL SHIP TRACK - PREVIOUS 2 DAYS

PROJECT VESSEL SHIP TRACKS

BULK (ORE) CARRIERS

- GOLDEN OPPORTUNITY
- GOLDEN PEARL
- NORDIC ORION
- NS YAKUTIA

GENERAL CARGO VESSELS

- ATLANTIC RAVEN

OIL TANKERS

- SARAH DESGAGNES
- MARINE MAMMAL REGIONAL STUDY AREA

ICE CONCENTRATION

- < 1/10
- 1-3/10
- 4-6/10
- 7-8/10
- 9-10/10

0 10 20
1:600,000 KILOMETRES

REFERENCE(S)
ICE CONCENTRATION OBTAINED FROM CANADIAN ICE SERVICE, GOVERNMENT OF CANADA. DAILY ICE CHARTS – APPROACHES TO RESOLUTE BAY. ACCESSED NOVEMBER 23, 2018. GEOGRAPHIC NAMES, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. WE ACKNOWLEDGE THE USE OF IMAGERY PROVIDED BY SERVICES FROM NASA'S GLOBAL IMAGERY BROWSE SERVICES (GIBS), PART OF NASA'S EARTH OBSERVING SYSTEM DATA AND INFORMATION SYSTEM (EOSDIS).
PROJECTION: UTM ZONE 17 DATUM: NAD 83

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PROJECT
MARY RIVER PROJECT - PHASE 2 PROPOSAL

CONSULTANT
GOLDER

YYYY-MM-DD	2019-09-26
DESIGNED	MF
PREPARED	AA
REVIEWED	AA
APPROVED	PR

TITLE
DAILY LOCATIONS OF NARWHAL IN RELATION TO VESSEL TRAFFIC AND ICE CONDITIONS - FALL - OCTOBER 02, 2018 (UTC)

PROJECT NO.	CONTROL	REV.	FIGURE
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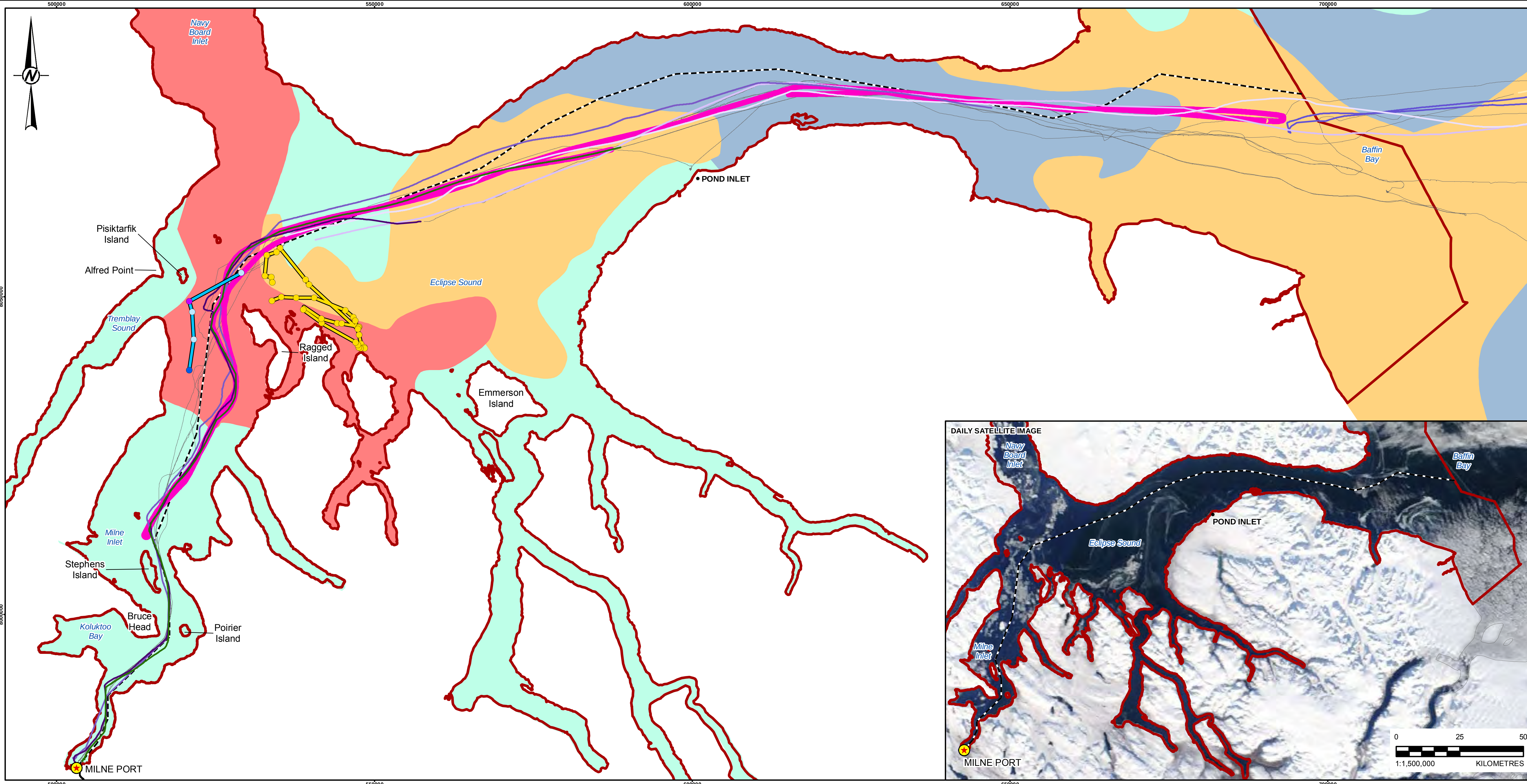

LEGEND

- COMMUNITY
- MILNE PORT

NARWHAL GPS LOCATIONS

- NW22 (MM02-760) FASTLOC GPS LOCATION

NW21 (MM02-763) ARGOS LOCATIONS

- CLASS 1 (~ERROR 500 m < < 1500 m)
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NARWHAL TRACKS

- NW22 (MM02-760) FASTLOC GPS LOCATION
- NW21 (MM02-763) ARGOS LOCATIONS (CLASSES 3, 2, AND 1)
- BOTNICA SHIP TRACK
- MILNE INLET TOTE ROAD
- NOMINAL SHIPPING ROUTE
- PROJECT VESSEL SHIP TRACK - PREVIOUS 2 DAYS

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1:600,000 KILOMETRES

REFERENCE(S)
ICE CONCENTRATION OBTAINED FROM CANADIAN ICE SERVICE, GOVERNMENT OF CANADA. DAILY ICE CHARTS – APPROACHES TO RESOLUTE BAY. ACCESSED NOVEMBER 23, 2018. GEOGRAPHIC NAMES, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. WE ACKNOWLEDGE THE USE OF IMAGERY PROVIDED BY SERVICES FROM NASA'S GLOBAL IMAGERY BROWSE SERVICES (GIBS), PART OF NASA'S EARTH OBSERVING SYSTEM DATA AND INFORMATION SYSTEM (EOSDIS).
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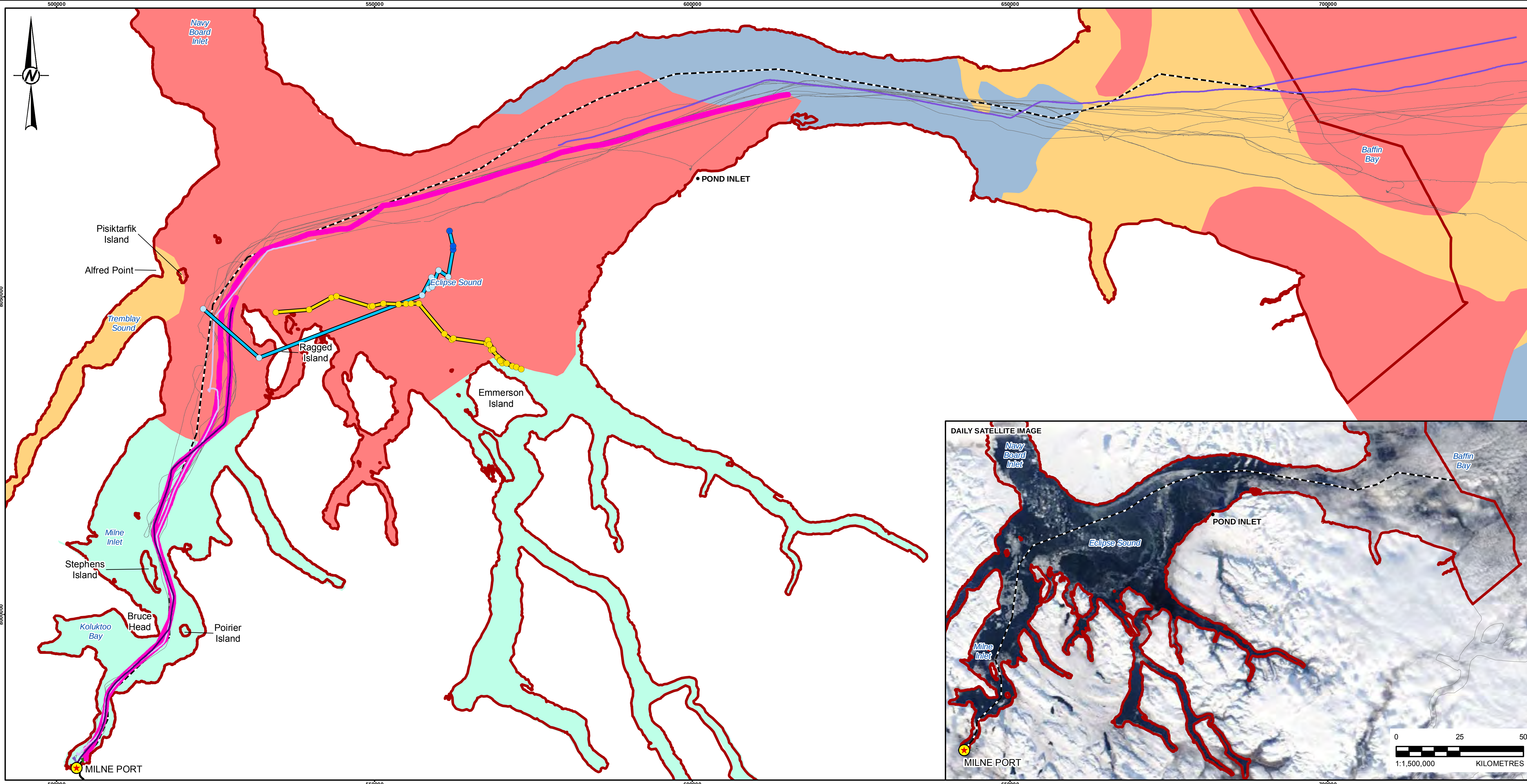
PROJECT
MARY RIVER PROJECT - PHASE 2 PROPOSAL

CONSULTANT
GOLDER

YYYY-MM-DD	2019-09-26
DESIGNED	MF
PREPARED	AA
REVIEWED	AA
APPROVED	PR

TITLE
DAILY LOCATIONS OF NARWHAL IN RELATION TO VESSEL TRAFFIC AND ICE CONDITIONS - FALL - OCTOBER 03, 2018 (UTC)

