

Grise Fiord – Community Harbour

Environmental and Socio-Economic Existing Conditions Report

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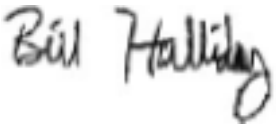
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The information presented in this document was compiled and interpreted exclusively for the purposes permitting requirements for the Grise Fiord community harbour. Dynamic Ocean Consulting Ltd. (Dynamic Ocean) in collaboration with Worley Canada Services Ltd. (operating as Worley Consulting) provided this report for the Government of Nunavut – Community and Government Services / Economic Development and Transportation (GN-CGS/EDT) solely for the purpose noted above.

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Acronyms and Abbreviations

Acronym /Abbreviation	Definition
AFA	Arctic Fishery Alliance
AIA	Archaeological Impact Assessment
ATK	Aboriginal Traditional Knowledge
BB	Baffin Bay
BC	British Columbia
BF	Baffin Fisheries
BNL	Basic Needs Level
BOLD	Barcode of Life Datasystem
BV	Bureau Veritas
CALA	Canadian Association for Laboratory Accreditation Inc.
CanNor	Canadian Northern Economic Development Agency
CBMN	Community Based Monitoring Network
CCME	Canadian Council of Ministers of the Environment
CD	Chart Datum
CEGEP	Collège d'enseignement général et professionnel (English translation - General and Vocational College)
CESCC	Canadian Endangered Species Conservation Council
CIRNAC	Crown Indigenous Relations and Northern Affairs Canada
CMIP5	Coupled Model Intercomparison Project Phase 5
CO	Cobble
CO1	Cytochrome Oxidase Subunit 1
CO_2	Carbon Dioxide
CoC	Chain of Custody
COP	Conference of the Parties
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CSAS	Canadian Science Advisory Secretariat
CSF	Coastal Shoreline and Flats
CSFL	Cumberland Sound Fisheries Ltd.
CWS	Canadian Wildlife Service
DFCA	Disko Fan Conservation Area
DFO	Fisheries and Oceans Canada

Acronym /Abbreviation	Definition
DFO-SCH	DFO Small Craft Harbour
DHC	Disturbed Human-Caused
DIO	Designated Inuit Organization
DNA	Deoxyribonucleic Acid
DSCA	Davis Strait Conservation Area
Dynamic Ocean	Dynamic Ocean Consulting Ltd.
EBSA	Ecologically and Biologically Significant Area
ECCC	Environment and Climate Change Canada
EEZ	Exclusive Economic Zone
ELC	Ecological Land Classification
EQuIS	Environmental Quality Information System
ESEB	Environmental and Socio-Economic Baseline
ESWG	Ecological Stratification Working Group
FAO	United Nation's Food and Agriculture Organization
FB	Fox Basin
FRP	Forward Regulatory Plan
FYI	First Year Ice
GN	Government of Nunavut
GN-CGS	GN Community and Government Services
GN-C&H	GN Department of Culture & Heritage
GN-DoE	GN Department of Environment
GN-EDT	GN Economic Development and Transportation
GN-PPD	GN Petroleum Products Division
GN-TIN	GN Departments of Transportation and Infrastructure
GPS	Global Positioning System
GR	Gravel
HHWLT	Higher High Water Large Tide
HHWMT	Higher High Water Mean Tide
HRQ	Haul Road Quarry
HTA	Hunters and Trappers Association
HTO	Hunters and Trappers Association
HWL	High Water Line
IBA	Important Bird Area

Acronym /Abbreviation	Definition
IBKS	Inuit Bowhead Knowledge Study
ICSP	Integrated Community Sustainability Plan
IFMP	Integrated Fisheries Management Plans
IIBA	Inuit Impact and Benefit Agreement
IHT	Inuit Heritage Trust
INAC	Indigenous and Northern Affairs Canada
IPCA	Inuit-led Protected and Conserved Areas
IPCC	Intergovernmental Panel on Climate Change
IQ	Inuit Qaujimajatuqangit or Inuit Traditional Knowledge
IUCN	International Union for the Conservation of Nature
kt	knots
LLWLT	Lower Low Water Large Tide
LLWMT	Lower Low Water Mean Tide
LTE	Long Term Evolution
LWL	Low Water Line
MBS	Migratory Bird Sanctuaries
Mbps	Megabits per second
MMR	Marine Mammal Regulations
MOU	Memorandum of Understanding
MPA	Marine Protected Areas
MUN	Memorial University of Newfoundland
MWL	Mean Water Level
MYI	Multi Year Ice
NAC	Nunavut Arctic College
NAMMCO	North Atlantic Marine Mammal Commission
NAFO	North Atlantic Fisheries Organization
NBRLUP	North Baffin Regional Land Use Plan
NCRI	Nunavut Coastal Resources Inventory
NEAS	Nunavut Eastern Arctic Shipping Inc.
NFR	Nunavut Fishery Regulations
NFS	Nunavut Fisheries Strategy
NGMP	Nunavut General Monitoring Plan
NHC	Nunavut Housing Corporation’s

Acronym /Abbreviation	Definition
NIRB	Nunavut Impact Review Board
NLCA	Nunavut Lands Claim Agreement
NMCA	National Marine Conservation Area
NPC	Nunavut Planning Commission
NR	Not Ranked
NRC	National Research Council
NRI	Nunavut Research Institute
NSA	Nunavut Settlement Area
NSIDC	National Snow and Ice Data Centre
NSSI	Nunavut Sealink and Supply Inc.
NTI	Nunavut Tunngavik Inc.
NWA	National Wildlife Area
NWHB	North and West Hudson Bay
NWHS	Nunavut Wildlife Harvest Study
NWMB	Nunavut Wildlife Management Board
OECM	Other Effective Area-Based Conservation Measures
OTN	Ocean Tracking Network
OW	Open Water
the Project	Grise Fiord Community Harbour Project
PSIR	Project Specific Information Requirements
QA/QC	Quality Assurance/Quality Control
QCorp	Qikiqtaaluk Corporation
QEC	Qulliq Energy Corporation
QFC	Qikiqtaaluk Fisheries Corporation
QIA	Qikiqtani Inuit Association
QP	Qualified Professional
RCMP	Royal Canadian Mounted Police
RDL	Reporting Detection Limit
RNLUP	Recommended Nunavut Land Use Plan
ROV	Remotely Operated Vehicle
RPD	Relative Percent Difference
RWO	Regional Wildlife Organizations
S1	Critically Imperilled

Acronym /Abbreviation	Definition
S2	Imperilled
S3	Vulnerable
S4	Apparently Secure
SA	Sand
SAO	Senior Administrative Officer
SAP	Sampling Analysis Plan
SAR	Species at Risk
SARA	*Species at Risk Act*
SCF	Small Communities Fund
SEB	South and East Baffin
SHSUBL	South Hudson Strait-Ungava Bay-Labrador
SoW	Scope of Work
SST	Sea Surface Temperature
SU	Unrankable
TAH	Total Allowable Harvest
TI NMCA	Tallurutiup Imanga (Lancaster Sound) National Marine Conservation Area
TOC	Total Organic Carbon
TSS	Total Suspended Solids
UBC	University of British Columbia
UDS	Upland Dwarf Shrub
UGM	Upland Graminoid Meadow
ULB	Upland Lichen Barren
Underhill	Underhill Geomatics Ltd.
UoG	University of Guelph
USDA	United States Department of Agriculture Plants Database
WGD	Wetland Graminoid Drainage
WJS	Western Jones Sound
WMB	Wildlife Management Boards
Worley Consulting	Worley Canada Services Ltd.
WQG	Water Quality Guidelines
WSP	Waste Stabilizer Pond
WWF	World Wildlife Fund

Executive Summary

Worley Canada Services Ltd., operating as Worley Consulting, has been retained to support the detailed design of a community harbour in Grise Fiord, Nunavut. The Project is being managed by the Government of Nunavut (GN), where GN-Community and Government Services (CGS) is the proponent during the construction stage, and ownership will transfer to GN – Economic Development and Transportation (EDT) during the operations stage. The two GN departments are working collaboratively on the Project and are collectively referred to as GN-CGS/EDT as the proponent for the permitting of the Grise Fiord community harbour. Effective 1 April 2025, GN-CGS and GN-EDT, will be merged and referred to as the Departments of Transportation and Infrastructure (GN-TIN) (GN, 2024b).

The community harbour is part of the Inuit Impact and Benefit Agreement (IIBA) negotiated for the Tallurutiup Imanga (Lancaster Sound) National Marine Conservation Area (TI NMCA) (see Section 3.2.1). Dynamic Ocean Consulting Ltd. (Dynamic Ocean is supporting Worley Consulting on the permitting requirements for the Project. This Environmental and Socio-Economic Baseline (ESEB) Report, conducted to support the detailed design and permitting phase for the Grise Fiord community harbour, builds upon the ESES produced by Worley Consulting in January 2020, where Worley Consulting was engaged by DFO-SCH to conduct a feasibility study (Advisian, 2020a).

Grise Fiord is located on the southern shore of Ellesmere Island in Jones Sound. It is within the Qikiqtaaluk Region of Nunavut and conforms with the North Baffin Regional Land Use Plan (NBRLUP) (Nunavut Planning Commission (NPC, 2000)). The environmental baseline studies included both the terrestrial and marine footprints for a quarry, haul road and community harbour. Each Study Area is defined to include the footprint and a 100 m buffered area to include possible residual effects during construction, as defined in Section 1.3. The socio-economic baseline study incorporated information on the community from the Hamlet of Grise Fiord, the Iviq Hunters and Trappers Association (HTA), and other Grise Fiord community leaders. The Socio-Economic Study Area included an area within the municipal borders of Grise Fiord and the marine environment where socioeconomic effects of the proposed development are likely to occur. Two Archaeological Impact Assessments (AIAs) (AECOM, 2024; Lifeways of Canada Limited, 2019) have been conducted under Class 2 Archaeologist Permits (2019-52A, 2024-63A) in support of the Project, in 2019 and 2024. No other archaeological sites were recorded within the Project Study Area, therefore further engagement with the GN – Culture and Heritage Department (C & H)

The ESEB Report was undertaken using both desktop review and field survey means to understand the environmental and socio-economic conditions in Grise Fiord. Inuit Qaujimajatuqangit (IQ) was used through desktop review and project specific workshops with HTA board members and local knowledge holders to identify existing conditions of important environmental and socio-economic resources in and around Grise Fiord. Additionally, early engagement with the community allowed for a collaborative approach between the field team and community members during the field surveys with access to local resources for personnel and equipment, including boats. Integrating Inuit and scientific knowledge advances the understanding of the biological and socio-economic conditions providing a baseline that is not only scientifically sound but also connected to local values, needs, and priorities.

The environmental scope considered terrestrial vegetation, terrestrial wildlife, marine and migratory birds, fish and fish habitat, and marine mammals. These organism groups are important both

ecologically and culturally in Nunavut. The habitat values within the Project Study Area were generally low in the terrestrial portions and low to moderate in the marine portions (Community Harbour Study Area), as the areas were dominated by human development and settlement. Details on the specific groups are provided in the relevant sections of this ESEB Report. Several Species at Risk (SAR) organisms do have the potential to be present in several Study Areas, but the Project footprint(s) and Study Areas do not provide critical habitat requirements for these species. Table 3-2 identifies potential SAR species and the likelihood of their presence in the relevant study areas.

Engagement with the community—including the Hamlet, the HTA, the Guardians, and residents—on the Project's design and construction planning has shown strong support for the Project and its benefits. Hunters do not anticipate significant impacts on wildlife or their ability to continue subsistence activities during construction. The community is eager for the long-awaited harbour, which will provide safer access and improved shelter for boats. Consultation remains ongoing throughout the design and permitting phase to address potential impacts and ensure that any risks to the community or harvesting rights are mitigated.

1 Introduction

This document is the Environmental and Socio-Economic Baseline (ESEB) Report conducted to support the permitting and detailed design of the Grise Fiord community harbour Project (the Project).

The Tallurutiup Imanga National Marine Conservation Area (TI NMCA) is an important designated area located in the Canadian Arctic, specifically in Lancaster Sound (Tallurutiup Imanga) and its adjacent waterways. This conservation area was established to protect and preserve the unique and ecologically important marine environment for Inuit and all Canadians. Establishment of protected areas within Canada's High Arctic basin, such as the TI NMCA, is a requirement of the Inuit Impact and Benefit Agreement (IIBA). A Memorandum of Understanding (MOU) between the Qikiqtani Inuit Association (QIA), the Government of Nunavut (GN), and the Government of Canada has resulted from the creation of the TI NMCA and was signed in the summer of 2021. The purpose of this agreement is to recognize that marine infrastructure is connected to community wellbeing as well as economic and social development, and to address the marine infrastructure deficit in several communities, including Grise Fiord and Resolute Bay. A portion of the waterfront within the several communities (such as Grise Fiord) that are within the TI NMCA is excluded through Article 4 of the IIBA (IIBA, 2019) to allow for the development of marine infrastructure. This will be accomplished with funding from the Government of Canada for a community harbour in both Grise Fiord and Resolute Bay.

The Project is being managed by the GN, where GN-Community and Government Services (CGS) is the proponent during the construction stage, and ownership will transfer to GN – Economic Development and Transportation (EDT) during the operations stage. The two GN departments are working collaboratively on the Project and are collectively referred to as GN-CGS/EDT as the proponent for the permitting of the Grise Fiord community harbour. Effective April 1, 2025, GN-CGS and GN-EDT, will be merged and referred to as the Departments of Transportation and Infrastructure (GN-TIN) (GN, 2024b).

Worley Canada Services Ltd., operating as Worley Consulting, has been retained by the GN-CGS/EDT to support the detailed design of a community harbour in Grise Fiord, Nunavut (Figure 1-1). Dynamic Ocean Consulting Ltd (Dynamic Ocean) is supporting Worley Consulting on the permitting requirements for the Project. The Grise Fiord community harbour was a component of an earlier feasibility study, completed by Fisheries and Oceans Canada – Small Craft Harbour (DFO-SCH) in 2019.

1.1 Project Overview

The Project will improve safety and access to water, functionality of boating activities, and reduce the congestion and environmental risks associated with the current use of the community harbour (see Section 1.3 of the Grise Fiord Project Specific Information Requirements [PSIR] Report for existing infrastructure (Dynamic Ocean & Worley Consulting, 2025a)).

The permanent components of the Project include the construction of:

- Two new breakwaters (to create a protected harbour).
- Boat launch ramp.
- Two small craft floating docks to support mooring of small craft vessels.

- Laydown area.
- Shoreline raised and graded to create a level driving surface.
- Navigational aids.
- Harbour lighting.

Dredging is required on the leeward side of the breakwater there will be a dredged berth pocket and approach channel allowing all tide vessel access for the small craft vessels (see Section 2.1.2.2 of the PSIR Report (Dynamic Ocean & Worley Consulting, 2025a)).

A General Arrangement of the community harbour is provided in Drawing 1-1. The final arrangement of the community harbour may change through the design development phase of the Project as GN-CGS/EDT plans to continue consulting with the community to refine the Project design, however any design modifications that do occur, are not expected to change the predicted environmental effects discussed in the PSIR Report (Dynamic Ocean & Worley Consulting, 2025a). Temporary components to support construction includes a quarry (borrow pits) and haul road, with the quarry (borrow pits) required to supply rock for construction, and a haul road to transport rock from the quarry (borrow pits) to the community harbour. Project components are further described in Section 1.3.

Construction is anticipated to require four years and is planned to occur from the open-water seasons of 2026 through to 2029.

During construction, the Project will use the existing scheduled sealift deliveries and scheduled flights, with the potential for use of chartered flights when additional cargo or construction crew capacity is required. Potable water, sanitary and solid waste disposal are anticipated to be provided via existing facilities. Fuel supply may use existing facilities if there is sufficient capacity and quantity, if the existing facilities are not adequate the Contractor will be required to install temporary fuel storage facilities and/or arrange additional fuel shipments. Construction crew accommodations will be provided by a construction camp to be established by the construction contractor.

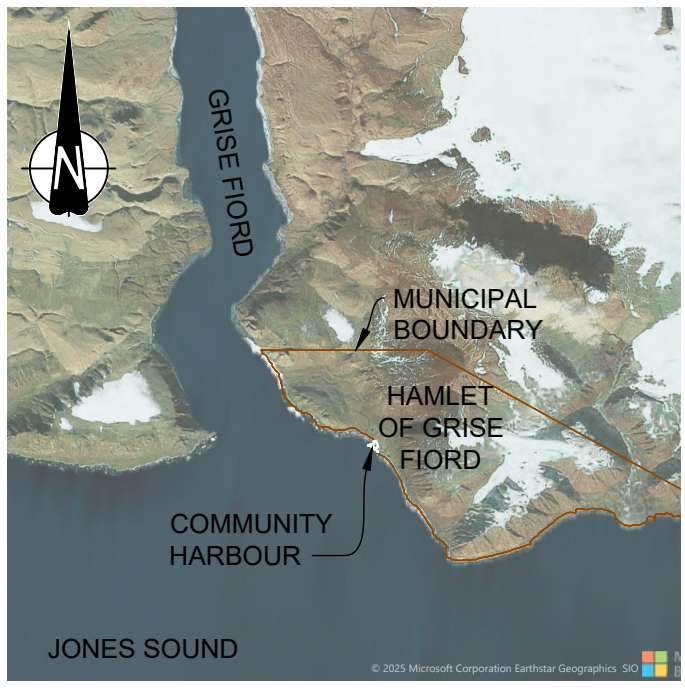
1.2 Project Location

The Project is located at Grise Fiord, a Hamlet on the southern shore of Ellesmere Island in Jones Sound (76° 25.001'N, 82° 54.935'W, see Figure 1-1). The community is located approximately 1,100 km north of the Arctic Circle in the Qikiqtaaluk Region of Nunavut, and conforms with the North Baffin Regional Land Use Plan (NBRLUP) (Nunavut Planning Commission (NPC, 2000)). While Grise Fiord is within the NBRLUP, the Recommended Nunavut Land Use Plan (RNLUP) (NPC, 2023b) will replace the NBRLUP once it is approved.

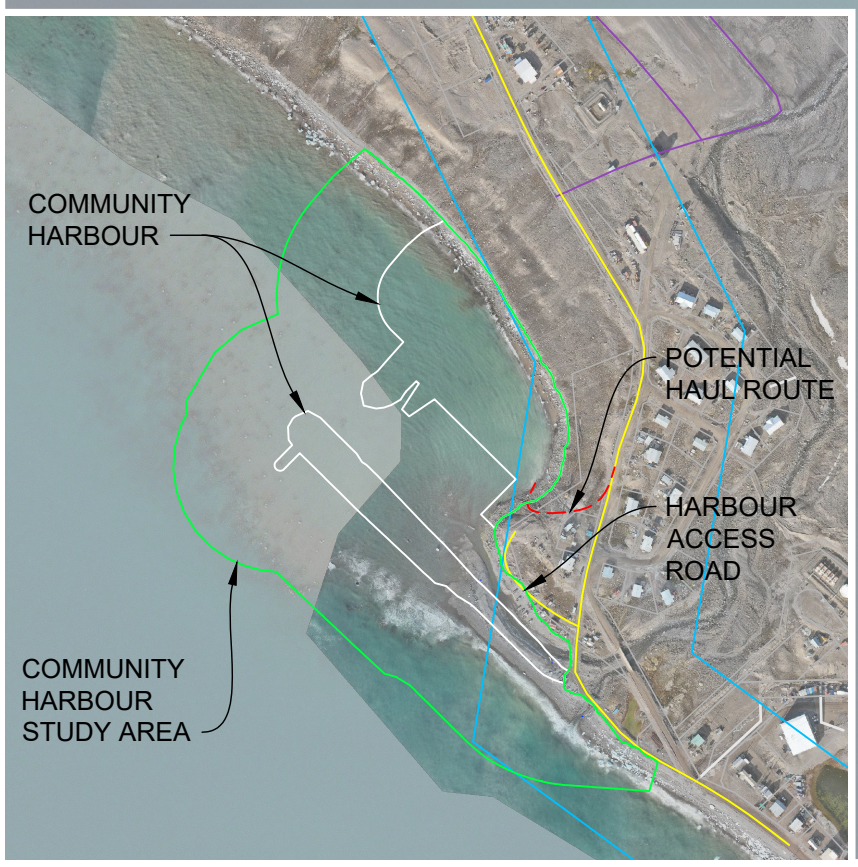
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SAVE DATE & TIME: 3/4/2025 12:38:53 PM
USER NAME: jennifer.coppendale
ISSUING OFFICE: VANCOUVER, B.C.

QUARRY LOCATION 2C
POTENTIAL ALTERNATE HAUL ROUTE
QUARRY LOCATION 2D
QUARRY LOCATION 2B
HAUL ROUTE
QUARRY LOCATION 2A
HAUL ROUTE
POTENTIAL STOCKPILE / LAYDOWN / AGGREGATE PRODUCTION AREAS
SEWAGE LAGOON
AIRPORT KUURAALUK
VALLEY CREEK
COMMUNITY HARBOUR
COMMUNITY HARBOUR STUDY AREA
HAMLET OF GRISE FIORD
KUURAALUK CREEK



KEY PLAN
1:300000



INSET PLAN
1:7500

PLAN
1:15000

LEGEND

- HAUL ROAD ON EXISTING ROAD/TRACK
- ALTERNATE/ADDITIONAL HAUL ROUTE
- COMMUNITY STUDY AREA
- QUARRIES STUDY AREA
- EXISTING ROAD STUDY AREA
- STOCKPILE/LAYDOWN AREA
- QUARRY

m 0 100 200 300 400 m
1:7500

m 0 100 500 1000m
1:15000

GOVERNMENT OF NUNAVUT
GRISE FIORD COMMUNITY
HARBOUR DEVELOPMENT

Figure 1-1 **PROJECT COMPONENTS (QUARRY, HAUL ROAD, COMMUNITY HARBOUR)**

Date: 03-APR-25	Drawn by: JLC	Edited by: JLC	App'd by: CM

Worley Project Number 317086-54170

DRG No 1 | REV 1

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1.3 Project Components

The Project components include temporary and permanent components, which are marine and terrestrial. Temporary components are terrestrial and include a quarry (borrow pits) and haul road; the quarry (borrow pits) to supply rock for construction, and a haul road to transport rock from the borrow pits to the community harbour. The permanent component is the community harbour and is primarily marine with small portions that are terrestrial (Figure 1-1 (community harbour location and components); Figure 1-2 of the PSIR Report (community harbour location) (Dynamic Ocean & Worley Consulting, 2025a); Drawing 1-1 (General Arrangement of community harbour)). Potential requirements for a contractor laydown area are discussed in Section 2.2.3 of the PSIR Report (Dynamic Ocean & Worley Consulting, 2025a).

The selected locations to be used for the Project components are discussed in this section. Site selection is determined by a variety of variables including harbour usage, environmental, regulatory, socio-economic, constructability, geological and engineering characteristics, cost, and future maintenance requirements.

Marine traffic, sealift operations and other ship operations are not considered in this ESEB Report.

1.3.1 Community Harbour

Three options were considered for Grise Fiord, which had been conceptualized in collaboration with DFO-SCH in the early feasibility study in 2019. The generalized arrangements form the basis of this study and were developed based on the local knowledge and feedback received during community consultations in the feasibility (2018) and detailed design (2024) phases. Option 1 (community harbour), located to the northwest, was the chosen design. Option 2 and 3 were southeast of Option 1. Option 1 was selected as the preferred option, since it was the best for working with the natural landscape (within a sheltered bay) and providing maximum protection from waves for small craft vessels (see Drawing 1-1; Figure 1-2 of the PSIR Report (Dynamic Ocean & Worley Consulting, 2025b)), and better constructability. Option 1 was also the preferred choice through community consultation.

1.3.2 Quarry

Initial quarry (borrow pits) locations were developed as part of the community consultations in the feasibility (2018). Based on community feedback of preferred locations, four borrow pit locations (surficial deposits) were identified (see Figure 1-1; Photo 1-3 in the PSIR Report (Dynamic Ocean & Worley Consulting, 2025b)). The locations were selected through a review of aerial imagery, community consultations during the feasibility and design consultation programs, and the 2019 feasibility phase field program. These four borrow pits were investigated during the 2024 detailed design phase field program to determine the efficacy of suitable rock for construction of the community harbour. Demonstrative photos of the quarry (borrow pits) can bee seen in Photo 1-3 of the PSIR Report (Dynamic Ocean & Worley Consulting, 2025a). Due to potential variability in rock size, all four areas may be used by the contractor during construction.

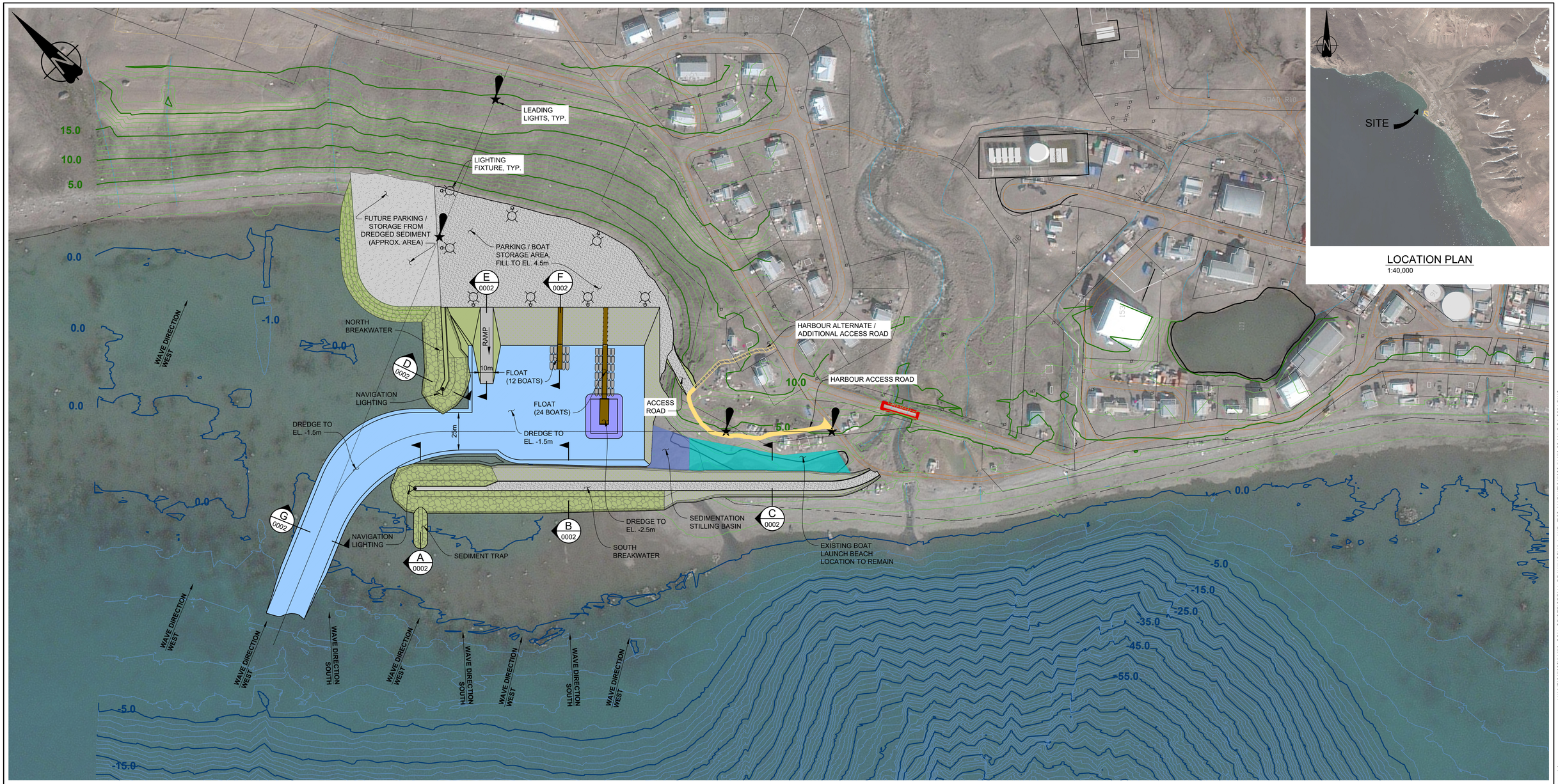
- Location 2A contains smaller block sizes.

- Location 2B offers some appropriately sized material and features a chute or outwash channel with cleaner rock fill of variable sizes.
- Locations 2C and 2D are mainly composed of terminal moraine and feature suitably sized material.

The four borrow pits are between approximately 4 km and 2 km northwest of the community.

1.3.3 Haul Road

Requirements for a haul road to support the transportation of rock material from the quarry (borrow pits) to the community harbour, can largely be met through the utilization of an existing road. The existing haul road can access borrow pit locations 2A, 2B and 2D. Should access to borrow pit 2C be required, a new haul road will need to be constructed that will be one of two options: extension (new road) of 250 m and 600 m (see Figure 1-1). The existing road will require upgrades to make it a suitable haul road; it extends 4.2 km. An additional 1.6 km of haul road may be constructed to provide access to the potential stockpile laydown area in proximity to the airport, this would largely use existing tracks to the Hamlets existing borrow pits located to the east of the airport. Both areas for the haul road extensions were assessed for terrestrial (wildlife, vegetation; see Sections 8 and 0) and archaeological effects (see Section 5.4.1 and 7.1.3.6 of the PSIR Report (Dynamic Ocean & Worley Consulting, 2025a)).



PLAN
1:1500

LOCATION PLAN
1:40,000

m 0 10 20 30 40 50 100 m

1:1500

NOTES:

1. WATER DEPTHS WITHIN THE SURVEY BOUNDARY PROVIDED BY FISHERIES AND OCEANS CANADA. SURVEY WAS PERFORMED ON SEPTEMBER 22, 2018 BY AQUATICS-ESI, PROJECT NO. 18S022002, DRAWING NO. A1, REVISION 2, DATED 19/01/07

REV	DATE (DD-MMM-YY)	REVISION DESCRIPTION	DRAWN	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	QAR	REF DRAWING No	REFERENCE DRAWING TITLE
B	28-NOV-24	ISSUED FOR REVIEW	JLC	-	CM	DH	CM	-		
A	29-JUL-24	ISSUED FOR REVIEW	JLC	-	CM	DH	CM	-		

D SHEET | SCALE | SHOWN

WORLEY PROJECT No
317086-54170

ENGINEERING AND PERMIT STAMPS (As Required)

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Building Nunavut Together
Nunavuliuqatigiingniq
Bâtir le Nunavut ensemble

"This drawing is prepared for the use of the contractual customer of Worley Canada Services Ltd. and Worley Canada Services Ltd. assumes no liability to any other party for any representations contained in this drawing."

worley consulting

Drawing 1-1

GRISE FIORD
COMMUNITY HARBOUR
PLAN

DRG No
317086-54170-00-MA-DGA-0001

REV
B

LOCATION: U:\YVR\317086\54170_GCN_GRISEFIORD\11_DRAWINGS\15_I_AND_E\02_MARINE\317086-54170-
USER NAME: jennifer.coppendale
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1.4 Study Areas & Marine Corridors

The Study Areas were developed for the Project components and were determined based on potential temporary and permanent footprints and alignment with existing quarry (borrow pits), road, and shoreline access infrastructure (Figure 1-1).

Environmental (Physical, Biological) Study Areas for the haul road, quarry (borrow pits) and community harbour are considered the footprint plus a 100 m buffer. This is to account for potential environmental effects during construction and to be inclusive of any archaeological buffers that may have been required. When the haul road and quarry are collectively discussed, it will be referred to as the HRQ Study Area, and when all Environmental Study Areas are collectively discussed, they will be referred to as the Project Study Area.

The Socio-Economic Study Area is inclusive of the municipal boundary of Grise Fiord and the marine environment where socio-economic effects due to the community harbour have the potential to occur (see Figure 1-1).

For many of the marine organisms discussed, they are mobile with migratory routes or ranges that extend beyond the Community Harbour Study Area. This is particularly true of marine mammals who will be discussed in the broader context of the water bodies pertinent to their migratory routes relevant to potential access to Grise Fiord. Hereafter called Marine Corridors, this is considered inclusive of Baffin Bay, Jones Sound, Nares Strait, Lancaster Sound, Lady Ann Strait, and Davis Strait (see Figure 1-2, Section 4.3).



Talluritiup Imanga NMCA



N

0 55 110 220 Km

Spatial Reference
GCS: GCS WGS 1984
Datum: WGS 1984
Projection: Stereographic North Pole
Scale: 1:5,466,762
Date Exported: 2025-04-02 11:40 AM
Drawn: C. Knight

Figure 1-2

Important Marine Water Bodies (Marine Corridors) Pertinent to the Project

1.5 Scope of Study and Objectives

The objective of the ESEB Report is to summarize the environmental (physical, biological) and socio-economic environment conducted to inform the detailed design phase of the Project. Information was synthesized from a combination of desktop review, field programs, and Inuit Qaujimajatuqangit (IQ). Desktop review and field program methodologies are provided in their respective sections throughout this report. Methodology for the IQ program is provided in Section 2.3. IQ has been incorporated into the desktop review and discussion sections of each discipline.

The Scope of Work (SoW) to support the ESEB Report is summarized below, with a more detailed description provided in Table 1-1:

- Inuit Qaujimajatuqangit.
- Species at Risk and Designated Areas.
- Aquatic Fish Habitats.
- Marine Water and Sediment Quality.
- Terrestrial Vegetation (Including Rare Plants).
- Marine Mammals.
- Marine Fish (including Marine Invertebrates) and Fish Habitat.
- Freshwater Fish and Fish Habitat
- Terrestrial Wildlife.
- Migratory and Marine Birds.
- Socio-Economic Environment.
- Archaeological and Cultural Historic Site Assessment.

Program objectives for the different disciplines are detailed in Table 1-1.

Table 1-1: Project Environmental and Socio-Economic Survey Program Objectives

Category	Relevant Study Areas	Program Objectives	Approach	Report Section
IQ	Project	• Document historical and current land use in the Project Study Area including fishing, hunting, trapping, plant harvesting, and any other traditional or cultural uses as identified by local Inuit land users. • Document local Inuit knowledge of fish, marine and land mammals, migratory and marine birds. • Document marine access requirements for users during the open-water and iced-in season (i.e., snowmobile). • Obtain input and feedback to harbour design such as wind direction and strength, currents, seasonal changes to ice, water and ice access, current boating practices, traffic, and community needs.	• Desktop review, IQ workshops, and interviews with Inuit knowledge holders.	Section 2, IQ was incorporated within each discipline chapter. A discussion on local land and resource use can be found in Section 11.2.6.
Archaeological and Cultural Historic Site Assessment	Project	• Archaeological and Cultural Historic Site Assessment. • Assessment to encompass Project Study Area.	• On site assessment by a professional archaeologist recognized by the GN-Culture & Heritage (GN-C&H) occurred in the feasibility (2019) and detailed design (2024) phases. • Services provided by AECOM accompanied the Worley Consulting terrestrial team to assess the Project Study Area. • The Archaeological Impact Assessment (AIA) was permitted as detailed in Table 1-6 and will be submitted to the GN-C&H.	N/A

Category	Relevant Study Areas	Program Objectives	Approach	Report Section
Species at Risk and Designated Habitats	Project	• Species at Risk Assessment to determine the potential for SAR to be present in the vicinity of the Project Study Area.	• Desktop review and field program to determine presence potential. • Review of designations through international, federal, and territorial (when available) processes. • Identification of marine and terrestrial designated habitats were investigated, with documentation of proximity to the Grise Fiord community.	Section 3.1
Aquatic Habitats	Project	• Understanding of the benthic landscape, waterbodies, and water circulation patterns.	• Desktop review of freshwater and marine benthic habitat, vegetation, and water bodies of importance to the Project. • Water circular patterns collected through Drogue field program to inform coastal processes.	Section 4
Marine Water and Sediment Quality	Community Harbour	• Understanding of water quality parameters and the impact of tidal fluctuation.	• Desktop study to describe marine water and sediment quality characteristics of the Community Harbour Study Area.	Section 5.1
			• Water quality analysis through physicochemical (YSI) and laboratory analysis (Canadian Council of Ministers of the Environment (CCME) guidelines (CCME, 1999)).	Sections 7.1.4.2, 7.4.4.2
Marine Fish (including Marine Invertebrates) and Fish Habitat	Community Harbour	• Assessment of existing conditions and potential effects on fish and fish habitat. • Determination of species important for harvesting by Inuit, and whether harvesting practices occur within the Community Harbour Study Area.	• Determination of buffer zones for Project Study Area based on determination of the extent of potential impacts during construction (e.g. turbidity).	Sections 1.1, 1.4
			• Identification of focal fish species to be considered representative of fish habitat utilization in the Community Harbour Study Area.	Section 6.1

Category	Relevant Study Areas	Program Objectives	Approach	Report Section
			• Selection of focal fish species driven by IQ and further supported through desktop and a field program.	
			• Development of a habitat map of the Community Harbour Study Area, informed through field data (intertidal, subtidal surveys) and IQ.	Section 7, Figure 2-1, Figure 7-8

			• Determination of habitat utilization (e.g. spawning, nursery, rearing, feeding, migration) by focal fish species.
			• Accomplished through:
			  ○ Desktop study, IQ, field programs, and laboratory data to identify focal fish species.
			  ○ Collection of amphipods occupying the Community Harbour Study Area in the intertidal area.
			  ○ Collection of fish (sculpin, Arctic cod, Arctic char) was planned to support a dietary study, however there was limited local support available during the field program. Collection of sculpins will be attempted during the spring 2025 geotechnical program.
			  ○ Performance of a plankton survey, dietary analysis on a fish species occupying the Community Harbour Study Area (Arctic cod).
				Sections 6, 7

Marine Mammals	Community Harbour	• Assessment of existing conditions and potential effects on marine mammals.	• Desktop study, IQ and incidental observations during the field program to identify focal marine mammal species.	Sections 6.1, 6.4

Category	Relevant Study Areas	Program Objectives	Approach	Report Section
		• Determination of species important for harvesting by Inuit, and whether harvesting practices occur within the Community Harbour Study Area.	• Desktop and IQ for confirming presence of marine mammals in vicinity of the community harbour or that are important for subsistence purposes.	
Fresh Water Fish and Fish Habitat	Haul Road and Quarry (Borrow Pits) (only if fish bearing water courses)	• Assessment of existing conditions and potential effects on fish and fish habitat.	• Discussion through IQ, desktop study and incidental observations during the field program to determine if there are freshwater water courses in proximity to Project Study Area, and if they are fish bearing.	Sections 4.4, 7.1.5, 7.4.5, 7.5.4
Terrestrial Vegetation	HRQ, Community Harbour	• Terrestrial vegetation assessment including identification of SAR and rare plants in the Project Study Area.	• IQ, desktop review and a field program (2019 only) to determine terrestrial plant species, plant communities, and SAR that occur within the Project Study Area.	Sections 3.1, 8
Terrestrial Wildlife	HRQ, Community Harbour	• Assessment of existing conditions and potential effects on terrestrial wildlife. • Determination of species important for harvesting by Inuit, and whether harvesting practices occur within the HRQ Study Area.	• IQ, desktop review and a field program (2019 only) to determine presence of terrestrial wildlife (including SAR) and habitat utilization within the HRQ Study Area.	Sections 3.1, 0
Migratory and Marine Birds	Project	• Assessment of existing conditions and potential effects on migratory and marine birds. • Determination of species important for harvesting by Inuit, and whether harvesting practices occur within the Project Study Area.	• IQ, desktop review and a field program (2019 only) to determine presence of migratory and marine birds (including SAR) and habitat utilization within the HRQ Study Area.	Sections 3.1, 10
Socio-Economic	Project, Socio-Economic	• Characterization of the socio-economic conditions of the community including: ○ Population, education and labour force activity.	• Desktop review including Statistics Canada census data and GN community data and infrastructure planning.	Section 11

Category	Relevant Study Areas	Program Objectives	Approach	Report Section
		○ Infrastructure and services: health services, education, emergency services, utilities, and infrastructure. ○ Resource use in the area, including subsistence harvesting, tourism, and any trapping and guiding operations. ○ Traffic patterns; community health and wellness; and other valued socioeconomic components as determined through community consultation.	• Community consultations and interviews with key community members, service providers, and Hamlet administration.	