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	30000-05	A	A-5



LEGEND

- COMMUNITY
- MILNE PORT

NARWHAL GPS LOCATIONS

- NW22 (MM02-760) FASTLOC GPS LOCATION

NW21 (MM02-763) ARGOS LOCATIONS

- CLASS 1 (~ERROR 500 m < < 1500 m)
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NARWHAL TRACKS

- NW22 (MM02-760) FASTLOC GPS LOCATION
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- BOTNICA SHIP TRACK
- MILNE INLET TOTE ROAD
- NOMINAL SHIPPING ROUTE

- PROJECT VESSEL SHIP TRACK - PREVIOUS 2 DAYS

PROJECT VESSEL SHIP TRACKS

BULK (ORE) CARRIERS

- GOLDEN AMBER
- GOLDEN OPPORTUNITY
- GOLDEN PEARL
- NORDPOL

OIL TANKERS

- SARAH DESGAGNES
- MARINE MAMMAL REGIONAL STUDY AREA

ICE CONCENTRATION

- < 1/10
- 1-3/10
- 4-6/10
- 7-8/10
- 9-10/10

0 10 20
1:600,000 KILOMETRES

REFERENCE(S)
ICE CONCENTRATION OBTAINED FROM CANADIAN ICE SERVICE, GOVERNMENT OF CANADA. DAILY ICE CHARTS – APPROACHES TO RESOLUTE BAY. ACCESSED NOVEMBER 23, 2018. GEOGRAPHIC NAMES, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. WE ACKNOWLEDGE THE USE OF IMAGERY PROVIDED BY SERVICES FROM NASA'S GLOBAL IMAGERY BROWSE SERVICES (GIBS), PART OF NASA'S EARTH OBSERVING SYSTEM DATA AND INFORMATION SYSTEM (EOSDIS).
PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

PROJECT
MARY RIVER PROJECT - PHASE 2 PROPOSAL

CONSULTANT
GOLDER

YYYY-MM-DD	2019-09-26
DESIGNED	MF
PREPARED	AA
REVIEWED	AA
APPROVED	PR

TITLE
DAILY LOCATIONS OF NARWHAL IN RELATION TO VESSEL TRAFFIC AND ICE CONDITIONS - FALL - OCTOBER 04, 2018 (UTC)

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	30000-05	A	A-6

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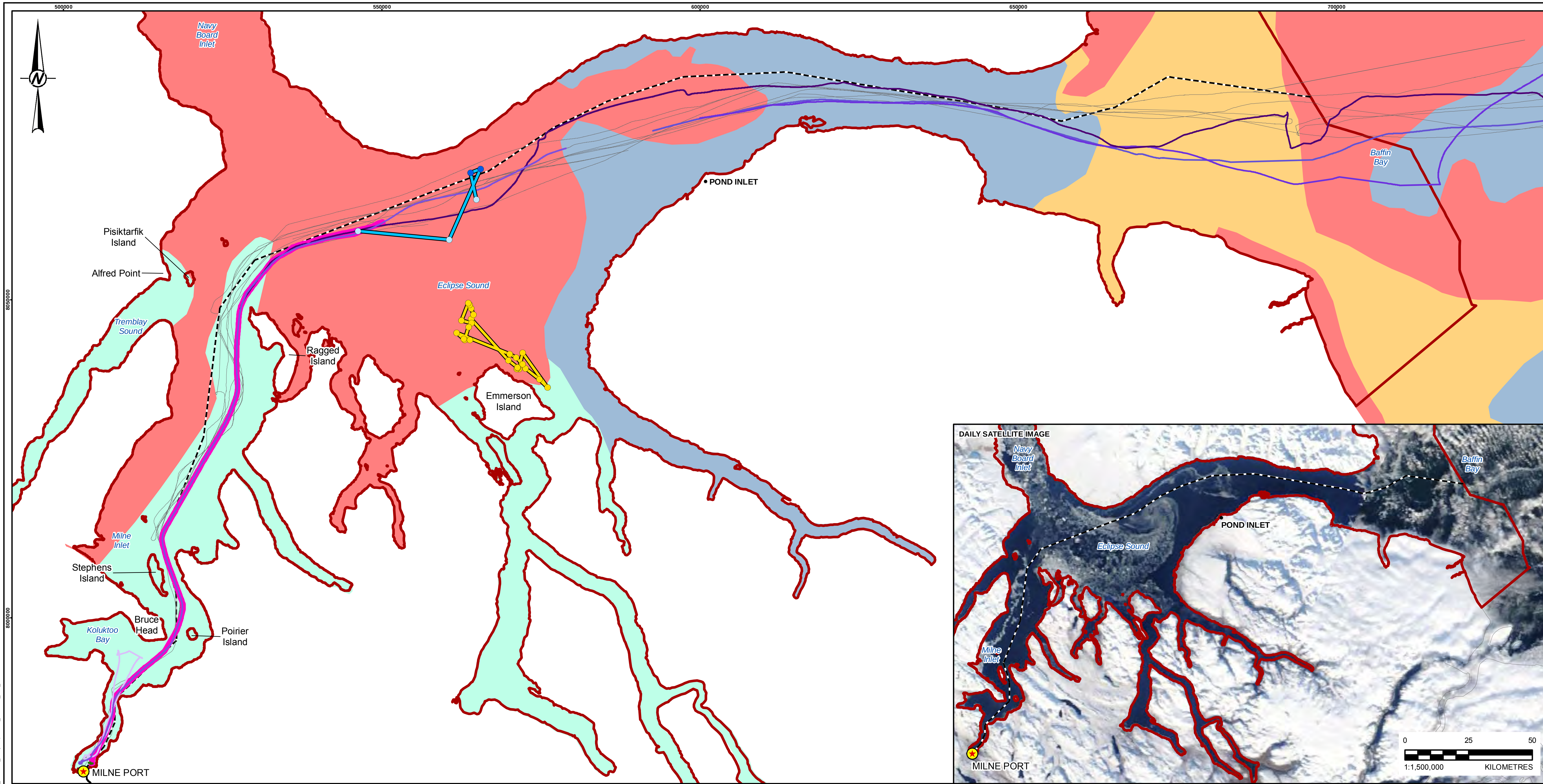

LEGEND

- COMMUNITY
- MILNE PORT

NARWHAL GPS LOCATIONS

- NW22 (MM02-760) FASTLOC GPS LOCATION

NW21 (MM02-763) ARGOS LOCATIONS

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- MILNE INLET TOTE ROAD
- NOMINAL SHIPPING ROUTE

- PROJECT VESSEL SHIP TRACK - PREVIOUS 2 DAYS

PROJECT VESSEL SHIP TRACKS

BULK (ORE) CARRIERS

- GOLDEN AMBER
- GOLDEN OPPORTUNITY
- GOLDEN PEARL
- NORDIC ODIN
- NORDIC OLYMPIC
- NORDPOL

OIL TANKERS

- SARAH DESGAGNES
- MARINE MAMMAL REGIONAL STUDY AREA

ICE CONCENTRATION

- < 1/10
- 1-3/10
- 4-6/10
- 7-8/10
- 9-10/10

0 10 20

1:600,000 KILOMETRES

REFERENCE(S)

ICE CONCENTRATION OBTAINED FROM CANADIAN ICE SERVICE, GOVERNMENT OF CANADA. DAILY ICE CHARTS – APPROACHES TO RESOLUTE BAY. ACCESSED NOVEMBER 23, 2018. GEOGRAPHIC NAMES, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. WE ACKNOWLEDGE THE USE OF IMAGERY PROVIDED BY SERVICES FROM NASA'S GLOBAL IMAGERY BROWSE SERVICES (GIBS), PART OF NASA'S EARTH OBSERVING SYSTEM DATA AND INFORMATION SYSTEM (EOSDIS).
PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

PROJECT
MARY RIVER PROJECT - PHASE 2 PROPOSAL

CONSULTANT
GOLDER

YYYY-MM-DD	2019-09-26
DESIGNED	MF
PREPARED	AA
REVIEWED	AA
APPROVED	PR

TITLE
DAILY LOCATIONS OF NARWHAL IN RELATION TO VESSEL TRAFFIC AND ICE CONDITIONS - FALL - OCTOBER 05, 2018 (UTC)

PROJECT NO.	CONTROL	REV.	FIGURE
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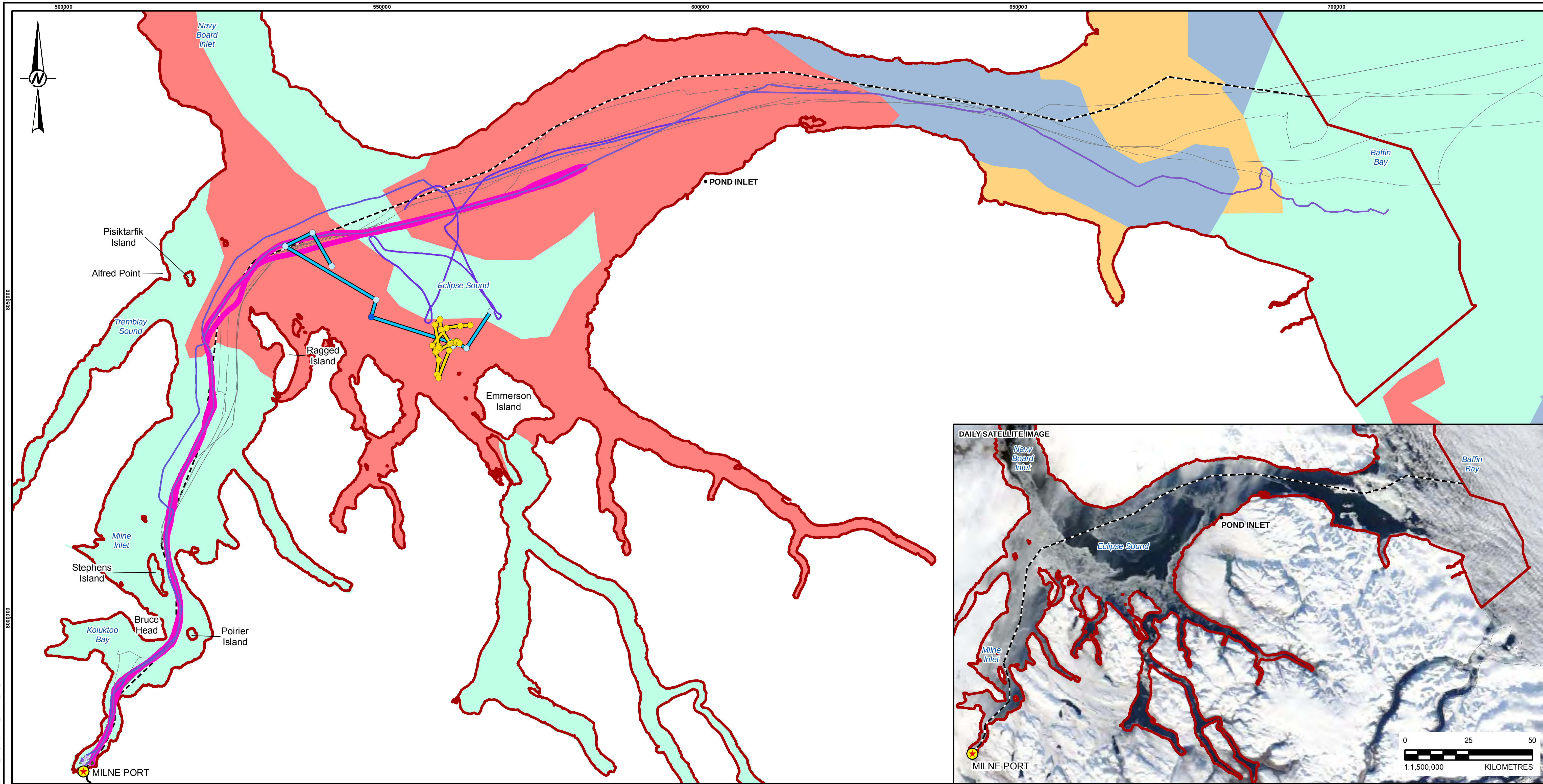