1.5.1 Desktop Resources

The desktop review of scientific, government, natural history, and IQ sources focused on species of management importance in Nunavut either through their role in the ecosystem, conservation status, importance for subsistence or commercial fisheries, and based on their potential to occur in the Project Study Area. Species were further assessed for being designated through territorial, federal (e.g., SAR Registry) (Government of Canada, 2024g) and international databases (International Union for the Conservation of Nature [IUCN] registry) (IUCN, 2024). From this, a focal species list was developed for terrestrial wildlife, fish, marine mammals, and migratory birds based on presence within the Marine Corridors (Figure 1-2).

Desktop resources that were particularly helpful in providing regional context for the ESEB Report are summarized in Table 1-2.

Table 1-2: Desktop Resources Used to Support the Environmental and Socio-Economic Baseline Report

Source	Description	Reference	Environmental	Socioeconomic	IQ
Social Media Posts	Information posted on social media sites such as Facebook and SIKU.	Various online groups such as Grise Fiord News, Sell/Swap and This & That, Inuit Hunting Stories of the day, posts on the SIKU app. etc.	✓	✓	✓
Google Earth Imagery	Evaluated prior to field programs to identify freshwater sources and inform potential site selection for quarries.	Google Earth (2022)	✓	-	-
Online Databases	Various online databases were reviewed to provide information, some examples are below: • Committee on the Status of Endangered Wildlife in Canada (COSEWIC) registry. • International Union for the Conservation of Nature Red List of Threatened Species registry. • Species at Risk Public registry.	Canadian Endangered Species Conservation Council,CESCC (2016); Government of Canada (2024g); IUCN (2024)	✓	-	-
Nunavut Coastal Resources Inventory (NCRI) for Grise Fiord	Nunavut Coastal Resource Inventory studies were launched in 2007 by the GN -Department of Environment (GN-DoE) and serve as an important community-based management tool. Currently, these have been developed for 24 of the 27 Nunavut communities (GN, 2020).	GN (2012)	✓	✓	✓
Draft Nunavut Land Use Plan	The commission is mandated by the agreement under Article 11: Land Use Planning, to develop, implement and monitor land use plans in the designated area consisting of the Nunavut Settlement Area (NSA) and Outer Land Fast Ice Zone. This land use plan is intended to guide and direct resource use and development.	NPC (2021)	✓	✓	✓

Source	Description	Reference	Environmental	Socioeconomic	IQ
North Baffin Land Use Plan	The NBLUP was approved and implemented by the NPC in 2000, as a document to lay out land use planning for the North Baffin region of the NSA which contains Grise Fiord. The document contains high level information to ecological and environmental resources important to Inuit sustenance and culture.	NPC (2000)	✓	✓	✓
Recommended Nunavut Land Use Plan	The RNLUP was developed in 2023 by the NPC as an updated plan for the NSA. This document is intended to be a Nunavut-wide update to previous land use plans such as the North Baffin Regional Land Use Plan once approved. The document contains high level information to ecological and environmental resources important to Inuit subsistence and culture.	NPC (2023b, 2023c)	✓	✓	-
The NPC Public Hearings Report on the 2021 Draft Nunavut Land Use Plan	Provides a summary of feedback on the 2021 Draft Nunavut Land Use Plan, highlighting key concerns and recommendations from public hearings.	NPC (2023a)	-	✓	✓
Summary of Community Meetings on the Draft Land Use Plan- Grise Fiord	Summary of community feedback on land use planning, reflecting Inuit perspectives on environmental and socio-economic needs and priorities.	(NPC, 2013)	-	✓	✓
Nunavut Wildlife Harvest Study (NWHS)	Described in Part 4 of the *Nunavut Agreement.* The NWHS was mandated by the Nunavut Lands Claim Agreement (NLCA) and carried out under the direction of the NWMB. Harvest data were collected monthly from Inuit hunters for a total of five years covering the harvest months from June 1996 to May 2001. The purpose of the NWHS was to determine current harvesting levels and patterns of Inuit use of wildlife resources.	Priest and Usher (2004) and summarized Section 6.2 (Table 6-2)	✓	✓	✓
Qikiqtaaluk Inuit Qaujimatatuqangit and Inuit Quajimatangit Iliqqusingitigut for the Baffin Bay and Davis Strait Marine Environment	Presents Inuit Knowledge (IQ) on the Baffin Bay and Davis Strait marine environment, highlighting IQ of marine species, seasonal patterns, ecological changes and marine management.	QIA (2018b).	-	✓	✓

Source	Description	Reference	Environmental	Socioeconomic	IQ
Inuit Bowhead Knowledge Study (IBKS)	Described in Part 5 of the *Nunavut Agreement.* As mandated by the Nunavut Land Claims Agreement of 1993, Inuit knowledge of bowhead whales in Nunavut, Canada was collected by means of 257 individual interviews with 252 Inuit hunters and elders in 18 communities during 1995 and 1996. During 1996 and 1997, follow-up workshops were held in eight of these communities where bowheads appear to be most numerous and seasonally predictable in their occurrence.	NWMB (2000)	✓	✓	-
A Study of Inuit Knowledge of the Southeast Baffin Beluga	In planning and carrying out the study, the NWMB, DFO, and the three communities were involved in the planning and collection of topics and questions for the three-day workshops.	Kilabuk (1998)	-	✓	✓
Integrated Community Sustainability Plan (ICSP)	Integrated Community Sustainability Plans are infrastructure profiles that detail the current infrastructure situation in each community in Nunavut and identify future infrastructure needs and goals. They provide a breakdown of all community infrastructure assets and allow for future infrastructure planning based on the goals for each community.	GN (2013)	-	✓	-
Community Based Wildlife Monitoring Network	The intention of which is to address concerns affecting wildlife management, conservation, and Inuit harvesting rights and to obtain IQ in a format that can be integrated with western science modelling.	NWMB (2022)	✓	-	✓
Inuit Heritage Trust (IHT): Place Names Program	Documents Inuit place names, their environmental and landscape features and cultural significance.	IHT (2007).	-	✓	✓
North Atlantic Marine Mammal Commission (NAMMCO)	North Atlantic Marine Mammal Commission is an international regional body for cooperation on conservation, management and study of cetaceans (whales, dolphins, and porpoises) and pinnipeds (seals and walrus) in the North Atlantic. NAMMCO aims to	NAMMCO (2022)	✓	-	-

Source	Description	Reference	Environmental	Socioeconomic	IQ
	strengthen and progress the conservation and management measures for marine mammals.				
Government Publications	Various government publications on fisheries management and scientific research from DFO including: • Canadian Science Advisory Secretariat ([CSAS], reports, research documents, proceedings). • Integrated Fisheries Management Plans (IFMP).	DFO (2019a, 2019c)	✓	-	-
Tallurutiup Tariunga Inulik: Inuit Participation in Determining the Future of Lancaster Sound	Summary of Inuit participation in shaping the future of Lancaster Sound through traditional knowledge and policy discussions.	QIA (2012).	-	✓	✓

1.5.2 Field Program and Permitting

Field programs were performed during the feasibility (2019) and detailed design (2024) phases of the Project during the open-water seasons. Based on the nature of the Field Programs, different components of the Project Study Area were targeted. Terrestrial wildlife, migratory and marine bird, and wildlife surveys were not completed in 2024, as it was determined the 2019 field program was sufficient to address existing conditions for those areas. Field Programs undertaken to support the detailed design (geotechnical, geophysical), environmental (fish and fish habitat) and socio-economic (archaeological) are outlined in Table 1-3. Weather conditions and tides during the Field Programs are provided in Table 1-4 and Table 1-5. Permits obtained to support the Field Programs are detailed in Table 1-6.

Table 1-3: Summary of the Environmental and Socio-Economic Baseline Discipline, Survey Types, Study Area Focus, and Date

Discipline	Survey Type	Study Area	Year 2019	Year 2024
Environmental (Physical, Biological)				
Marine	Intertidal (quadrat)	Community Harbour	15, 16-Aug	04-Sep
	Intertidal (drone)		-	28-Aug
	Subtidal (ROV)		15, 16-Aug	03, 06-Sep
	Water		16-Aug	-
	Plankton		15, 16-Aug	04, 05-Sep
	Drogue		-	05-Sep
	Amphipod		15, 16-Aug	04, 06-Sep
	Arctic cod		15, 16-Aug	-
Terrestrial	Vegetation	Project (excluding subtidal areas of Community Harbour)	15, 16-Aug	-
	Birds		15, 16-Aug	-
	Wildlife		15, 16-Aug	-
Socio-Economic				
Archaeological	Archaeological	Project (excluding subtidal areas of Community Harbour)	15, 16-Aug	-
Detailed Design				
Geological	Geological	HRQ	15, 16-Aug	27 to 29-Aug
Geophysical	Geophysical (including bathymetric)	Community Harbour	15, 16-Aug	03 to 05-Sep
Topographic	Topographic	Project	15, 16-Aug	27 to 29-Aug

Note: ROV = remotely operated vehicle; HRQ = Haul Road Quarry

Table 1-4: Survey Dates, Weather, and Tides for the Field Program (2024)

Tide Information									
28-Aug-24		**03-Sep-24**		**04-Sep-24**		**05-Sep-24**		**06-Sep-24**	
Time	**Height (m)**	**Time**	**Height (m)**	**Time**	**Height (m)**	**Time**	**Height (m)**	**Time**	**Height (m)**
00:48	1.26	02:12	0.4	02:48	0.4	03:22	0.4	03:55	0.4
06:10	1.93	08:37	1.2	09:10	1.2	09:42	1.2	10:13	1.2
12:05	1.01	14:36	0.4	15:10	0.4	15:43	0.4	16:14	0.4
19:25	2.70	20:46	1.1	21:23	1.1	21:57	1.2	22:29	1.2
Conditions/Parameters									
28-Aug-24		**03-Sep-24**		**04-Sep-24**		**05-Sep-24**		**06-Sep-24**	
Cloud Cover	5 %	Cloud Cover	0-2 %	Cloud Cover	0-2 %	Cloud Cover	0-2 %	Cloud Cover	5 %
Precipitation	0 mm	Precipitation	0.2 mm	Precipitation	0.1 mm	Precipitation	0 mm	Precipitation	0.2 mm
Temperature	3 °C	Temperature	1 °C	Temperature	0 °C	Temperature	-1 °C	Temperature	5 °C
Wind	10 kt	Wind	3kt to 4 kt	Wind	4kt to 8 kt	Wind	1kt to 2 kt	Wind	1 kt to 10 kt
Chart Datum Depth Surveyed (m)									
Community Harbour Study Area: Maximum: 0.4 m Maximum: 23.5 m									

Source: Tide information - Grise Fiord Station (06570) in CHS (2024)

Table 1-5: Survey Dates, Weather and Environment during Field Programs (2019)

Tide Information					
15-Aug-19		**16-Aug-19**		**17-Aug-19**	
Time	**Height (m)**	**Time**	**Height (m)**	**Time**	**Height (m)**
00:52	3.3	01:27	3.3	00:59	3.3
07:21	0.5	07:53	0.4	07:23	0.4
13:15	2.5	13:49	2.5	13:22	2.6
18:57	0.5	19:31	0.4	19:05	0.5
Conditions/Parameters					
15-Aug-19		**16-Aug-19**		**17-Aug-19**	
Cloud Cover	0-2 %				
Precipitation	0mm				
Temperature	8-10 ° C				
Wind	1-2 km/h				
Chart Datum Depth Surveyed (m)					
Community Harbour Study Area: Minimum: 0.5 m Maximum: 6.5 m					

Source: Tide information - Grise Fiord Station (06570) in CHS (2019)

Table 1-6: Field Program Permits for the Feasibility (2019) and Design (2024) Phases

Authority Having Jurisdiction	Permit/File No.		Permit Type
	2019	2024	
Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC)	N/A	N2024X0026	Land Use Permit (CIRNAC, 2024)
NPC	149159	150435	Conformity Determination (NPC, 2019, 2024)
Nunavut Impact Review Board (NIRB)	19YN031	24YN030	Screening Decision Report (NIRB, 2019, 2024)
Nunavut Research Institute (NRI)	02 058 19N-M	02-045-24N-M	Scientific Research License (NRI, 2019, 2024)
DFO	S-19/20-1018-NU	S-24/25-1071-NU	License to Fish for Scientific Purposes (DFO, 2019e, 2024f)
GN-C&H	2019-52A	2024-63A	Class 2 Territory Archaeologist Permit (GN-C&H, 2019, 2024)

2 Inuit Qaujimajatuqangit - Traditional Knowledge Study

2.1 Program Objectives

Inuit Qaujimajatuqangit, although often translated as Inuit Traditional Knowledge, also includes important Inuit values, principles, cultural beliefs and behaviours. Its literal translation is, "that which has long been known by Inuit". There are many different definitions of IQ that aim to describe its holistic nature. The QIA's following description has guided our understanding of IQ (QIA, 2018b):

> *"Inuit Qaujimajatuqangit is a morality that is the base for Inuit existence. It is the belief system at the core of Inuit identity and governs Inuit society. It is born through a collective effort to survive in extreme conditions where no one else could and there is no other way to do so but together. Within this ideal lives a great life-affirming admiration to the land and animals. It is about living through helping each other. It is the Inuit way."*

Inuit Qaujimajatuqangit, as we understand it, is not merely a collection of information about the land and wildlife, but also an approach and set of principles to conducting research and project development that is based in respect and collaboration. The local knowledge holders we worked jointly with were also actively guiding decisions on the concept designs and early planning of the community harbour for Grise Fiord. Our IQ program therefore aimed to gather local Inuit knowledge of marine habitat, wildlife, land use, year-round access for harvesting, and areas of cultural value in and around the Project to support early Project decision-making and planning, and to inform the permitting process.

We are grateful to the residents of Grise Fiord who graciously shared their time, knowledge and thoughtful feedback during our workshops.

Objectives for the IQ program are provided in Table 1-1.

2.2 Intellectual Property

The ESEB Report was prepared with IQ gathered by Worley Consulting and IQ reported in various regional studies. Advisian considers all IQ to be the intellectual property of the knowledge holders. The Land Use and Occupancy map presented in (Figure 2-1) was created jointly by Worley Consulting and local knowledge holders to inform the GN's community harbour Project for Grise Fiord. Any use of Figure 2-1, other than for the purpose stated, shall be done only with the express consent of the knowledge holders (Figure 2-1).

INUIT PLACE NAMES

NAME - ROMAN ORTHOGRAPHY	NAME	TYPE OF FEATURE	DESCRIPTION
UTAQQIUVITUQAQ	ᐅᑕᖅᑭᐅᕙᑎᑐᖅ	POINT	FURTHER THAN THE PLACE IN GRISE FIORD TO WAIT FOR SEA MAMMALS
PAURNGALIK	ᐸᐅᓐᖏᓚᐃᖅ	BAY	CLIFF FOLLOWS SHAPE OF SMALL BAY. BERRY-PICKING PLACE
NUVURULUK	ᓄᕙᕐᓗᓗᒃ	POINT	SMALL POINT

UTAQQIUVITUQAQ
ᐅᑕᖅᑭᐅᕙᑎᑐᖅ

PAURNGALIK
ᐸᐅᓐᖏᓚᐃᖅ

NUVURULUK
ᓄᕙᕐᓗᓗᒃ

PLAN
1:10000

LEGEND:

- FISHING (HOOKS - JIGGING)
- ARCTIC FOX PRESENCE
- DAY SPOT (RECREATIONAL)
- SEAL / MARINE MAMMAL WAITING AREA
- ARCTIC HARE PRESENCE
- PTARMIGAN (HUNTING)
- BERRY HARVESTING
- NARWHAL AND BELUGA
- BELUGA HARVESTED
- BELUGA WHALE
- THULE SITE
- ICE CRACK
- CLAM HARVESTING
- CLAMS (MINIMAL ABUNDANCE - LITTLE TO NO HARVESTING)
- SOURCE INUIT HERITAGE TRUST: PLACE NAMES PROGRAM. INUIT HERITAGE TRUST INCORPORATED. 2007
- SPRING ICE ACCESS (FROM MAY TO JUNE / JULY)
- POTENTIAL ARCHAEOLOGICAL SITE
- GLACIAL RUN-OFF STREAMS
- WATER SUPPLY RESERVOIR
- DOGS

m 0 100 200 300 400 500 m
1:10000

NOTES:

1. WATER DEPTHS WITHIN THE SURVEY BOUNDARY PROVIDED BY FISHERIES AND OCEANS CANADA. SURVEY WAS PERFORMED ON SEPTEMBER 22, 2018 BY AQUATICS-ESI, PROJECT NO. 18SO22002, DRAWING NO. A1, REVISION 2, DATED 19/01/07

REV	DATE (DD-MMM-YY)	REVISION DESCRIPTION	DRAWN	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER	REF DRAWING No	REFERENCE DRAWING TITLE
C	10-JAN-25	FOR DISCUSSION	JLC	-	DP	-	CM	-		
B	21-NOV-24	FOR DISCUSSION	JLC	-	DP	-	CM	-		
A	26-JUL-24	FOR DISCUSSION	JLC	-	DP	-	CM	-		

D SHEET | SCALE | SHOWN

OneWay to zero harm

WORLEYPARSONS PROJECT No
317086-54170

ENGINEERING AND PERMIT STAMPS (As Required)

PRELIMINARY
DO NOT USE FOR CONSTRUCTION
Last Saved: Jan. 10/25 12:15pm

CUSTOMER

Nunavut
Building Nunavut Together
Nunavut Iliuqatigiingniq
Bâtir le Nunavut ensemble

"This drawing is prepared for the use of the contractual customer of Worley Canada Services Ltd. and Worley Canada Services Ltd. assumes no liability to any other party for any representations contained in this drawing."

worley consulting

Figure 2-1 GRISE FIORD
LAND USE AND OCCUPANCY MAP

DRG No 317086-54170-00-CI-DSK-0001

REV C

LOCATION: U:\YVR\317086\54170_GDN_GRISEFIORD\1T_DRAWINGS\15_I_AND_E\02_MARINE\LAND USE MAPS\317086-54170-00-CI-DSK-0001.DWG
USER NAME: jennifer.coppendale
PLOT DATE & TIME 10/1/2025 12:19:35 PM
SAVE DATE & TIME 10/1/2025 12:15:25 PM

2.3 Methodology

Inuit Qaujimajatuqangit was obtained during the feasibility and detailed design phases of the Project, as summarized in Table 2-1.

Table 2-1: Inuit Qaujimajatuqangit Workshops

Phase	Workshop Description
Feasibility	• Five design meetings in November 2018, May 2019, November 2019, December 2021 and May 2022 with Mayor and Council, Iviq Hunters and Trappers Association (HTA) board members and local hunters. • One land use and wildlife focused workshop with active Inuit hunters and fishers (knowledge holders) in May 2019. • Verification with knowledge holders in November 2019.
Detailed Design and Permitting	• Two design meetings in August 2024 and December 2024 with Mayor and Council, HTA board members, and local hunters. • One land use and wildlife focused workshop in August 2024 with the HTA and the Nauttiqsuqtiit (Guardians). • Verification with knowledge holders in December 2024.

Local interpreters were hired as required to support workshops and interviews. Before the start of the IQ workshops and interviews, knowledge holders were asked to read a project information sheet and consent form and then complete and sign the form before the start of the meetings. The consent form was provided in English and Inuktitut and described the workshop's objectives, methodology, and uses for the information, allowed the knowledge holder to specify where a copy of the transcript and map should be sent, and whether the knowledge holder wished to be acknowledged by name for their contribution.

To better understand the potential interactions between harvesting rights and anticipated Project activities, discussions during the workshops and interviews focused on: harvest locations; water and ice access; local site conditions such as winds, waves, currents, rivers and creeks, sedimentation etc.; fishing; marine and land mammals; birds and other wildlife; carving stone; camps and other culturally important areas; and the potential locations of the community harbour, quarry and haul routes in relation to land use activities (e.g. fishing, hunting, gathering and trapping).

Land use and areas of cultural or ecological value were marked on maps and later digitized. Maps were verified by knowledge holders in December 2024 to confirm that the information gathered during the IQ program was interpreted and presented in the intended manner.

All knowledge holders consented to their knowledge being shared with the team and for the purpose of informing the ESEB Report, the archaeological assessment and the overall Project design and construction planning. Consent was also provided by the knowledge holders to have their knowledge presented as noted in the Land Use and Occupancy map (see Figure 2-1).

Inuit Qaujimajatuqangit has been joined with results from the Field Program to allow the Project team, in collaboration with community members, to make informed decisions on the design and construction planning of the community harbour that reflect the communities' needs, priorities and values.

A review for existing and accessible IQ research relevant to the Project area was also conducted. See Table 1-2 for sources that were especially helpful in providing valuable regional context to the ESBS Report.

Where applicable, topic specific IQ information has been incorporated into this report. The Land Use and Occupancy map also includes place names in the area from the IHT database. A discussion on local land and resource use can be found in Section 11.2.6.

The IQ findings are based on a small number of workshops and a selection of readily available literature, and do not represent the full intensity and extent of Inuit use and occupancy of the Study Area or the surrounding region.

3 Species at Risk and Designated Areas

3.1 Species at Risk

Species discussed in this section have been assessed by IUCN, COSEWIC, federal agencies (e.g. SAR registry), territory agencies (e.g. GN-DoE), and the RNLUP (NPC, 2023b). Determining species occurrence to the level of Project Study Area can be difficult with marine species; therefore, likelihood of occurrence was considered within Grise Fiord (see Table 3-2).

A description of focal species, their status, SAR status, and their probability of occurrence (within Grise Fiord) are listed in Table 3-2. Species at Risk were categorized by international, federal, and territorial designations, and were selected as those having the potential to overlap with the Project Study Area for various life history stages (e.g., breeding, nursery, resident, migration, and feeding). The DFO has generated an Aquatic species at risk map; however, at the time of this report there is nothing to note for Grise Fiord (DFO, 2024a).

3.1.1 Federal Designation

The status of individual species is independently reviewed annually by COSEWIC. As a part of COSEWIC species assessments, Aboriginal Traditional Knowledge (ATK) is incorporated through an ATK subcommittee with regular communication and involvement of Wildlife Management Boards (WMB), including the NWMB (COSEWIC, 2009b). Once a species has been designated by COSEWIC, it is recommended for addition to the List of Wildlife Species at Risk whereby it would obtain legal protection under *Species at Risk Act* (SARA); for marine species, DFO provides listing policy guidance (COSEWIC, 2021; DFO, 2018c), and for terrestrial species, Environment and Climate Change Canada (ECCC) provides listing guidelines (ECCC, 2016c). Once listed, SARA provides legislated protection to recognized threatened, endangered, or extirpated species and requires that the responsible government agencies design and implement an approved recovery plan.

Three sections of the SARA have relevance to the Project:

- Section 32 prohibits the killing, harming, harassing, or capturing of a threatened, endangered, or extirpated species.
- Section 33 prohibits the damage or destruction of the residence of a threatened, endangered, or extirpated species.
- Section 58 prohibits the damage or destruction of any part of designated critical habitat of a threatened, endangered, or extirpated species.

3.1.2 Territorial Designation

There are two processes for Nunavut specific designations of habitat and species types, that are coordinated through a) the Nunavut *Wildlife Act* and b) RNLUP (NPC, 2023b), which are described in Table 3-1.

Table 3-1: Nunavut Designations for Habitats and Species

Nunavut *Wildlife Act*	Recommended Nunavut Land Use Plan
The Nunavut *Wildlife Act* further protects species at risk and provides a framework for the management of wildlife and habitat in Nunavut (GN, 2018d). The territorial status of a native species is assessed by the Nunavut Species at Risk Advisory Committee and a recommendation for the designation of a species is provided to the NWMB, which is responsible for the designation of rare, threatened, and endangered species under both SARA and the Nunavut Land Claims Agreement (NLCA) (GN, 2018d). Species status are reviewed and issued every five years in the Wild Species report (CESCC, 2022).	Designated habitats in Nunavut have been categorized in the RNLUP (NPC, 2023b), which discusses: key migratory bird habitat sites, caribou (calving and post calving sites, key access corridors, sea ice crossings, freshwater crossings, polar bear denning areas, walrus terrestrial haul outs, Atlantic cod lakes, and marine areas of importance. Species specific categorizations, when relevant to proximity to the Project Study Area will be discussed in the respective organism sections. Marine areas of importance, are discussed in designated habitats and is inclusive of Ecologically and Biologically Significant Areas (EBSAs, Section 3.2.4), Polynyas (Section 3.2.5), and Floe Edges (Section 3.2.6).

Table 3-2: Status of Flora and Fauna in the Terrestrial and Marine Environment with Potential to be Present in the Project Study Area

Species	Latin Name	Inuktitut		IUCN Status	COSEWIC Status	SARA Status	Nunavut Rank	Study Area	Likelihood of Occurrence	Species Summary
		Syllabics	Transliteration							
Fish										
Amphipod	*Amphipoda sp.*	Not available	Kingu[3]	No Status	No Status	Not Listed	Not Ranked (NR)	Community Harbour	Likely	See Section 6.3.1. Probability is likely based on a general assumption of coastal areas in Nunavut.
Arctic char	*Salvelinus alpinus*	ᐃᖏᓗᓱᑦ	Ikaliviit[1], Ivitaruk[2]	Least Concern	No Status	Not Listed	NR	Community Harbour	Unlikely	See Section 6.3.2.
Arctic cod	*Boreogadus saida*	ᐅᒐᐃᑦ	Ugak[1], Uugaq[3]	Least Concern	No Status	Not Listed	NR	Community Harbour	Possible	See Section 6.3.3.
Sculpin (Shorthorn)	*Myoxocephalus scorpius*	ᑲᓇᕆᐃᑦ	Kanayuk[1], Kanajuq[2]	No Status	No Status	Not Listed	NR	Community Harbour	Possible	See Section 6.3.4.
Sculpin (Staghorn)	*Gymnocanthus tricuspis*			Least Concern	No Status	Not Listed	NR	Community Harbour	Possible	See Section 6.3.4
Truncate softshell clam	*Mya truncata*	ᐊᒡᒍᒪᕆᖅ	Ammuumajuq	No status	No status	Not listed	NR	Community Harbour	Likely	See Section 6.3.5.
Marine Mammals										
Atlantic Walrus (High Arctic population)	*Odobenus rosmarus*	ᐊᐃᓵᑦ	Akvik[1]	Vulnerable	Special Concern	Not Listed	S3	Community Harbour	Likely	See Section 6.4.1.
Bearded seal	*Erignathus barbatus*	ᐅᒡᕈᐃᑦ	Ukalik[1], Qilalugaq[3]	Least Concern	Data Deficient	Not Listed	NR	Community Harbour	Likely	See Section 6.4.2.
Beluga whale (Eastern High Arctic/Baffin Bay population)	*Delphinapterus leucas*	ᖃᓄᖅ ᖁᓕᓗᒃ	Kilalugak[1], Qilalugak[2]	Least concern	Special Concern	Not Listed	NR	Community Harbour	Likely	See Section 6.4.3.
Bowhead whale (Eastern Canada-Western Greenland population)	*Balaena mysticetus*	ᐊᖏᕆᔪ	Arviq[3]	Least Concern	Special Concern	Not Listed	NR	Community Harbour	Possible	See Section 6.4.4.
Harp seal	*Pagophilus groenlandicus*	ᖃᐃᖅᓀᑦ	Qairulik[2]	Least Concern	Not Assessed	Not Applicable	NR	Community Harbour	Likely	See Section 6.4.5.

Species	Latin Name	Inuktitut		IUCN Status	COSEWIC Status	SARA Status	Nunavut Rank	Study Area	Likelihood of Occurrence	Species Summary
		Syllabics	Transliteration							
Hooded seal	*Cystophora cristata*	ᓄᑲᓴᖅ	Nattivak	Vulnerable	Not At Risk	Not Listed	NR	Community Harbour	Possible	See Section 6.4.6. Hooded seal are sometimes present during the summer months, but has interannual variability, and is not considered to be a common species.
Killer whale (Northwest Atlantic/Eastern Arctic population)	*Orcinus orca*	Not available	Aarluk[2]	Data Deficient	Special Concern	Not Listed	NR	Community Harbour	Likely	See Section 6.4.7.
Narwhal	*Monodon monoceros*	ᐊᓕᓐᒃ ᖁᓗᖏᑦ	Allanguaq[2], Tuugaalik[3]	Least Concern	Not at Risk	Not Listed	NR	Community Harbour	Likely	See Section 6.4.8.
Polar bear	*Ursus maritimus*	ᐊᓂᐃᑦ	Nanuit[1], Nanuk[2]	Vulnerable	Special Concern	Special Concern	S3	Community Harbour	Likely	See Section 6.4.9
Ringed seal	*Pusa hispida*	ᓄᓕᒃ	Natinat[1], Natsiq[2]	Least Concern	Special Concern	Not Listed	NR	Community Harbour	Likely	See Section 6.4.10.
Vegetation										
Porsild's Bryum	*Haplodontium macrocarpum*	Not available	Ivruijak[1]	No Status	Threatened	Threatened	S1	HRQ	Possible	Known distribution only on Ellesmere Island in Nunavut
Migratory Birds										
Buff-breasted sandpiper	*Calidris subruficollis*	Not available	Satqarillak[1], Sitjariaq[2]	Vulnerable	Special Concern	Special Concern	S3	Project	Unlikely	Outside mapped breeding range and habitat limited.
Ivory gull	*Pagophila eburnean*	ᖃᔪᓪᓗᒃ	Naujat[3]	Near Threatened	Endangered	Endangered	S1	Project	Likely	Near year-round mapped range but breeding and nesting habitat not present therefore unlikely to nest near Project.
Red knot	*Calidris canutus*	ᓯᐅᕆᐊᖅ	Sijjariaq[3]	Near Threatened	Endangered	Endangered	S2	Project	Likely	Within mapped breeding range and nesting habitat present near Project

Species	Latin Name	Inuktitut		IUCN Status	COSEWIC Status	SARA Status	Nunavut Rank	Study Area	Likelihood of Occurrence	Species Summary
		Syllabics	Transliteration							
Red-necked phalarope	*Phalaropus lobatus*	ᓴᐅᖅᑭᖅ	Saurraaq[1]	Least Concern	Special Concern	Special Concern	S3	Project	Low	Outside mapped breeding range though habitat present
Ross's gull	*Rhodostethia rosea*	ᓇᐅᔪᑦ	Naujat[3]	Least Concern	Endangered	Threatened	S1	Project	Unlikely	Outside mapped breeding range and breeding habitat not present near Project
Terrestrial Wildlife										
Peary caribou (Western Queen Elizabeth subpopulation)	*Rangifer tarandus pearyi*	ᑐᑲᖏᑦ	Tuktut[1]	Vulnerable	Threatened	Threatened	S3S4	HRQ	Possible	Historical harvest records near Project
Wolverine	*Gulo gulo*	ᖃᒃᐱᐊᓕᖅ	Qavvigaarjuk[1]	Least Concern	Special Concern	Special Concern	S3	HRQ	Low	Within mapped range but observations are rare and not documented locally.

Note:
Sources for species designation: 1. [territorial, CESCC (2022)]; 2. [federal Government of Canada (2024g]); 3. [international IUCN (2019]),
Sources for transliteration: 1. Priest and Usher (2004); 2. Rapinski *et al.* (2018); 3. QIA (2018b). Inuktitut translations provided by various online resources. Transliterations and Inuktitut translations was confirmed in Grise Fiord during the IQ verification workshop in December 2024.
HRQ = Haul Road Quarry.

Fish Probability Description
Possible: based on biogeographic range and literature may be in the Community Harbour Study Area.
Unlikely: based on biogeographic range and desktop review is unlikely to be in the Community Harbour Study Area.

Marine Mammal Probability Description
Likely: based on biogeographic range, desktop review and IQ and may be in the Project Study Area with regularity.
Possible: based on biogeographic range and desktop review and IQ and may be in the Project Study Area on an irregular basis.
Unlikely: based on biogeographic range and desktop review and IQ and is unlikely to be in the Project Study Area.
Nunavut Territorial Rank (CESCC, 2016): S1=critically imperilled, S2=imperilled, S3=Vulnerable, S4=apparently secure, SU=unrankable, NR = not ranked.

Terrestrial Vegetation
Likelihood of occurrence within Project Study Area was based upon a qualitative assessment of results of potential habitat. Other factors such as known locations were also incorporated.
Likely: Study Areas are located within areas that have known occurrence records and most of the area is habitat for the species.
Possible: Study Areas are located within areas that have known occurrence records and some habitat may be available for the species.
Low: Study Areas are located outside areas that have known occurrence records and habitat may be available for the species.
Unlikely: Study Areas are located outside areas that have known occurrence records and habitat is not identified.

Wildlife and Migratory Birds Probability Description
Likelihood of occurrence within Project Study Area was based upon a qualitative assessment of results of potential habitat. Similarly, other factors such as breeding range, location of known colonies, etc., were incorporated.
Likely: Study Areas are located within the mapped range and the majority of the area is available habitat.
Possible: Study Areas are located within the mapped range and some of the available habitats may provide suitable breeding or other life-stage requirements.
Low: Study Areas are located within the mapped range and some of the available habitat may provide marginal breeding or other life-stage requirements.
Unlikely: Study Areas are located outside of the mapped range or outside of known colonies (or the species is colonial and such a colony would likely be known to locals given its proximity to the hamlet), and available habitat is generally not present.

3.2 Designated Habitats

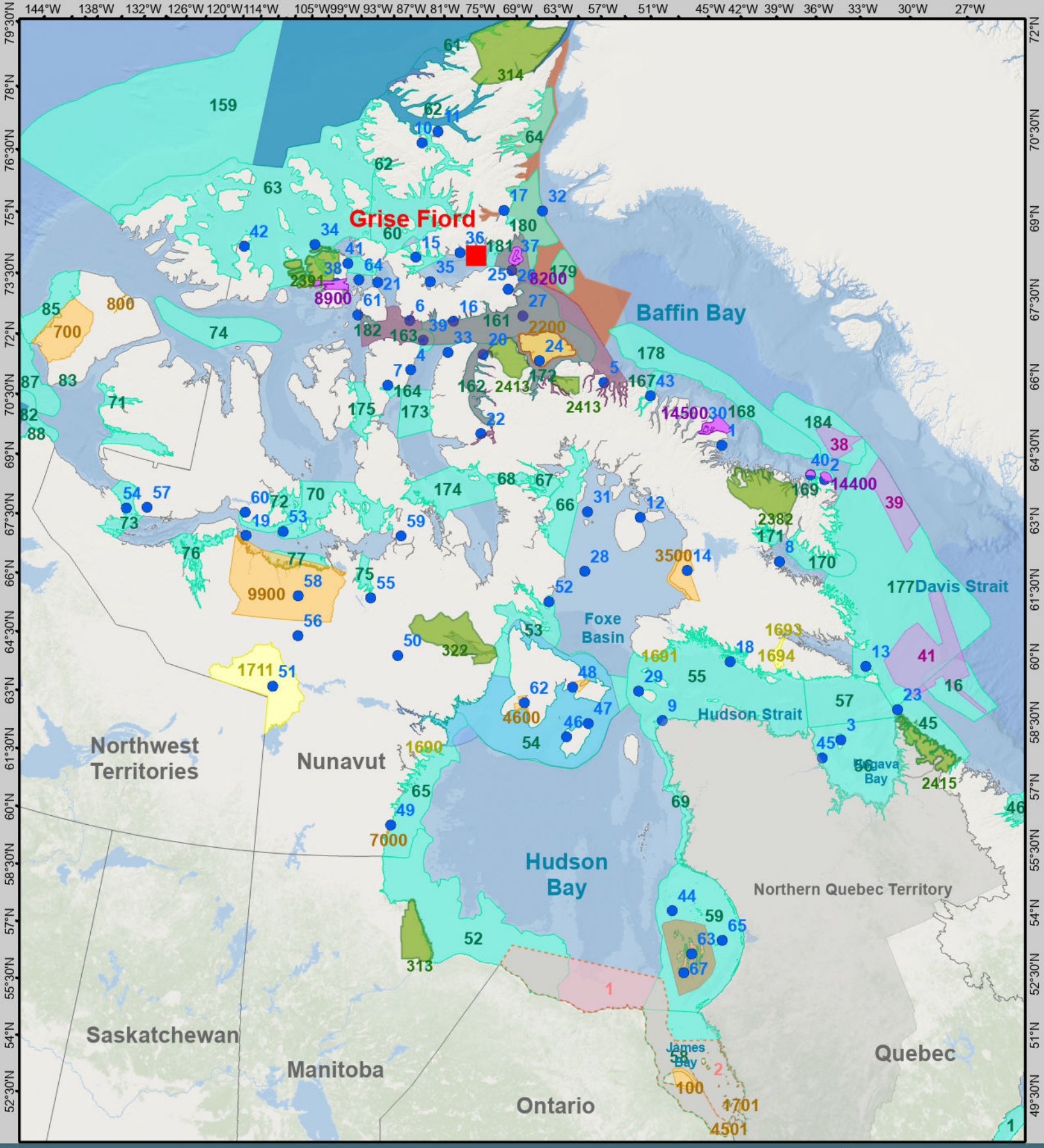
Designated areas in Canada meet the IUCN's definition of protected area, which states protected areas are "a clearly defined geographic space, recognized, dedicated and managed through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural value" (ECCC, 2016b). Canada, through Target 3 of the Kunman-Montreal Global Biodiversity Framework, has committed to conserving 30 % of marine areas by 2030 (ECCC, 2022). As of the end of 2024, Canada has conserved 13.7 % of terrestrial areas and inland waters (Canadian Parks Council, 2024), and had protected 14.7 % of marine and coastal areas, including two designated conservation areas in the Arctic (DFO, 2021a; National Observer, 2019). In 2022, Canada developed the Other Effective Area-Based Conservation Measures (OECMs) based on international guidance and interpreted into a Canadian context (DFO, 2022b). As of 2024, 10. 2 % (213,052 km^2) of the territory of Nunavut is protected (Government of Canada, 2024b).

NMCAs, Marine Protected Areas (MPAs), National Wildlife Areas (NWAs), Migratory Bird Sanctuaries (MBS) and national parks are designed and designated for the protection or conservation of species and species habitat. Other areas such as territorial parks, EBSAs and Important Bird Areas (IBAs) have been designated by various government and non-governmental organization as providing significant and important habitats.

The RNLUP has presented existing and proposed protected areas, some of which are included in the NMCA and MPA described in Section 3.2.1 and 3.2.2, respectively (NPC, 2023b). Marine habitat designations are managed federally by Parks Canada, DFO, Transport Canada and ECCC (Government of Canada, 2017a). Canadian designated areas can be viewed on DFO's interactive map for designated areas with their contribution to Canada's coastal and marine areas targets (DFO, 2024b).

The location of designated areas that are within the Grise Fiord Marine Corridors (see Figure 2-1) are provided in Figure 3-1 (Nunavut) and Figure 3-2 (Marine Corridors in Proximity to Grise Fiord). The numbers on the figures that correlate to designated areas is provided in Appendix C (Table C-1). To further support a determination of the locations of all designated areas discussed in this section, footnotes with a link to websites has been provided.

Distances and direction are also summarized in Table 6-3 of the PSIR Report (Dynamic Ocean & Worley Consulting, 2025a).



- Ecologically and Biologically Significant Areas
- Tuvaijuittuq Marine Protected Area
- Talluritiup Imanga National Marine Conservation Area
- Study Area James/Hudson Bay National Marine Conservation Area * *
- Proposed Qikiqtait Protected Area*
- South Hampton Island Area of Interest*
- Migratory Bird Sanctuaries
- Important Bird Areas
- National Wildlife Areas
- Territorial Parks
- Marine Refuges
- Proposed Sarvarjuaq Protected Area * *
- National Parks

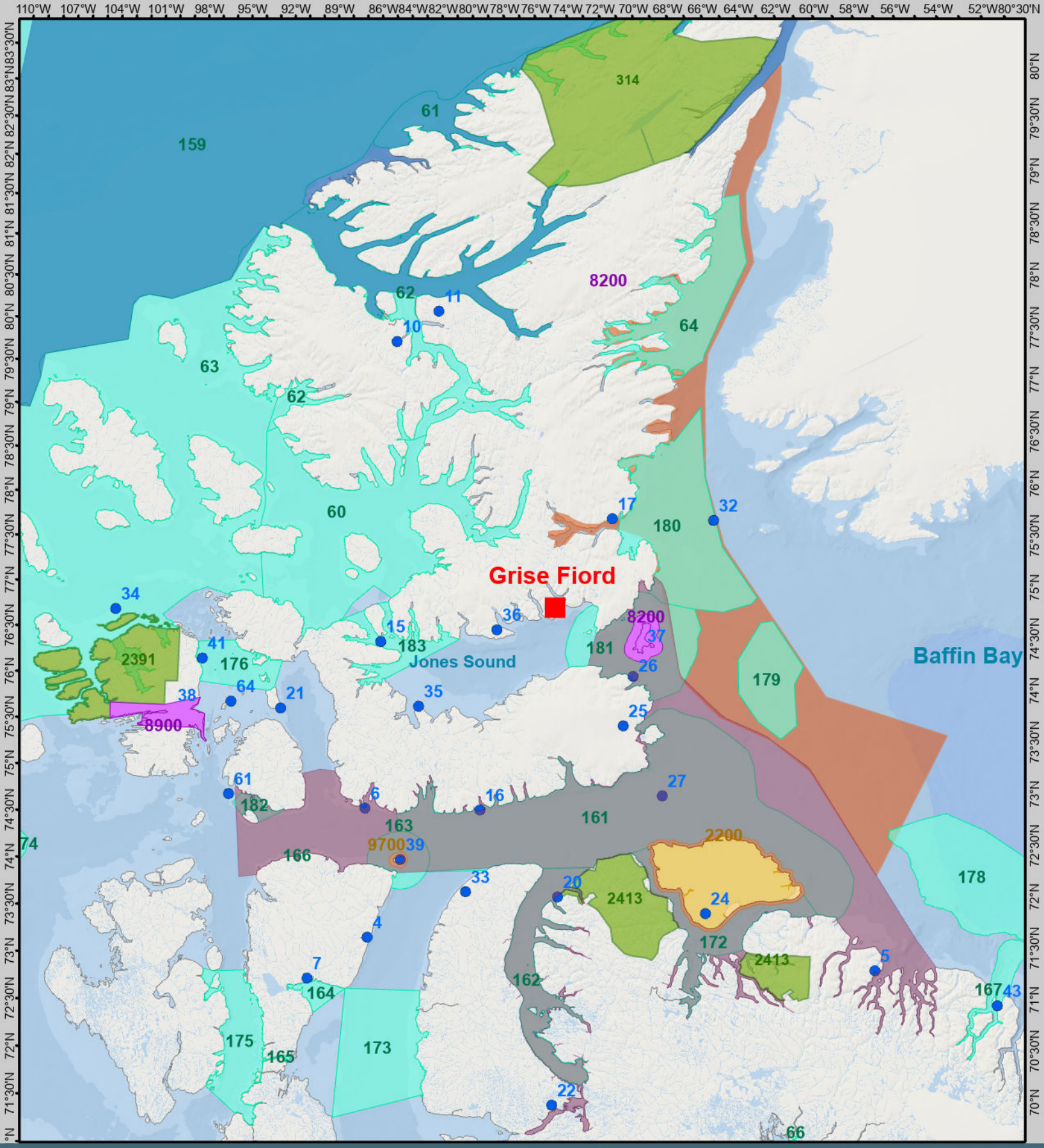
* Not final boundaries of Study Area *Boundary traced
Appendix 1, Table 1: names of designated areas

Figure 3-1

GSC: NAD 1983
PCS: Can Albers Equal Area Conic

Drawn: L. Gendall
Basemap source: ESRI World Oceans Map Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

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worley
Nunavut



Proposed Sarvarjuaq Protected Area + *
Ecologically and Biologically Significant Areas
Marine Refuges
Talluritiup Imanga National Marine Conservation Area

Migratory Bird Sanctuaries
Important Bird Areas
National Wildlife Areas
Territorial Parks
National Parks

+ Not final boundaries
* Boundary traced
Appendix 1, Table 1: names of designated areas

Figure 3-2

N

0 45 90 180 km

GSC: NAD 1983
PCS: Can Albers Equal Area Conic

Drawn: L. Gendall
Basemap source: ESRI World Oceans Map Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

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3.2.1 National Marine Conservation Areas

The federal government manages NMCAs through Parks Canada. The purpose of these designations is to protect and conserve representative marine habitat for the benefit, education and enjoyment of Canadians (Parks Canada, 2024a). The 2022 *Policy on the Establishment and Management of National Marine Conversation Areas* describes eight interconnected management goals to manage NMCAs and reflects the Government of Canada's commitment to Target 3 of the Kunman-Montreal Global Biodiversity Framework, ensuring that 30 % of Canada's marine waters will be protected by 2030 (ECCC, 2022; Parks Canada, 2022a).

Areas established as NMCAs represent a marine region and include protection of the seabed, water column above it and may include wetlands, estuaries, islands, and other coastal lands (Parks Canada, 2024a). These areas are protected from activities such as ocean dumping, undersea mining, and oil and gas exploration and development. Traditional hunting and fishing activities are permitted but must be managed with the conservation of the ecosystem as the main goal. Parks Canada states NMCAs are designed and designated for the following (Parks Canada, 2017):

- Represent oceanic and lake diversity.
- Maintain ecological processes and life support systems.
- Provide a model for sustainable use of marine species and ecosystems.
- Encourage marine research and ecological monitoring.
- Protect depleted, vulnerable, threatened, or endangered marine species and their habitats.
- Provide for marine interpretation and recreation.
- Contribute to a growing worldwide network of MPAs.

The establishment of the TI NMCA was announced on 1 August 2019 (ITK, 2019; Parks Canada, 2024c). The TI NMCA is approximately 108,000 km[1] and reaches 1.9 % of Canada's 30 % by 2030 target (Parks Canada, 2022a). In addition, the TI Nauttiqsuqtiit program secured and utilized $9,658,342 from Parks Canada for activities related to the TI NMCA in 2022-2023 (QIA, 2023). This funding was used to support TI NMCA governance, plan and develop infrastructure projects, support fisheries development, fund the TI major patrol, and support Hunters and Trappers Organizations (QIA, 2023)[2].

The closest NMCA to Grise Fiord is the TI NMCA[1], approximately 55 km southeast of Grise Fiord (see Figure 3-1) located in Lancaster Sound and Baffin Bay.

[1] See Figure 3.1.4 (RNLUP, Appendix C-Chapter 3) for a depiction of NMCAs in proximity to Resolute Bay: https://www.nunavut.ca/sites/default/files/23-015e_2023-09-07-2023_or_appendix_c_maps_chapter_2_english.pdf

[2] TI NMCA image location available at this URL: https://canadiangeographic.ca/articles/mapping-the-lancaster-sound-national-marine-conservation-area/

3.2.2 Marine Protected Areas

Marine Protected Areas are designed for long-term conservation of ocean systems and environments; though some activities are permitted depending on their impacts to the ecological features encompassed within the MPA (DFO, 2024g). Marine Protected Areas are nature-based solutions that contribute to a healthy marine environment by protecting and conserving marine species and populations, and ecosystem diversity that marine organisms depend on (DFO, 2024g). This includes areas such as connected waterways, underwater canyons, and hydrothermal vents. In addition, MPAs are designed to support economic goals of society and contribute to Canadian culture by protecting areas with cultural heritage value (DFO, 2024g).

3.2.2.1 Sarvarjuaq (Proposed) MPA

The North Water Polynya[3] is under consideration by DFO and the QIA to be designated as the Sarvarjuaq MPA. This area is the largest open-water area surrounded by ice in the Arctic and is one of the most productive ecosystems in the world supporting marine life as a feeding area and migration corridor (DFO, 2023, 2024h). The Sarvarjuaq MPA will cover an area of approximately 73,737 km^2 (DFO, 2024h).

The DFO and the QIA have been collaborating on options to protect the Sarvarjuaq (North Water Polynya) since 2019, where the Sarvarjuaq Working Group was established in 2021 (NIRB, 2025a, 2025b), to allow for appropriate consultation with the six Nunavut communities that are in closest proximity (Resolute Bay, Grise Fiord, Arctic Bay, Pond Inlet, Clyde River, Qikiqtarjuaq). The Sarvarjuaq (NPC No: 126016, NIRB No: 24VN054 (NIRB, 2025b)) MPA was submitted to the NIRB by DFO and QIA for designation by Ministerial Order and the SDR was issued on 12 December 2024.

The proposed Sarvarjuaq MPA[4] is approximately 150 km east of Grise Fiord.

[3] See Figure 2.8.4 (RNLUP, Appendix C-Chapter 2) for a depiction of the north water polynyas in proximity to Resolute Bay: https://www.nunavut.ca/sites/default/files/23-015e_2023-09-07-2023_or_appendix_c_maps_chapter_2_english.pdf, and see Figure 3.2.6 (RNLUP, Appendix C- Chapter 3) for a depiction of MPAs in proximity to Resolute Bay: https://www.nunavut.ca/sites/default/files/23-016e_2023-09-07-2023_or_appendix_c_maps_chapter_3_english.pdf

[4] Proposed Sarvarjuaq MPA location depiction available at this URL: https://www.dfo-mpo.gc.ca/oceans/aoi-si/sarvarjuaq-eng.html

3.2.2.2 Tuvaijuittuq MPA

The Tuvaijuittuq MPA was designated on 29 July, 2019 and reached 5.6 % of Canada's 10 % target (DFO, 2021b). A second ministerial order MPA for the Tuvaijuittuq MPA has been designated on 14 August 2024 to describe human activities that will be allowed in this area for the next five years, while DFO works collaboratively with Inuit and northern partners to consider long-term protection priorities including supporting Inuit-led Protected and Conserved Areas (IPCA) (DFO, 2019h).

Located off the coast of northwest Ellesmere Island, this MPA is approximately 319,411 km^2 and includes the marine waters off northern Ellesmere Island starting from the low water mark and extending to the outward boundary of Canada's Exclusive Economic Zone (EEZ) (DFO, 2019h).

The Tuvaijuittuq MPA[5] is approximately 360 km north of Grise Fiord.

3.2.3 Other Effective Area-Based Conservation Measures

Protected areas and Other Effective Area-Based Conservation Measures (OECMs) that qualify as fisheries area closures are known as marine refuges (DFO, 2024c). OECMs are coined as a Pan-Canadian conservation tool that recognizes the collaborative efforts federal, provincial, territorial and municipal jurisdictions, Indigenous Peoples, non-governmental organizations, for-profit organizations and philanthropic organizations (Government of Canada, 2023). When implemented in Canada's oceans, OECMs are similar to MPAs in that they manage conservation of biodiversity by managing and/or prohibiting human activities within their boundaries (DFO, 2022b). Marine refuges, aka. Fisheries-area closures that have been assessed and recognized as OECMs, are the only OECMs in Canada's Oceans at present (DFO, 2022b).The measures are intended to last long-term and contribute to Canada's marine conservation targets (Government of Canada, 2023).

The Davis Strait Conservation Area (DSCA) and the Disko Fan Conservation Area (DFCA) are marine refuges in closest proximity to Grise Fiord, which fit the classification of an OECM, and are located within the Eastern Arctic Bioregion of Baffin Bay near Davis Strait. The objective of the DSCA is to conserve sensitive benthic areas, to minimize impacts within food and overwintering habitat for narwhal (*Monodon monoceros*) and to conserve coral concentrations (Government of Canada, 2024e). Both marine refuges prohibit all bottom-contact fishing activities.

The DSCA[6] and the DFCA are approximately 1,500 km and 1,300 km southeast of Grise Fiord.

3.2.4 Ecologically and Biologically Significant Areas

Ecologically and Biologically Significant Areas are areas within Canada's oceans that have been identified through formal scientific assessments as having special biological or ecological significance when compared with the surrounding marine ecosystem (DFO, 2005a). The identification of EBSAs is a key component of

[5] Tuvaijuittuq MPA location depiction available at this URL: https://www.dfo-mpo.gc.ca/oceans/mpa-zpm/tuvaijuittuq/index-eng.html

[6] DSCA and DFCA location depiction available at this URL: https://www.dfo-mpo.gc.ca/oceans/oecm-amcepz/refuges/diskofan-eng.html

basis for the development of federally designated areas (DFO, 2011a). EBSA's are developed by government by using criteria set out by, and facilitated by, the Conference of the Parties (COP) to the Convention on Biological Diversity (Convention on Biological Diversity, 2019).

The criteria include:

- Uniqueness or rarity.
- Special importance for species' life history.
- Important for at-risk species and habitats.
- Vulnerability, fragility, sensitivity, or slow recovery.
- Biological productivity and diversity.
- Naturalness.

Grise Fiord is within the Eastern Arctic bioregion[7], which contains twenty EBSAs (Schimnowski *et al.*, 2018). EBSAs are also demonstrated in the RNLUP (see Section 3.3) (NPC, 2023b).

The EBSAs in closest proximity to Grise Fiord[8, 9] are summarized below:

- Eastern Jones Sound: approximately 30 km east.
    - The closest EBSA to Grise Fiord. The Eastern Jones Sound EBSA is inclusive of Lady Ann Strait between Ellesmere Island, Coburg Island, and northeastern Devon Island. The area includes recurrent an ice-free area surrounding Coburg Island supports overwintering seabirds and more than 500,000 breeding marine birds that occupy this EBSA between April and September (DFO, 2015a; Mallory & Fontaine, 2004; Schimnowski *et al.*, 2018).
- North Water Polynya: approximately 100km northeast.
    - Details on the North water polynya can be found in Section 3.2.2.
- Cardigan Strait/Hell Gate: approximately 100km west
    - Cardigan Strait and Hell Gate are two narrow passages on either side of North Kent Island between Ellesmere and Devon Island. Strong recurrent tidal currents for a polynya in these two narrows, enabling a year-round presence of walrus and allows early access to feeding and nesting sites for seabirds in the area (DFO, 2015a; Schimnowski *et al.*, 2018).

[7] See Figure 1 for a depiction of the spatial boundaries of the Eastern Arctic Bioregion, and Figure 2 for location boundaries relative to Grise Fiord https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/40656123.pdf

[8] EBSAs in proximity to Grise Fiord figure locations: Eastern Jones Sound (Figure 35, p. 69), North Water Polynya (Figure 34, p. 65), Cardigan Strait/Hell Gate (Figure 36, pg. 71), Lancaster Sound(Figure 29, p. 58) https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/40656123.pdf

[9] See Figure 2.7.3 (RNLUP, Appendix C-Chapter 2) for a depiction of EBSAs in proximity to Grise Fiord: Eastern Jones Sound (No. 44), North Water Polynya (No. 43), Cardigan Strait/Hell Gate (No. 46), Lancaster Sound (No. 26) https://www.nunavut.ca/sites/default/files/23-015e_2023-09-07-2023_or_appendix_c_maps_chapter_2_english.pdf

- Lancaster Sound: approximately 160 km southeast.
    - Lancaster Sound is an important migratory corridor for several species of marine mammals such as beluga, narwhal, bowhead whale, Atlantic walrus, harp seal, and polar bears (Schimnowski *et al.*, 2018). It is also recognized as an important foraging, nesting, and staging area for several seabird species, and constitutes a major portion of the TI NMCA (see Section 3.2.1). The EBSAs are also confirmed in the RNLUP (see Appendix A, Figure A-3) (NPC, 2023b).

Further details on the importance of these EBSAs to marine mammals and migratory birds is available in Sections 6.4 and 10, respectively.

3.2.5 Polynyas

A polynya is an area of open-water that remains ice-free all year round (National Snow & Ice Data Center) (NSIDC, 2019). Polynyas are fundamental components of Arctic environments that has a significant effect on the spatial and temporal distribution of marine life across all trophic levels. The presence of polynyas has contributed to some of the EBSA designations described in Section 3.2.4. There are 23 polynyas in Canada's Arctic[10], of which 14 exist in the Eastern Arctic Biogeographic Region[11].

Polynyas and their ice edge habitat are characteristically areas of higher productivity, have a long history of cultural significance to the Inuit (NPC, 2000). The North Water Polynya[10, 12] is one of the most productive food webs in the Arctic Ocean and have provided the basis for subsistence hunting and human presence on Ellesmere Island and the northernmost part of Baffin Bay (Heide-Jørgensen *et al.*, 2013). The North Water Polynya is host to a rich and diverse array of Arctic species, including beluga, narwhal, walrus, bearded seal, ringed seal, and polar bear (Heide-Jørgensen *et al.*, 2013). Polynya characteristics are dependent on a combination of bathymetric, coastal, and atmospheric variables, including tidal forces and vertical excursions (Hannah *et al.*, 2009).

The polynyas in closest proximity to Grise Fiord[10,12, 13] are summarized below:

- North Water Polynya – see description for Sarvarjuaq MPA (Section 3.2.2).
- Cardigan Strait/ Hell Gate – See description for Cardigan Strait/Hell gate EBSA (Section 3.2.4).
- Lady Ann Strait – see description for Eastern Jones Sound EBSA (Section 3.2.4).
- Coburg Island – see description for Eastern Jones Sound EBSA (Section 3.2.4).

[10] Arctic Polynya locations depiction available in Figure 1 of this URL: North Water (No. 21), Cardigan Strait-Hell Gate (No. 17), Lady Ann Strait (No. 19), Coburg Island (No. 20): https://journalhosting.ucalgary.ca/index.php/arctic/article/view/63179/47117

[11] Arctic Polynya Locations in East Arctic Biogeographic region available in Figure 8 of this URL: North Water (No. 14), Karluk Brooman (No. 8), Dundas Island (No. 9), and Queens Channel and Penny strait (No. 10) : https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/40656123.pdf

[12] Arctic Polynya Locations in East Arctic Biogeographic region available in Figure 8 of this URL: North Water (No. 14), Cardigan Strait-Hell Gate (No. 11), Lady Ann Strait (No. 12), Coburg Island (No. 13): https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/40656123.pdf

[13] See Figure 2.7.4 (RNLUP, Appendix C-Chapter 2) for a depiction of Polynyas in proximity to Grise Fiord: https://www.nunavut.ca/sites/default/files/23-015e_2023-09-07-2023_or_appendix_c_maps_chapter_2_english.pdf

3.2.6 Floe Edges

The floe edge, or "Sinaaq" in Inuktitut, are locations where landfast ice meets open water[14]. Floe edges are seasonally important areas for migratory birds and marine mammals, which concentrate at the floe edge as it retreats and breaks up in the spring and summer (DFO, 2015a). Floe edges are particularly important for Inuit during Springtime, as hunters travel to the floe edge and shore leads, where beluga, narwhal, and polar bear concentrate (NPC, 2023b).

The nearest floe edge to Grise Fiord is approximately 160km Southwest on the Eastern edge of Devon Island, near Lancaster Sound (NPC, 2023c)[15].

3.2.7 National Wildlife Areas

National Wildlife Areas (NWA) contain nationally significant terrestrial and/or marine habitats for animals or plants (Government of Canada, 2025). Under the *Canada Wildlife Act*, NWAs are created and managed for the purposes of wildlife conservation, research, and interpretation. They are established through the Wildlife Area Regulations, and can only be designated on federally owned lands, however; partnerships can be created with territories, provinces, aboriginal groups, and private land owners to establish and cooperatively manage a wildlife area (Government of Canada, 2025).

Nirjutiqavvik NWA is the nearest NWA to Grise Fiord[16] and includes the Cambridge Point Important Bird Area (IBA), described in Section 3.2.8, which is 94 km east of the Grise Fiord and contains Coburg Island, at the east end of Jones Sound, and portions of Eastern Jones Sound EBSA described in Section 3.2.4.

3.2.8 Important Bird Areas

Important Bird Areas are sites that have been identified as internationally significant for the conservation of birds and biodiversity (Bird Studies Canada, 2024). The IBAs support birds such as threatened species, large congregations of birds, and birds restricted in range or habitat. These IBAs are identified according to internationally agreed upon, standardized, quantitative, and scientifically defensible criteria. The IBAs have been identified for their global and continental significance for species that congregate, and concentrations of waterfowl, and colonial waterbird and seabirds. Though IBAs are located outside the Project Study Area, birds are highly mobile and most are migratory. Consequently, there is potential for these species to occupy, stop-over, or pass through on their way to nearby IBAs. Some IBAs have also been identified as Key Bird and Habitat Sites and in some cases are also designated as EBSA (DFO, 2015a; Oceans North Conservation Society *et al.*, 2018).

The IBAs in proximity to Grise Fiord are summarized below (Bird Studies Canada, 2024):

[14] See Figure 2.7.4 (RNLUP, Appendix C-Chapter 2) for a locations of polynyas in proximity to Grise Fiord: https://www.nunavut.ca/sites/default/files/23-015e_2023-09-07-2023_or_appendix_c_maps_chapter_2_english.pdf

[15] See Figure 2.7.5 (RNLUP, Appendix C-Chapter 2) for a depiction of floe edges in proximity to Grise Fiord: https://www.nunavut.ca/sites/default/files/23-015e_2023-09-07-2023_or_appendix_c_maps_chapter_2_english.pdf

[16] See Figure 3.2.5 (RNLUP, Appendix C-Chapter 3) for a depiction of NWAs in proximity to Grise Fiord: https://www.nunavut.ca/sites/default/files/23-016e_2023-09-07-2023_or_appendix_c_maps_chapter_3_english.pdf

- Sydkap Ice Field: approximately 50 km west
    - Located on South Cape, Ellesmere Island, and at the southern edge of the Sydkap ice field. Contains breeding sites for ivory gulls.
- Eastern Devon Island Nunataks: approximately 65 kilometers south
    - Across Jones Sound and on the northeast end of Devon Island. Contains four ivory gull colonies.
- Inglefield Mountains: Approximately 75 km northeast
    - Over-land of Ellesmere Island, and adjacent to Makinson Inlet. Site may support one-third of ivory gulls in Canada.
- Cambridge Point: approximately 95 km east
    - Lies at the east end of Coburg Island and surrounds the island, covering a part of East Jones Sound. Supports large numbers of thick-billed murres, black-legged kittiwakes, glaucous gulls and black guillemots.

Refer to Section 10 and Table 10-1 for further information relative to migratory and marine birds.

3.2.9 Migratory Bird Sanctuaries

Under the *Migratory Birds Convention Act*, ECCC, through the Canadian Wildlife Service (CWS), can establish MBS's on federal, provincial/territorial, or private land to protect terrestrial and marine habitat and provide safe refuge for migratory birds (Government of Canada, 2017b). Once established, hunting of a listed species is not permitted, and rules and prohibitions are established with respect to taking, injuring, destruction, and molestation of migratory birds, their nests, or eggs. The RNLUP has further defined migratory bird habitat sites that align with the above designated habitats such as MBSs, IBAs, MPAs, Polynyas, and EBSAs. These habitats for migratory birds under the RNLUP are categorized in three classes[17] based on their importance to sustaining bird habitats, risk intolerances of the species' populations, and include set back requirements for aerial, marine, and terrestrial activities from bird groups such as migratory birds, seabirds, and coastal waterfowl (NPC, 2023b).

The MBSs in closest proximity to Grise Fiord are summarized below:

- Inglefield Mountains, Class 1: Approximately 75 km northeast – See description in Section 3.2.9.
- Devon Island, Class 1: Approximately 65 kilometers south – See description in Section 3.2.9.
- Cardigan Strait – Hell Gate, Class 2: Approximately 100km west – See description in Section 3.2.4.

Refer to Section 10 for further information relative to migratory and marine birds.

[17] See RNLUP, Appendix C-Chapter 2) for a depiction of MBA in proximity to Resolute Bay: Figure 2.1A (Class 1), Figure 2.1B (Class 2, 3) https://www.nunavut.ca/sites/default/files/23-015e_2023-09-07-2023_or_appendix_c_maps_chapter_2_english.pdf

3.3 Recommended Nunavut Land Use Plan

While Grise Fiord is within the NBRLUP (NPC, 2000), it will be replaced with the RNLUP (NPC, 2023b). For the purposes of this ESEB Report, the RNLUP[18] has been used. Summaries of the contents both land use plans can be found in Table 1-2.

3.4 National Parks

Nunavut has five national parks, three of which are in proximity to Grise Fiord, which are described in Table 3-3.

Table 3-3: List of National Parks near Grise Fiord

National Park	Distance/direction relative to Grise Fiord, and description
Sirmilik National Park	Approximately 310 km south. Located on North Baffin Island, extending from the eastern entrance to Admiralty Inlet to west of the Hamlet of Pond Inlet. Established in 2001 (McNamee & Finkelstein, 2012) and protects 22,252 km^2 of geological, natural history, and cultural values within the Eastern Arctic Lowlands and North Davis Natural Regions (Parks Canada, 2024b)The park is divided into four parcels: Bylot Island, Borden Peninsula, Baillarge Bay, and Oliver Sound. With respect to wildlife, Sirmilik hosts the most diverse avian community in the High Arctic with more than 74 species of birds, of which 45 are confirmed breeders. Bylot Island in particular has up to 320,000 thick-billed murres and 50,000 black-legged kittiwakes. In addition to its avian diversity, 19 mammal species inhabit Bylot Island, of which, nine are terrestrial (Laval, 2016).
Qausuittuq National Park	Approximately 400 km west. Located on northern Bathurst Island and smaller surrounding islands, and was established in 2015 and protects 11,000 km^2 of traditional hunting and fishing areas (McNamee & Finkelstein, 2012; Parks Canada, 2024b). It includes the waters of May Inlet and Young Inlet and is boarded to the south by Polar Bear Pass NWA Together these two areas protect a large, ecologically intact area in the Canadian Arctic Archipelago. Much of the landscape is tundra and also varies from wetlands and lowlands to plateaux, bluffs, and hills. Vegetation is sparse and found mostly on irregular surfaces of small hummocks. Terrestrial wildlife are not abundant and marine mammals inhabit the waters off Bathurst Island. The rich ocean life supports abundant

[18] Interactive maps from 2014, 2016, 2021 and 2023 Nunavut Land Use Plans are available at this URL: https://www.nunavut.ca/land-use-planning/interactive-maps.

National Park	Distance/direction relative to Grise Fiord, and description
	seabirds and the wet sedge meadows support nesting grounds for geese and shorebirds (McNamee & Finkelstein, 2012).
Quttinirpaaq National Park	Located approximately 550 km north. Located on northern Ellesmere Island and was established in 1988 protects 37,775 km^2 of land with hundreds of archaeological sites (McNamee & Finkelstein, 2012). It is Canada's second-largest and most northern national park. The landscape is dominated by hundreds of glaciers. Vegetation is sparse in upland areas and relatively lush in lowland areas. Few terrestrial wildlife species are present but species that are present can be abundant. About 30 species of birds nest in meadows of the park (McNamee & Finkelstein, 2012).

3.5 Territorial Parks

Territorial parks in Nunavut are managed by the GN-DoE. Each park is established to meet three objectives: protect Nunavut's cultural and natural landscapes, enhance community and visitor experience, and engage with community in heritage appreciation and conservation (GN, 2016b). Territorial parks create a place to highlight the cultural importance and rich history of Nunavut, while aiming to protect representative examples of Nunavut's natural landscapes.

The GN-DoE put out a call for people interested in participating in a joint planning and management committee for four territorial parks, which included Kinngaaluk Territorial Park near Sanikiluaq, Aguttinni Territorial Park near Clyde River, Napartulik Territorial Park near Grise Fiord and Kugluk Territorial Park near Kugluktuk. The Committees are composed of six people, based on interest, knowledge, Inuit culture and heritage. Community interest in the development of territorial parks is based on; Inuit rights to continue to use and enjoy parks; protecting culturally significant sites and important wildlife areas; promoting cultural and natural heritage; and developing economic and education benefits (Nunavut News, 2019).

The proposed Napatulik (or Napaaqtulik) Territorial Park is located about 50 km west of Eureka and 400 km north of Grise Fiord (NPC, 2023b; Nunatsiaq News, 2015). The park is located on Axel Heiberg Island and protects well-preserved, mummified plant remains (also known as the fossil forest) which was first documented in 1986 (Jahren, 2007). The site is unique because ancient remains reveal that a tall, lush forest once covered the area 50 to 40 million years ago, during the period called the Eocene (Laird, 2017; Nunatsiaq News, 2015). Stumps and logs from that era can still be found there (Nunatsiaq News, 2015).

3.6 Critical Habitat

In the context of this report, critical habitat is classified as crucial to the survival and recovery of wildlife species (DFO, 2020a). For aquatic species, critical habitat includes spawning, rearing or nursery grounds, and aquatic areas with associated physical, chemical and biological properties necessary for a fish species' full life cycle (Duenas Camacho & Associates Inc., 2019).

For all designated species, the SARA defines critical habitat as "*the habitat that is necessary for the survival or recovery of listed extirpated, endangered, or threatened species, and that is identified as critical habitat in a recovery strategy or action plan"* (DFO, 2020a). Further to this, a Critical Habitat Order provides legal protection to the critical habitats of listed species through the application of the prohibition in subsection 58(1) of SARA . Terrestrial species critical habitat management in Canada is carried out by several legislative bodies; the federal government (on federal lands only) and provincial or territorial government (non-federally administered lands). Conversely, aquatic species and migratory birds are protected on all lands in Canada. The main legislative tool used to protect critical habitat for designated species is SARA.

Critical habitat for Peary caribou (*Rangifer tarandus pearyi*) has been designated for winter sea ice corridors. The corridors support caribou migration and are located west of Grise Fiord between Ellesmere Island, Graham Island and Cornwall Island, as well as north between Ellesmere Island and Axel Heiberg Island during the winter[19] (Government of Canada, 2024c). This habitat is seasonal and exists when ice starts forming in the fall until ice breakup in the following spring and summer. The sea ice in these mapped areas is protected from marine traffic that could break or prevent ice from forming when needed by caribou (Government of Canada, 2024c). During the winter pack ice that forms within mapped areas is protected; however, during the summer pack ice is not designated as critical habitat. To date the waters surrounding Grise Fiord have not been recognized as critical habitat for any marine species.

[19] See Figure 2.2.12 of the Recommended Nunavut Land Use Plan Appendix C for a map showing the sea ice crossings for caribou in Nunavut. Available at: https://www.nunavut.ca/sites/default/files/23-015e_2023-09-07-2023_or_appendix_c_maps_chapter_2_english.pdf

4 Aquatic Habitats

Arctic environments are characterized by dramatic shifts in light, temperature, and frozen versus open-water states of the ocean (Carmack *et al.*, 2006). Variations in the extent and quality of sea ice in the Arctic has a fundamental influence on Arctic ecosystems and the Inuit who rely on marine life for subsistence (Ford J.D. *et al.*, 2021; Oceans North Conservation Society *et al.*, 2018).

The coastal marine environment in Nunavut represents a distinctive ecosystem for aquatic marine life. Intertidal areas are inaccessible throughout periods of the year when the ocean is frozen, and scouring of the shoreline by sea ice virtually wipes out intertidal communities annually (Conlan & Kvitek, 2005). Marine vegetation has limited periods of time to facilitate growth because sufficient light and nutrients are only available during the short period of summer conditions (Wiencke *et al.*, 2007). These variables have led to uniquely adapted species that can tolerate the experience of harsh Arctic climate conditions (Lindgren *et al.*, 2016). It has also established an important socio-economic function for the Inuit who are dependent on fish and marine mammals for subsistence harvesting.

Aquatic habitats, like their terrestrial counterparts, are undergoing rapid change due to warming effects of climate change (Intergovernmental Panel of Climate Change [IPCC], 2019). Northward shifts of southern species (e.g., killer whales) and the potential for longer growing seasons for marine vegetation (Krause-Jensen *et al.*, 2020) present challenges for resident marine species, consequently impacting the year-round resource harvesting carried out by the Inuit.

4.1 Marine Benthic Habitats

Arctic benthic flora and fauna have adapted to be resilient due to extreme fluctuations in temperature, salinity, light availability, and ice scouring (Brown *et al.*, 2011; Conlan & Kvitek, 2005; Kupper *et al.*, 2016; Wiencke *et al.*, 2007), which varies with depth. For these reasons, vertical zonation is one of the most important variables shaping intertidal and shallow subtidal benthic communities. Disturbance from ice scouring is believed to be the most important 'architect' of Arctic biodiversity (Conlan & Kvitek, 2005) in intertidal and shallow subtidal waters. Substrate of Arctic shorelines is predominantly sand intermixed with small rocks and gravel (Greenwood, 2016) and a barren high intertidal (Ellis, 1955).