LEGEND

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- MILNE PORT

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- NOMINAL SHIPPING ROUTE

- PROJECT VESSEL SHIP TRACK - PREVIOUS 2 DAYS

PROJECT VESSEL SHIP TRACKS

BULK (ORE) CARRIERS

- GOLDEN AMBER
- GOLDEN PEARL
- NORDIC ODIN
- NORDIC OLYMPIC
- NORDPOL

OIL TANKERS

- SARAH DESGAGNES
- MARINE MAMMAL REGIONAL STUDY AREA

ICE CONCENTRATION

- < 1/10
- 1-3/10
- 4-6/10
- 7-8/10
- 9-10/10

0 10 20
1:600,000 KILOMETRES

REFERENCE(S)

ICE CONCENTRATION OBTAINED FROM CANADIAN ICE SERVICE, GOVERNMENT OF CANADA. DAILY ICE CHARTS – APPROACHES TO RESOLUTE BAY. ACCESSED NOVEMBER 23, 2018. GEOGRAPHIC NAMES, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. WE ACKNOWLEDGE THE USE OF IMAGERY PROVIDED BY SERVICES FROM NASA'S GLOBAL IMAGERY BROWSE SERVICES (GIBS), PART OF NASA'S EARTH OBSERVING SYSTEM DATA AND INFORMATION SYSTEM (EOSDIS).
PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

PROJECT
MARY RIVER PROJECT - PHASE 2 PROPOSAL

CONSULTANT
GOLDER

YYYY-MM-DD	2019-09-26
DESIGNED	MF
PREPARED	AA
REVIEWED	AA
APPROVED	PR

TITLE
DAILY LOCATIONS OF NARWHAL IN RELATION TO VESSEL TRAFFIC AND ICE CONDITIONS - FALL - OCTOBER 06, 2018 (UTC)

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	30000-05	A	A-8

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B
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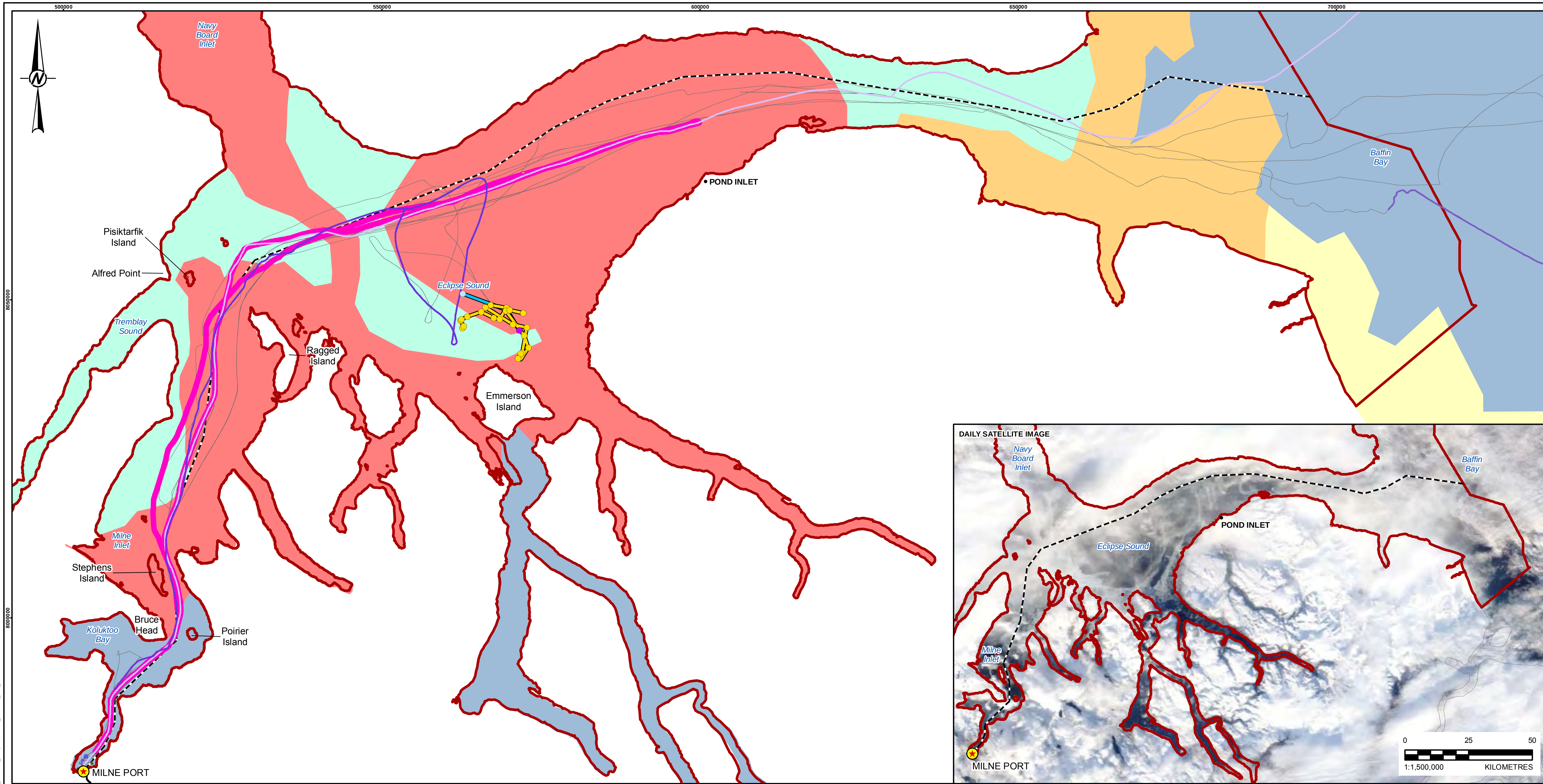

LEGEND

- COMMUNITY
- MILNE PORT

NARWHAL GPS LOCATIONS

- NW22 (MM02-760) FASTLOC GPS LOCATION

NW21 (MM02-763) ARGOS LOCATIONS

- CLASS 1 (~ERROR 500 m < < 1500 m)
- CLASS 3 (~ERROR < 250 m)

NARWHAL TRACKS

- NW22 (MM02-760) FASTLOC GPS LOCATION
- NW21 (MM02-763) ARGOS LOCATIONS (CLASSES 3, 2, AND 1)
- BOTNICA SHIP TRACK
- MILNE INLET TOTE ROAD
- NOMINAL SHIPPING ROUTE

- PROJECT VESSEL SHIP TRACK - PREVIOUS 2 DAYS

PROJECT VESSEL SHIP TRACKS

BULK (ORE) CARRIERS

- GOLDEN AMBER
- GOLDEN PEARL
- NORDIC ODIN
- NORDIC OLYMPIC
- NORDPOL

OIL TANKERS

- SARAH DESGAGNES
- MARINE MAMMAL REGIONAL STUDY AREA

ICE CONCENTRATION

- < 1/10
- 1-3/10
- 4-6/10
- 7-8/10
- 9-10/10

0 10 20
1:600,000 KILOMETRES

REFERENCE(S)

ICE CONCENTRATION OBTAINED FROM CANADIAN ICE SERVICE, GOVERNMENT OF CANADA. DAILY ICE CHARTS – APPROACHES TO RESOLUTE BAY. ACCESSED NOVEMBER 23, 2018. GEOGRAPHIC NAMES, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. WE ACKNOWLEDGE THE USE OF IMAGERY PROVIDED BY SERVICES FROM NASA'S GLOBAL IMAGERY BROWSE SERVICES (GIBS), PART OF NASA'S EARTH OBSERVING SYSTEM DATA AND INFORMATION SYSTEM (EOSDIS).
PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

PROJECT
MARY RIVER PROJECT - PHASE 2 PROPOSAL

CONSULTANT
GOLDER

YYYY-MM-DD	2019-09-26
DESIGNED	MF
PREPARED	AA
REVIEWED	AA
APPROVED	PR

TITLE
DAILY LOCATIONS OF NARWHAL IN RELATION TO VESSEL TRAFFIC AND ICE CONDITIONS - FALL - OCTOBER 07, 2018 (UTC)

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	30000-05	A	A-9

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

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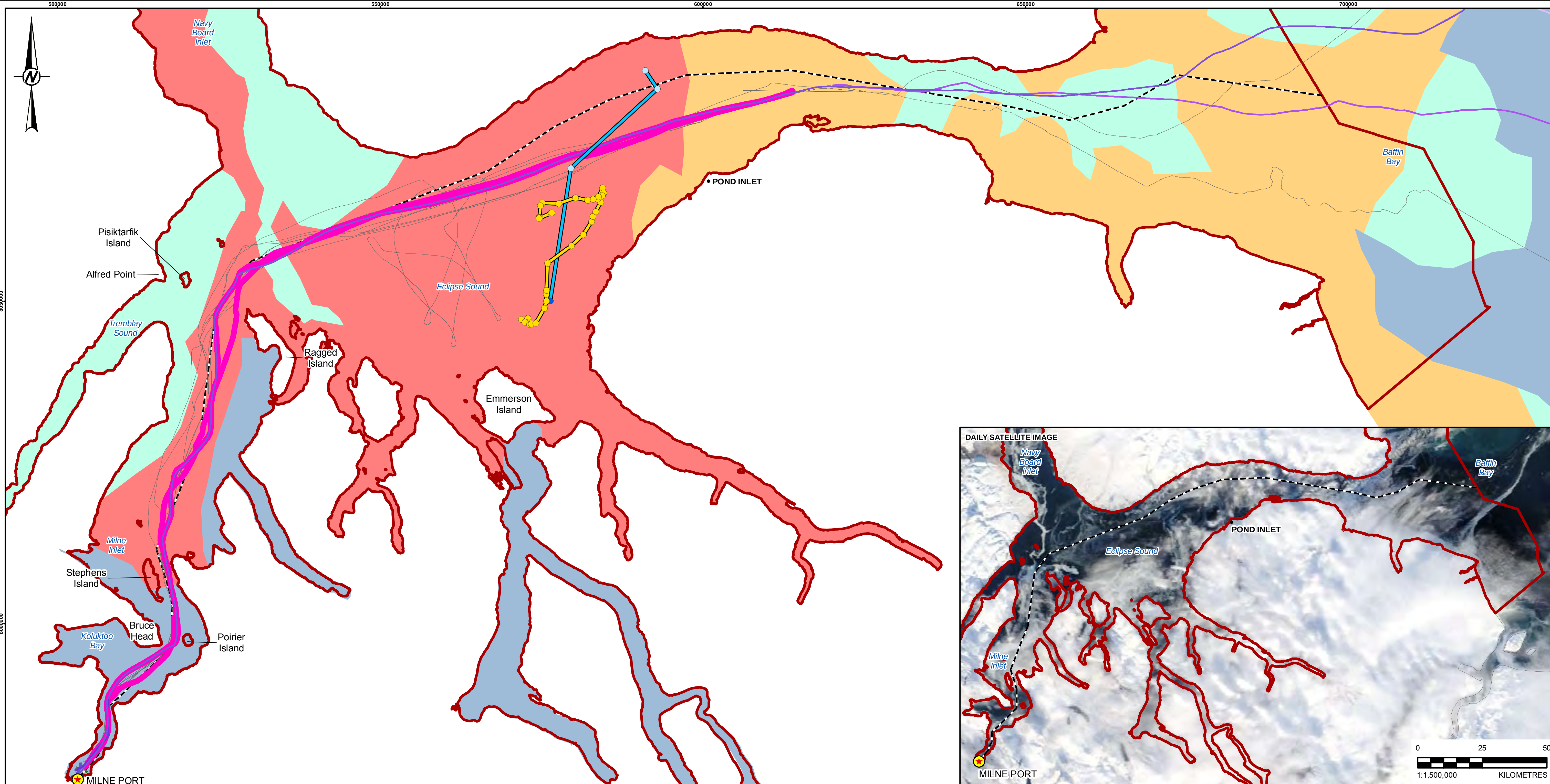