Limited available research describes the Grise Fiord benthic substrate as predominantly composed of fine-grained sediment interspersed with gravel and cobbles (Devine *et al.*, 2019; Greenwood, 2016). The Arctic region generally exhibits a barren high intertidal and in the subtidal marine vegetation is controlled by availability of hard substrates (e.g., cobble, boulder) for attachment (Ellis, 1955).

4.2 Marine Vegetation

Marine vegetation has a large influence on biomass and biodiversity of marine species in temperate environments (Brown *et al.*, 2011; Cristie *et al.*, 2003; Radio Canada International, 2019; Warfe *et al.*, 2008; Wikstrom & Kautsky, 2007), providing three-dimensional habitat functioning as shelter and sustenance for multiple life history stages of marine fish and invertebrates (Radio Canada International, 2019). The extent to which this interaction exists in the Arctic has gone mostly unstudied. Włodarska-Kowalczuk *et al.* (2009) hypothesize that holdfasts of larger kelps provide refuge for organisms such as amphipods, as they offer

protection from ice scour events. It is likely that established seaweed beds are important for a variety of life stages of marine species occurring in the coastal waters of Arctic environments.

Marine vegetation species are primary producers and thus play an important role in broader ecosystem productivity during a relatively short open-water season (Glud *et al.*, 2002). It is not well understood how subtidal kelp species within the crush zone (the area where ice impact destroys marine life annually) survive from year to year, but some kelp species may continue to survive or even grow during the iced season (CBC, 2019). Winter growth of kelp has been documented for the endemic Arctic species Arctic suction-cup kelp (*Laminaria solidungula*) where growth is lowest during the ice-free period and most rapid during winter (Chapman & Lindley, 1980). Marine vegetation specific to Grise Fiord is not well documented, however a recent study from Goldsmit *et al.* (2021) in the region focused on the expanding distribution of sea colander (*Agarum clathratum)*, winged kelp *(Alaria esculenta)*, brown kelp (*Laminaria solidungula)*, and sugar kelp (*Saccharina latissimi*).

4.2.1 Biogeographic Distribution

The diversity of kelp species in the High Arctic tends to be lower than temperate kelp forests, as the optimal growth temperatures for the kelp is higher than temperatures experienced during Arctic summers (Filbee-Dexter *et al.*, 2019). However, kelps still form dense canopies in some Arctic regions (west Alaska and Northern Norway) with one truly endemic arctic kelp, *Laminaria solidungula* (Filbee-Dexter *et al.*, 2019). Other species found in the Canadian Arctic regions include *Alaria esculenta* (Labrador Sea, Baffin Bay, Hudson Bay and Ungava Bay), *Agarum clathratum* (Labrador Sea, Baffin Bay, Hudson Bay, and Ungava Bay), *Laminaria digitata* (Hudson Bay and Ungava Bay), *Saccharina latissima* (Labrador Sea and Baffin Bay), *Saccharina longicruris* (Labrador Sea, Hudson Bay and Ungava Bay), and *Saccorhiza dermatodea* (Baffin Bay) (Filbee-Dexter *et al.*, 2019). In Grise Fiord, a variety of kelp species (dulse, edible kelp, goose grass, hollow stemmed kelp, and sea colander) are documented as 'areas of occupation' in and around southern Ellesmere Island, which were all documented near the Hamlet of Grise Fiord taken from GN (2012) (see Figure 1-1 for locations). The scientific names that correlate with these common names were not provided in GN (2012). These species are accessed July through September which can justifiably be determined by their accessibility in relation to the open-water season. During the IQ study it was stated that there is a high abundance of kelp and rockweed, *"it's everywhere"* (IQ Workshop 2019 - Amon Akeeagok).

4.2.2 Harvesting

Seaweed harvesting occurs throughout Nunavut (QIA, 2018b). *Kuanniq (*edible kelp), qiqquaq (hollow stemmed kelp), dulse and other seaweed is harvested most and used primarily to provide flavour and salt to food (QIA, 2018b). During the IQ workshop it was confirmed that two methodologies for kelp harvesting are from *"some people harvest kelp in the clam area and some wait for it to be pushed ashore"* (IQ Workshop 2019 - Amon Akeeagok). Kelp is limited near the community, with regular seaweed harvesting occurring outside the community (see Figure 1-2).

4.3 Water Bodies (and Marine Corridors)

The Arctic Ocean is a unique environment that fluctuates between open-water and iced ocean conditions, and it is the smallest and shallowest of the worlds five major oceans (Arctic, Pacific, Atlantic, Indian, and

Southern) (Pidwirny, 2006), as well as the coldest. Canada's Arctic Ocean region experiences extreme variations in daylight, temperature, and frozen versus open-water states of the ocean (Carmack *et al.*, 2006). As previously mentioned, Marine Corridors are the water bodies that interconnect providing extensive migratory routes for many marine organisms. Six Marine Corridors in proximity to Grise Fiord are discussed in detail to follow (see Section 1.4 and Figure 1-2).

4.3.1 Baffin Bay

Baffin Bay is a deep body of water located between Greenland and Baffin Island with an area of 1400 km by 550 km (Tang *et al.*, 2004). A large abyssal plain in the central region contributes to maximum water depths of 2400 m near its centre and water depths less than 1000 m throughout the bay (Clarke & Drinkwater, 2015). The continental shelf off Baffin Island is narrower than Greenland, but both continental shelves are deeply cut by canyons (Tang *et al.*, 2004). Baffin Bay is connected to the Labrador Sea by its biggest and deepest channel, Davis Strait, and connects to the Arctic Ocean through Jones Sound, Nares Strait, and Lancaster Sound (Preußer *et al.*, 2015; Tang *et al.*, 2004).

Baffin Bay has marginal sea-ice coverage with complete ice coverage from December to April and open-water from August to September, where only icebergs are present (Britannica & Encyclopaedia, 1998; Tang *et al.*, 2004). Northern Baffin Bay is fed by Lancaster and Jones Sounds to the west, and Nares Strait to the north (Addison & Bourke, 1987). The water flow within Baffin Bay is cyclonic, pushing the fresh and cold Arctic water into the Labrador Sea, contributing to the salinity of the Labrador Sea and the thermohaline circulation of the North Atlantic ocean (Tang *et al.*, 2004; Zhang *et al.*, 2021). The annual fluctuation of sea-ice from the Canadian Arctic Archipelago, through Baffin Bay, plays a significant role in the Atlantic Meridional Overturning Circulation which could regulate the global climate system as an important component of great ocean conveyor (Zhang *et al.*, 2021). Furthermore, the annual fluctuation of sea-ice coverage further contributes to the interannual variability of deep convection and stabilization of the water column in the Labrador Sea (Tang *et al.*, 2004).

4.3.2 Jones Sound

Located north of Devon Island and south of Ellsemere Island, Jones Sound connects the Arctic Ocean to Baffin Bay (Tang *et al.*, 2004). The western end of Jones Sound connects to the Arctic Ocean through Cardigan Strait and a 120 m deep sill at Hell's Gate and flows to Baffin Bay though a channel of less than 30 km (Tang *et al.*, 2004; Zhang *et al.*, 2021). A high-resolution model simulated the throughflow in the Canadian Arctic Archipelago (CAA) from 1978-2016 showing significant interannual and seasonal variability within the Jones Sound (Zhang *et al.*, 2021). Large volumes of water flow through Davis Strait contributing to 15.5 % influx to Baffin Bay, particularly in spring and winter (Zhang *et al.*, 2021).

4.3.3 Nares Strait

Located east of Ellsemere Island and west of Greenland, Nares Strait includes Robertson Channel, Hall Basin, Kennedy Channel, Kane Basin, and Smith from north to south (Kalenitchenko *et al.*, 2019). The northern end of Nares strait connects to the Arctic Ocean through Robertson Channel where an ice arch forms between Nares Strait and the Lincon Sea (Kalenitchenko *et al.*, 2019). The southern end of Nares Strait connects to Baffin Bay through a 25 km wide channel with a deep sill at Smith Sound where an ice arch typically forms in

winter (Kalenitchenko *et al.*, 2019). These ice arches are crucial for maintaining the North Water Polynya, also known as *Pikialasorsuaq* (Jennings *et al.*, 2015). The two ice arches breach in summer, followed by sea ice transported through Nares Strait into Baffin Bay, influencing the salinity and temperature of the Labrador Sea Nares (Kalenitchenko *et al.*, 2019). Nares Strait is the first principal narrow path of through flow in the Canadian Arctic Archipelago and contributes to 50.6 % of the water flowing into Baffin Bay (Zhang *et al.*, 2021). Simulations based on a long-term dataset (1978-2016) indicated that the water volume transported by Nares Strait played the most significant role in the volume on transport in Davis Strait (Zhang *et al.*, 2021). Due to the cyclonic water currents in Baffin Bay, a large inflow of water from Baffin Bay is also pushed into Nares Strait through Smith Sound (Tang *et al.*, 2004).

4.3.4 Lancaster Sound

Located north of Baffin Island and south of Devon Island, Lancaster sound connects the Arctic Ocean to Baffin Bay. The western end of Lancaster Sound connects to the Arctic Ocean through Barrow Strait where the depth is ~125 m and width is ~55 km (Tang *et al.*, 2004). The eastern end of Lancaster Sound flows to Baffin Bay through a ~100 km wide passage (Zhang *et al.*, 2021). Lancaster Sound is the second principal pathway for the Canadian Arctic Archipelago and provides a net inflow to Baffin Bay twice that of Jones and Smith Sound (Addison & Bourke, 1987; Zhang *et al.*, 2021). Lancaster Sound experiences interannual variability with a larger flux of water outflow in winter and spring and contributes to 33.9 % of the water flowing into Baffin Bay (Zhang *et al.*, 2021). Due to the cyclonic water currents in Baffin Bay, a large inflow of water from Baffin Bay is also pushed over the Baffin Island slope, into the eastern side of Lancaster Sound (Tang *et al.*, 2004).

4.3.5 Lady Ann Strait

Lady Ann Strait connects Jones Sound and Baffin Bay with Devon Island north and Coburg Island south of the strait.

4.3.6 Davis Strait

The Davis strait connects Baffin Bay to the Labrador Sea. Warm waters flowing north along Greenland delays ice formation for the eastern side of the strait, leading to faster ice break up in the spring (Pharand & Legault, 1984). The depth of Davis Strait ranges between 1000 m to 2000 m.

4.4 Fresh Water

Northern Ellesmere Island contains 32 ponds and lakes where typical cool High Arctic conditions occur. Conversely, there are 23 ponds and lakes located in the Hazen Basin which is known as a High Arctic oasis with an atypical warm environment on Ellesmere Island (Keatley *et al.*, 2007). Shallow tundra ponds dominate the High Arctic which are characterised by small volumes (> 2 m depth), low dilution of solutes, high sensitivity to external inputs and freezing completely during the winter months (Antoniades *et al.*, 2003). A major difference between lakes and ponds in the High Arctic is lakes will remain completely frozen for nine months of the year verses ponds, with lower thermal capacities, will freeze and thaw earlier than lakes (Antoniades *et al.*, 2003).

Over time stronger rivers in the area have evolved into smaller creeks due to reductions in flow (Nunavut Climate Change Centre, 2004). Five years ago, flow strength was greater in rivers resulting in high levels of erosion on the land, while lakes retained higher snow coverage. Today, rivers are known to flow up until the end of December with less force and lakes are not freezing as early as they used to. Further, surface ice is not as thick as in previous years nor is it melting fully in the summer months (Nunavut Climate Change Centre, 2004).

There are two creek crossings (Kuuraaluk Creek, Valley Creek) that intersect the haul road, one of which drains into the community harbour (see Figure 7-10).

- Kuuraaluk Creek: Located southeast of the Community Harbour Study Area and split into two arms before reaching the marine environment, where the northern arm drains into the community harbour (see Photo 4-1). The northern arm has five large culverts and the southern arm has one culvert (see Figure 1-2, Photo 7-8). Locally, this creek is referred to as Kuuraaluk (pronounced Kuu-Raa-Luk) (IQ Workshop 2019 - Marty Kuluguqtuq). Kuuraaluk is not considered fish bearing and there was no mention of fish during the IQ workshop (Amon Akeeagok, HTA Chair. pers. comm. Dec 2019). Potential impacts to the southern arm of the Kuuraaluk Creek are discussed in Sections 2.1.2.4, 5.1.3, 6.3.5.1, 7.1.1.5) of the PSIR Report (Dynamic Ocean & Worley Consulting, 2025a).
- Valley Creek: Located northwest of the Community Harbour Study Area, in close proximity to Quarry Locations 2B, 2C, and 2D. It has a culvert at the intersection with the road. There is no publicly available information on this creek, and it was not mentioned as an important fish resource during the IQ Workshop nor is it considered fish bearing (Amon Akeeagok, HTA Chair. pers. comm. Dec 2019).

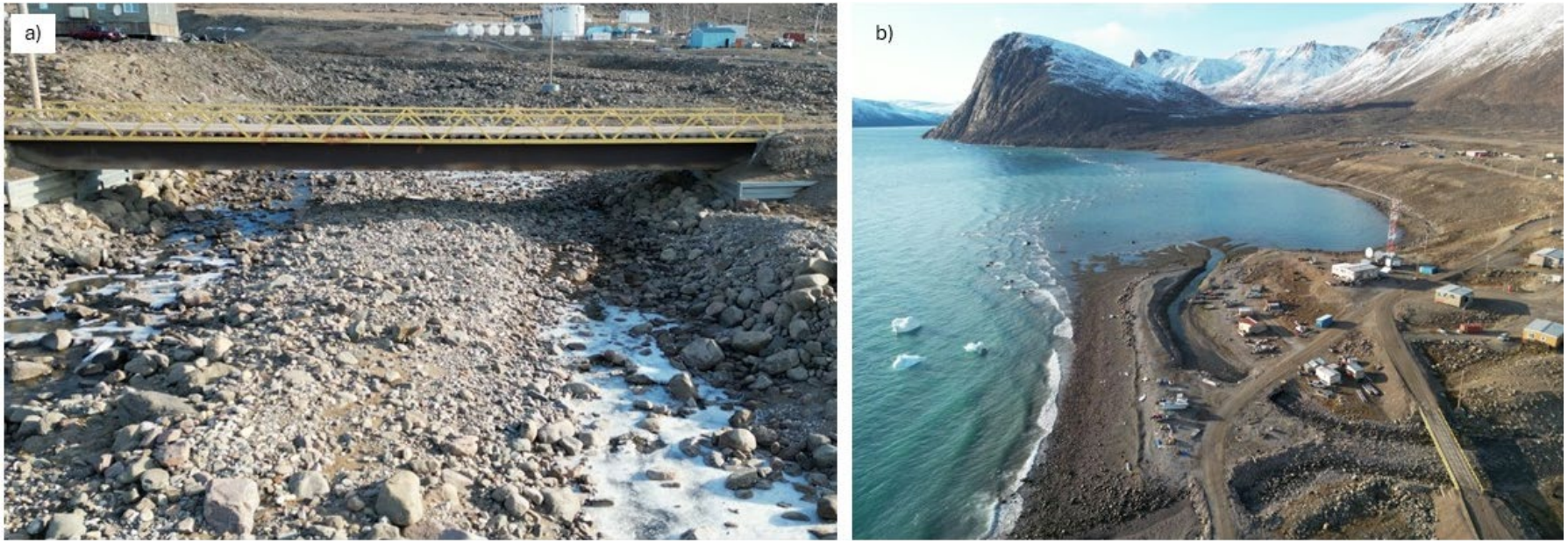


Photo 4-1: Kuuraaluk Creek: a) Inland View; b) Seaward View

Source: Dynamic Ocean, 2024

4.5 Ocean Currents

There are two major wind-driven currents in the Arctic Ocean, the Beaufort Gyre and the Transpolar Drift Stream. Surface water circulates clockwise from east to west. The Arctic Ocean connects to the Atlantic Ocean through the Baffin Island Current, a combination of the West Greenland current inflow, and Artic outflow from channels of the Canadian Artic Archipelago (Figure 4-1) (Britannica & The Editors of Encyclopaedia, 1998).

Surface current data was collected in Grise Fiord using a drogue (a surface float with a Global Positioning System [GPS] tracker) in the detailed design (2024) phase. The drogue was visually monitored using binoculars to track its location. Current data was collected for approximately one hour and 15 minutes. The average and maximum current speed were 0.2 km/h and 3.4 km/h, respectively, with a net displacement towards the northeast (see Section 4.6).

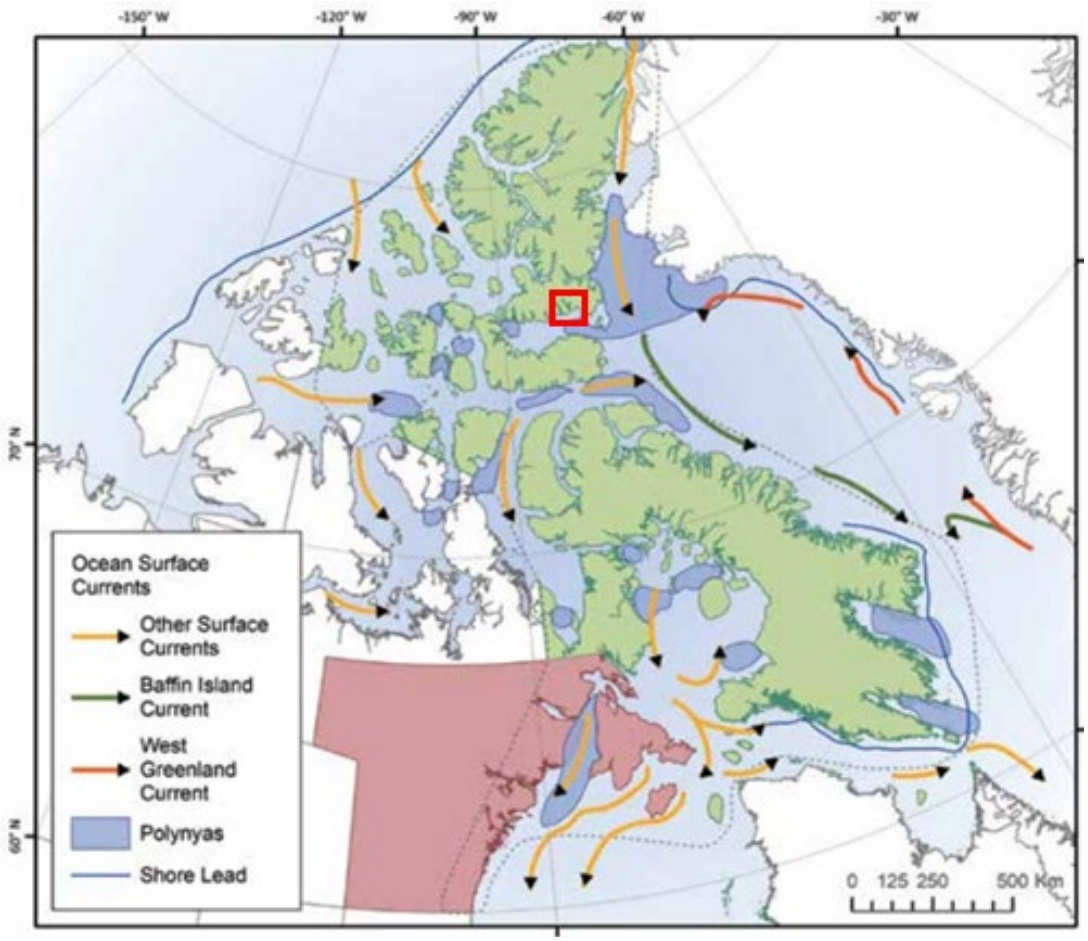


Figure 4-1: Ocean Currents of the Canadian Arctic

Source: Figure 8 in Copland *et al.* (2018)

4.6 Surface Circulation Drogue Program

Surface current data was collected using a drogue (a surface float with a GPS tracker). The surface float was set up with a Bad Elf GPS Pro, which enabled recording of the trajectory during the survey, in conjunction with visual tracking using binoculars.

A surface drogue was deployed during the feasibility (15 August 2019) and detailed design (05 September 2024) phases in the northern extent of the Community Harbour Study Area (see Figure 4-2). The drogue was tracked visually by the field team with binoculars and a GPS tracker attached to it. The GPS was turned on in 'track' mode, and a deployment and retrieval GPS position was documented by the field team. See Photo 4-2 for a photograph of the drogue during deployment. Results of the two drogue surveys are provided in Table 4-1, and the tidal variation during which the drogue was deployed can been see in Figure 4-3.

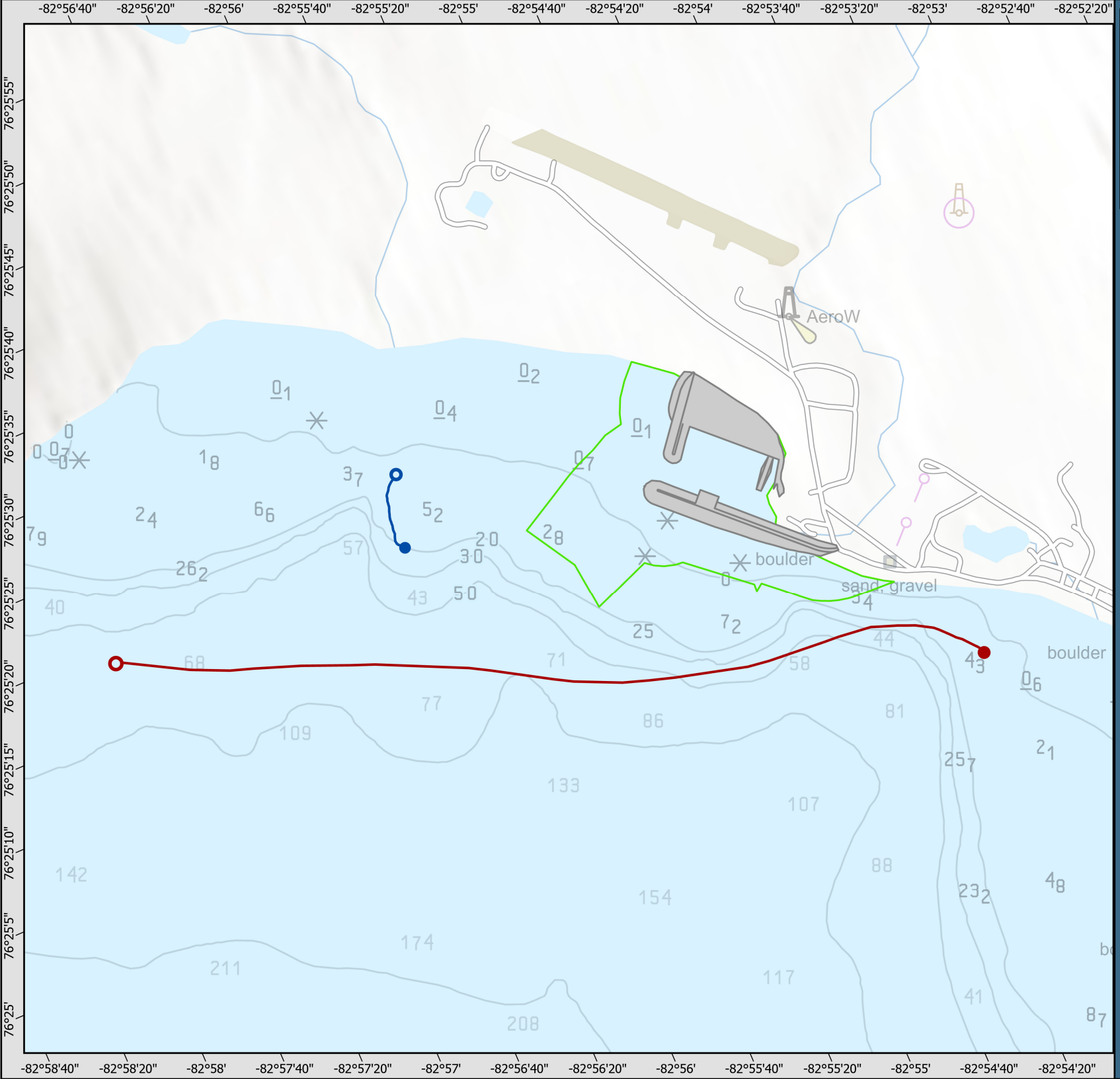


Photo 4-2: Demonstrative Photo of Drogue Deployment

Source: Dynamic Ocean, 2024

Table 4-1: Feasibility (2019) and Detailed Design (2024) Drogue Results

Survey Year	Start Position		Ending Position		Time		Distance Travelled	Tide Height (m)		Travel Speed	
	Latitude (N)	Longitude (W)	Latitude (N)	Longitude (W)	Deployment	Retrieval		Deployment	Retrieval	Max	Mean
2024	76° 25.308	82° 56.219	76° 25.385	82° 56.219	13:13	14:34	0.15 km	2.85	2.70	1.84 NM/h	0.10 NM/h
2019	76° 25.310	82° 57.624	76° 24.952	82° 53.934	09:39	12:16	1.60 km	1.70	2.45	1.73 NM/h	0.17 NM/h



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Community Harbour

Community Harbour Study Area

Drogue Deployment Path

2019		2024	
Start		Start	
End		End	



N

Scale: 1:10,000

0 100 200 400 m

Spatial Reference
GCS: GCS WGS 1984
Datum: WGS 1984
Projection: Stereographic North Pole
Map Units: Meter
Date Exported: 26-02-2025
Drawn: C. Laidlaw

Figure 4-2

Grise Fiord Community Harbour Drogue Deployment Path for 2019 and 2024

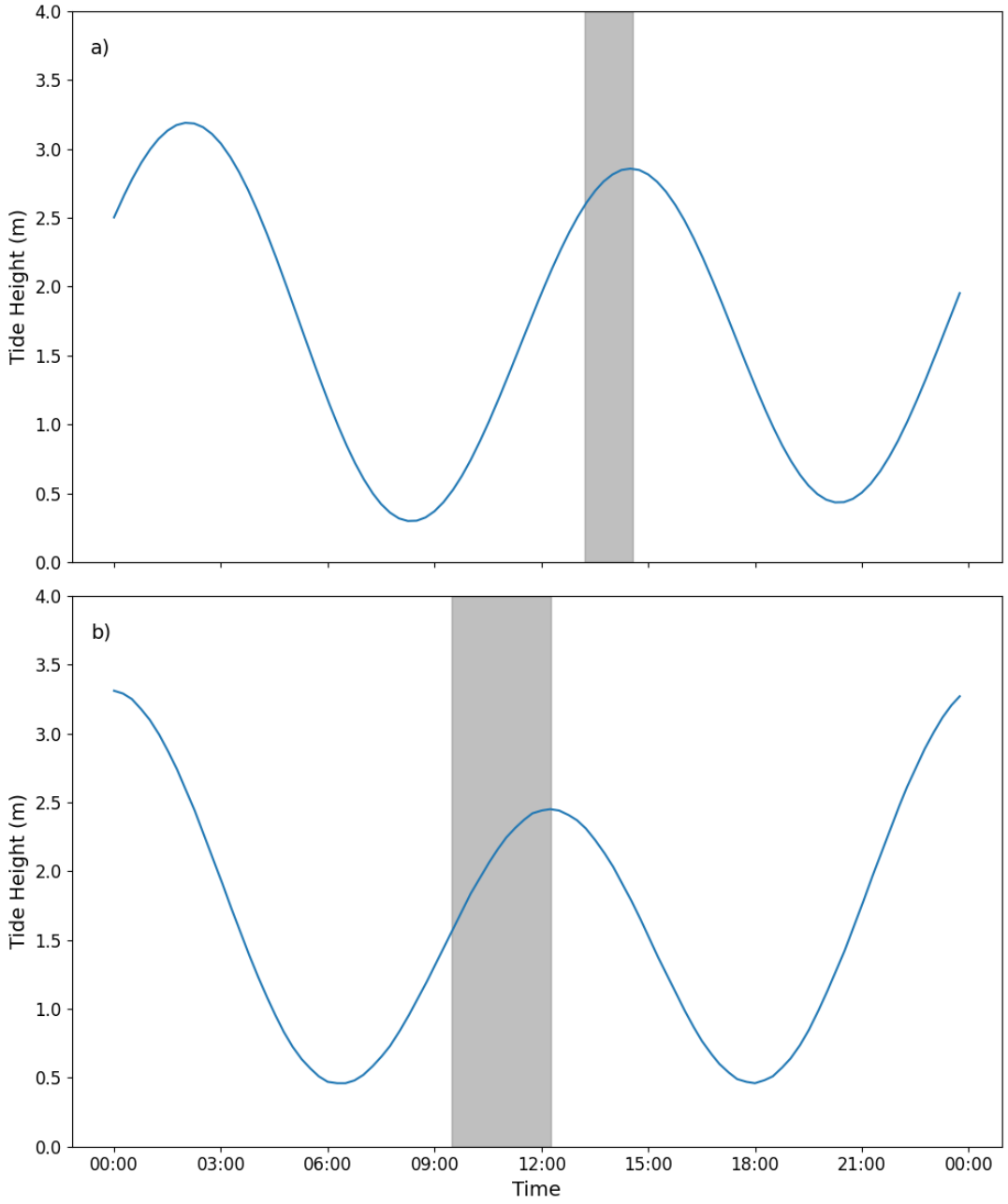


Figure 4-3: Drogue Survey Time and Tide Information: a) 05 September 2024; b) 15 August 2019

Source: Grise Fiord Station (6570) in CHS (2019, 2024)
Note: Duration of drogue program represented by grey column

4.7 Tidal Range

Tide levels for Grise Fiord were obtained from the Canadian Tide and Current Tables, Volume 4 (CHS, 2025), and are provided in Table 4-2. Average half-daily tidal range for the Arctic is represented in Figure 4-4.

Table 4-2: Tide Levels at Grise Fiord

Tide	Elevation (m, CD)
Extreme Predicted High*	4.0
Higher High Water Mean Tide (HHWMT)	3.6
Higher High Water Large Tide (HHWLT)	3.0
Mean Water Level (MWL)	1.7
Lower Low Water Mean Tide (LLWMT)	0.6
Lower Low Water Large Tide (LLWLT)	-0.1
Extreme Predicted Low*	-0.4

Source: Grise Fiord Station (6570) in CHS (2025)
Note: *Estimated, based on extremes at the reference station of Resolute Bay

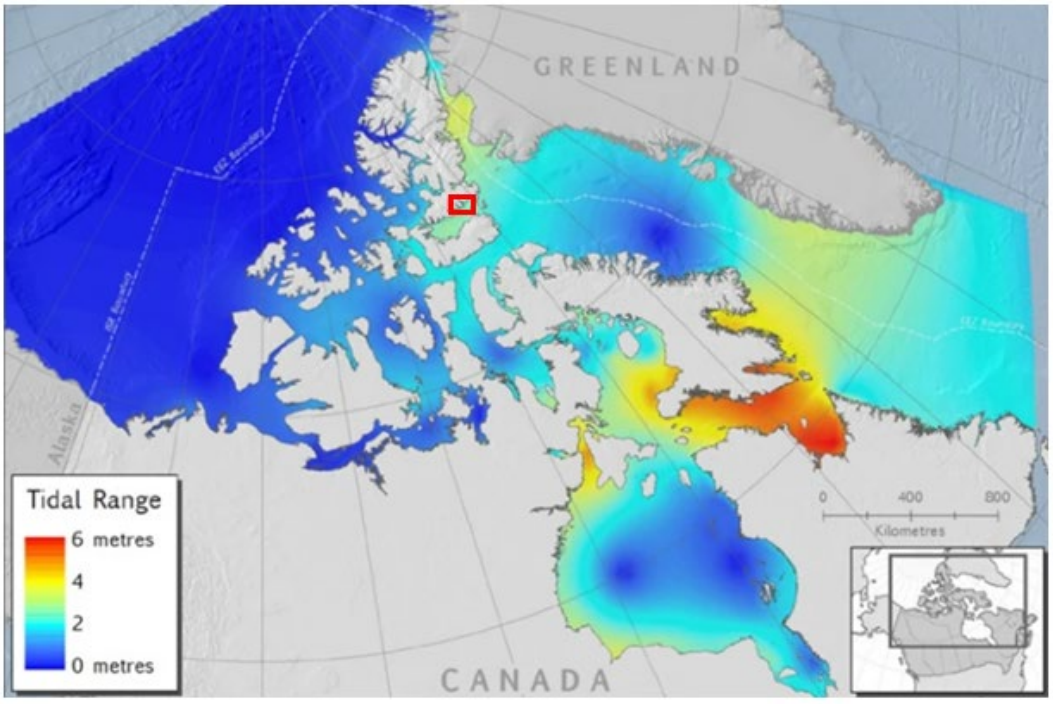


Figure 4-4: Changes in Sea-Level with the Dominant Half-Daily Tide

Source: Oceans North Conservation Society *et al.* (2018)
Note: Red square depicts Grise Fiord location

4.8 Ocean State

Arctic circulation flows in a quasi-closed circuit counterclockwise in the Beaufort Gyre with an eastern coastal flow. Pacific water entering the Arctic flow through the Arctic Archipelago to Baffin Bay and then south to the Labrador Sea (Greenan *et al.*, 2019).

4.8.1 Ocean Temperature

Documentation of ocean temperatures is of critical interest at this time when climate change is thought to be driving increased water temperatures in the Arctic (Greenan *et al.*, 2019). Arctic Sea Surface Temperature (SST) has increased by greater than 0.5 °C per decade from 1982 to 2017 in open-water areas of the Beaufort Sea, Hudson Bay and Baffin Bay (Greenan *et al.*, 2019). Temperature trends near the seabed of Lancaster Sound have increased by 0.2 °C (2002-2011), while the Baffin Island Shelf in depths of 50 m to 200 m there is slight cooling of -0.05 °C per decade. Additional cooling trends recorded in central Baffin Bay in the surface (0 m to 50 m) of -0.16 °C per decade (Greenan *et al.*, 2019). Conversely, further warming trends were observed in off-shelf basins at subsurface (150 m to 900 m) temperatures increasing by 0.48 °C per decade since 1970.

4.8.2 Open and Iced Water Conditions

One of the major environmental forces against marine infrastructure in the Arctic is the formation, breakup, and movement of ice. The relationship between the Arctic's annual snow, ice and daylight compared to the time of year is represented in Figure 4-6. Based on the 30-year average between 1991 to 2020, the typical dates in Grise Fiord for break-up and freeze-up are the weeks of 16 July to 6 August, and 1 to 8 October, respectively (Figure 4-7).

Overall, the Arctic has been experiencing a significant reduction in Multi-Year Sea Ice (MYI). Currently, over 70 % of the Arctic Sea ice is First Year Ice (FYI) and melts seasonally. This thin ice melts faster and breaks up easier than MYI and can be moved more easily by wind (Kwok 2018). Large sheets of ice floating into a marine structure can have higher impact forces than normal berthing energy. Within the community harbour, the thickness of the ice combined with the tidal range can significantly impact the mooring system; therefore, ice thickness is considered a crucial aspect in the design of marine infrastructure.

4.8.3 Sea Ice Conditions and Thickness

Sea ice conditions are described in four distinct annual cycles which are termed: freeze-up, iced, break-up, and open-water (see Figure 4-5, Figure 4-6, Figure 4-7). Additional categories of ice cover which may be referred to in other sections of this report are provided in Table 4-2.

Annual mean sea ice extent has on average declined since 1979, at a current rate of 13.1 % per decade (ECCC, 2021). Depending on the region, the Canadian Arctic summer sea ice area has decreased by 5 % to 20 % per decade from 1968 to 2016 (Derksen *et al.*, 2019). The fraction of open-water varies significantly from year to year, especially in the summer months, though it is generally on the rise (see Figure 4-6) (Canatec Associates International Ltd., 2014). According to Coupled Model Intercomparison Project Phase 5 (CMIP5) models, by 2050 the majority of the Canadian Arctic sea will have at least one ice-free month (Derksen *et al.*, 2019).

The north coastline of Ellesmere Island hosts all remaining ice shelves in Canada (Government of Canada, 2020a). These ice shelves were formed after the Ellesmere Ice Shelf, 8597 km^2 in size in 1906, broke apart in 1959 (Government of Canada, 2020a; Mueller *et al.*, 2017). By 2015, the total ice shelf area dropped to a total of 525 km^2 (Government of Canada, 2020a). Ice shelves decline as large sections calve off into the Arctic Ocean. For example, the last fully intact ice shelf, Milne Ice Shelf, lost 79 km^2 (43 % of its mass) into the Arctic Ocean in less than 48 hours at the end of July 2020 (Kubny, 2020; Nunavut News, 2020).

In discussions with locals, during ice break-up it is said that ice gets pushed up onto the shoreline and piles up above high tide during break-up and around freeze-up time when strong southerly winds occur. Recent years are seeing the effects of climate change, and the 30-year averages are not necessarily applicable.