LEGEND

- COMMUNITY
- MILNE PORT

NARWHAL GPS LOCATIONS

- NW22 (MM02-760) FASTLOC GPS LOCATION

NW21 (MM02-763) ARGOS LOCATIONS

- CLASS 1 (~ERROR 500 m < < 1500 m)
- CLASS 2 (~ERROR 250 m < < 500 m)

NARWHAL TRACKS

- NW22 (MM02-760) FASTLOC GPS LOCATION
- NW21 (MM02-763) ARGOS LOCATIONS (CLASSES 3, 2, AND 1)
- BOTNICA SHIP TRACK
- MILNE INLET TOTE ROAD
- NOMINAL SHIPPING ROUTE

- PROJECT VESSEL SHIP TRACK - PREVIOUS 2 DAYS

PROJECT VESSEL SHIP TRACKS

BULK (ORE) CARRIERS

- GOLDEN AMBER
- NORDIC ODIN
- NORDIC ODYSSEY
- NORDIC OLYMPIC
- NORDPOL

OIL TANKERS

- SARAH DESGAGNES
- MARINE MAMMAL REGIONAL STUDY AREA

ICE CONCENTRATION

- < 1/10
- 1-3/10
- 4-6/10
- 7-8/10
- 9-10/10

0 10 20
1:600,000 KILOMETRES

REFERENCE(S)

ICE CONCENTRATION OBTAINED FROM CANADIAN ICE SERVICE, GOVERNMENT OF CANADA. DAILY ICE CHARTS – APPROACHES TO RESOLUTE BAY. ACCESSED NOVEMBER 23, 2018. GEOGRAPHIC NAMES, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. WE ACKNOWLEDGE THE USE OF IMAGERY PROVIDED BY SERVICES FROM NASA'S GLOBAL IMAGERY BROWSE SERVICES (GIBS), PART OF NASA'S EARTH OBSERVING SYSTEM DATA AND INFORMATION SYSTEM (EOSDIS).
PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

PROJECT
MARY RIVER PROJECT - PHASE 2 PROPOSAL

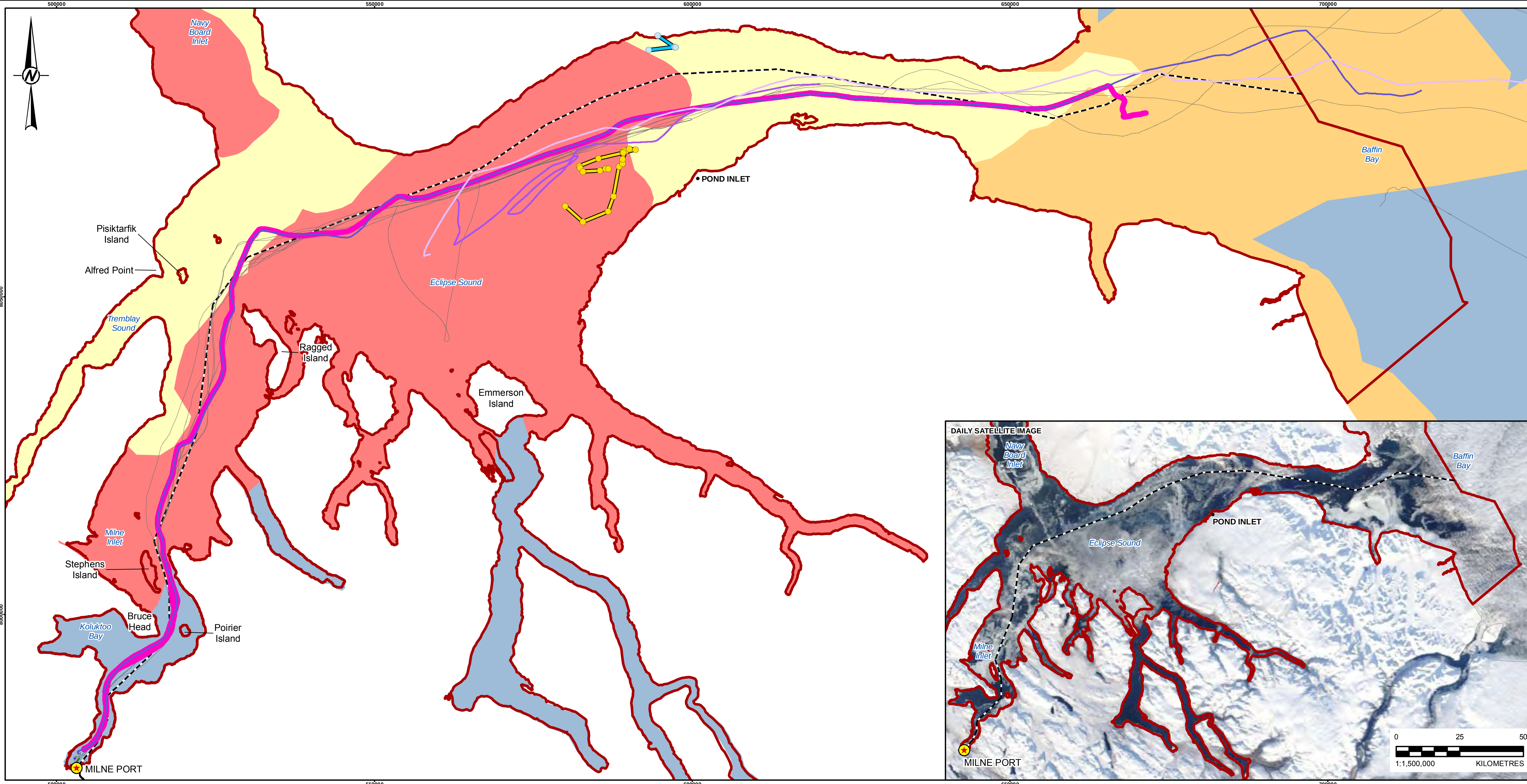
CONSULTANT

GOLDER

YYYY-MM-DD	2019-09-26
DESIGNED	MF
PREPARED	AA
REVIEWED	AA
APPROVED	PR

TITLE
DAILY LOCATIONS OF NARWHAL IN RELATION TO VESSEL TRAFFIC AND ICE CONDITIONS - FALL - OCTOBER 08, 2018 (UTC)

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	30000-05	A	A-10



LEGEND

- COMMUNITY
- MILNE PORT

NARWHAL GPS LOCATIONS

- NW22 (MM02-760) FASTLOC GPS LOCATION

NW21 (MM02-763) ARGOS LOCATIONS

- CLASS 1 (~ERROR 500 m < < 1500 m)

NARWHAL TRACKS

- NW22 (MM02-760) FASTLOC GPS LOCATION
- NW21 (MM02-763) ARGOS LOCATIONS (CLASSES 3, 2, AND 1)
- BOTNICA SHIP TRACK
- MILNE INLET TOTE ROAD
- NOMINAL SHIPPING ROUTE
- PROJECT VESSEL SHIP TRACK - PREVIOUS 2 DAYS

PROJECT VESSEL SHIP TRACKS

BULK (ORE) CARRIERS

- ARKADIA
- NORDIC ODIN
- NORDIC ODYSSEY
- NORDIC OLYMPIC

OIL TANKERS

- SARAH DESGAGNES
- MARINE MAMMAL REGIONAL STUDY AREA

ICE CONCENTRATION

- < 1/10
- 1-3/10
- 4-6/10
- 7-8/10
- 9-10/10

0 10 20
1:600,000 KILOMETRES

REFERENCE(S)
ICE CONCENTRATION OBTAINED FROM CANADIAN ICE SERVICE, GOVERNMENT OF CANADA. DAILY ICE CHARTS – APPROACHES TO RESOLUTE BAY. ACCESSED NOVEMBER 23, 2018. GEOGRAPHIC NAMES, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. WE ACKNOWLEDGE THE USE OF IMAGERY PROVIDED BY SERVICES FROM NASA'S GLOBAL IMAGERY BROWSE SERVICES (GIBS), PART OF NASA'S EARTH OBSERVING SYSTEM DATA AND INFORMATION SYSTEM (EOSDIS).
PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

PROJECT
MARY RIVER PROJECT - PHASE 2 PROPOSAL

CONSULTANT
GOLDER

YYYY-MM-DD	2019-09-26
DESIGNED	MF
PREPARED	AA
REVIEWED	AA
APPROVED	PR

TITLE
DAILY LOCATIONS OF NARWHAL IN RELATION TO VESSEL TRAFFIC AND ICE CONDITIONS - FALL - OCTOBER 09, 2018 (UTC)