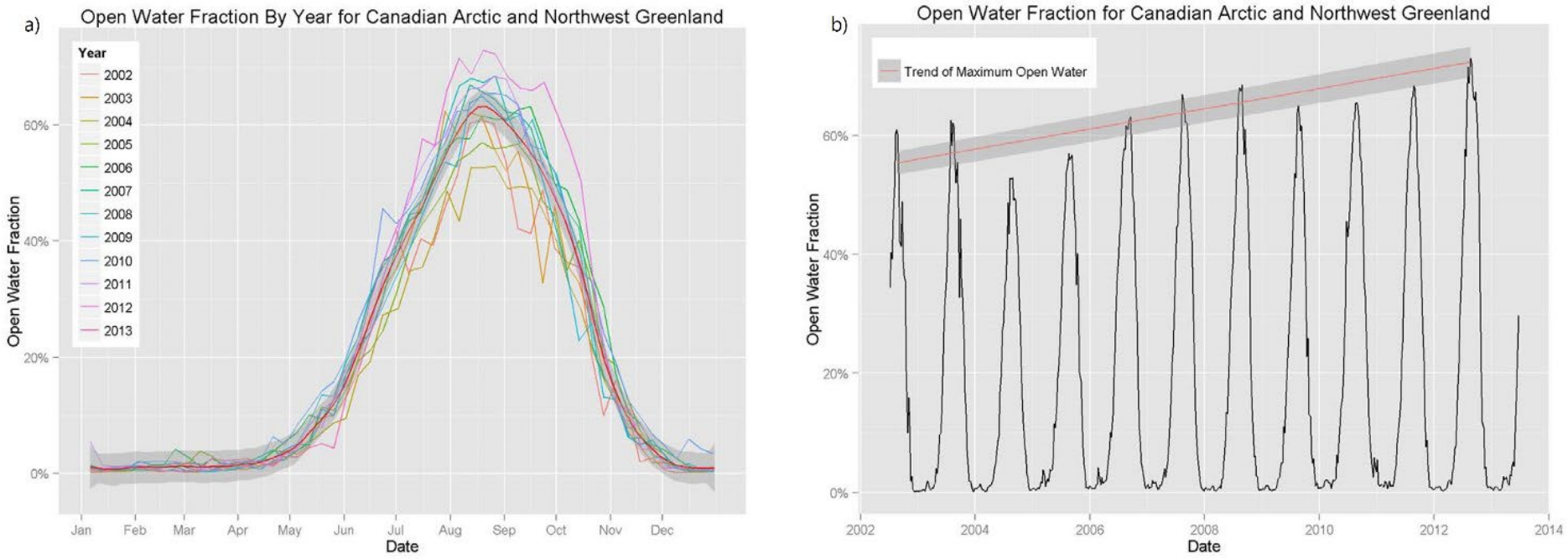


Figure 4-5: Fraction of Open-Water: a) January to December; b) 2002 to 2013

Source: Canatec Associates International Ltd. (2014)

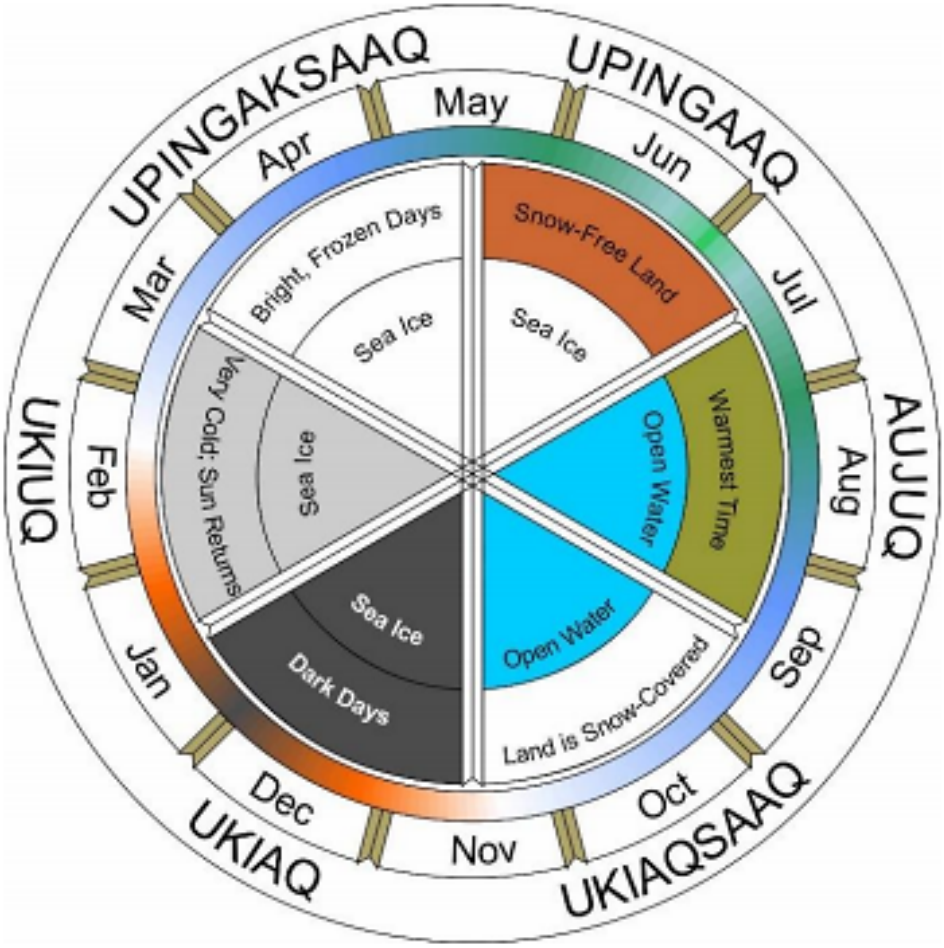


Figure 4-6: Generalized Annual Snow, Ice, Water and Light Cycles in Nunavut

Source: Figure 4 in NPC (2023b)

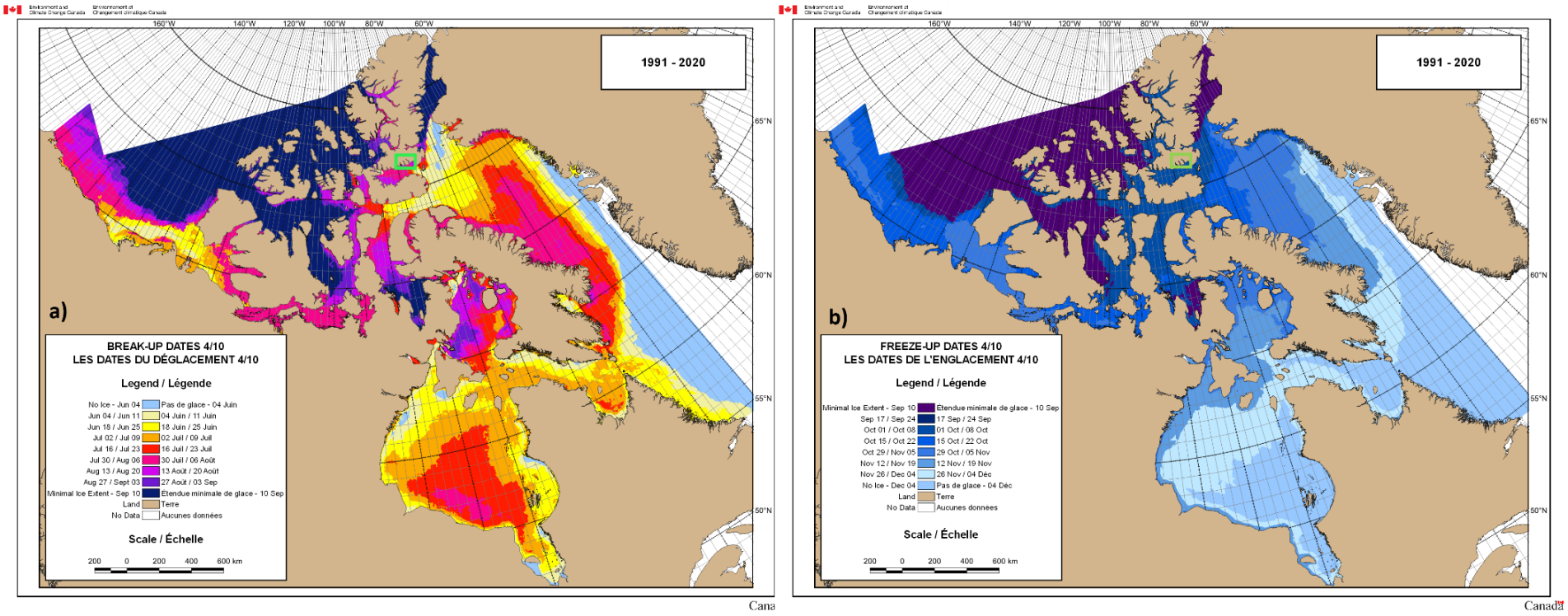


Figure 4-7: 30-Year Ice: a) Break-Up; b) Freeze-Up

Source: Government of Canada (2021a)
Note: Green square depicts Grise Fiord location

Table 4-3: Categories of Arctic Sea Ice

Term	Definition
Anchor Ice	Submerged ice attached or anchored to the bottom, irrespective of the nature of its formation.
Fast Ice	Ice which forms and remains fast along the coast. It may be attached to the shore, to an ice wall, to an ice front, between shoals or grounded icebergs. Vertical fluctuations may be observed during changes of sea level. It may be formed "in-situ" from water or by the freezing of floating ice of any age to shore and can extend a few metres or several hundred kilometres from the coast. It may be more than one year old in which case it may be prefixed with the appropriate age category (old, second year, or multi-year). If higher than 2 m above sea level, it is called an ice shelf.
First Year Ice	Sea ice of not more than one winter's growth, developing from young ice; 30 cm or greater. It may be subdivided into thin first year ice (sometimes referred to as white ice), medium first year ice, and thick first year ice.
Floe Edges	Created at the end of winter/beginning of spring as non-land-fixed ice breaks away from land-fixed ice. Floe edges are composed of thick land-fixed ice at the interface of fully or partially open-water.
Freeze-Up	This term refers to a particular length of time over which ice appears in a given area (generally one to two weeks). However, freeze up does not necessarily imply a growth of ice, but can also indicate a movement of ice into a particular area.
Ice Edge	The demarcation at any given time between open-water and sea, lake or river ice, whether fast or drifting.
Ice Foot	A narrow fringe of ice attached to the coast, unmoved by tides and remaining after the fast ice has moved away.
Landfast Ice	A type of largely immobile sea ice that primarily forms off coasts in shallow water for a certain period of time. In High Arctic, landfast ice may linger for several years, dependent on weather conditions. Typically, landfast ice starts to grow in fall and melts away completely in summer. The offshore extension of landfast ice varies, dependent largely on coastal bathymetry and topography. This type of sea ice has a profound influence on coastal resources and residents.
Multi-Year Ice	Old ice which has survived at least two summer's melt. Hummocks are smoother than on second year ice and the ice is almost salt-free. Where bare, this ice is usually blue in colour. The melt pattern consists of large interconnecting, irregular puddles and a well-developed drainage system.
Polynya	Areas of persistent open-water surrounded by sea ice (see Section 3.2.5).
Ice Shelf	Ice shelves are extensions of thick land ice that flow out over a cold coastal ocean. Ice shelves range in thickness from about 50 to 600 meters (160 to 2000 feet) and can extend tens to hundreds of miles from the coast, where the ice first goes afloat. Some ice shelves have

Term	Definition
	persisted for thousands of years. When an ice shelf is narrower than the bay it occupies, it is sometimes called an ice tongue.

Source: Government of Canada (2020b); Lemieux *et al.* (2018); NSIDC (2024); Polar Science Center (2010)

4.9 Seasonal Daylight Regimes

Grise Fiord experiences 24 hours of sunlight from late April to mid August. During the winter, the community experiences 24 hours of darkness. Figure 4-8 breaks down hours of sunshine, dusk, darkness, and dawn over the course of the year.

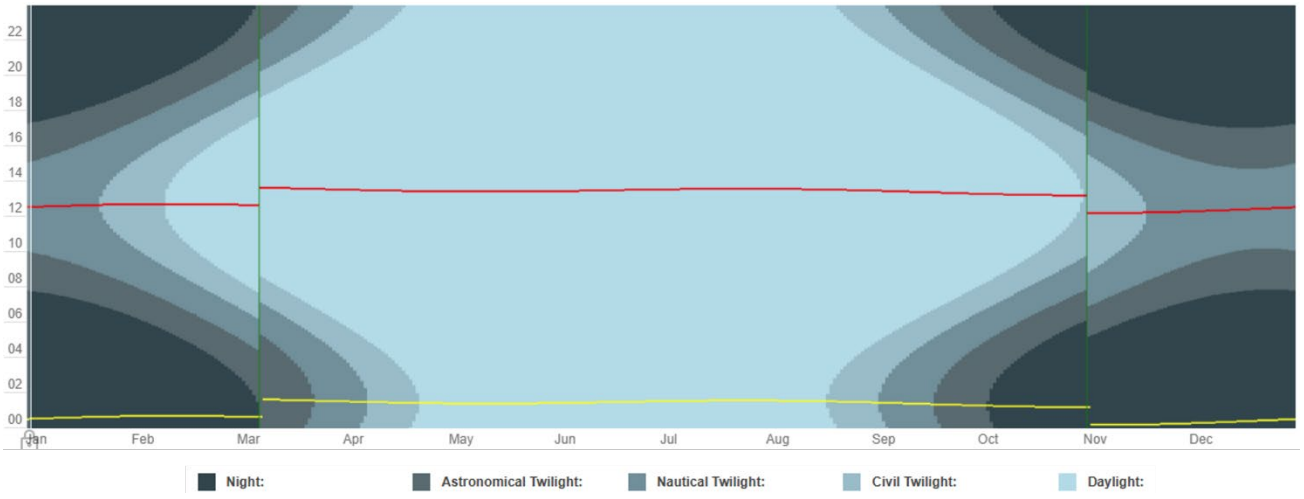


Figure 4-8: Sunrise, Sunset, Dawn, and Dusk Time in Grise Fiord

Source: Time and Date (2024)

4.10 Precipitation

Average rainfall, snowfall, and snow depth in Grise Fiord were obtained from the Monthly Data Reports from the Government of Canada from 1991 to 2020 and are presented in Table 4-4.

Table 4-4: Precipitation Averages in Grise Fiord, Nunavut

Month	Total Precipitation (mm)	Average Snow Depth (mm)
January	0.0	68
February	0.0	57
March	0.0	111
April	0.0	104
May	0.2	96
June	10.2	47
July	31.8	16
August	21.3	112
September	5.1	143
October	0.1	-

Month	Total Precipitation (mm)	Average Snow Depth (mm)
November	0.0	148
December	0.0	-
Yearly Total	68.7	-

Source: Government of Canada (2024a)

5 Marine Water and Sediment Quality

Program objectives for marine water and sediment quality are provided in Section 1.5 (Table 1-1).

5.1 Desktop Review

Marine water and sediment quality monitoring data for Nunavut is limited, particularly at the local scale. The Nunavut General Monitoring Plan (NGMP) classifies water and sediment quality monitoring into two categories: project monitoring (project specific within a local study area), and general monitoring (addresses information on the long-term state and health of aquatic ecosystems in the Nunavut territory) (NGMP, 2013).

There is no established mechanism for the monitoring of marine water quality in the NGMP (NGMP, 2013). The lack of marine water quality data for the Arctic is identified as knowledge gap by NPC due to its potential impact on marine mammals and seabirds (Government of Canada, 2018c). The Northern Contaminants Program is one organization that collects marine water quality information (Government of Canada, 2018a). Understanding marine water quality is important in Nunavut, particularly in the context of climate change, where changing conditions of sea ice and freshwater runoff are important drivers in Arctic water quality (Nummelin *et al.*, 2015). Understanding these variables provides a broader understanding of variable seasonal effects on coastal and offshore processes (Government of Canada, 2002)

Within Nunavut communities, the influence of storm water runoff, the effectiveness of wastewater treatment, and localized spills can influence marine water and sediment quality. Stormwater run off in Grise Fiord is poorly understood, but its impact is likely at a localized level, since Grise Fiord is a relatively unimpacted area. Wastewater treatment in Grise Fiord consists of a single-cell waste stabilization pond (WSP), similar to those in other Nunavut communities (Centre for Resource Studies, 2015). The wastewater is discharged to a small wetland and subsequently enters the marine environment approximately 620 m northwest of the community of Grise Fiord (Schmidt *et al.*, 2016). There is little information available surrounding the effects of the wastewater treatment system in Grise Fiord on the marine environment. Schmidt *et al.* (2016) indicated that further research is necessary to inform options assessments for improvement. There are concerns in the community about contamination due to the wastewater outfall, and little to no harvesting around the Community Harbour Study Area due to its proximity (IQ Workshop 2019 - Amon Akeeagok; IQ Workshop 2019 - Manasie Noah; IQ Workshop 2019 - Marty Kuluguqtuq).

5.2 Field Program (Water Quality)

A field program for water or sediment quality was not conducted in 2024, as the 2019 water quality data was considered sufficient.

5.2.1 Survey Location

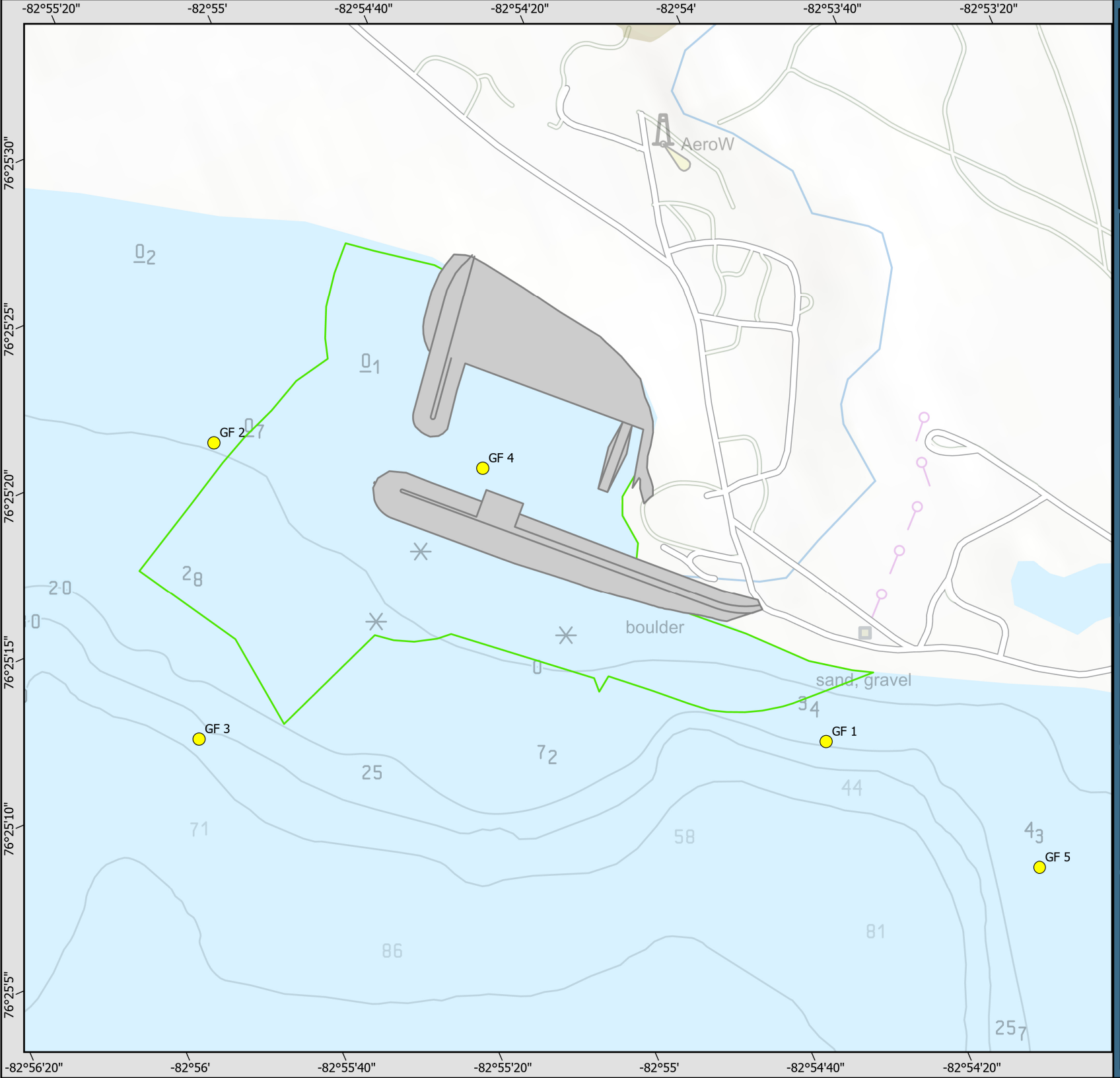
Marine water and sediment quality in Grise Fiord was assessed over one sampling event on 16 August 2019. Marine water samples were taken by an experienced marine scientist and a local Inuit assistant from five locations as shown in Figure 5-1. Sample locations were selected to give a broad overview of water quality in the vicinity of the Community Harbour Study Area. Sample locations were delineated and georeferenced using the Avenza App on an iPad.

Marine water quality survey locations and depth sampled are provided in Table 5-1.

Table 5-1: Water Quality Sampling Locations (16 August 2019)

Sample ID	Start		Time	Sample Depth Category	Depth (m)	Station Depth (m)	Tide Height (m)	Chart Datum Depth (m)
	Latitude (N)	Longitude (W)						
GF 1	76° 25.015'N	82° 54.349'W	13:01	S	1	40.0	2.5	37.5
			13:10	D	39			
GF 2	76° 25.257'N	82° 55.380'W	13:28	M	2	4.2	2.5	1.7
GF 3	76° 25.172'N	82° 55.684'W	13:50	S	1	38.0	2.5	35.5
			14:00	D	37			
GF 5	76° 25.246'N	82° 54.830'W	13:40	M	1	2.5	2.5	0
GF 6	76° 24.926'N	82° 54.009'W	14:05	M	2.5	5.2	2.3	2.9

Note: S = Shallow (1m below surface), D = Deep (1m above seabed), M = midwater



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Nunavut

Dynamic Ocean Consulting

- Community Harbour
- Community Harbour Study Area
- Water Quality Survey Sites



N

Scale: 1:5,000

0 50 100 200 m

Spatial Reference
GCS: GCS WGS 1984
Datum: WGS 1984
Projection: Stereographic North Pole
Map Units: Meter
Date Exported: 26-02-2025
Drawn: C. Laidlaw

Figure 5-1

Grise Fiord Community Harbour Study Area Water Quality Survey (2019)

5.2.2 Methodology

5.2.2.1 Marine Water Sample Collection

Samples for chemical analysis were collected from each sampling site using a 5.0 L Teflon lined Niskin bottle deployed from the vessel. The Niskin was cleaned with Alconox metals-free soap to remove any contaminants, then rinsed with site water prior to each deployment. When depths were greater than 8 m, two samples were taken from each site, one at the surface (1 m below surface) of the water column and one from the bottom of the water column (1 m above seabed). The Niskin was lowered over the side of the vessel to the required depth, a messenger was deployed and the Niskin retrieved to the surface with contained sample. Once at the surface, the water sample was decanted into specific containers, supplied by the laboratory, for the required analyses. Any bottles intended to receive analysis for dissolved analytes (e.g. metals) were filtered using a sterile 0.45 µm suction filtration system before decanting to the required bottle. Samples were preserved in the field per laboratory guidance, appropriately labelled using indelible ink to write the sample location number, depth of sample and date, and were immediately stored in coolers. Samples remained in refrigerated condition until dispatched to the analytical testing laboratory, where they are maintained at four degrees Celsius (4°C).

All samples were retained at the analytical laboratory for three months from the date of submission for repeat/verification testing, if required.

Physicochemical analysis was not performed in 2019 due to travel logistics in 2019. In 2024, YSI Specific Conductivity, Temperature, pH, Turbidity, and Depth were taken during the plankton field program (see Sections 7.1.4.2, 7.4.4.2).

5.2.2.2 Laboratory

Samples sent to the laboratory for chemical analysis were analyzed for the following:

- Nutrients (ammonia, nitrate, nitrite, phosphate, orthophosphate).
- Physical parameters (pH, total suspended solids, total organic carbon).
- Total metals, including mercury.
- Dissolved metals, including mercury.

5.2.3 Data Analysis

Laboratory data were directly imported into the Environmental Quality Information System (EQuIS) 5.5.1 database (Earthsoft, Concord, MA). Checks for data quality were conducted to confirm data are admissible for use. Analytical water quality results were compared to the CCME - Canadian Water Quality Guidelines (WQG) for the Protection of Aquatic Life (CCME, 2003). These guidelines provide nationally endorsed, sciencebased goals for maintaining quality in aquatic ecosystems and are used for guidance to assess marine water quality. Water quality results were compared to long term guidelines.

5.2.4 Quality Assurance/Quality Control

5.2.4.1 Field QA/QC

The field Quality Assurance/Quality Control (QA/QC) measures for the water quality field program included procedures to reduce the risk of cross-contamination. The following QA/QC procedures were incorporated during sampling to ensure the highest quality results:

- Using qualified environmental staff experienced in marine water sampling and field supervision of local assistants.
- Decontaminating all water sampling equipment by washing with a phosphate-free detergent solution, followed by thorough rinsing with site water, prior to collecting a sample at each location.
- Prevention of cross-contamination by wearing a new pair of nitrile gloves for each sampling location when handling samples and sampling equipment.
- Storing samples in the appropriately cleaned and labelled sample containers.
- 'Blind labelling' all field QA/QC duplicate samples in the field with QA/QC field numbers which do not relate to the sampling location names.
- Keeping water samples cool (4 °C) after sampling and during transport.
- Avoiding headspace in the sample containers.
- Maintaining a clean and organized work area.
- A regimented process for sample documentation was used, including:
    - Labelling all field sample containers and field data sheets with pencil/indelible ink and waterproof labels.
    - Backing up electronic data (i.e. positional data from GPS, photographs), in duplicate, at the end of each field day and labelling electronic files.
    - Keeping thorough notes, including photographs, GPS coordinates, tidal/weather conditions, and recording potential confounding factors observed during field days and at sites.
- Transporting samples under Chain of Custody (CoC) documentation.

5.2.4.2 Laboratory QA/QC

Laboratory analysis was conducted in accordance with professional standards using accepted testing methodologies, quality assurance, and quality control. The laboratory used for sediment sample analyses is a Canadian Association for Laboratory Accreditation Inc. (CALA) accredited for the methodologies used and is experienced in the analysis of marine sediments.

QA/QC procedures for contaminant assessment were used from sampling through to completion of laboratory analysis included:

- Chain of Custody documentation
- Field and intra-laboratory QA/QC protocols

One field duplicate sample was collected in Grise Fiord and analyzed to determine the variability in analytical parameters.

Laboratory QA/QC included procedures to promote high quality laboratory results as well as measures to verify the results. These procedures included analysis of laboratory methodology blank, laboratory matrix spike, laboratory spiked blank, and laboratory duplicate.

A validation of the analytical data was undertaken to confirm that the data quality was suitable for undertaking an assessment to characterize water quality (see Section 5.2.2.2). This validation included a consideration of results for laboratory blanks, standards, spikes, and field and laboratory duplicate samples and is assessed against (CCME, 2016).

5.2.5 Results

5.2.5.1 Chemical

The results for chemical analyses for water quality are summarized below and presented in Appendix A, Table A-1 (General water chemistry), Table A-2 (Total Metals), Table A-3, (Dissolved Metals). Results are compared against the CCME (2003) long term marine water quality guideline for the protection of aquatic life.

Laboratory analytical results are available on request.

5.2.5.2 Major Ions, Nutrients and Physicochemical

Results of laboratory analysis for major ions, nutrients and physiochemical parameters are summarized as follows:

- pH was mainly consistent across depth and sample location, ranging from 7.83 to 8.00.
- Nutrients were low and relatively consistent across sampling locations.
- Water hardness was consistent across sampling locations.
- Total organic carbon (TOC) varied across sample location and depth, ranging from 70 mg/L to 100 mg/L.

5.2.5.3 Total Metals

Results of laboratory analysis for total metals are summarized as follows:

- All metals were below their respective CCME long term marine water quality guideline, where a guideline exists.
- Antimony, beryllium, bismuth, boron, cobalt, selenium, silicon, sliver, thallium, tin, titanium, zinc and zirconium were below Reportable Detection Limit (RDL) in all samples and therefore lower than the CCME long term marine water quality guideline, where a guideline exists.
- Aluminum was present above respective RDLs in all samples and was consistent across locations and depths.

- Arsenic, barium, calcium, magnesium, molybdenum, nickel, potassium, strontium, and uranium were above RDL in all samples. The concentrations of these metals were consistent across locations and depths.
- Cadmium was above RDL in one sample only (GF-3 deep; 0.060 µg/L).
- Chromium was above RDL in two samples (GF-1 shallow; 0.66 µg/L and GF-3 deep; 0.62 µg/L).
- Copper was above RDL in three samples, all shallow water locations (GF-1; 1.27 µg/L, GF-3; 1.00 µg/L and GF-6; 1.66 µg/L).
- Iron was above RDL in five of eight samples: GF-1 shallow, GF-5 shallow, GF-2 deep, GF-3 shallow and GF-6 shallow. These samples ranged from 14 µg/L to 25 µg/L of iron. Manganese was also above the RDL in the same samples as iron, and those samples ranged from 0.77 µg/L to 1.53 µg/L.
- Lead was above RDL in four samples and ranged from 0.11 µg/L. to 1.36 µg/L.

5.2.5.4 Dissolved Metals

Results of laboratory analysis for dissolved metals are summarized as follows:

- All dissolved metals were below their respective CCME long term marine water quality guideline, where a guideline exists.
- Antimony, beryllium, bismuth, boron, lithium, selenium, silicon, silver, thallium, titanium and zirconium were all below RDL in all samples.
- Aluminium and arsenic were both above respective RDLs in all samples. Concentrations were relatively consistent across depth and sample locations.
- Barium, calcium, magnesium, molybdenum, nickel, potassium, strontium, and uranium were above RDL in all samples. The concentrations of these metals were consistent across locations and depths.
- Cadmium was above the RDL in four of eight samples. These concentrations ranged from 0.066 µg/L. to 1.129 µg/L.
- Chromium was above the RDL in two samples (GF-1 shallow; 0.82 0.13 µg/L and GF-6 shallow; 0.51 µg/L).
- Cobalt was above RDL in one sample only (GF-1 shallow; 0.13 µg/L.). Lead was also found to be above the RDL at only this location (0.36 µg/L.).
- Copper was above the RDLs in one sample (GF-1 shallow; 0.61 µg/L).
- Iron was above the RDL in one sample (GF-5 shallow; 41 µg/L).
- Manganese was above the RDL in five of eight samples. These samples ranged from 0.66 µg/L. to 2.32 µg/L.
- Tin was above the RDL in one sample (GF-1 deep; 1.7 µg/L).
- Vanadium was equal to the RDL in three samples (GF-1 shallow, GF-2 deep and GF-3 shallow). Zinc was above the RDL in two samples, both shallow water (GF-1; 9.7 µg/L and GF-6; 6.0 µg/L).

5.2.6 Data Validation

5.2.6.1 Laboratory Accuracy and Precision

Bureau Veritas (BV) incorporated a range of QA/QC methodologies to ensure accuracy and precision of data. The results of the QA/QC completed are detailed below.

5.2.6.1.1 Laboratory Methodology Blanks

An assessment of laboratory blank samples reported by BV demonstrates concentrations below the RDL for most parameters, so cross-contamination of samples does not appear to have occurred.

5.2.6.1.2 Laboratory Duplicates

Canadian Council of Ministers of the Environment recommends that laboratory duplicate samples should be within a Relative Percent Difference (RPD) of ±20 % for metals and nutrients and ±0.3 pH units for pH (CCME, 2016).

Review of BV QC results shows all RPDs to be within acceptable limits.

5.2.6.1.3 Matrix Spikes

To verify that the physical properties or characteristics of the matrix do not interfere with the analytical result, a known concentration of the chemical of interest is mixed into a sample of the required matrix. Matrix spikes measure the analytical methodology's performance on a specific matrix type. CCME (2016) states that recovery limits of 70 % to 130 % for metals.

Review of BV QC results identified that all matrix spike recovery met the acceptability criteria for all metals except total molybdenum (126 %), total tin (135 %) and total ammonia (62 %). Dissolved mercury also did not meet the acceptability criteria (78 %). These values were only marginally above and below the recovery limits and are likely due to missing holding times.

5.2.6.2 Field Blank

A field blank is a distilled water sample that is processed in the field in the same manner as the seawater samples. The purpose of the field blank is to confirm cross contamination from field conditions did not occur. Review of the field blank data showed an exceedance of pH criteria and was above the RDL for several dissolved metals. The field blank result would require further analysis to confirm if an error occurred in either the field sapling or lab analysis.

5.2.6.3 Field Duplicate Analysis

Field duplicates are samples that are split from the original sample. These QC samples identify variation associated with sub-sample handling and repeatability of laboratory analysis. There was no field duplicate collected for Grise Fiord, as duplicate collection was considered from a program perspective for all four harbours.

5.2.6.4 Holding Times

All water samples that required refrigeration were stored in coolers and then transported to the laboratory chilled, where samples were stored under refrigeration until analyzed.

Samples were within laboratory holding times standards. Standard methodology for pH analysis state that pH should be analyzed within 15 minutes of sampling, and therefore, generally is measured in the field. Therefore, analysis of pH was completed outside of standard holding times. A summary is provided in Table 5-2.

Table 5-2: Grise Fiord Marine Water Quality Holding Times

Parameter	Date			Number of Days Passed	Recommended Holding Time (days)
	Sample Taken	Sample Delivered	Sample Analyzed		
Mercury (dissolved)	16-Aug-19	03-Sept-19	12-Sept-19	27	28
Mercury (total)					28
Total Organic Carbon					28
Total Metals			11-Sept-19	26	180

5.3 Discussion

Marine water quality in Grise Fiord was relatively consistent across sites and depth profiles.

Metal concentrations were below respective (CCME, 2024) guidelines, for all locations except for GF-3 deep, where dissolved cadmium was marginally above CCME guidelines.

Across all sample location, dissolved metal concentrations generally were comparable to total concentrations, indicating that metals typically are not bound to solids. pH, hardness, alkalinity, TOC, Total Suspended Solids (TSS), sulphur and metal concentrations were consistent across shallow and deep samples.

6 Fish and Marine Mammals

The coastal marine environment of the Arctic Ocean surrounding Nunavut represents an important ecosystem for fish and marine mammals. Intertidal areas are inaccessible throughout periods of the year when the ocean is frozen and, along with shallow subtidal areas, are impacted by seasonal ice scouring. Changing seasons and ice movement play an important role in the distribution of marine mammals. These variables have led to uniquely adapted species that have tolerance for extreme climatic regimes (Lindgren *et al.*, 2016). It also represents an important socio-economic function for the Inuit who are dependent on fish and marine mammals for subsistence harvesting.

Program objectives for fish and fish habitat are provided in Section 1.5, Table 1-5.

6.1 Fish and Marine Mammal Focal Species and Species Categories

Focal fish and marine mammal species were selected based on several variables which included: their importance to Inuit for subsistence and food security, their geographic ranges which includes the potential to occur in the Project Study Area, and for their representative role in food chain dynamics. Each species was then further categorized based on their use of the habitat (e.g. migratory, resident) to understand their potential for occurrence within the Project Study Area.

The IQ workshop (see Section 2) provided valuable insight and local knowledge into the seasonality, distributions and habitat use of marine species in Grise Fiord. Species identified as focal are listed in Table 6-1. The Marine Corridors relevant to water bodies for migratory organisms is provided in Figure 1-2. See Table 3-2 for species designations and probability of occurrence with the Project Study Area and Marine Corridors. Species categories were defined to represent the extent to which the marine species migrate and whether they are permanent residents of Arctic waters.

6.1.1 Fish

Marine fish species that are found in the Arctic occupy the ocean either as residents, migratory species, or anadromous, as defined below:

- Migratory: species that migrate exclusively in the marine environment on an annual or seasonal basis, triggered by local climate, food availability, or for mating reasons.
- Resident: species that occupy the same general area throughout the year.
- Anadromous: species that move between freshwater and marine environments for the purposes of feeding in one environment and spawning.

6.1.2 Marine Mammals

Marine mammals that are found in the Arctic were categorized as either Arctic Residents or Seasonal Visitors, as defined below:

- **Arctic Resident:** species that reside in the Arctic year-round.
- **Seasonal Visitor:** species that predictably reside within the Arctic region for a portion of the year, most typically the open-water season.