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	30000-05	A	A-11

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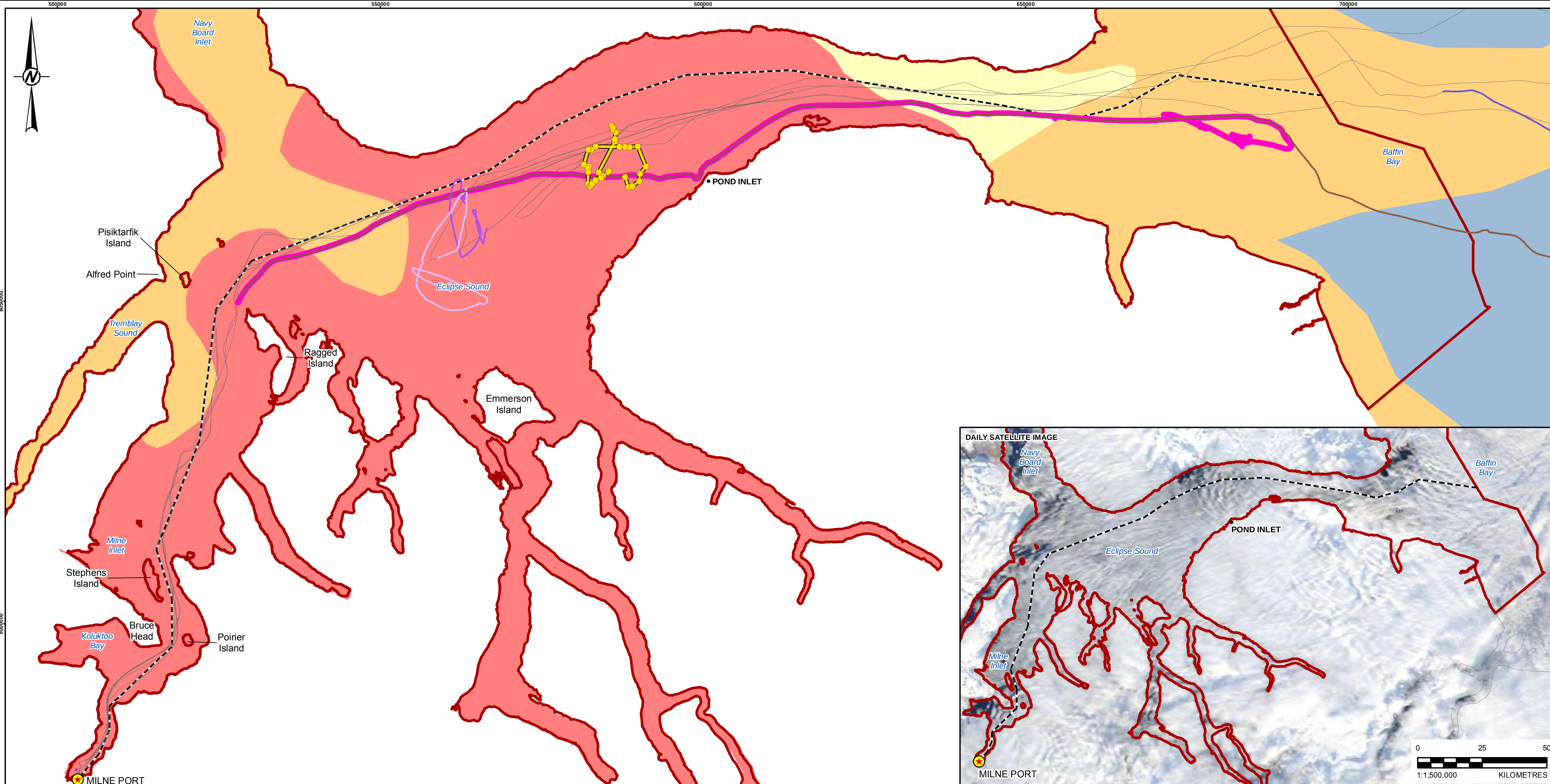


LEGEND

- • COMMUNITY
- MILNE PORT

NARWHAL GPS LOCATIONS

- NW22 (MM02-760) FASTLOC GPS LOCATION

NARWHAL TRACKS

- NW22 (MM02-760) FASTLOC GPS LOCATION
- BOTNICA SHIP TRACK
- MILNE INLET TOTE ROAD
- NOMINAL SHIPPING ROUTE
- PROJECT VESSEL SHIP TRACK - PREVIOUS 2 DAYS

PROJECT VESSEL SHIP TRACKS

BULK (ORE) CARRIERS

- ARKADIA
- NORDIC ODIN
- NORDIC ODYSSEY
- NORDIC OLYMPIC

GENERAL CARGO VESSELS

- ZELADA DESGAGNES

OIL TANKERS

- SARAH DESGAGNES
- MARINE MAMMAL REGIONAL STUDY AREA

ICE CONCENTRATION

- < 1/10
- 1-3/10
- 4-6/10
- 7-8/10
- 9-10/10

0 10 20
1:600,000 KILOMETRES

REFERENCE(S)
ICE CONCENTRATION OBTAINED FROM CANADIAN ICE SERVICE, GOVERNMENT OF CANADA. DAILY ICE CHARTS – APPROACHES TO RESOLUTE BAY. ACCESSED NOVEMBER 23, 2018. GEOGRAPHIC NAMES, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. WE ACKNOWLEDGE THE USE OF IMAGERY PROVIDED BY SERVICES FROM NASA'S GLOBAL IMAGERY BROWSE SERVICES (GIBS), PART OF NASA'S EARTH OBSERVING SYSTEM DATA AND INFORMATION SYSTEM (EOSDIS).
PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

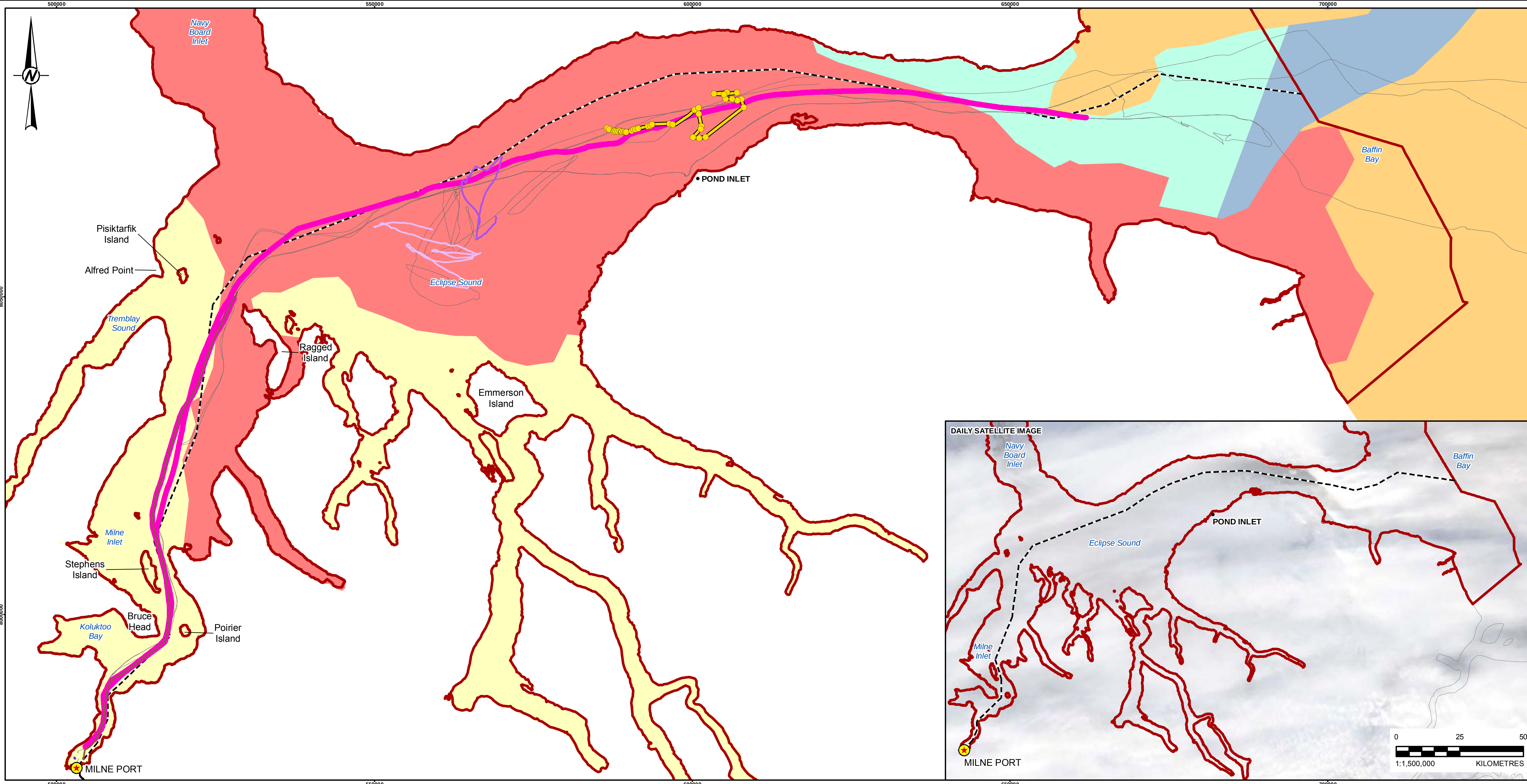
PROJECT
MARY RIVER PROJECT - PHASE 2 PROPOSAL

CONSULTANT
GOLDER

YYYY-MM-DD	2019-09-26
DESIGNED	MF
PREPARED	AA
REVIEWED	AA
APPROVED	PR

TITLE
DAILY LOCATIONS OF NARWHAL IN RELATION TO VESSEL TRAFFIC AND ICE CONDITIONS - FALL - OCTOBER 10, 2018 (UTC)

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	30000-05	A	A-12



LEGEND

- COMMUNITY
- MILNE PORT

NARWHAL GPS LOCATIONS

- NW22 (MM02-760) FASTLOC GPS LOCATION

NARWHAL TRACKS

- NW22 (MM02-760) FASTLOC GPS LOCATION
- BOTNICA SHIP TRACK
- MILNE INLET TOTE ROAD
- NOMINAL SHIPPING ROUTE
- PROJECT VESSEL SHIP TRACK - PREVIOUS 2 DAYS

PROJECT VESSEL SHIP TRACKS

BULK (ORE) CARRIERS

- ARKADIA
- NORDIC ODIN
- NORDIC ODYSSEY

GENERAL CARGO VESSELS

- ZELADA DESGAGNES

OIL TANKERS

- SARAH DESGAGNES
- MARINE MAMMAL REGIONAL STUDY AREA

ICE CONCENTRATION

- < 1/10
- 1-3/10
- 4-6/10
- 7-8/10
- 9-10/10

0 10 20
1:600,000 KILOMETRES

REFERENCE(S)
ICE CONCENTRATION OBTAINED FROM CANADIAN ICE SERVICE, GOVERNMENT OF CANADA. DAILY ICE CHARTS – APPROACHES TO RESOLUTE BAY. ACCESSED NOVEMBER 23, 2018. GEOGRAPHIC NAMES, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. WE ACKNOWLEDGE THE USE OF IMAGERY PROVIDED BY SERVICES FROM NASA'S GLOBAL IMAGERY BROWSE SERVICES (GIBS), PART OF NASA'S EARTH OBSERVING SYSTEM DATA AND INFORMATION SYSTEM (EOSDIS).
PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

PROJECT
MARY RIVER PROJECT - PHASE 2 PROPOSAL

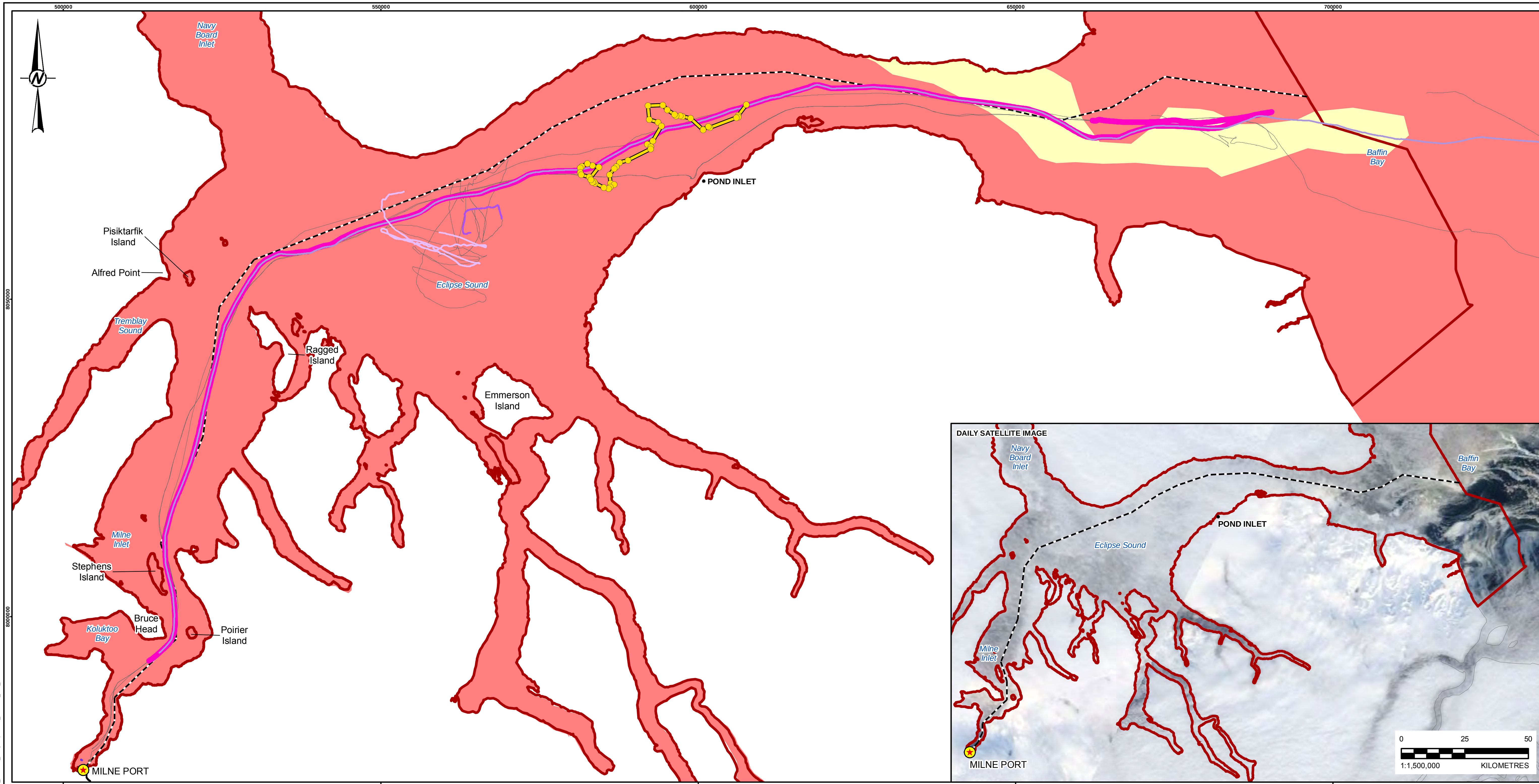
CONSULTANT

GOLDER

YYYY-MM-DD	2019-09-26
DESIGNED	MF
PREPARED	AA
REVIEWED	AA
APPROVED	PR

TITLE
DAILY LOCATIONS OF NARWHAL IN RELATION TO VESSEL TRAFFIC AND ICE CONDITIONS - FALL - OCTOBER 11, 2018 (UTC)

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	30000-05	A	A-13



LEGEND

- COMMUNITY
- MILNE PORT

NARWHAL GPS LOCATIONS

- NW22 (MM02-760) FASTLOC GPS LOCATION

NARWHAL TRACKS

- NW22 (MM02-760) FASTLOC GPS LOCATION
- BOTNICA SHIP TRACK
- MILNE INLET TOTE ROAD
- NOMINAL SHIPPING ROUTE
- PROJECT VESSEL SHIP TRACK - PREVIOUS 2 DAYS

PROJECT VESSEL SHIP TRACKS

BULK (ORE) CARRIERS

- ARKADIA
- NORDIC ODIN
- NORDIC ODYSSEY
- NORDIC OSHIMA

GENERAL CARGO VESSELS

- ZELADA DESGAGNES

OIL TANKERS

- SARAH DESGAGNES
- MARINE MAMMAL REGIONAL STUDY AREA

ICE CONCENTRATION

- < 1/10
- 1-3/10
- 4-6/10
- 7-8/10
- 9-10/10

0 10 20
1:600,000 KILOMETRES

REFERENCE(S)

ICE CONCENTRATION OBTAINED FROM CANADIAN ICE SERVICE, GOVERNMENT OF CANADA. DAILY ICE CHARTS – APPROACHES TO RESOLUTE BAY. ACCESSED NOVEMBER 23, 2018. GEOGRAPHIC NAMES, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. WE ACKNOWLEDGE THE USE OF IMAGERY PROVIDED BY SERVICES FROM NASA'S GLOBAL IMAGERY BROWSE SERVICES (GIBS), PART OF NASA'S EARTH OBSERVING SYSTEM DATA AND INFORMATION SYSTEM (EOSDIS).
PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

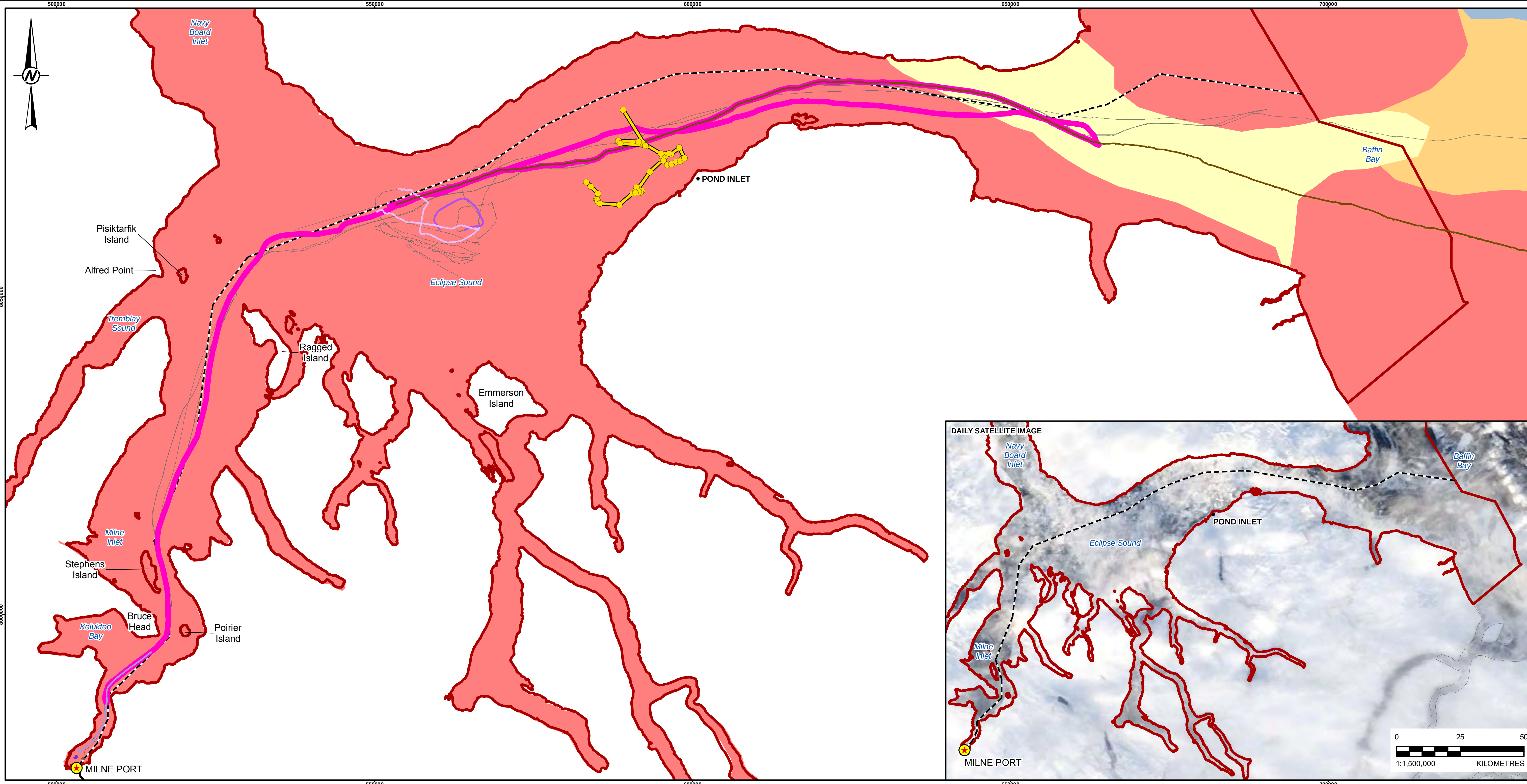
PROJECT
MARY RIVER PROJECT - PHASE 2 PROPOSAL

CONSULTANT
GOLDER

YYYY-MM-DD	2019-09-26
DESIGNED	MF
PREPARED	AA
REVIEWED	AA
APPROVED	PR

TITLE
DAILY LOCATIONS OF NARWHAL IN RELATION TO VESSEL TRAFFIC AND ICE CONDITIONS - FALL - OCTOBER 12, 2018 (UTC)

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	30000-05	A	A-14



LEGEND

- COMMUNITY
- MILNE PORT

NARWHAL GPS LOCATIONS

- NW22 (MM02-760) FASTLOC GPS LOCATION

NARWHAL TRACKS

- NW22 (MM02-760) FASTLOC GPS LOCATION
- BOTNICA SHIP TRACK
- MILNE INLET TOTE ROAD
- NOMINAL SHIPPING ROUTE
- PROJECT VESSEL SHIP TRACK - PREVIOUS 2 DAYS

PROJECT VESSEL SHIP TRACKS

BULK (ORE) CARRIERS

- ARKADIA
- NORDIC ODIN
- NORDIC ODYSSEY
- NORDIC OSHIMA

GENERAL CARGO VESSELS

- QAMUTIK
- ZELADA DESGAGNES

OIL TANKERS

- SARAH DESGAGNES
- MARINE MAMMAL REGIONAL STUDY AREA

ICE CONCENTRATION

- < 1/10
- 1-3/10
- 4-6/10
- 7-8/10
- 9-10/10

0 10 20
1:600,000 KILOMETRES

REFERENCE(S)

ICE CONCENTRATION OBTAINED FROM CANADIAN ICE SERVICE, GOVERNMENT OF CANADA. DAILY ICE CHARTS – APPROACHES TO RESOLUTE BAY. ACCESSED NOVEMBER 23, 2018. GEOGRAPHIC NAMES, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. WE ACKNOWLEDGE THE USE OF IMAGERY PROVIDED BY SERVICES FROM NASA'S GLOBAL IMAGERY BROWSE SERVICES (GIBS), PART OF NASA'S EARTH OBSERVING SYSTEM DATA AND INFORMATION SYSTEM (EOSDIS).
PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