Table 6-1: Occurrence of Focal Species

Species Type	Species (Common Name)	Species (Latin Name)	Species Spatial Category	Type	Seasonal Occurrence	Report Section
Fish	Amphipod	*Gammarus sp.*	Resident	Benthic invertebrate	Year-round	6.3.1
	Arctic char	*Salvelinus alpinus*	Anadromous	Pelagic fish	Year-round	6.3.2
	Arctic cod	*Boreogadus saida*	Migratory	Pelagic fish	Year-round	6.3.3
	Arctic sculpin	*Myoxocephalus scorpius* (shorthorn) *Gymnocanthus tricuspis* (Arctic staghorn)	Resident	Bottom dwelling fish	Year-round	6.3.4
	Truncate softshell clam	*Mya truncata*	Resident	Benthic invertebrate	Year-round	6.3.5
Marine Mammal	Atlantic walrus	*Odobenus rosmarus ssp. rosmarus*	Resident	Pinniped	Summer, Fall	6.4.1
	Bearded seal	*Erignathus barbatus ssp. barbatus*	Resident	Pinniped	Year-round	6.4.2
	Beluga whale	*Delphinapterus leucas*	Resident	Cetacean	Spring, Summer, Fall	6.4.3
	Bowhead whale	*Balaena mysticetus*	Resident	Cetacean	Summer	6.4.4
	Harp seal	*Pagophilus groenlandicus*	Visitor	Pinniped	Summer, Fall, Other seasons indicated by harvest data	6.4.5
	Hooded Seal	*Cystophora cristata*	Visitor	Pinniped	Summer, Fall. Spring and Winter ice dependent	6.4.6
	Killer whale	*Orcinus orca*	Visitor	Cetacean	Spring, Summer, Fall	6.4.7
	Narwhal	*Monodon monoceros*	Resident	Cetacean	Summer	6.4.8
	Polar bear	*Ursus maritimus*	Resident	Ursid/Fissiped	Spring, Summer, Fall	6.4.9

Species Type	Species (Common Name)	Species (Latin Name)	Species Spatial Category	Type	Seasonal Occurrence	Report Section
	Ringed seal	*Pusa hispida ssp. hispida*	Resident	Pinniped	Year-round	6.4.10

6.2 Resource Harvesting

The Inuit have a strong connection to the land and sea through resource harvesting and other cultural practices and are an integral part of the Arctic ecosystem (see Figure 6-1 for generalized diagram). Traditional resources, frequently termed as 'country foods' are critical to health of the people of Nunavut (Nunavummiut) (Wenzel *et al*., 2016). Inuit have a unique depth of knowledge of the abundance and distribution of marine and terrestrial species and rely on access to the land and water during all seasons for the acquisition of country foods. The transitions between seasons and ocean state conditions (e.g., iced, open-water) is displayed in Figure 4-7 and the Marine Corridors are depicted in Figure 1-2 and described in Section 4.3.

Inuit are dependent on access to country foods, and as a result, there is a close alignment between the management of marine resources in Nunavut and a co-management approach with the inclusion of IQ. This relationship between Inuit harvesters and resources is a significant consideration in the selection of 'focal species' and assessment of existing conditions in Arctic environments for this ESEB Report.

QIA (2018a) converted country foods into a monetary value, where the value of Arctic char country foods fishery for a study which involved six communities (Grise Fiord, Arctic Bay, Pond Inlet, Clyde River, Qikiqtaarjuak, Pangnirtung), provided a substitution value of $1,120,755. Arctic char represent the second-most widely consumed country food (Hurtubise, 2016b). As of 2024, Arctic char market value within Nunavut is $7.2 million per year (Harris L. *et al.*, 2022).

Arctic communities such as Grise Fiord rely heavily on country foods, and the communities recognize the important of productive and responsible land use (NPC, 2023b). With changes in climate comes reductions in wildlife population size in conjunction with longer periods of open seaways (NPC, 2023b).

The NWHS, which was mandated by the NLCA and carried out under the direction of the NWMB, was carried out from June 1996 to May 2001, and documented monthly harvest data from Inuit Harvesters in Nunavut Communities. Summary data from the five-year study specific to Grise Fiord is provided in Table 6-2. North Baffin seasonal harvesting cycles are also depicted in Figure 3[20] of the NBRLUP (NPC, 2000).

Table 6-2: Harvest and Hunter Estimates

Species	Harvest Five Year Mean	Total Number of Harvesters
Arctic char*	488	51
Arctic Cod*	108	13
Arctic Hare	28	22
Arctic Sculpin*	43	17

[20] See Figure 3 (p. 20) for a depiction of the North Baffin harvesting cycles https://www.nunavut.ca/sites/default/files/north_baffin_regional_land_use_plan.pdf

Species	Harvest Five Year Mean	Total Number of Harvesters
Atlantic walrus*	7	12
Bearded seal*	20	35
Beluga whale*	8	24
Brant Goose	1	2
Canada Goose	9	2
Caribou	41	18
Clam*	30	3
Eider Duck	18	13
Harp seal*	46	35
Muskox	7	11
Narwhal*	5	17
Old Squaw	<1	1
Polar bear*	19	n/d
Ptarmigan	277	36
Wolf	1	4
Red-throated Loon	<1	1
Ringed seal*	653	54
Snow goose	26	19
Thick-billed murre	<1	1

Source: Table 79 and 102 in Priest and Usher (2004)
Note: Species with * are focal species identified for the Project

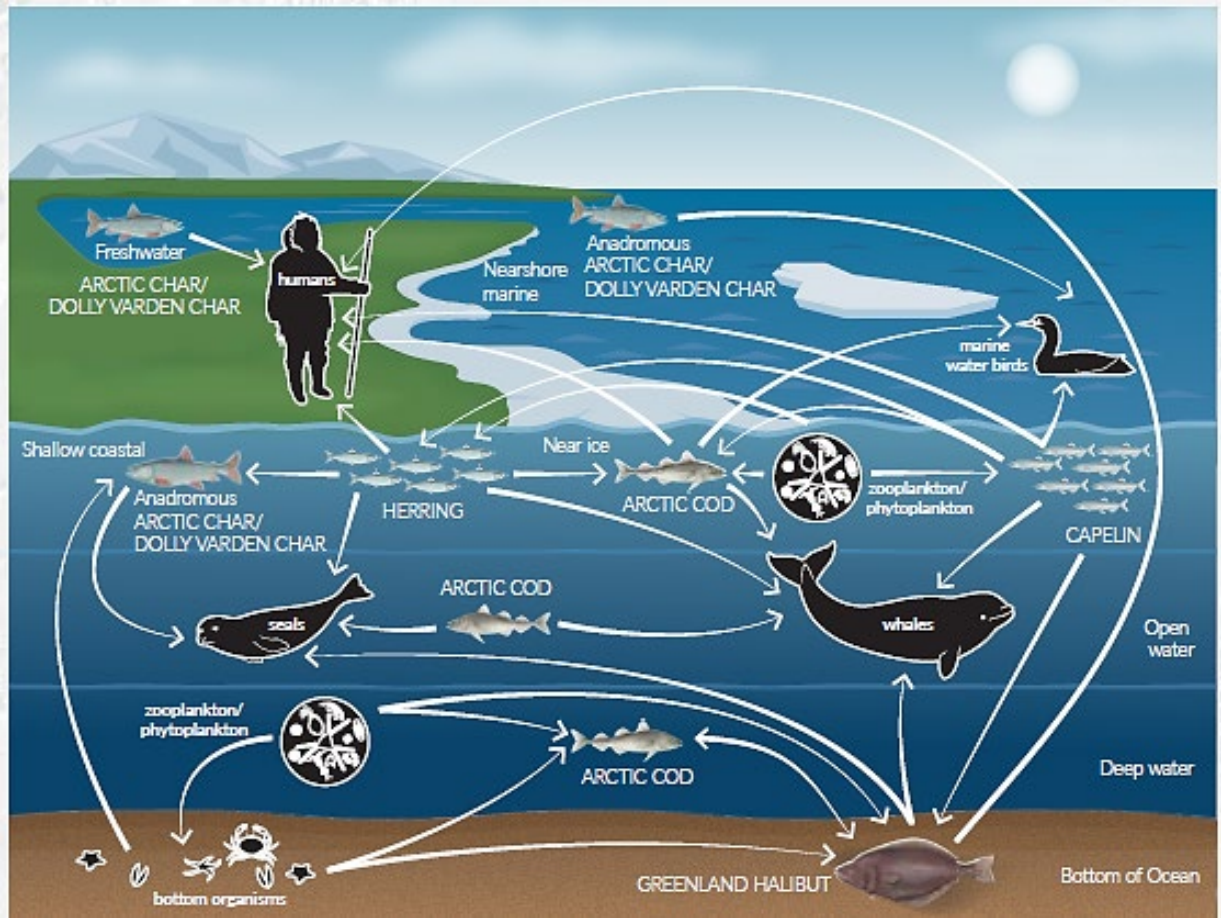


Figure 6-1: Ecosystem Connectivity in Nunavut

Source: Oceans North Conservation Society *et al.* (2018)

6.2.1 Food Chain Dynamics

Understanding food chain dynamics requires an assessment of carbon transfer through different trophic levels. Carbon-based fats are transferred to animals from the bottom of the food chain (e.g., phytoplankton) to the top (e.g. polar bear) (CIRES CEEE, 2021; Rapinski *et al.*, 2018). In Arctic ecosystems, there are several key species/organism types that can store large amounts of energy as lipids, an energy resource crucial for many large vertebrate species and Inuit.

Phytoplankton, often referred to as primary producers, build the base of the food chain. This group contains bacteria, algae and marine plants (Darnis *et al.*, 2012; Graeve *et al.*, 2016) able to store atmospheric and/or aqueous carbon dioxide (CO_2) in form of organic compounds, which then can be transported as energy-rich lipids up the food chain (Graeve *et al.*, 2016). Organisms preying on phytoplankton are known as zooplankton. One of the most common and important zooplankton groups are copepods (e.g. small crustaceans) belonging to the genus *Calanus* (Tarling *et al.*, 2022), which includes two species typical for the Arctic (*C. glacialis* and *C. hyperboreus*) and one species (*C.*

finmarchicus) that has recently been observed to start moving northwards (Wassmann *et al.*, 2020). These larger copepods are able to build up huge lipid reserves, reaching up to 60 % of their dry mass, over the duration of a few weeks by feeding intensively on phytoplankton. Therefore, energy stored within *Calanus* species are key for the energy transfer up the Arctic food chain (Darnis *et al.*, 2012). During the iced season, plankton contribute to carbon cycling in the deep ocean through respiration and mortality at depth (Darnis *et al.*, 2012). Since plankton are a common prey for marine mammals, birds and fish (Tarling *et al.*, 2022), these organisms represent a critical link connecting primary producing microalgae and meso-predators (Graeve *et al.*, 2016). Bowhead whales consume large amounts of zooplankton and are believed to prey on pelagic and epibenthic species during summer and fall (Finley, 2001; Lowry *et al.*, 2004; Pomerleau *et al.*, 2011), while calanoid copepods represent the primary prey species during winter and spring (Heide-Jørgensen *et al.*, 2012; Laidre *et al.*, 2007).

Anadromous Arctic char (*Salvelinus alpinus*) and Arctic cod (*Boreogadus saida*) are considered key species in the Arctic marine ecosystem. Both play a crucial role in transferring energy to higher tropic levels including Arctic fish, birds, and mammals (Ivanova *et al.*, 2020; Welch *et al.*, 1993). Arctic char is a highly valued fish species to the people of Nunavut for subsistence and commercial fisheries (Galappaththi *et al.*, 2022; Roux *et al.*, 2011), whereas Arctic cod, though less valuable for subsistence harvests, is rich in fat and believed to be the source of up to 75 % of energy transfer in Arctic food webs (Oceans North Conservation Society *et al.*, 2018). Arctic cod are hypothesized to be the primary consumer of Arctic copepods (Darnis *et al.*, 2012), while in turn, represent a main prey species for numerous high trophic level species such ringed seal (*Pusa hispida ssp. hispida)*, narwhal (*Monodon monoceros)*, beluga whale (*Delphinapterus leucas*) and various seabirds (Gaston *et al.*, 2012; Welch *et al.*, 1993), most of which play an important role in the annual subsistence hunt by Inuit (GN, 2018b).

Polar bears are considered the apex predator within the Arctic and are highly dependent on the intake of these energy resources when preying on seals, beluga and narwhal, among others. As climate change is causing warmer sea surface temperatures, smaller and less energy-rich copepods are hypothesized to be better adapted to the new conditions of the Arctic, consequently resulting in a shift within the zooplankton community, with an increase in smaller plankton species (Li *et al*., 2009). The magnitude of such a shift and its significance for marine mammals and predatory fish is unknown (Darnis *et al*., 2012), raising further concern about the effects this will have on the usually nutritious and omega-3-rich subsistence food consumed by Inuit.

6.2.2 Fishery Management Structure

Fisheries in Nunavut occur as traditional food (subsistence), commercial (inshore traditional and offshore non traditional), and recreational fisheries (Boudreau & Fanning, 2016; Nunatsiaq News, 2018). Nunavut's first 'Nunavut Fishery Strategy' (NFS) published in 2005 and a second publication in 2016 (GN, 2016a). The intention of the NFS was to identify development potential of Nunavut fisheries in the commercial sector. Commercial and subsistence fisheries are managed collaboratively under the *Nunavut Agreement* (Boudreau & Fanning, 2016; Kristofferson & Berkes, 2005). Management of fisheries by the *Nunavut Agreement* is accomplished with a co-management approach that includes: the NWMB, Nunavut Tunngavik Incorporated (NTI), GN, DFO, Regional Wildlife Organizations (RWOs), and Hunters and Trappers Organization/Association (HTOs/HTAs) (DFO, 2018b; GN, 2016a) (see depiction in Figure 6-2). While the Nunavut Agreement came into effect in 1993 and Nunavut was established in 1999,

Nunavut fisheries are managed under the Northwest Territories Fishery Regulations (DFO, 2024a; Government of Canada, 2019a). Nunavut Fishery Regulations are being developed cooperatively between DFO, NTI, NWMB, the GN and the Makivik Corporation. A consultation period ran from February 11 2018 to July 31 2019 (Government of Canada, 2019a). Initial stages of the Forward Regulatory Plan (FRP) for a draft policy proposal and pre-publication of the regulatory proposal of Nunavut Fishery Regulations began during the 2024-2026 planning period (DFO, 2024d).

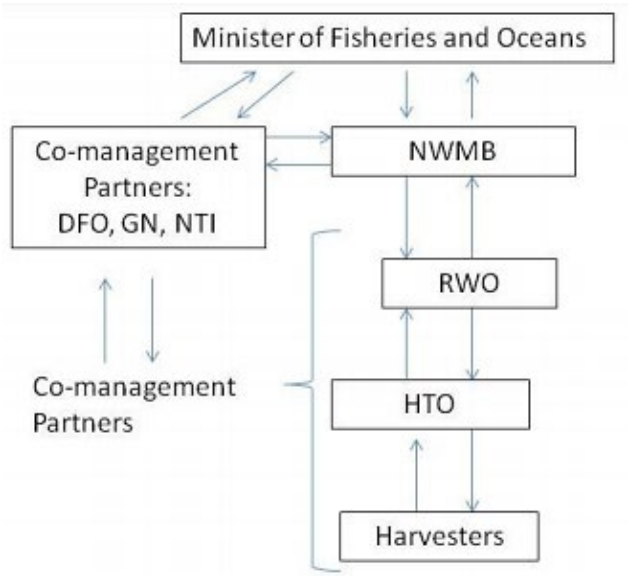


Figure 6-2: Governance of Fisheries in Nunavut

Source: Figure 3 of Boudreau and Fanning (2016)
Note: DFO = Fisheries and Oceans Canada; GN = Government of Nunavut; NTI = Nunavut Tunngavik Incorporated; NWMB = Nunavut Wildlife Management Board; RWO = Regional Wildlife Organizations; HTO = Hunters and Trappers Organization

The NTI is the primary Designated Inuit Organization (DIO) under the *Nunavut Agreement* and is responsible for confirming that Inuit rights and obligations are being met (DFO, 2013b). Regulated fisheries are governed by the *Fisheries Act* and in accordance with the Fishery (General) Regulations and the Marine Mammal Regulations (MMR). When either of these acts and regulations are inconsistent with the *Nunavut Agreement*, the latter shall prevail (DFO, 2013b).

Integrated Fisheries Management Plans are developed by DFO for harvested species to provide a planning framework for the conservation and sustainable use of fisheries resources (DFO, 2013c). IFMPs exist for the following Arctic species:

- Arctic char commercial Cambridge Bay fishery (DFO, 2018a) - no subsistence fishery component.

- Atlantic seal IFMP 21 (DFO, 2011b) - targets the commercial, but not the subsistence harvest of all seals in Atlantic Canada.
- Narwhal (DFO, 2013b).
- Atlantic walrus (*Odobenus rosmarus ssp. rosmarus*) (DFO, 2018b).
- Greenland Halibut (*Reinhardtius hippoglossoides*) Northwest Atlantic Fisheries Organization Subarea 0 (DFO, 2019d).
- Northern shrimp (*Pandalus borealis*) and striped shrimp (*Pandalus montagui*) – Shrimp fishing areas 0, 1, 4-7, the Eastern and Western Assessment Zones and the North Atlantic Fisheries Organization (NAFO) Division 3M (DFO, 2018d).

The Bering-Chukchi-Beaufort population of Bowhead Whale (*Balaena mysticetus*) was listed under SARA in 2007, and the SARA management plan was published in 2014 (DFO, 2014b, 2022c). Section 72 of SARA requires a progress report every five-years until the management plan objectives are met. From 2014 to 2019 conservation actions for habitat protection, research of threat evaluation and mitigation, monitoring and assessment, and outreach and communication were established and are currently ongoing (DFO, 2022c).

Table 6-3: Fishery Management Measures in Nunavut

Species Group	Detail
Fish, Invertebrates	There are generally no restrictions on fish or invertebrates for subsistence harvesting in Nunavut; however, harvesting of Arctic char is reported to DFO through the HTA.
Marine Mammals	Harvesting regulations are identified in the MMR (beluga whale: S20, bowhead whale: S22, narwhal: S23, walrus: S2, seals: S26). Quotas are further discussed in the respective species sections (beluga whale: Section 6.4.3, narwhal: Section 6.4.7, bowhead whale: Section 6.4.4 , and walrus: Section 6.4.1).
Seals	Commercial and subsistence harvesting of seals is managed under three management areas, with Nunavut encompassed in the Arctic Region (Sealing Areas 1-3). See Figure 2 in Library of Parliament (2017). Harbour (*Phoca vitulina*), hooded (*Cystophora cristata)*, bearded (*Erignathus barbatus ssp. Barbatus)*, and ringed seal are not harvested commercially, but harvests do exist for subsistence fisheries in Nunavut, with ringed seals being the most preferred (NPC, 2012).
Polar Bear	A Polar Bear Co-Management Plan has been developed for Nunavut by the NWMB and ECCC to address subsistence harvesting of this species (GN, 2019a). ECCC has not yet developed a national polar bear management plan

21 The IFMP covers six species of seals: harp, hooded, grey, ringed, bearded and harbour, with the majority of commercial harvest being the harp seal.

Species Group	Detail
	under the *Species at Risk Act* at the time of this report (Government of Canada, 2021b). However, when published it is expected to include: • Federal addition (Part 1). • Compendium of jurisdictional management plans and recovery strategies (Parts 2 to 7).

6.2.2.1 Commercial Fisheries

Commercial fisheries in Nunavut are considered as offshore and inshore fisheries, with offshore targeting Greenland halibut and northern shrimp, and the inshore targeting Arctic char and Greenland halibut. The potential for clams, scallops and crab are being explored (Nunavut Marine Council, 2019). The Hamlet of Resolute Bay is a co-owner of the Arctic Fishery Alliance (AFA) (AFA, 2018).

For the offshore fishery, there are four Nunavut-based companies that participate directly in the offshore fishery: Qikiqtaaluk Fisheries Corporation (QFC), Baffin Fisheries (BF), Cumberland Sound Fisheries Ltd. (CSFL) and the AFA. QFC is a subsidiary of the Qikiqtaaluk Corporation (QCorp), which is a for-profit arm of the QIA (Bernauer, 2022). There is also interest in developing marine infrastructure in Nunavut, for the landing, processing and shipping of fish products; however, currently all offshore fish caught in Nunavut waters are processed in Greenland or Atlantic Canada.

The inshore commercial fishery is currently exclusive to Arctic char, with the exception of Pangnirtung which has both an Arctic char and turbot fishery. Fish that are processed in the Kivalliq (Rankin Inlet, Chesterfield Inlet, Whale Cove) and Qikiqtani (Pangnirtung) Regions (Bernauer, 2022). The potential for several invertebrate species is being explored (Nunavut Marine Council, 2019) and is further described in Section 7.2.2.2.

Although the *Nunavut Agreement* came into effect in 1993 and Nunavut was established in 1999, Nunavut fisheries are still managed under the Northwest Territories Fishery Regulations (DFO, 2019b, 2024a). Nunavut Fishery Regulations (NFR) are being developed cooperatively between DFO, NTI, NWMB, the GN and the Makivik Corporation (representation for Nunavik Inuit interests; (DFO, 2019b). A consultation period was run from February 11, 2018 to July 31, 2019 (DFO, 2019b), where the goal was to obtain feedback on how to meet the key objectives of the NFR as listed below:

- Recognize the existing responsibilities and authorities for fisheries management in Nunavut.
- Recognize Inuit harvesting rights.
- Support the implementation of the fisheries (wildlife) management provisions of the *Nunavut Agreement.*
- Ensure the sustainability of fish stocks and fisheries.
- Support and preserve access to markets for Nunavut fish products.

The NFR is a co-development with NTI, GN, Nunavut Wildlfe Management board, and Makivik Coporation representing Nunavik Inuit interests (DFO, 2024d). A 2019 DFO information release states the spatial scope of the NFR includes the NSA, the Nunavik Marine Region, Hudson Bay and James Bay (DFO, 2019g). From 2019 to 2022 Arctic char harvested increased by 10,000 kg and the total landed value was $624,000 by the end of 2022 (DFO, 2024e). The GN developed a Fisheries and Sealing Division Strategic Plan for the five-year period of 2023-2028, prioritising offshore fishery through advocacy in quota and license allocations, research in offshore stocks, advocacy of sustainable emerging fisheries, and development of a deep-sea port (GN, 2023b).

6.2.2.2 Exploratory Commercial Fishery Interests

Exploratory fisheries occur in lakes and rivers that have never been fished before with the purpose of stock assessment and future commercial fisheries (DFO, 2004). Exploratory fishing licenses are issued by DFO, but approved by the NWMB (GN, 2016a). Prior to submission, applications must be approved by the local HTOs/HTAs (Boudreau & Fanning, 2016). Licenses are issued over a five-year period and the total harvest for each year is used to assess the efficacy of a commercial fishery both from a stock size and financial viability perspective (DFO, 2019f). As of 2018, Canadian North Economic Development Agency (CanNor) investments have expanded fisheries quotas and industry developments from exploratory fisheries research (Government of Canada, 2018b). In 2022 Northern Affairs began a $2.4 million investment into three Nunavut fisheries projects (Government of Canada, 2022a). The three areas are fisheries research to support industry development, advancement of fisheries and sealing economies, and training consortium for fisheries and marine.

The region of Qikiqtani includes Resolute Bay and encompasses 10 percent of Canada's landmass. Qikiqtaaluk Corporation (QC) conducted ghost fishing detection, seabed and habitat classification, environmental monitoring, and scientific research to strengthen the socio-economic health of the Qikiqtani region (Qikiqtaaluk Corporation, 2022).

The AFA have a vessel (Kiviuq 1) used for exploratory fisheries (AFA, 2018) which in recent years has regularly been in the High Arctic Waters, including Parry Sound seeking opportunities for commercial harvests for Greenland halibut and shrimp (Navigator, 2015). The AFA works with Memorial University of Newfoundland (MUN) on this endeavor. An exploratory license was first requested from DFO in 2008 by the HTAs of Grise Fiord, Arctic Bay and Resolute Bay for inshore fishing in Jones Sound, Admiralty Inlet, and Parry Sound, respectively (DFO, 2008). An exploratory fishery study in the open-water season of 2014 was supposed to include Resolute Bay, however the Kiviuq 1 had to detour to Greenland for fuel, and the six day delay resulted in ice conditions that made Resolute Bay inaccessible (Nunatsiaq News, 2014). Resolute Bay was part of study in the open-water season of 2015 that also included Arctic Bay and Qikiqtarjuaq (Cision, 2016). This study was partially funded by the federal Department of Innovation, Science and Economic Development, who provided $1.2M to study fisheries data gathered in the Eastern and High Arctic. As quoted by then Minister Honourable Navdeep Bains, "The Government of Canada is committed to economic development and diversification in the North. The research from this Project has the potential to help Inuit-owned businesses expand and innovate, and could lead to high quality jobs for Inuit." (Cision, 2016). The partners in the funding include: CanNor, the AFA, the GN-EDT and GN-DoE, the National Research Council (NRC), Oceans North, and the Ocean Tracking Network (OTN) (Cision, 2016).

The goal of the research was to examine the commercial value of Greenland halibut, shrimp and whelk (Cision, 2016; Navigator, 2015).

6.2.2.3 Subsistence Fisheries

Subsistence harvesting in Nunavut is intrinsic to the Inuit way of life.

Inuit harvesting rights are described in Part 6 of the *Nunavut Act*, where species may be restricted by a Total Allowable Harvest (TAH). For species without a TAH restriction, the species can be harvested by an Inuk 'to the full level of his or her economic, social, and cultural needs, subject to the terms of this Article" (S.5.6.1 Nunavut Agreement). For species that have a TAH restriction and are also a commercially harvested species, a Basic Needs Level (BNL) for Inuit is established (NWMB, 2019). When the BNL is less than the TAH, the NWMB will determine commercial allocations. The allocation and enforcement of the BNL is the responsibility of respective HTAs and RWOs (Nunavut Agreement S.5.7.3[b], 5.7.6[b]). BNLs do not exist for most species, but have been determined for narwhal, walrus, beluga and bowhead whales (Boudreau & Fanning, 2016). Implementation of fisheries regulations can be dependent on the migratory nature of the species. For example, allocation of tags for narwhal is through the RWOs and the HTAs to develop local hunting rules whereas Arctic char management can be implemented by the HTAs as stocks are more local (Boudreau & Fanning, 2016).

Subsistence harvesting of seals provides many resources for Inuit and is a significant part of their lifestyle and culture. Passing on the skill of hunting and knowledge of the environment is crucial for intergenerational links (Wenzel, 1983). Hunters will harvest seals by the traditional methods of lair breaking or using a needle technique, or by the modern methods of approaching basking seals or seal breathing holes (Furgal *et al.*, 2002). Bearded (*Erignathus barbatus ssp. barbatus*), harp (*Pagophilus groenlandicus*), hooded (*Cystophora cristata*), and ringed (*Pusa hispida ssp. hispida*) seals are all targets of subsistence hunts in Nunavut. Seal hunting occurs year-round with harvesters hunting seals in both open-water and iced ocean conditions. In the iced season, Inuit exclusively hunt ringed and bearded seals, with the largest harvests occurring in the Hudson Strait, Foxe Basin and the eastern region of Hudson Bay (Hurtubise, 2016b).

Cetaceans are not harvested commercially in Nunavut, but most species are harvested for subsistence purposes. Inuit hunters will harvest whales close to the shore by methods using harpoons from a boat (Tyrrell, 2007). Hunters may herd whales to shallow waters where the whales will be more easily harpooned (Tyrrell, 2007). Another method of harvesting whales is by use of whale nets (Tyrrell, 2007). Based on the location, hunting rifles may be used instead of harpoons (Tyrrell, 2007). Most species of whale that are present in Nunavut are harvested for subsistence purposes and generally fall under the BNL system with harvesting limitations. The exception to this is the killer whale (*Orcinus orca*) which is generally not harvested by Inuit of Nunavut (Westdal *et al.*, 2013).

The Community Based Monitoring Network (CBMN) developed by the NWMB is an important tool to identify species harvested by communities. The most frequently documented species by harvesters in 2021 included ringed seal, narwhal, beluga, walrus, shellfish and fishes (CBMN & NWMB, 2021). As per Priest and Usher (2004), the top marine species for the total number of harvesters hunting them over the five-year period (1996 to 2001) were ringed seal, Arctic char, beluga, and bearded seal (see Table 6-2).

Specific information on species, when available, is summarized in the respective components of Sections 6.3, 6.4.

6.3 Fish

Focal fish species were selected based on those that are important to ecosystem and to the Inuit for harvesting as identified through the Project-specific IQ (see Section 2.3 for methodology), online IQ, and published literature. Species identified as focal were Amphipod, Arctic char, Arctic cod, Arctic sculpin (*Myoxacephalius spp.*) and Truncate softshell clam (*Mya truncata).*

Fish species SAR status is listed in Table 3-1 for each species.

6.3.1 Amphipod

The amphipod is an Arctic resident and is referred to by Inuit as 'Kingu' (Inuktut Tusaalanga & GN, 2024).

6.3.1.1 Biogeographic Distribution

Amphipods are a group (order Amphipoda) of crustaceans. They are common throughout the Arctic in both benthic and pelagic environments, with many species being endemic to the Arctic. Generally, the *Gammaridae* family dominates benthic species, and *Hyperiidae* dominates pelagic species (Oceans North Conservation Society *et al.*, 2018). Amphipods are a key link in the Arctic food web and are a significant food source for marine fish, mammals and bird (Coad & Reist, 2017; Oceans North Conservation Society *et al.*, 2018).

Amphipod species can be found in a diverse range of habitats, including the sea floor, open-water environments, and beneath the sea ice in coastal and offshore areas (Conover, 1988; Gradinger & Bluhm, 2004, 2010; Siferd, 2010). Benthic (bottom-dwelling) amphipods occupy a variety of substrates such as rocky intertidal and soft-bottomed subtidal areas. When amphipods are present in intertidal environments, there is a tendency to be associated with moist habitats, as amphipods appear to prefer areas that stay moist in out-of-water tidal conditions or in small tide pools that remain inundated (pers. obs. Victoria Burdett-Coutts). Except for tube-building amphipods, amphipods are generally not present when there are silty or muddy habitats (Conlan *et al.*, 2019). Like most marine species, the distribution of Arctic amphipods is primarily guided by habitat type and available food resources (Oceans North Conservation Society *et al.*, 2018).

A systematic search of peer-reviewed literature within the Web of Science Core collection was conducted on July 23, 2024, with results of published literature on amphipods in Nunavut summarized in Appendix C (Table C-2) (Web of Science, 2022). Furthermore, amphipod collection was part of the Field Program in 2024, to assess the abundance and species assemblage on amphipods in Grise Fiord (see Section 7.1.3 and 7.4.5).

6.3.1.2 Ecology and Reproductive Behaviour

Arctic amphipods tend to be larger than those in lower latitudes, on average 20 mm and can range up to 50 mm in length. There are over 900 known species of benthic amphipod in the Arctic (Census of Marine Life, 2017), and it is thought that benthic diversity is higher than pelagic diversity (Tempestini *et al.*,

2018). Most known benthic amphipod species have multi-year lifespans (on average two and up to five-years depending on the species). All amphipods are sexually dimorphic, and eggs are incubated in the female's brooding pouch. Upon hatching, juveniles often linger in the female's brooding pouch for a few days before being released (Chang, 1972).

Amphipods utilize a variety of habitats. The adaptability of amphipods to diverse habitats likely emerges from opportunistic feeding strategies; many benthic amphipods are detritivores. Large food falls (e.g. sinking of deceased megafauna such as beluga whales, bowhead whales, and ringed seals) attracting aggregations of benthic amphipods within minutes (Soltwedel *et al.*, 2017).

Seasonality plays a large role in determining diet composition in some amphipod species. *Onisimus litoralis* primarily consumes benthic detritus early in the year then shifts to sea ice-associated diatoms (microalgae) during and after the onset of ice melt in the spring (Gradinger & Bluhm, 2010). An exception to the observation that many amphipods are habitat generalists is tube-building *ampeliscid* amphipods. Species such as *Haploops* spp., *Ampeliscus* spp., and *Byplis* spp. live their entire lives in tubes built from fine sediments and consume diatoms, detritus, and microorganisms through suspension feeding (Conlan *et al.*, 2019). Most benthic amphipods may occupy a range of depths, including shallow, nearshore areas fewer than 5 m, to deep sea floor environments upwards of 500 m deep (Conlan *et al.*, 2019; Cusson *et al.*, 2007).

Some amphipod species found in Nunavut are carnivorous, including *Themisto libellula*, which has been observed in both surface and benthic environments, and consumes *calanoid* copepods (Hobson *et al.*, 2002), a key trophic link in Arctic food webs (Dunbar, 1957).

In shallow, nearshore areas across the Arctic much of the food web energy is derived from benthic environments. Ampeliscid (tube-building amphipods), most commonly *Ampeliscus eschricti*, have a widespread geographic distribution and are a main food source for grey whales (*Eschrictius robustus*) during their residence in the Arctic (Demchenko *et al.*, 2016). In Grise Fiord, *Themisto libellula* was the dominant prey type of immature ringed seals (Holst *et al.*, 2006).

6.3.1.3 Harvesting

There is no evidence that amphipods are directly harvested for consumption in the Arctic. During the December 2024 IQ workshop, amphipods were not discussed. Despite a lack of direct harvesting, amphipods are a primary food source for higher trophic level animals of commercial and cultural interest, highlighting their importance to the integrity of Arctic food webs.

6.3.2 Arctic char

Arctic char are an Arctic resident and are referred to by the Inuit as 'Ikaliviit' or 'Ivitaruk'; however, there are several other Inuktitut and Innuinaqtun names for the fish that refer to specific ecotypes or life history stages (Coad & Reist, 2017). Arctic char exists in both anadromous (referred to as sea run char in IQ) and lacustrine (land locked) forms; however, anadromous Arctic char were selected as the focal species as the Project occurs in the marine environment.

6.3.2.1 Biogeographic Distribution

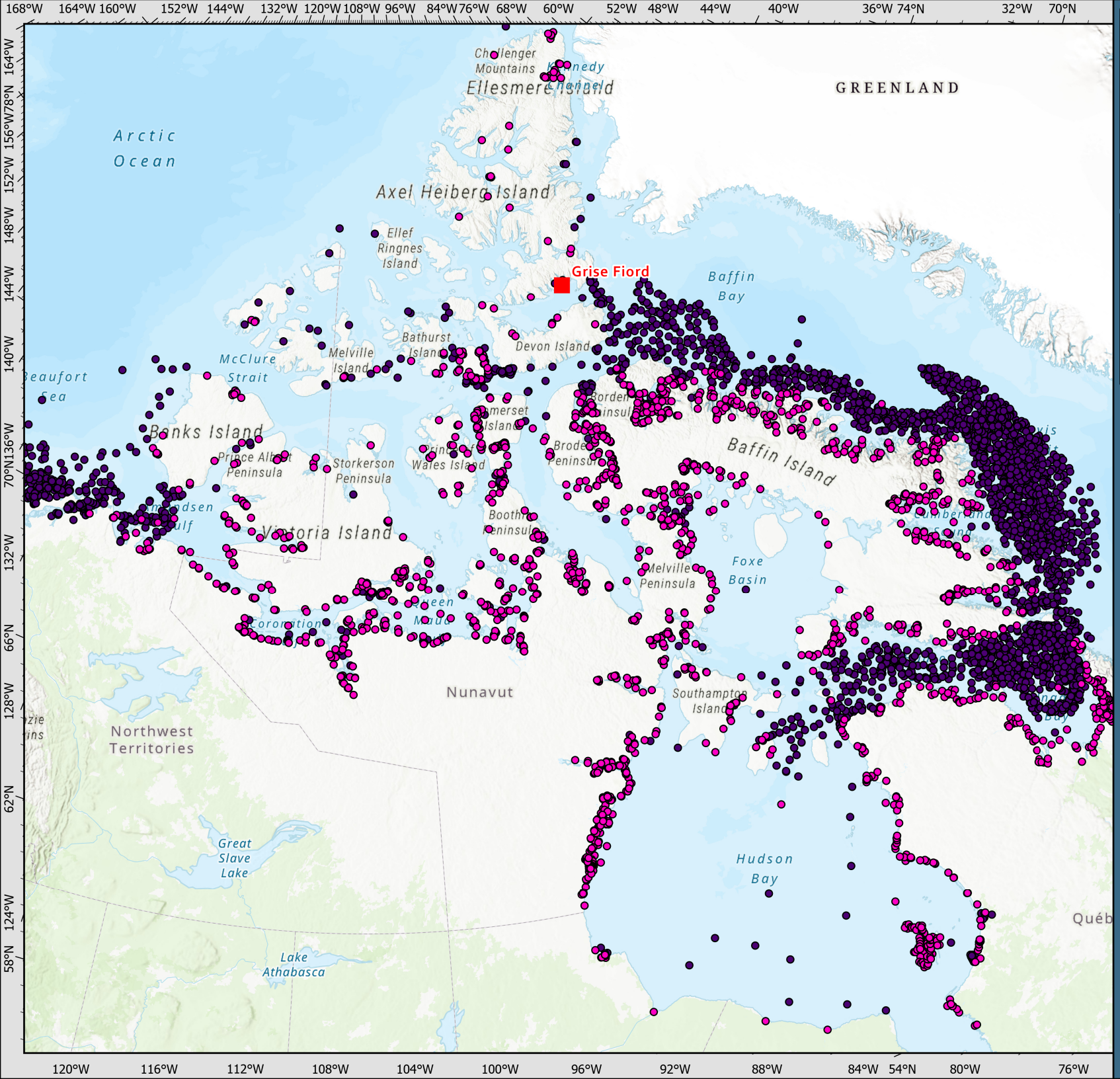
Arctic char are ecologically and socio-economically important in Canada's Arctic and can be either anadromous (referred to as sea run char by Nunavummiut) or lacustrine (land-locked) forms (GN, 2018a). Anadromous (sea run) char are not considered to be common in the High Arctic, but they sometimes occur where outflows are substantial enough to ensure a return migration in August (GN, 2010).

Arctic char are the northernmost freshwater fish species (Brunner *et al.*, 2001; Evans *et al.*, 2015; Oceans North Conservation Society *et al.*, 2018) with a circumpolar distribution north of 75 °N with sporadic occurrences throughout Jones Sound and around Ellesmere Island (Figure 6-3). Various morphological forms of char have been found in southern and northern locations, as far north as Lake Hazen on Ellesmere Island (DFO, 2018a). Arctic char have the potential to be misidentified with other salmonid species, such as Dolly Varden (*Salvenus malma*), Atlantic (*Salmo salar*) and Pacific Salmon (*Oncorhynchus*), which are increasingly being observed in Nunavut, however these other species are not common enough in Nunavut to influence the occurrences of char referenced in Figure 6-3 (Oceans North Conservation Society, 2018).