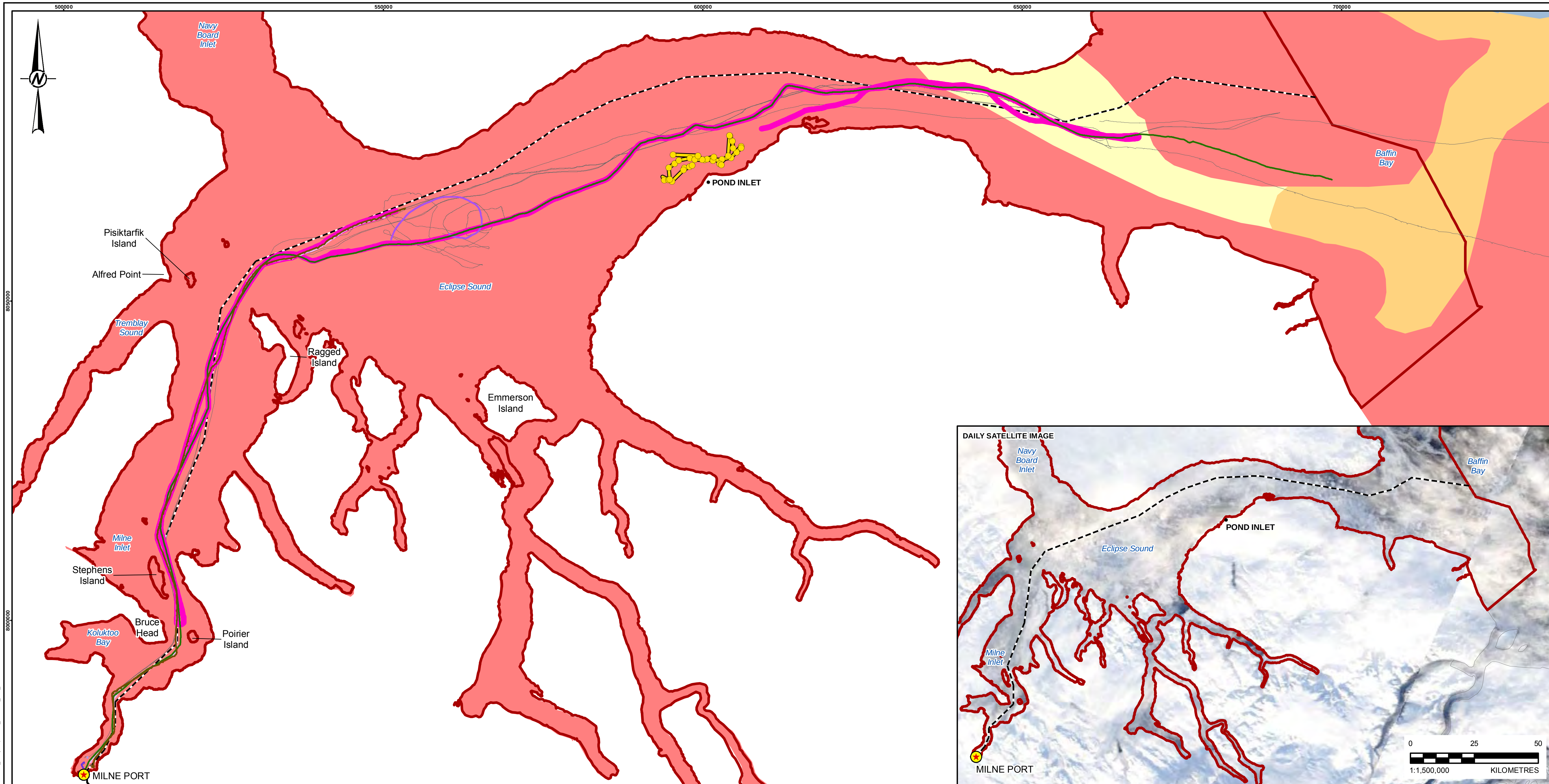
PROJECT
MARY RIVER PROJECT - PHASE 2 PROPOSAL

CONSULTANT
GOLDER

YYYY-MM-DD	2019-09-26
DESIGNED	MF
PREPARED	AA
REVIEWED	AA
APPROVED	PR

TITLE
DAILY LOCATIONS OF NARWHAL IN RELATION TO VESSEL TRAFFIC AND ICE CONDITIONS - FALL - OCTOBER 13, 2018 (UTC)

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	30000-05	A	A-15



LEGEND

- COMMUNITY
- MILNE PORT

NARWHAL GPS LOCATIONS

- NW22 (MM02-760) FASTLOC GPS LOCATION

NARWHAL TRACKS

- NW22 (MM02-760) FASTLOC GPS LOCATION
- BOTNICA SHIP TRACK
- MILNE INLET TOTE ROAD
- NOMINAL SHIPPING ROUTE
- PROJECT VESSEL SHIP TRACK - PREVIOUS 2 DAYS

PROJECT VESSEL SHIP TRACKS

BULK (ORE) CARRIERS

- ARKADIA
- NORDIC ODIN
- NORDIC ODYSSEY
- NORDIC OSHIMA

GENERAL CARGO VESSELS

- QAMUTIK
- ZELADA DESGAGNES

OIL TANKERS

- SARAH DESGAGNES
- MARINE MAMMAL REGIONAL STUDY AREA

ICE CONCENTRATION

- < 1/10
- 1-3/10
- 4-6/10
- 7-8/10
- 9-10/10

0 10 20
1:600,000 KILOMETRES

REFERENCE(S)
ICE CONCENTRATION OBTAINED FROM CANADIAN ICE SERVICE, GOVERNMENT OF CANADA. DAILY ICE CHARTS – APPROACHES TO RESOLUTE BAY. ACCESSED NOVEMBER 23, 2018. GEOGRAPHIC NAMES, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. WE ACKNOWLEDGE THE USE OF IMAGERY PROVIDED BY SERVICES FROM NASA'S GLOBAL IMAGERY BROWSE SERVICES (GIBS), PART OF NASA'S EARTH OBSERVING SYSTEM DATA AND INFORMATION SYSTEM (EOSDIS).
PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

PROJECT
MARY RIVER PROJECT - PHASE 2 PROPOSAL

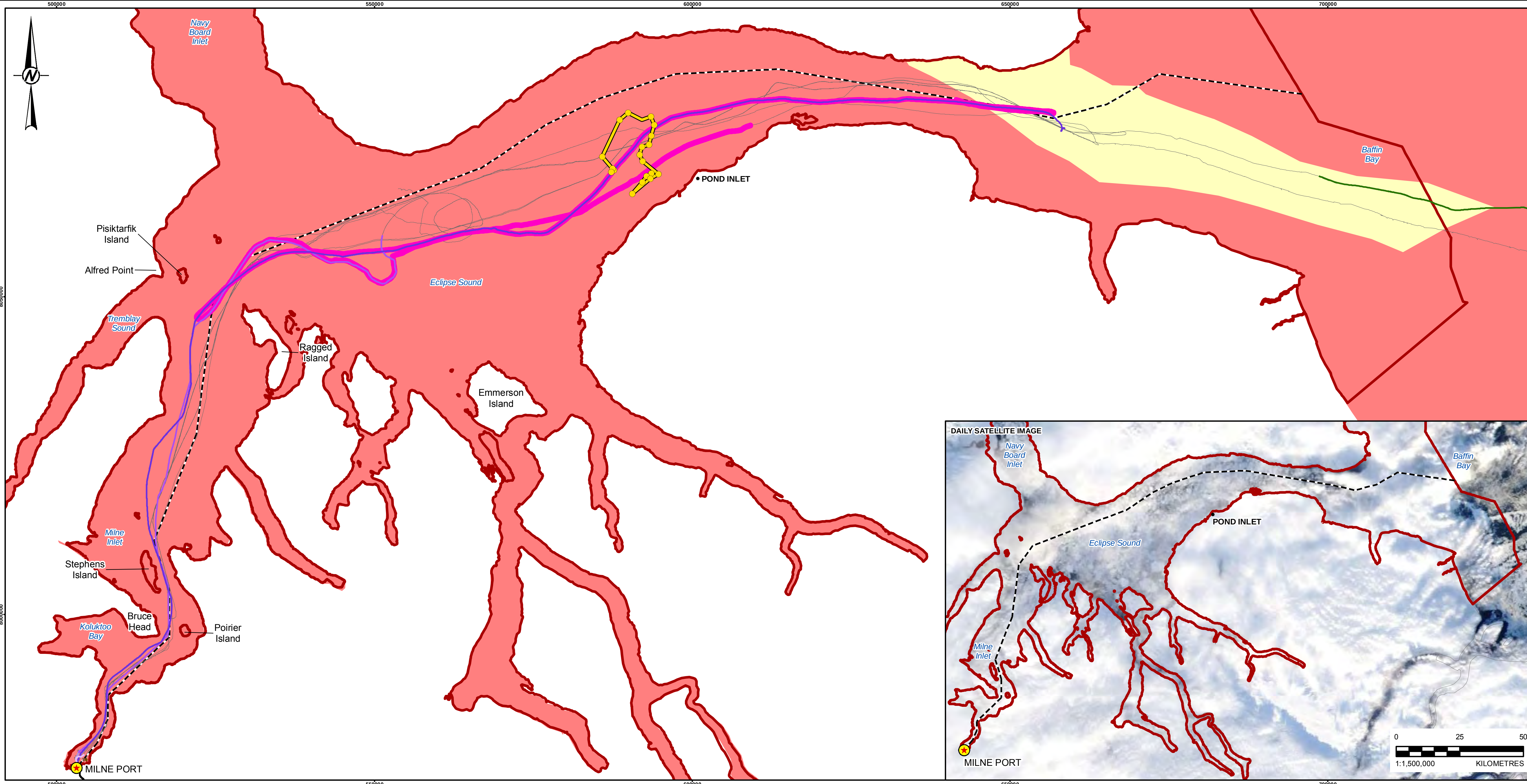
CONSULTANT
GOLDER

YYYY-MM-DD	2019-09-26
DESIGNED	MF
PREPARED	AA
REVIEWED	AA
APPROVED	PR

TITLE
DAILY LOCATIONS OF NARWHAL IN RELATION TO VESSEL TRAFFIC AND ICE CONDITIONS - FALL - OCTOBER 14, 2018 (UTC)

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	30000-05	A	A-16

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B
25mm



LEGEND

- COMMUNITY
- MILNE PORT

NARWHAL GPS LOCATIONS

- NW22 (MM02-760) FASTLOC GPS LOCATION

NARWHAL TRACKS

- NW22 (MM02-760) FASTLOC GPS LOCATION
- BOTNICA SHIP TRACK
- MILNE INLET TOTE ROAD
- NOMINAL SHIPPING ROUTE
- PROJECT VESSEL SHIP TRACK - PREVIOUS 2 DAYS

PROJECT VESSEL SHIP TRACKS

BULK (ORE) CARRIERS

- ARKADIA
- NORDIC ODIN
- NORDIC ODYSSEY
- NORDIC OSHIMA

GENERAL CARGO VESSELS

- QAMUTIK
- ZELADA DESGAGNES

OIL TANKERS

- SARAH DESGAGNES
- MARINE MAMMAL REGIONAL STUDY AREA

ICE CONCENTRATION

- < 1/10
- 1-3/10
- 4-6/10
- 7-8/10
- 9-10/10

0 10 20
1:600,000 KILOMETRES

REFERENCE(S)
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PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