Anadromous (sea run) char are not considered to be common in the High Arctic, but they sometimes occur where outflows are substantial enough to ensure a return migration in August (GN, 2014). The primary purpose of the seaward migration is to increase energy reserves, at which time they may double their body mass (Jørgensen *et al.*, 1997) over a relatively short summer migration (~20 to 45 days) (Bégout *et al.*, 1999; Klemetsen *et al.*, 2003).

The Grise Fiord NCRI document does not reference any occurrence of Arctic char in or around Grise Fiord, which was confirmed during the IQ Workshop, where no Arctic char are found along the shoreline (GN, 2012; IQ Workshop 2019 - Amon Akeeagok; IQ Workshop 2019 - Manasie Noah; IQ Workshop 2019 - Marty Kuluguqtuq). The closest 'Probability of Occurrence' being from 1 of 8 interviewees in Baad Fiord, west of Grise Fiord (GN, 2012) (Figure 2-1), where the interviewee's statement was that the arctic char were 'new to this area in the last few years', and were caught between August and September[22]. The closest anadromous river to Grise Fiord is in in Baad Fiord (IQ Workshop 2019 - Amon Akeeagok). There is no information on the migratory patterns of Arctic char in and around Grise Fiord and IQ information suggests they are not in the coastal foreshore of Grise Fiord (IQ Workshop - December 2024).

[22] See Figure 7 in the Grise Fiord NCRI Report for a depiction of 'probability of occurrence' for Arctic char https://www.gov.nu.ca/sites/default/files/documents/2022-07/ncri_grise_fiord_en.pdf



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DELIVERING SUSTAINABLE CHANGE

Nunavut

Dynamic Ocean Consulting Ltd.

- Arctic Cod
- Arctic Char



N

0 140 280 560 Km

Spatial Reference
Name: WGS 1984 Arctic Polar Stereographic
GCS: GCS WGS 1984
Datum: WGS 1984
Projection: Stereographic North Pole
Map Units: Meter
Drawn: C. Knight

Figure 6-3

Arctic Cod and Arctic Char Distribution Throughout the Canadian Arctic

6.3.2.2 Ecology and Reproductive Behaviour

Arctic char has been referred to as a highly variable species, owing to a diversity of morphologies and life history strategies across its range (Coad & Reist, 2017). There is considerable variability within and among populations in life-history tactics such as age to first migration, spawning frequency, and migration length and spawning location. Owing to this variability, understanding Arctic char ecology is a highly site- and population-specific endeavour (Reist *et al.*, 2018).

Anadromous Arctic char begin migrating to marine environments between two and 11 years old when they are 150-200 mm in length (Reist *et al.*, 2018). Marine environments generally offer more foraging opportunities than freshwater systems, and thus allow for higher growth (Jørgensen *et al.*, 1997), survival (Jensen *et al.*, 2018) and reproductive output (Tallman *et al.*, 1996), assuming the energetic costs and mortality risks of migrations can be overcome. Given the energetic costs of migration, anadromous Arctic char are generally shorter-lived than their land-locked counterparts (Coad & Reist, 2017).

Acoustic telemetry technology has facilitated the ability to understand habitat use and migratory routes of anadromous species (Moore *et al.*, 2016; Moore, 1975). Some studies show that Arctic char prefer migrating along coastlines as opposed to across water bodies (Moore *et al.*, 2016; Moore, 1975), and thus are typically found within 30 km of their natal rivers (Bégout *et al.*, 1999). In Cambridge Bay, coastline distance has been shown to be the closest genetic link between individual fish (Harris *et al.*, 2014).

Marine migration is primarily driven by dietary requirements; however, little is known about the diet of anadromous Arctic char. Arctic char are opportunistic predators, feeding on fish (capelin, northern sand lance), crustaceans (mysids, amphipods, decapods), polychaetes, and insects (Guiguer *et al.*, 2002; Johnson, 1989; Moore & Moore, 1974; Rikardsen & Elliot, 2000). Recent studies have been undertaken in proximity to Hudson Bay communities (e.g. Naujaat, Coral Harbour [Salliq]) to understand the diet of Arctic char in the region, with results showing that Arctic char diet consists largely of amphipods (NWSF, 2019a, 2019b).

Arctic char typically return to their natal rivers to spawn in freshwater (Gilbert *et al.*, 2016), regardless of their sexual maturity. This is likely an adaptation to avoid harsh environmental conditions (e.g. freezing temperatures; (Klemetsen *et al.*, 2003). Arctic char are iteroparous and spawn over redds in gravel during September and October (Duitil, 1986; Harwood & Babaluk, 2014). Eggs incubate under the ice for approximately six months and once hatching occurs, juveniles spend their early life history in freshwater (DFO, 2013d). Spawning season in the fall and spring migrations are key characteristics of anadromous Arctic char life history (QIA, 2018b).

6.3.2.3 Harvesting

Arctic char is a highly valued fish species to the people of Nunavut for subsistence and commercial fisheries. Arctic char represent the second-most widely consumed country food (Hurtubise, 2016a).

Commercial

The commercial fishery is primarily in Cambridge Bay and Cumberland Sound (DFO, 2018a; NWMB & DFO, 2020). Commercially, Arctic char are harvested using gillnet or weir (DFO, 2013d), typically near the mouth of rivers in July (DFO, 2014a). An IFMP has been developed for the Cambridge Bay fishery (DFO, 2018a), and are not developed for subsistence fisheries in the territory. Exploratory fisheries for Arctic char are not currently occurring in Grise Fiord or Jones Sound, however locations of known commercial Arctic char fisheries are provided in Figure 5.4.2.1[23] of the RNLUP (NPC, 2023c). There is no available information to confirm or hypothesis on the condition of Arctic char sea-run fish stocks. DFO has a study that provides information on stock condition for several subsistence fisheries (DFO, 2013a). The most northern stock is for a southern Prince of Wales Island, which is approximately 750 km southwest of southern Ellesmere island (DFO, 2013a). Several collaborative research projects occurring throughout Nunavut between DFO and the relevant HTOs/HTAs to fill these information gaps.

Subsistence

Subsistence fisheries are an important component of the diets of the people of Nunavut, who depend on these fisheries for their livelihood. QIA (2018b) converted country foods into a monetary value, where the value of Arctic char country foods fishery for a study which involved six communities (Grise Fiord, Arctic Bay, Pond Inlet, Clyde River, Qikiqtaarjuak, Pangnirtung), provided a substitution value of $1,120,755.

In Grise Fiord, fishing occurs mostly by jigging, there is no nets or casting, and Arctic char are not harvested along the shoreline (see Figure 2-1). Read (2000) conducted a study to summarize information on Arctic char in the Baffin Region from 1995 to 1999. Grise Fiord and Resolute Bay were not included in the study because, at the time, these communities did minimal fishing (Read, 2000). Arctic char, however is still an important subsistence fishery to the people of Grise Fiord who travel long distances from the community to harvest them with the total number of harvesters documented at 51 from 1996 to 2001 in the NWHS (Priest & Usher, 2004) (see Table 6-2).

6.3.3 Artic cod

The Arctic cod is an Arctic resident species and referred to by Inuit as ‘Ugak’ (Inuktut Tusaalanga & GN, 2024).

6.3.3.1 Biogeographic Distribution

Arctic cod, Atlantic cod and Greenland cod are all present in Baffin Bay and Davis Strait but Arctic cod are the most common (QIA, 2018b). As a very cold-water fish (0-4°C), Arctic cod have one of the northernmost ranges among all fish species (DFO, 2016).

[23] See Figure 5.4.2.1 (RNLUP, Appendix C-Chapter 5) for a depiction of the location of Arctic char commercial fisheries in proximity to Resolute Bay: https://www.nunavut.ca/sites/default/files/23-018e_2023-09-07-2023_or_appendix_c_maps_chapter_5_english.pdf

Migratory patterns of Arctic cod are not fully understood, with the exception of a pre-spawning late-summer migration to coastal waters (FAO, 2017). Arctic cod can migrate fairly long distances, in the hundreds of kilometres (Kessel *et al.*, 2017), and move from open-water to under-ice in their first year of life. The floe edge is an important ecological niche for Arctic cod, likely because they are feeding on the abundant sea ice zooplankton (Bradstreet, 1982). At the floe edge, Arctic cod are predated on by numerous marine mammal and marine bird species. Arctic cod are known to form large schools in bays and inlets (Crawford & Jorgensen, 1993; Hop *et al.*, 1992), with approximate densities of 80 fish/m^3 and surface areas up to 4.6 hectares (Crawford & Jorgensen, 1996).

Little is known about size distribution of Arctic cod; however, they are reported to be 'everywhere' in Grise Fiord (IQ Workshop 2019 - Amon Akeeagok; IQ Workshop 2019 - Manasie Noah; IQ Workshop 2019 - Marty Kuluguqtuq). Small schools of cod are seen to come in towards shore every second or third year, they can easily be mistaken for capelin, who also occasionally visit the waters near Grise Fiord (IQ Workshop – December 2024)

Given their importance to the diet of marine mammals such as narwhals, who are known to be present in the in Jones Sound during the open-water season (mid June to end of July (QIA, 2018b), and given their abundance in nearby Lancaster Sound (Bradstreet, 1982), Arctic cod would be in and around the waters of Grise Fiord. The Grise Fiord NCRI document found that Arctic cod was confirmed in the waters off Grise Fiord by three of eight interviewees[24]. Often, when Arctic cod are observed, they are being followed by predators. Narwhal (IQ Workshop 2019 - Marty Kuluguqtuq) and seals (IQ Workshop 2019 - Manasie Noah) come to feed on the cod, and at times large schools are being followed by whales (GN, 2012). Interestingly, the seals are observed feeding on Arctic cod in July (IQ Workshop 2019 - Manasie Noah) while the narwhals are feeding in August (IQ Workshop 2019 - Marty Kuluguqtuq).

6.3.3.2 Ecology and Reproductive Behaviour

Arctic cod (*Boreogadus saida*) are a pelagic marine species believed to be the single most important species in the trophic link between plankton, and marine birds and mammals in the Arctic ecosystem (Sekerak, 1982; Welch *et al.*, 1992). Arctic cod are believed to be the source of up to 75 % of energy transfer in Arctic food web dynamics (Oceans North Conservation Society *et al.*, 2018). They are considered an important 'indicator species' as their presence in large numbers generally attracts other species that are important for harvesting (e.g. narwhal) (Oceans North Conservation Society *et al.*, 2018). This species is considered to be inferior to Arctic char in terms of a harvestable species, "*The cods poor diet and high water content leads to poorer tasting meat and shorter preservation*," (Hurtubise, 2016a; p43, pers comm July 13 2015). However, while they are less important than Arctic char in regard to human consumption, they are more important in consideration of the food chain of marine birds and mammals (Sekerak, 1982).

Arctic cod are a semelparous (single reproductive episode) highly fecund, fast-growing, short-lived fish species highly specialized to living in cold Arctic waters that are partially frozen for portions of the year (DFO, 2016; Lawson *et al.*, 1998). Arctic cod spawning occurs in winter underneath sea ice, and hatching

[24] See Figure 9 in the Grise Fiord NCRI Report for a depiction of 'probability of occurrence' for Arctic cod https://www.gov.nu.ca/sites/default/files/documents/2022-07/ncri_grise_fiord_en.pdf

occurs in the spring, with precise timing depending on the bloom of ice microalgae (January to July, peaks April to May) (Bouchard & Fortier, 2011; Bradstreet, 1982; Hop *et al.*, 1992).

Juvenile and adult Arctic cod have different prey species preferences but feed primarily on plankton and small fish (Matley *et al.*, 2013). In the Atlantic fishery, Arctic cod are considered a demersal fish; however,, their water column distribution spans both pelagic and benthic areas (DFO, 2020b). The floe edge is an important ecological niche for Arctic cod, likely because they are feeding on the abundant sea ice plankton or hiding in crevices in the ice undersurface (Bradstreet, 1982). At the floe edge, Arctic cod are predated on by numerous marine mammal and marine bird species. They are generally considered an aggregate or schooling species and have been found in offshore (Majewski *et al.*, 2016) and coastal settings (Welch *et al.*, 1992) with approximate densities of 80 fish/m^3 and surface areas up to 4.6 ha (Crawford & Jorgensen, 1996). Cod at the floe edge is an essential to the Arctic food web in the spring migration and are known to be an important dietary item for narwhal (QIA, 2018b).

6.3.3.3 Harvesting

There are currently no commercial fisheries or exploratory fishery licenses for Arctic cod in the Canadian Arctic. There is interest in commercial fisheries for this species the but viability is affected by the lack of local fuelling facilities for large commercial vessels. (CBC, 2015; Nunatsiaq News, 2016). An experimental license for Arctic cod was issued from 1996 to 1997 (License No. Exp. 96/97-02) to be fished with traps or nets and a quota of 250 kg (DFO, 1999). The harvested weight and level of effort expended is not publicly available, other than to state 'minimal harvest' (DFO, 1999). The primarily consideration for commercial fisheries and Arctic cod are concerns over Arctic cod as bycatch in Arctic shrimp fisheries, particularly in Baffin Bay (Shrimp Fishing Area 1) and Hudson Strait (Shrimp Fishing Area 3)(DFO, 2022a, Figure 2). Internationally, commercial fishery for Arctic cod were popular in Scandinavia and Russia in the late 1900s (Aune *et al.*, 2021).

Arctic cod are generally not a primary subsistence fishery in Nunavut. This species is considered to be inferior to Arctic char in terms of a harvestable species; "*The cods poor diet and high water content leads to poorer tasting meat and shorter preservation*," (Hurtubise, 2016b; p43, pers comm July 13 2015) and are considered too small to fish (IQ Workshop 2019 - Amon Akeeagok; IQ Workshop 2019 - Manasie Noah; IQ Workshop 2019 - Marty Kuluguqtuq).

6.3.4 Arctic Sculpin

The Arctic sculpin is an Arctic resident and is referred to by Inuit as 'Kanayuk' or 'Kanajuq' (Inuktut Tusaalanga & GN, 2024). Amongst the 14 species of marine sculpin found in Nunavut (Coad & Reist, 2017),) the ones with documented occurrences in GN (2012) in the waters fronting Grise Fiord (see Figure 6-4) in the region are the Shorthorn sculpin (*Myoxocephalus scorpius*) and Arctic staghorn sculpin (*Gymnocanthus tricuspis)* [25], which are the focus of this desktop review.

[25] See Figure 14 in the Grise Fiord NCRI Report for a depiction of 'probability of occurrence' for Arctic sculpin https://www.gov.nu.ca/sites/default/files/documents/2022-07/ncri_grise_fiord_en.pdf

6.3.4.1 Biogeographic Distribution

Sculpins are ubiquitous in the Canadian Arctic and generally inhabit shallow coastal water; however, some are known to range as deep as 2000 m (Mechlenburg & Rask, 2018). Arctic staghorn sculpin are considered high-latitude species and are restricted to colder habitats compared to shorthorn sculpin, which is found globally in marine environments ranging from 0 to 18°C (Coad & Reist, 2017). Sculpins were also observed at other high-arctic communities at past field surveys, including Sanikiluaq, Naujaat, Coral Harbour [Salliq], Chesterfield Inlet, Arctic Bay, Pond Inlet, and Iqaluit, further confirming their range (see Table 6-4).

Sculpins are found on all types of substrate, including underneath fronds of large-bladed kelp species (Moeller, 2018). As their distribution suggests, experimental data have shown that Arctic sculpin and Arctic staghorn sculpin have optimal cardiorespiratory performance at temperatures between 1 and 4°C, whereas shorthorn sculpin has optimal performance between 2 and 10°C. This suggest that the former two species may be more sensitive to climate change (Franklin *et al.*, 2013). The presence of sculpin were confirmed during the IQ Workshop as being one of the main fishes caught (IQ Workshop 2019 - Amon Akeeagok; IQ Workshop 2019 - Manasie Noah; IQ Workshop 2019 - Marty Kuluguqtuq); however, identification to the species level was not confirmed. Shorthorn and fourhorn (*Myoxocephalus quadricornis*) were observed during the subtidal field study in 2019 (see Section 7.1.2). The freshwater form of fourhorn sculpin are listed as Data Deficient on the Species at Risk Public Registry (Government of Canada, 2024g); however, the saltwater form is not at risk.

Table 6-4: Worley Consulting and Dynamic Ocean Observations of Sculpin During Site Specific Field Program in Nunavut

Location	Year	Sculpin Species Observed			
		Shorthorn sculpin	Arctic staghorn sculpin	Fourhorn sculpin	Other sculpin species
Arctic Bay	2019	2	-	-	2
Chesterfield	2022	-	-	-	2
Coral Harbour [Salliq]	2022	2	8	-	-
Grise Fiord	2019	3	-	1	1
Iqaluit	2024	-	-	-	17
Naujaat	2022	-	32	-	8
Pond Inlet	2024	-	-	-	6
Resolute Bay	2019	-	-	-	-
Sanikiluaq	2022	-	1	-	2

Source: Advisian-Ikpiaryuk JV (2021, 2023a, 2023b, 2023c, 2023d); Advisian (2020b); Dynamic Ocean (2025a, 2025c)

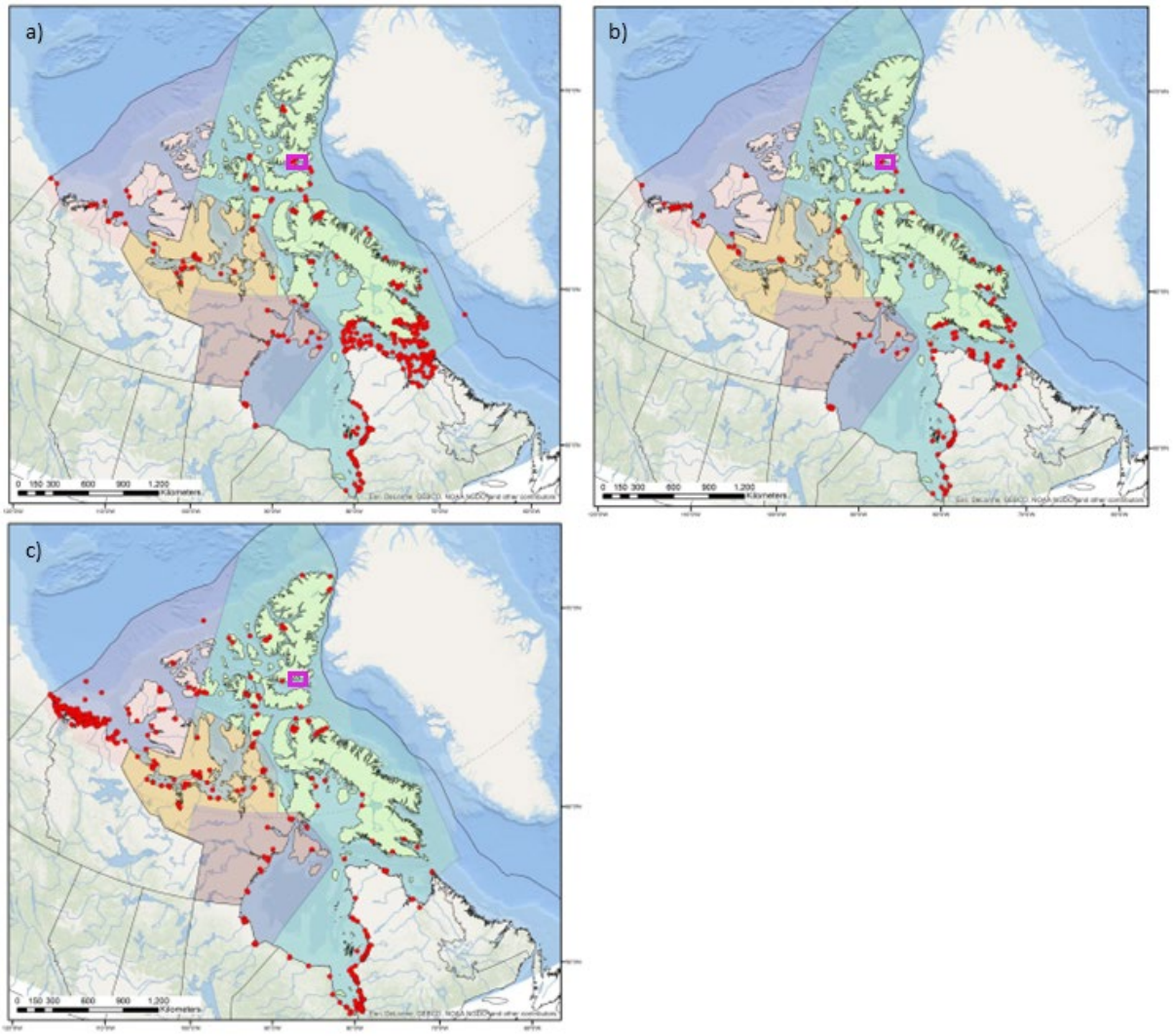


Figure 6-4: Marine Fishes of Canada Database Sculpin Records: a) Shorthorn; b) Arctic; c) Fourhorn

Source: Figures 157, 156, and 91 in Alfonso *et al.* (2018)
Note: Pink square depicts Grise Fiord location

6.3.4.2 Ecology and Reproductive Behaviour

Sculpins are generally solitary, benthic marine fishes belonging to the superfamily Cottidae. Distinguished by a large broad head with a body that tapers toward the tail, large mouths with small teeth, two dorsal fins, large pectoral fins and one anal fin (University of Guelph, 2019). The largest of species are from the genus *Myoxocephalus*, which can reach up to 60 cm in length, although most are much smaller (Alfonso *et al.*, 2018). Shorthorn sculpin generally reach up to 30 cm length. Unlike their other scorpaeniform relatives, most sculpin do not have scales but instead are naked or have modified scales in the form of spines (Coad & Reist, 2017). Adults tend to lack a swim bladder, making it difficult to swim in pelagic environments (Coad & Reist, 2017).

All sculpin in the region are generalist feeders, preying on plankton, benthic molluscs, small fishes, crustaceans, polychaete worms, kelp, and sea urchins (Landry *et al.*, 2018). Amphipods tend to dominate their diets by abundance, with common genera such as *Themisto*, *Onisimus,* and *Gammarus* (Coad & Reist, 2017). Shorthorn sculpin, in particular, has been observed to consume a diversity of smaller fishes based on regional availability, including capelin, herring, eelpouts, other sculpins, and small Arctic cod. A study on the stomach content of a high-arctic sculpin population identified that their diet consists of amphipod, polychaete worms, cetaceans, shrimps, cnidarians, and bivalves (Dynamic Ocean, 2025b). Due to limited number of studies on sculpin feeding behaviour, there is a lack of quantitative, localized diet information available for Grise Fiord. Sculpins also serve as an important forage fish for larger organisms, being found in the stomachs of narwhal, belugas, bowheads and seals (GN, 2010; QIA, 2018b).

Sculpins reach sexual maturity between three to five years, with females reaching sexual maturity slightly later than males. Spawning tends to occur in the fall between September and December, and hatching occurs in the springtime depending on the region. Sculpins lay demersal eggs that become planktonic larvae after hatching (Coad & Reist, 2017; Landry *et al.*, 2018). These larvae are sometimes guarded by the male (Ivanova *et al.*, 2018). Sculpin lifespans may exceed 20 years, though most adult specimens are under 10 years old.

6.3.4.3 Harvesting

There are no commercial fisheries for Arctic sculpins in Nunavut; however, it is considered an important subsistence fishery species in Grise Fiord (GN, 2012; QIA, 2018b). Fishing for sculpin is conducted along the tide line east of the community and near shore in an area southwest of the community (see Figure 2-1). Fishing is done by jigging, there are no gillnets placed (IQ workshop 2019). During the NWHS 5 year study period (1996-2001) a total of 17 harvesters were documented for fishing for Sculpin (Priest & Usher, 2004) (Table 6-2). Elsewhere, sculpins are often by-catch to other targeted fisheries, used as bait, or harvested for scientific research (Department of Fisheries and Aquaculture, 2019). Specific documented uses for sculpin vary considerably by community.

6.3.5 Truncate Softshell Clam

The truncate softshell clam (*Mya truncata*) is important infaunal species in the Arctic and is referred to by Inuit as ‘ammuumajuq’ (Inuktut Tusaalanga & GN, 2024).

6.3.5.1 Biogeographic Distribution

The truncate softshell clam’s distribution is largely influenced by ice scour events, either by direct mechanical interference, or modification of seafloor topography (Conlan & Kvitek, 2005). Habitat preferences of this particular species have not been studied extensively, but a similar sub-arctic species (*M. arenaria*) showed higher densities in eddies, estuaries, and in slack water adjacent to swift currents (Christian *et al.*, 2010).

The truncate soft shell clam is known to be present in Grise Fiord with between one to eight interviewees confirming a ‘Probability of Occurrence’ (GN, 2012), which are found July through August

likely due to availability during the open-water season[26]. During the IQ Workshop, clams were documented as occurring along the entire foreshore of Grise Fiord, albeit with differential harvesting rates (see Figure 2-1). The degree of harvesting is more likely driven by both contamination concerns from the wastewater outfall and a smaller clam bed (IQ Workshop 2019 - Manasie Noah).

6.3.5.2 Ecology and Reproductive Behaviour

This clam species is important to Arctic ecosystems for its role in carbon cycling and providing prey for many species of marine mammals. Given their sedentary adult life stage, they are a predictable food source for higher trophic level species (Highsmith & Coyle, 1990). As is characteristic of other Arctic bivalves, the truncate soft shell clam has a long life span and low annual growth, which is influenced largely by the length of the open-water season (Piepenburg *et al.*, 2011).

Like most species of the Myidae family, adult truncate softshell clam burrow deeply into sandy and muddy sediments or dwell in rocky crevices and abandoned bore holes (da Costa, 2012). Their shells are widely oval in shape with a compressed, grooved foot, byssal gland, and byssus which is used to anchor to substrate (da Costa, 2012). Truncate softshell clams remain in the same level of sediment depth and cannot dig again into the sediment when taken out and thus become victims of predators (da Costa, 2012). They are also facultative anaerobes and are able to go without oxygen for many days (da Costa, 2012).

Individuals are gonochoric and fertilization occurs in the water column which is followed by a free-floating plankton larvae phase that drifts through the water as they feed and grow (Wood *et al.*, 2022). After the pediveliger stage, the clam undergoes metamorphosis to transform into a sedentary benthic stage where they burrow into the sediment and grow extensively (da Costa, 2012).

6.3.5.3 Harvesting

There is no commercial fishery for benthic species, including clams in Grise Fiord, but this species is harvested for subsistence purposes. Clams are included in the category of sea floor dwellers in QIA (2018b) and are considered to be critical for food chain dynamics of larger predators such as marine mammals, fish and marine birds.

There is interest in expanding commercially exploited fisheries in Nunavut, some of which include soft shell clam, soft corals, amphipods, brittle stars, and brown sea cucumber (*Cucumaria frondosa*) (Boudreau & Fanning, 2016). However, at this time, there are no known exploratory fisheries occurring in the vicinity of Grise Fiord. During the NWHS 5 year study period (1996-2001) a total of 3 harvesters were documented for fishing for clams (Priest & Usher, 2004) (see Table 6-2). During the IQ Workshop, an extensive clam bed was documented along the foreshore of Grise (see Figure 2-1), where the foreshore fronting the community harbour is mostly avoided due to contamination concerns from the wastewater outfall (IQ Workshop 2019 - Manasie Noah). Access to the clams occurs during low tide, where 'when the tide goes out, the men go whale hunting and women go clam digging' (IQ Workshop 2019 - Manasie

[26] See Figure 18 in the Grise Fiord NCRI Report for a depiction of 'probability of occurrence' for Truncate softshell clam https://www.gov.nu.ca/sites/default/files/documents/2022-07/ncri_grise_fiord_en.pdf

Noah). The area marked south of the community harbour was a location where people would harvest clams at low tides (IQ Workshop – December 2024) (see Figure 2-1).

6.4 Marine Mammals

Focal marine mammals were selected based on those that are important to the ecosystem and to the Inuit for harvesting, as identified through the Project-specific IQ (see Section 2.3 for methodology), online IQ and published literature. Species identified as focal include four species of seal, one species of walrus, four species of whale and the polar bear (*Ursus maritimus*).

Marine mammal SAR status is listed in Table 3-2 for each species. The distribution of every focal species in Canada can be found in Figure 6-5.

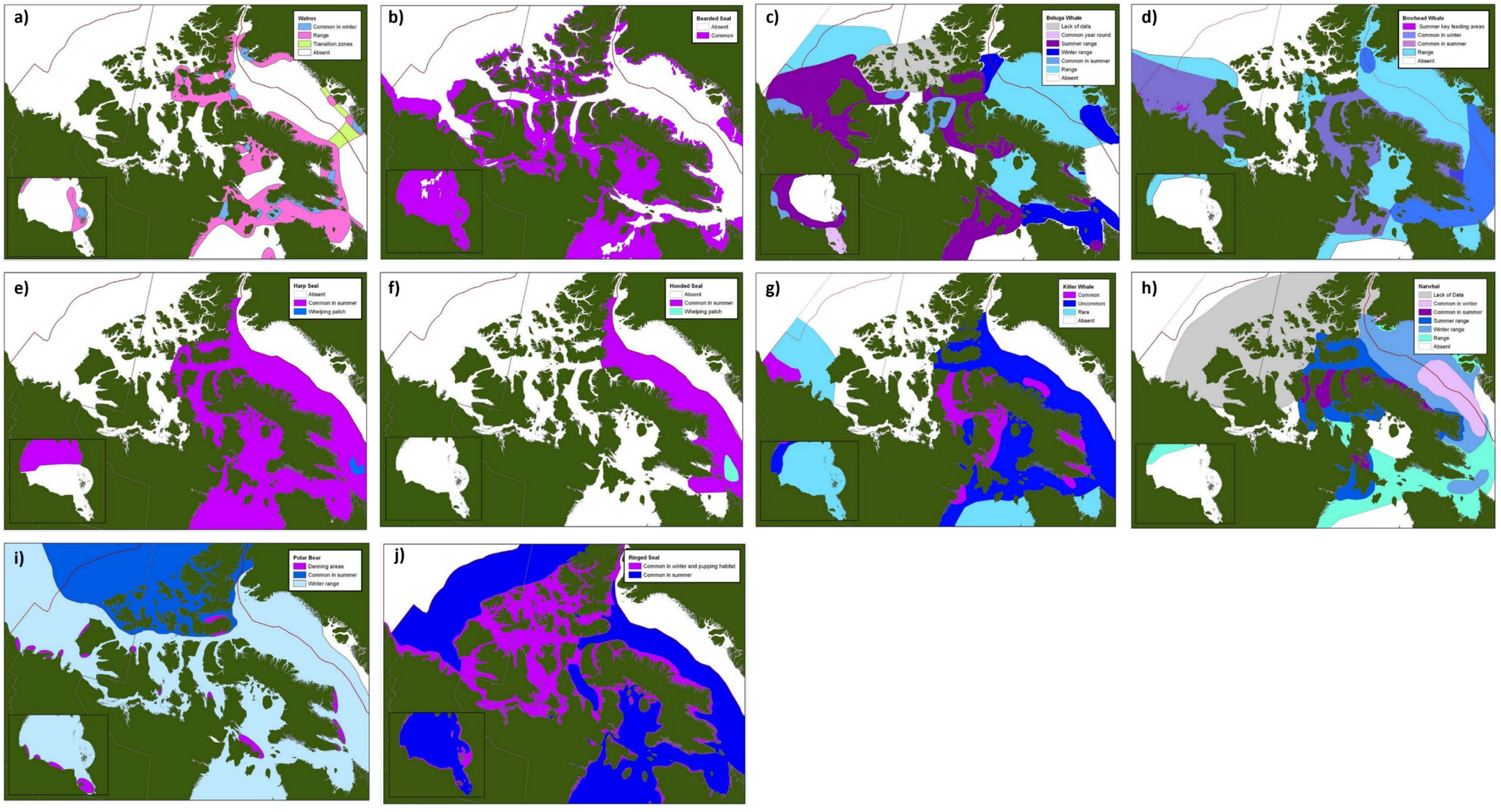


Figure 6-5: Panel displaying seasonal distributions of: a) Atlantic Walrus; b) Bearded Seal; c) Beluga whale; d) Bowhead Whale; e) Harp Seal; f) Hooded Seal; g) Killer Whale; h) Narwhal; i) Polar Bear; j) Ringed Seal in the East Canadian Arctic

Source: a) Figures 2 (Panel j),4(b),5 (e),6(f),7 (a),8(d),9(g), 10(c), and 11(h) in Stephenson and Hartwig (2010)

6.4.1 Atlantic Walrus

The Atlantic walrus (*Odobenus rosmarus*) is an Arctic resident and is referred to by Inuit as 'Akvik' (Inuktut Tusaalanga & GN, 2024).

6.4.1.1 Biogeographic Distribution

Atlantic walrus can be found in Arctic and sub-Arctic waters, usually around the shallow continental shelf. They are native to Canada, Greenland, Russian Federation, Svalbard and Jan Mayen, and the United States (i.e. Alaska) (Lowry, 2016b). The IUCN lists Atlantic walrus globally as *Vulnerable* (Lowry, 2016b). Based on the Species at Risk Public Registry, there two populations of walrus that occur in the Canadian Arctic (i.e., Central Low Arctic population, and the High Arctic population). Both are listed as *Special Concern* by COSEWIC (2017a), with no status under SARA (Government of Canada, 2024g). However, the Central Low Arctic and High Arctic populations are under consideration for addition to Schedule 1 (Government of Canada, 2024g).

Seasonal distribution of Walrus across the East Canadian Arctic can be found in Figure 6-5, Panel a. The Central/Low Arctic population can be found in Foxe Basin, Hudson Bay, south and east Baffin, southern Hudson Strait-Ungava Bay-Labrador Bay, and James Bay (COSEWIC, 2017a). The High Arctic population can be found in Penny Strait-Lancaster Sound, western Jones Sound, and Baffin Bay (see Figure 6-6) (COSEWIC, 2017a). A 2009 survey resulted in an estimate of 2,481 animals in the High Arctic population (COSEWIC, 2017a), and a minimum of 18,900 animals in the Central/Low Arctic population, though survey coverage is incomplete in the latter case and trends are unknown (COSEWIC, 2017a).

Walrus are year-round residents in the Arctic, though seasonal changes in distribution are noted in relation to ice cover (COSEWIC, 2017a). they are known to aggregate in the waters off northwestern Bylot Island in Lancaster Sound, with some summer haul-outs present on the South shore of Devon Island (Baffinland Iron Mines Corporation, 2012; Born *et al.*, 1995). Most migration activity has been observed in mid-October (Koski & David 1994 cited in QIA, 2012); when walrus leave as ice forms and move to areas with open-water and mobile ice. Walrus are known to winter in several locations in Lancaster Sound (DFO, 2015a), including Devon Island, the floe edges in Lancaster and Jones Sounds, and the North Water polynya (Born *et al*. 1995 cited in QIA, 2012).

Grise Fiord is located within the Eastern Jones Sound EBSA which contains walrus haul-out sites and feeding areas in nearby areas of open-water in the vicinity of Coburg Island (DFO, 2011a)[27]. Coburg Island and the surrounding waters are designated the Nirjutiqavvik National Wildlife Area, and this area provides important feeding ground for walrus (Government of Canada, 2024f). Other reported summer haul outs are scattered throughout Ellesmere Island and Devon Island (GN, 2012). In the winter, walrus can be seen year-round in polynyas along the western edge of Jones Sound, and there are breathing holes along the cracks just to the south of Grise Fiord, though most move out of the Sound in October (GN, 2012). A haul-out site for walrus can be found at Craig Harbour (just east of Grise Fiord), and the

[27] See Figure 31 in the Grise Fiord NCRI Report for a depiction of 'probability of occurrence' for Atlantic Walrus https://www.gov.nu.ca/sites/default/files/documents/2022-07/ncri_grise_fiord_en.pdf

western end of Jones Sound includes both haul out and wintering areas for walrus (Born *et al.*, 1995; Stewart, 2008).

IQ informs that walrus have been observed from Grise Fiord in all months of the year (QIA, 2018b). In *Ukiaq* (fall and early winter), *Ukiuq* (winter) and *Upirngasaaq* (early spring), this species is found in the North Water Polynya, along the pack ice in Davis Strait and at breathing holes (QIA, 2018b). By late spring (*Upirngaaq*), walrus are found at the floe edge, and are in the open waters, inlets and fiords and on haul-outs during *Aujaq* (summer) (QIA, 2018b). By *Ukiassaaq* (early fall) the walrus depart for their wintering grounds (QIA, 2018b).