PROJECT
MARY RIVER PROJECT - PHASE 2 PROPOSAL

CONSULTANT
GOLDER

YYYY-MM-DD	2019-09-26
DESIGNED	MF
PREPARED	AA
REVIEWED	AA
APPROVED	PR

TITLE
DAILY LOCATIONS OF NARWHAL IN RELATION TO VESSEL TRAFFIC AND ICE CONDITIONS - FALL - OCTOBER 15, 2018 (UTC)

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	30000-05	A	A-17

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

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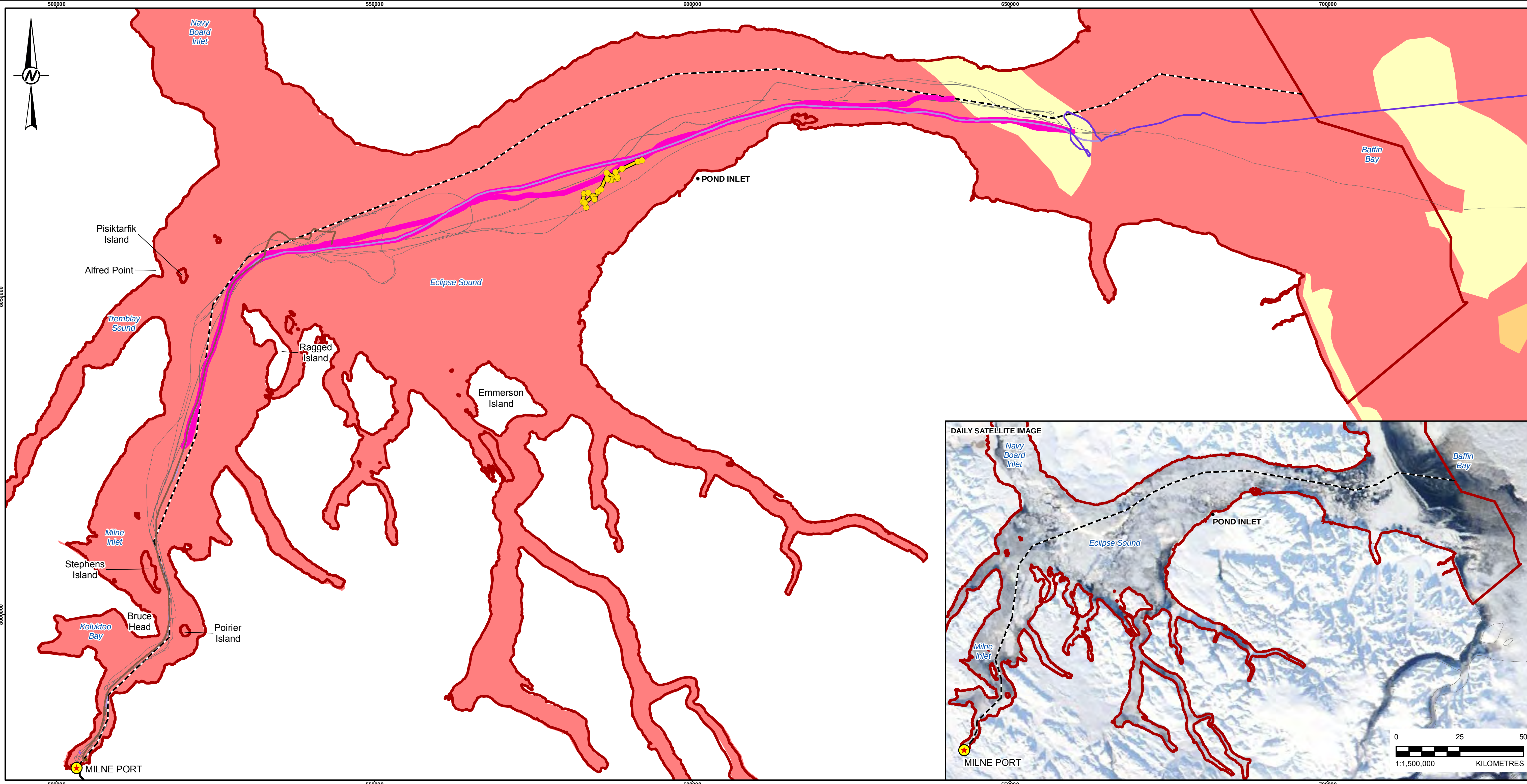


LEGEND

- COMMUNITY
- MILNE PORT

NARWHAL GPS LOCATIONS

- NW22 (MM02-760) FASTLOC GPS LOCATION

NARWHAL TRACKS

- NW22 (MM02-760) FASTLOC GPS LOCATION
- BOTNICA SHIP TRACK
- MILNE INLET TOTE ROAD
- NOMINAL SHIPPING ROUTE
- PROJECT VESSEL SHIP TRACK - PREVIOUS 2 DAYS

PROJECT VESSEL SHIP TRACKS

BULK (ORE) CARRIERS

- ARKADIA
- NORDIC ODIN
- NORDIC ODYSSEY
- NORDIC OSHIMA

GENERAL CARGO VESSELS

- QAMUTIK
- ZELADA DESGAGNES
- MARINE MAMMAL REGIONAL STUDY AREA

ICE CONCENTRATION

- < 1/10
- 1-3/10
- 4-6/10
- 7-8/10
- 9-10/10

0 10 20
1:600,000 KILOMETRES

REFERENCE(S)
ICE CONCENTRATION OBTAINED FROM CANADIAN ICE SERVICE, GOVERNMENT OF CANADA. DAILY ICE CHARTS – APPROACHES TO RESOLUTE BAY. ACCESSED NOVEMBER 23, 2018. GEOGRAPHIC NAMES, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. WE ACKNOWLEDGE THE USE OF IMAGERY PROVIDED BY SERVICES FROM NASA'S GLOBAL IMAGERY BROWSE SERVICES (GIBS), PART OF NASA'S EARTH OBSERVING SYSTEM DATA AND INFORMATION SYSTEM (EOSDIS).
PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

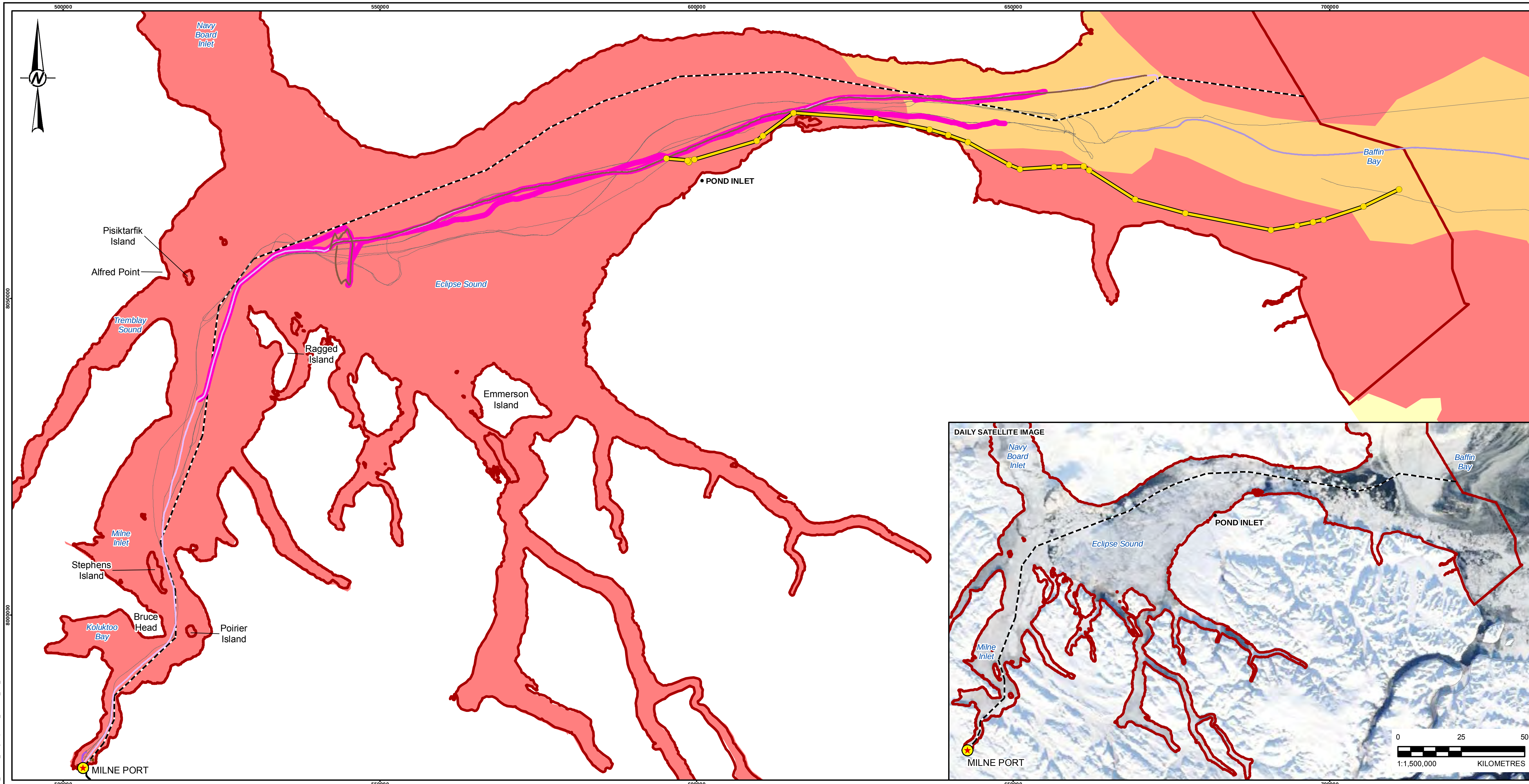
PROJECT
MARY RIVER PROJECT - PHASE 2 PROPOSAL

CONSULTANT
GOLDER

YYYY-MM-DD	2019-09-26
DESIGNED	MF
PREPARED	AA
REVIEWED	AA
APPROVED	PR

TITLE
DAILY LOCATIONS OF NARWHAL IN RELATION TO VESSEL TRAFFIC AND ICE CONDITIONS - FALL - OCTOBER 16, 2018 (UTC)

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	30000-05	A	A-18



LEGEND

- COMMUNITY
- MILNE PORT

NARWHAL GPS LOCATIONS

- NW22 (MM02-760) FASTLOC GPS LOCATION

NARWHAL TRACKS

- NW22 (MM02-760) FASTLOC GPS LOCATION
- BOTNICA SHIP TRACK
- MILNE INLET TOTE ROAD
- NOMINAL SHIPPING ROUTE
- PROJECT VESSEL SHIP TRACK - PREVIOUS 2 DAYS

PROJECT VESSEL SHIP TRACKS

BULK (ORE) CARRIERS

- ARKADIA
- NORDIC ODYSSEY
- NORDIC OSHIMA

GENERAL CARGO VESSELS

- QAMUTIK
- ZELADA DESGAGNES
- MARINE MAMMAL REGIONAL STUDY AREA

ICE CONCENTRATION

- < 1/10
- 1-3/10
- 4-6/10
- 7-8/10
- 9-10/10

0 10 20

1:600,000 KILOMETRES

REFERENCE(S)

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DAILY LOCATIONS OF NARWHAL IN RELATION TO VESSEL TRAFFIC AND ICE CONDITIONS - FALL - OCTOBER 17, 2018 (UTC)

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	30000-05	A	A-19