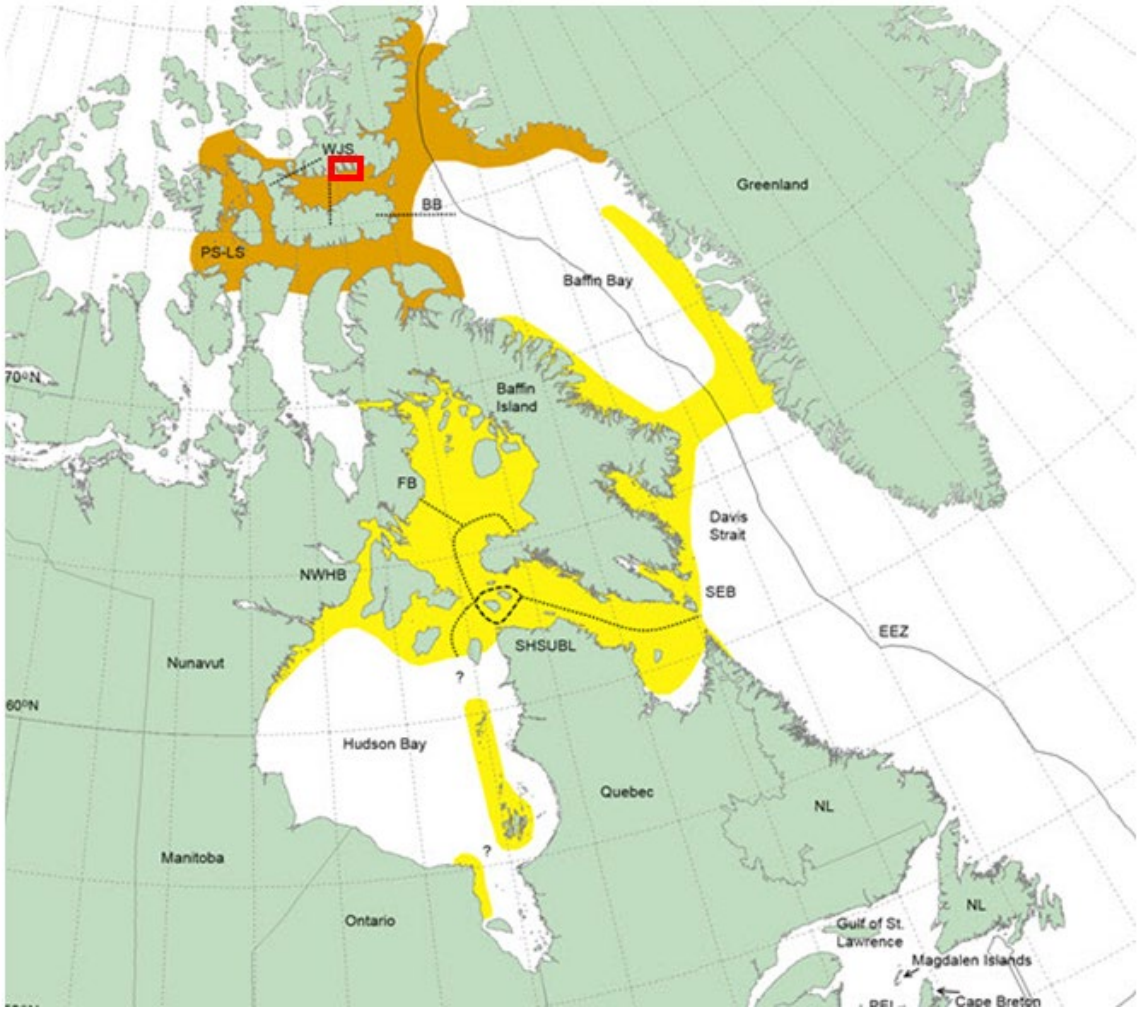


Figure 6-6: Atlantic Walrus Distribution of the High Arctic (orange) and Central/Low Arctic (yellow) designatable units

Source: Figure 4 in COSEWIC (2017a)
Notes:
1. Red square depicts Grise Fiord location
2. PS-LS – Penny Strait-Lancaster Sound; WJS – western Jones Sound; BB – Baffin Bay; SEB – South and East Baffin; SHSUBL – South Hudson Strait-Ungava Bay-Labrador; NWHB – North and West Hudson Bay; FB – Foxe Basin

6.4.1.2 Ecology and Reproductive Behaviour

Walrus spend approximately two-thirds of their lives at sea, with the other third spent hauled out on drifting pack ice or on land to rest, pup, and moult (Godwin, 1990). They typically prefer near-shore areas during the open-water season that provide haul out locations and shallow water (less than 100 m) suitable for providing access to prey (Outridge *et al*. 2003 cited in QIA, 2012). Walrus require shallow, coastal, ice-free waters with significant bivalve growth and haul out sites close by (Lowry, 2016b). The local population is often seen at the mouth of Admiralty Inlet in the winter, near the edge of the ice floe (GN, 2012). Walrus devote a large proportion of the day (8 to 12 hours) foraging (Goodwin, 1990), and can remain submerged for nearly half an hour (COSEWIC, 2017a). Though walrus have a diverse diet ranging from clams and worms, to fish, squid, sea birds, and occasionally seals, they are primarily benthic feeders and use soft substrate coastal waters that range from 10 to 80 m in depth. Walrus are a gregarious species often found in groups (Lowry, 2016b). Males establish territories in winter during the mating season (Lowry, 2016b). Pups are born in May and have an extended weaning period of about two years (Goodwin, 1990; Lowry, 2016b).

6.4.1.3 Harvesting

Walrus have been historically used for food, hides, ivory and bones by Indigenous communities (Lowry, 2016b). Walrus are hunted in Nunavut, with inter-annual variation in the numbers taken and the months hunted (Priest & Usher, 2004). An average of seven walrus are killed annually in Grise Fiord (Priest & Usher, 2004), and walrus viewing opportunities can be arranged from this community (Canadian Northern Economic Development Agency, 2019).

Based on this species' life history, ecology, habitat use, and IQ, and harvest reports walrus could occur in the area year-round, with much lower likelihood of occurrence during the winter months. Natural predators include polar bears and killer whales (Lowry, 2016b). Other threats include harvesting, degradation of feeding areas (e.g. disturbance by benthic trawl fisheries, industrial development), anthropogenic disturbance (including vessel and aircraft traffic), oil and gas exploration, and climate change (and effects on ice conditions) (COSEWIC, 2017a). From the 1700s to the mid-1800s commercial harvests depleted the population significantly, and there is concern around the impacts from increased shipping disturbance that could result in walrus individuals moving further away from hunting communities; as observed in Resolute during the 1990s (AMSA, 2009; Lowry, 2016b).

6.4.2 Bearded seal

The bearded seal (*Erignathus barbatus*) is an Arctic resident and is referred to by Inuit as 'Ukalik' or 'Ugjuk (Inuktut Tusaalanga & GN, 2024).

6.4.2.1 Biogeographic Distribution

Bearded seals inhabit Arctic and sub-Arctic waters year-round, and are native to Canada, Greenland, Iceland, Norway, Russian Federation, Svalbard and Jan Mayen, and the United States (COSEWIC, 2007b; Kovacs, K.M., 2016). Two separate subspecies, the Atlantic and the Pacific, can be found in the Canadian Arctic (Kovacs, 2015). The Atlantic bearded seal (*E. b. barbatus*) is listed by the IUCN as *Least Concern*

(Kovacs, 2015). Bearded seals are present in the Arctic year-round and are the largest of the Arctic seals (Goodwin, 1990; Natures Edge, 2015). This species is listed as *Data Deficient* in Canada (COSEWIC, 2007b).

Limited data is available on bearded seals, but Grise Fiord and adjacent waters are within the known spring-summer distribution (COSEWIC, 2007b). Grise Fiord is located within the Eastern Jones Sound EBSA (DFO, 2011a) just north of a bearded seal high-density area, which reaches to the southern end of the entrance of Jones Sound (NPC, 2023b) . Bearded seals are known to winter in Lancaster Sound and Davis Strait (COSEWIC, 2007b), and can be seen in this area year-round (DFO, 2015b). Bearded seals are expected in Jones Sound from July to October and can be seen around Coburg Island throughout the year (GN, 2012).

IQ informs that bearded seals have been observed from Grise Fiord in all months of the year except January; some variability exists as some sources indicate the species is not present during the winter (QIA, 2018b)[28]. In Grise Fiord, bearded seals are said to be present during the open-water season and occur from June to September (IQ Workshop 2019 - Amon Akeeagok; IQ Workshop 2019 - Manasie Noah; IQ Workshop 2019 - Marty Kuluguqtuq). Additional information indicates the species returns at the same time as harp seals when leads start opening up in June (QIA, 2018b). Bearded seals and harp seals summer near Coburg Island in the mouth of Lancaster Sound and at other unspecified sites in the area (QIA, 2018b). Bearded seals make use of breathing holes in *Upirngasaaq* (March - mid May), leads in *Qupirngaaq* (mid May to early July) and open-water until *Ukiaq* (November and December) (QIA, 2018b).

The global distribution of both bearded seal subspecies is displayed in Figure 6-7, and their presence across the Canadian Arctic can be found in Figure 6-5, Panel b.

[28] See Figure 20 in the Grise Fiord NCRI Report for a depiction of 'probability of occurrence' for bearded seal https://www.gov.nu.ca/sites/default/files/documents/2022-07/ncri_grise_fiord_en.pdf

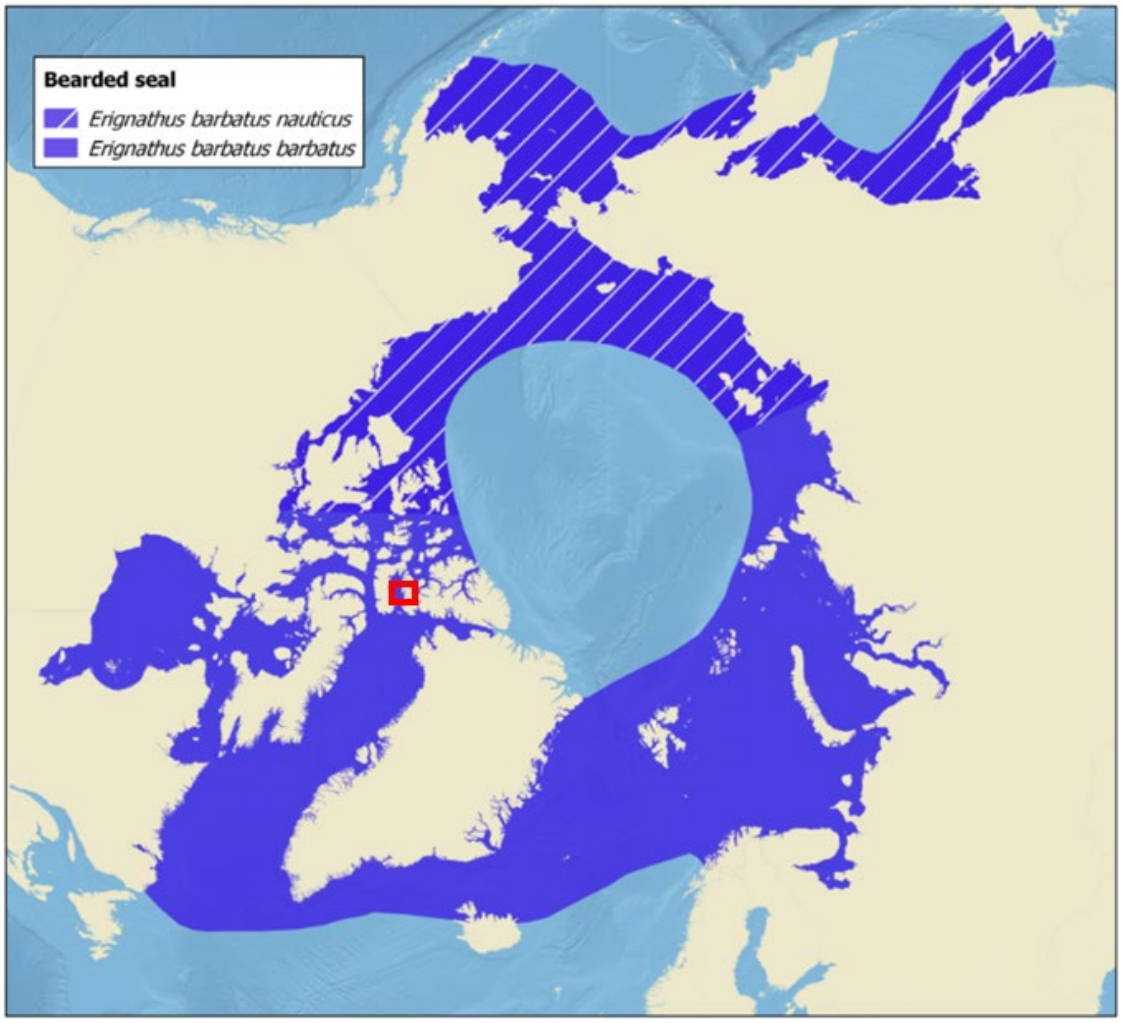


Figure 6-7: Global Distribution of Bearded Seal

Source: NAMMCO (2020)
Note: Red square depicts Grise Fiord location

6.4.2.2 Ecology and Reproductive Behaviour

Bearded seals show a preference for open-water less than 200 m deep with broken ice (COSEWIC, 2007b), and their seasonal movements depend upon prey availability and ice distribution (Kovacs, 2015). Bearded seals are primarily benthic feeders but have a varied diet including pelagic fishes, crustaceans and molluscs (COSEWIC, 2007b). Coburg Island, at the entrance of the Sound, and the surrounding waters are designated the Nirjutiqavvik National Wildlife Area, and this area provides important feeding ground for bearded seals (Government of Canada, 2024f). When not feeding, they will haul out on the ice, and is one of the few species to use pack ice for resting, pupping, and moulting (COSEWIC, 2007b). Bearded seals are reported as often around drifting ice floes, and feeding in shallower waters (GN, 2012).

Pups are born in the spring (April-May), and are nursed for around 24 days, maintaining a close bond with their mothers even after weaning (COSEWIC, 2007b). Mating occurs in the water following weaning, and then by a period of moulting (COSEWIC, 2007b; Goodwin, 1990). Bearded seals use waters northwest from Bylot Island in Lancaster Sound, with pupping sites identified along north and east coasts of Bylot Island (Baffinland Iron Mines Corporation, 2012; Daniel Komangapik Transcript, 2009; Jokebed Katsak, 2007). Large aggregations of bearded seals are not often encountered as this species is typically not a social animal and occurs among or in small groups (Goodwin, 1990). In the spring, the calls of bearded seals can be audible under the water for up to 25 km, likely as part of courtship behaviours, with observed vocalizations ranging from 0.02 to 11 kHz (Todd *et al.*, 2015). (COSEWIC, 2007b). Dives are usually a few minutes in length and to depths shallower than 100 m, but they have been recorded longer than 20 minutes and up to 450 m (COSEWIC, 2007b).

6.4.2.3 Harvesting

Bearded seals are harvested year-round in Nunavut where they are available, with the majority killed from June to October (COSEWIC, 2007b). Harvests in Grise Fiord of bearded seal occur in February and March, and from May to November, with annual variations in the timing and numbers (Priest & Usher, 2004). Around 20 animals are killed annually in Grise Fiord (Priest & Usher, 2004).

Based on this species' life history, ecology, habitat use, IQ, and harvesting reports bearded seals can be expected year-round, but could be more common during the summer months. Natural predators include polar bears and walrus (COSEWIC, 2007b). Threats to bearded seal conservation include harvesting, climate change (reduction of sea ice), anthropogenic disturbance, entanglement in fisheries, and pollution (contaminants and spills) (COSEWIC, 2007b; Kovacs, 2015).

6.4.3 Beluga whale

The beluga whale (*Delphinapterus leucas*) is an Arctic resident and is referred to by Inuit as 'Kilalugak' or 'Qilalugak' (Inuktut Tusaalanga & GN, 2024).

6.4.3.1 Biogeographic Distribution

Beluga whales are circumpolar in distribution, and can be found throughout Arctic and subarctic waters, as far south as the Gulf of Saint Lawrence, and as far north as 82°N (COSEWIC, 2020; Lowry *et al.*, 2017b). Their range includes Canada, Greenland, the Russian Federation, Svalbard and Jan Mayen, and the United States (i.e. Alaska), though occasional sightings have been reported in areas like Japan, New Jersey, Scotland and France, among others (Lowry *et al.*, 2017b). Globally, there is only one species of beluga whale and it is listed by the IUCN as *Least Concern* (Lowry *et al.*, 2017b). In Canada, there are eight identified populations by COSEWIC (see Figure 6-8) (COSEWIC, 2020). Grise Fiord is within the primary range of the Eastern High Arctic Baffin Bay population (Table 3-1). Seasonal distribution of beluga across the Canadian Arctic can be found in Figure 6-5, Panel c. Seasonal distribution of beluga across the Canadian Arctic can be found in), with a COSEWIC status of *Special Concern* and no listing under SARA (Government of Canada, 2024g). Seasonal distribution of beluga across the Canadian Arctic can be found in Figure 6-5, Panel c.

The Eastern High Arctic/Baffin Bay population may actually consist of two separate populations: the North Water population numbering around 15,000, and the West Greenland population of around 5,000 (COSEWIC, 2020). Innes *et al.* (2002) found an estimated 21,123 whales during an aerial survey of the Canadian High Arctic. The TI NMCA provides essential habitat for up to 20 % of the Canadian beluga whale population (Parks Canada, 2022b).

The Eastern High Arctic/Baffin Bay population is found from the eastern Canadian Arctic to Greenland (COSEWIC, 2020; Lowry *et al.*, 2017b). These animals summer around Somerset Island in Barrow Strait, Lancaster Sound, Prince Regent Inlet and Peel Sound, and winter amongst the heavy pack ice and in the North Water Polynya in northern Baffin Bay and off Greenland (see Figure 6-9). Grise Fiord**,** on Ellesmere Island, is within the summer range of beluga whales (Vard Marine Inc., 2016). IQ describes the habitat and distribution of beluga whales as occurring along the east coast of Ellesmere Island, travelling northward as the ice dissipates and open-water increases, and then returning to Jones Sound as the ice starts to freeze over again (see Figure 6-9) (QIA, 2018b). IQ informs that beluga whale presence at and near Grise Fiord is influenced by the North Water Polynya that extends into Jones Sound (QIA, 2018b). This natural feature enables beluga whales to be present year-round (QIA, 2018b).

Grise Fiord is located to the west of Eastern Jones Sound EBSA, where beluga are known to frequent a nearby area of open-water in the vicinity of Coburg Island (DFO, 2011a)[29]. Coburg Island and the surrounding waters are designated the Nirjutiqavvik National Wildlife Area, and this area provides important feeding ground for beluga whales (Government of Canada, 2024f) (Government of Canada, 2022b). Beluga whales are known to come in very close to Grise Fiord in late September, right along the shoreline, and have been seen in large numbers (IQ Workshop 2019 - Amon Akeeagok)[29].

[29] See Figure 23 in the Grise Fiord NCRI Report for a depiction of 'probability of occurrence' for beluga https://www.gov.nu.ca/sites/default/files/documents/2022-07/ncri_grise_fiord_en.pdf

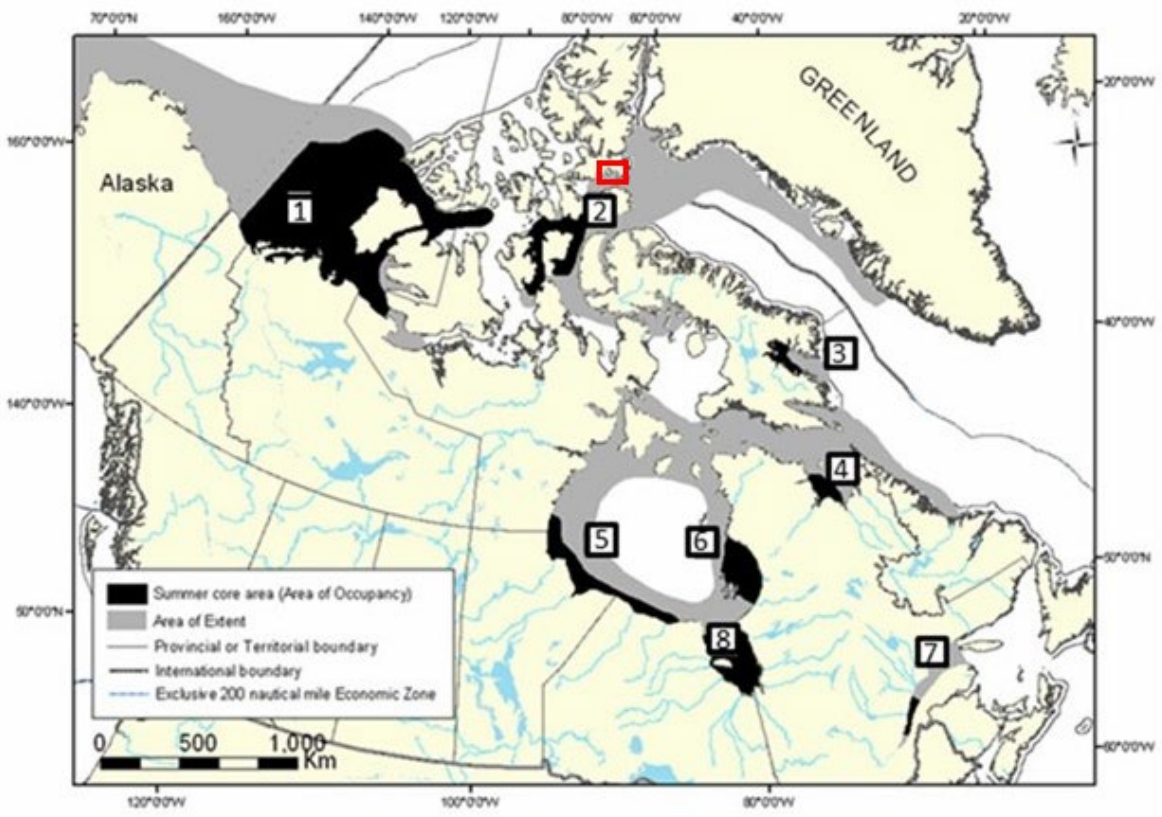


Figure 6-8: Distribution of belugas in Canada and the designable units currently recognized: (1) Eastern Beaufort Sea; (2) Eastern High Arctic-Baffin Bay; (3) Cumberland Sound; (4) Ungava Bay; (5) Western Hudson Bay; (6) Eastern Hudson Bay; (7) St. Lawrence Estuary; (8) James Bay

Source: Figure 2 from COSEWIC (2020)
Note: Red square depicts Grise Fiord location

6.4.3.2 Ecology and Reproductive Behaviour

In late spring as the sea ice breaks, beluga whales follow leads in the ice to river estuaries, and throughout the summer they are found in the coastal shallows and at glacier fronts (COSEWIC, 2020). In mid-August they move away from land to deeper waters then overwinter in areas with loose pack ice or polynyas (COSEWIC, 2020). Beluga whales have a seasonal cycle of mating and parturition, mating occurring earlier in the year during the late-winter to early-spring (Brodie *et al.*, 1981; Kleinenberg *et al.*, 1964), with a peak before mid-April (Burns & Seaman, 1985). Beluga whales are believed to calve offshore, and coastal habitats are understood to be important for rearing and nursing (Higdon, 2017). Nearby Lancaster Sound is likely a calf rearing habitat as females have been observed returning in the summer with calves, rather than having their calves there (Higdon, 2017). In general, parturition occurs offshore during the summer months (June to September), with the peak from mid-June to early-July (Higdon, 2017; Stewart *et al.*, 1995). However, calving has been noted in Jones Sound during *Aujaq* (July to September) along the floe edge (QIA, 2018b). Calves have also been reported from February to October suggesting that perhaps beluga whales do not have a single calving period (QIA, 2018b). This species seasonal movements are heavily influenced by both prey species and ice cover (COSEWIC, 2020).

The beluga whale diet is diverse with pelagic and benthic prey (Ellis, 1980), and includes a variety of fish, squid, octopus, crustaceans, molluscs, and polychaete worms (Bluhm, B.A. & Gradinger, R., 2008). Beluga whale habitat use is likely related to prey species distribution, and the association between beluga whale presence at the ice floe edges, may be related to the presence of Arctic cod, which is an important prey species (Kilabuk, 1998). Beluga whales commonly use the waters near Devon, Cornwallis and Somerset islands (Higdon, 2017). The importance of these High Arctic waters for beluga whale survival was recognised in the formation of TI NMCA which includes essential habitat for beluga whales (Parks Canada, 2022b).

Beluga whales are a social and highly vocal species that makes a wide range of underwater calls and echolocation clicks (Ellis, 1980). The frequency range is broad for this species, ranging from 0.1 - 120 kHz (Todd *et al.*, 2015), and they have been called the “canaries of the sea” because of their frequent and diverse vocalizations (Ellis, 1980). This species can remain submerged for up to about 15 minutes (Ridgeway *et al.*, 1984), and can make forays under ice. Beluga whales often use the same coastal habitats from year to year and have long been targeted by hunters throughout their distribution. Natural predators include killer whales and polar bears (COSEWIC, 2020).

6.4.3.3 Harvesting

Hunts for beluga whales are reported to occur throughout Nunavut, with harvests from Grise Fiord in May and from July to October (Priest & Usher, 2004), occurring very close to shore (see Figure 2-1). Inter-annual variability in the numbers taken and the monthly effort is evident in harvest data, with less than 100 animals harvested per year in the High Arctic (Priest & Usher, 2004). The Eastern High Arctic/Baffin Bay population is also heavily harvested in west Greenland (COSEWIC, 2020). Other threats to beluga whale conservation include climate change (loss of sea ice), human activities (oil and gas development, shipping) (DFO, 2014c), pollution and disease (COSEWIC, 2020; Lowry *et al.*, 2017b).

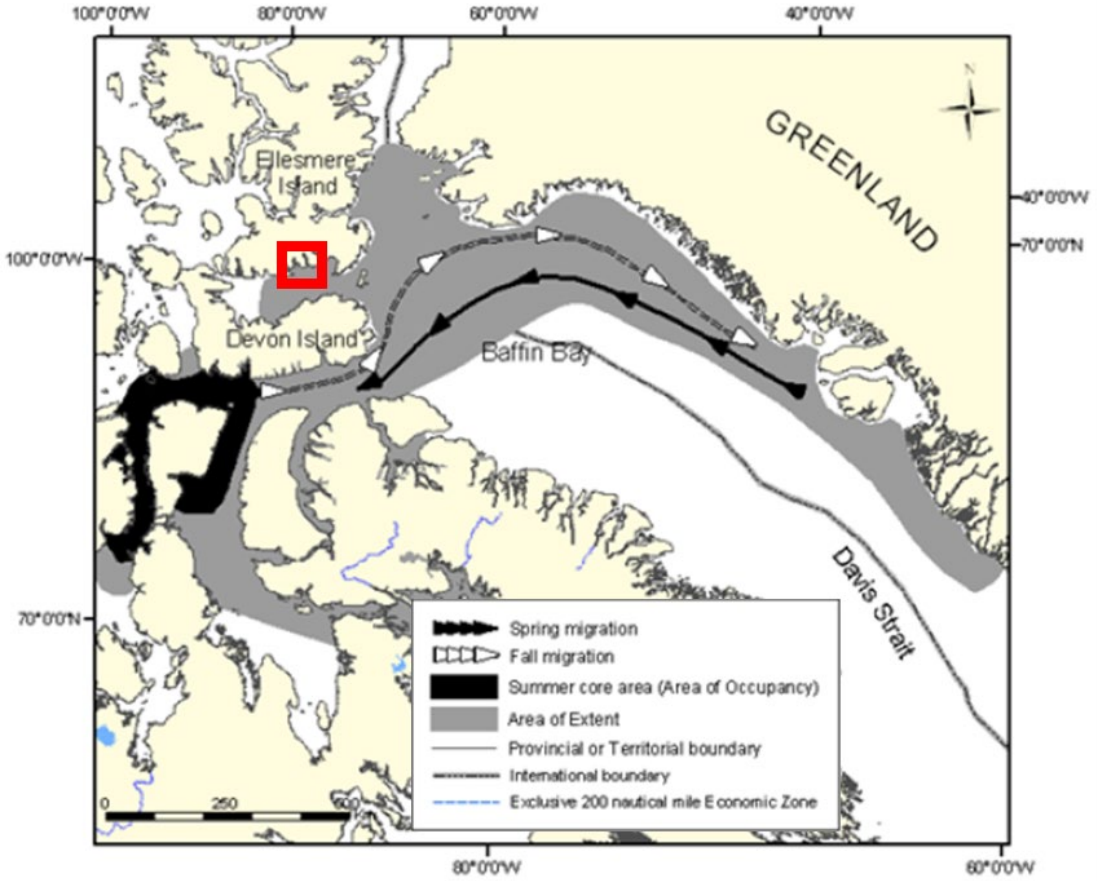


Figure 6-9: Biogeographic Range and Migratory Routes of the Eastern High Arctic – Baffin Bay Beluga Population

Source: Figure 3a from (COSEWIC, 2020)
Note: Red square depicts Grise Fiord location

6.4.4 Bowhead whale

The bowhead whale (*Balaena mysticetus*) is an Arctic resident and is referred to by Inuit as 'Arviq' (Inuktut Tusaalanga & GN, 2024).

6.4.4.1 Biogeographic Distribution

Bowhead whales inhabit the Arctic and subarctic waters of Canada, Greenland, and the United States (i.e. Alaska) (Bluhm, B.A. & Gradinger, R., 2008; Ellis, 1980; Reilly *et al.*, 2012). There is only one species of bowhead whale and is listed globally as *Least Concern* (Bluhm, B.A. & Gradinger, R., 2008; Ellis, 1980; Reilly *et al.*, 2012) by IUCN. Of the four recognized subpopulations, two are in Canada; the Eastern Canada-West Greenland population is relevant to Lancaster Sound (see Figure 6-10) (ESWG, 1995). The Eastern Canada-West Greenland population has *Special Concern* status under COSEWIC and is not listed

under the Species at Risk Public Registry, but is currently under consideration for addition to Schedule 1 (GN, 2018b).

Bowhead whales seasonally move into the area, and are known to occur throughout the region during the summer and may be seen in the Lancaster Sound area in late spring, summer and early fall (COSEWIC, 2009a; Thomas *et al.*, 2016). The seasonal migration path follows the eastern shore of Baffin Island, into and out of Lancaster Sound and Admiralty and Prince Regent Inlets (see Figure 6-10) (COSEWIC, 2009a). Sightings come from northern Hudson Bay and Foxe Basin, along the eastern coast of Baffin Island, and south of Lancaster Sound in Pond Inlet, Eclipse Sound, Navy Board Inlet, Admiralty Inlet, Prince Regent Inlet, and the Gulf of Boothia (QIA, 2012). Regent Inlet, specifically south of Creswell Bay, is thought to be a highly utilized area by bowhead whales in the summer season (Dueck & Ferguson, 2008), in addition to Isabella Bay on the east coast of Baffin Island (Finley, 1990). Seasonal distribution of bowhead across the Canadian Arctic can be found in Figure 6-5, Panel d.

IQ informs that bowhead whales occur at the floe edge and move into Jones Sound in the *Upirngaaq* (late spring), then are present in low numbers during the *Aujaq* (summer), and move toward the North Water Polynya before freeze up during the *Ukiassaaq* (early fall) (QIA, 2018b)[30]. Bowhead whales can be found in the North Water Polynya during the *Ukiaq* (fall/early winter) but are not present in the *Ukiuq* (winter) (QIA, 2018b).

Bowhead whales can sometimes be seen in the waters just south of Grise Fiord (GN, 2012; QIA, 2018b). This species is reported to occur around the area once every 10 years (IQ Workshop 2019 - Marty Kuluguqtuq). In October 2019, a bowhead whale was reported in front of Qarmavinik (Grise Fiord News - Facebook Page, 2019).

6.4.4.2 Ecology and Reproductive Behaviour

Bowhead whales forage during the open-water season, taking advantage of the productive arctic waters. The main prey is pelagic zooplankton (Bluhm, B.A. & Gradinger, R., 2008; Ellis, 1980; Reilly *et al.*, 2012). Bowhead whales can remain submerged for up to an hour and will swim under ice (Ellis, 1980; Krutzikowsky & Mate, 2011). They are capable of breaking through ice that is several inches thick due to their large skulls and powerful bodies (World Wildlife Fund [WWF, 2019]). Bowhead whales can communicate over large distances and use a frequency range from 0.02 to 5 kHz (Todd *et al.*, 2015). Seasonal distribution over the years is dependent upon timing and distribution of sea ice (Cooke & Reeves, 2019).

6.4.4.3 Harvesting

Bowhead whales are not often harvested in the Canadian eastern Arctic compared with other harvested species (NWMB, 2000; Priest & Usher, 2004), though throughout Nunavut Inuit communities now harvest between one and three bowhead whales per year. The frequency and numbers killed in the eastern Canadian Arctic may change in the future if the population continues to increase. Based on this species' life history, ecology, habitat use, and IQ, bowhead whales can be expected at the floe edge in

[30] See Figure 25 in the Grise Fiord NCRI Report for a depiction of 'probability of occurrence' for bowhead whale https://www.gov.nu.ca/sites/default/files/documents/2022-07/ncri_grise_fiord_en.pdf

the spring, can occur in Jones Sound during the open-water season, and will leave the in the early fall. Currently, they are infrequently sighted at Grise Fiord. Threats to bowhead whale conservation include increased human activity, vessel strikes, pollution, and climate change (COSEWIC, 2009a).

The Eastern Canada-West Greenland subpopulation was heavily hunted from the 1500s until the early 1900s. The population is thought to be over 4,000 animals (Ferguson *et al.*, 2021) and is increasing but still well below pre-whaling levels of over 25,000 (Cooke & Reeves, 2019). This population summers in western Baffin Bay, northwestern Hudson Bay, Foxe Basin, and the Lancaster Sound region, and winters in Davis Strait and Hudson Strait (Cooke & Reeves, 2019; COSEWIC, 2009a).

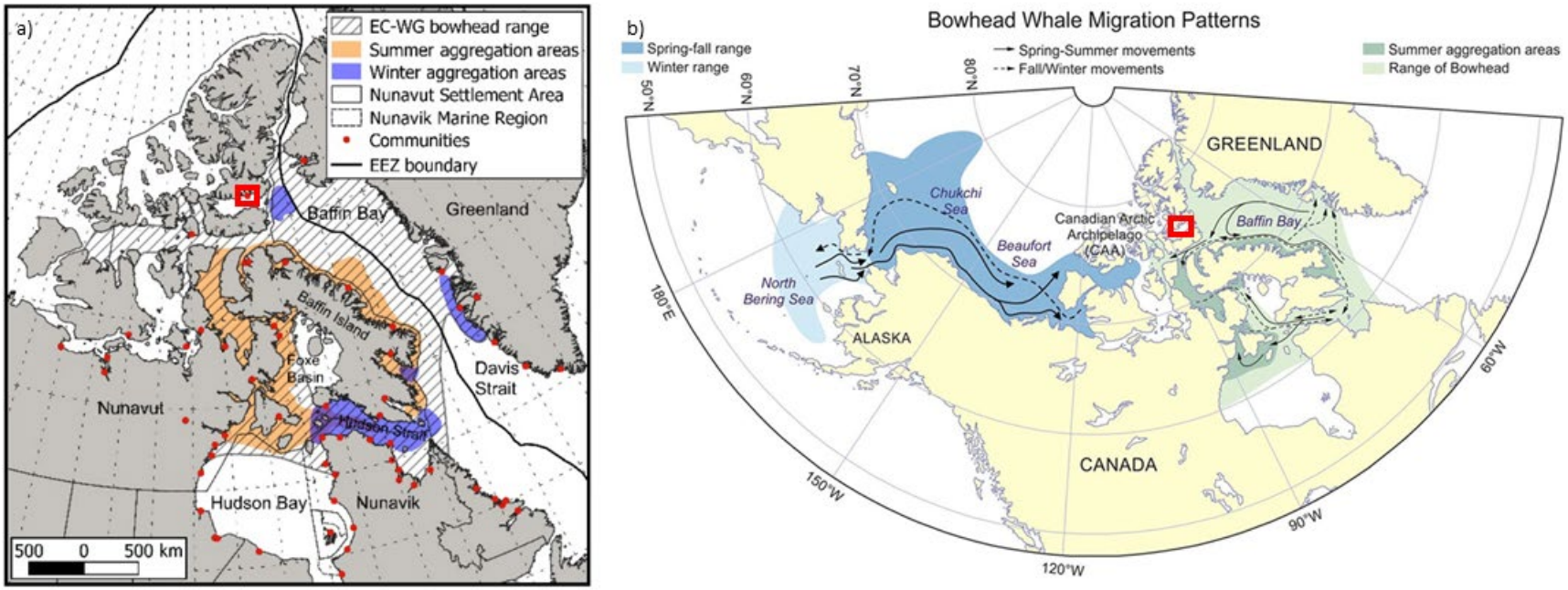


Figure 6-10: a) Distribution (Summer & Winter) of Bowhead Whale Populations in Canada; b) Generalized Seasonal Occurrences and Movements for Bowhead Whale Population

Source: a) Figure 1 in Ferguson *et al.* (2021), and b) Figure 1 in Pomerleau *et al.* (2018)
Note: Red square depicts Grise Fiord location

6.4.5 Harp seal

The harp seal (*Phagophilus groenlandicus*) is a seasonal visitor to the Arctic and is referred to by Inuit as 'Qairulik' (Inuktut Tusaalanga & GN, 2024).

6.4.5.1 Biogeographic Distribution

Harp seals can be found in the North Atlantic and Arctic oceans (Figure 6-11), and are native to Canada, Greenland, Iceland, Norway, Russian Federation, and Svalbard and Jan Mayen (Kovacs, 2015). Globally, harp seals are listed as *Least Concern* by the IUCN, with the stipulation that climate change could seriously affect this species and it should be reassessed within a decade (Kovacs, 2015). While they are considered a single species, there is some taxonomic uncertainty related to breeding populations (Kovacs, 2015). Harp seals have not yet been assessed by COSEWIC.

Summer and whelping areas for harp seal in the Canadian Arctic can be seen on Figure 6-5, Panel e. Harp seals are the most abundant marine mammal species in the North Atlantic (NAMMCO, 2021a; Stenson *et al.*, 2022) and the most abundant pinniped in the northern hemisphere, with a stable Northwest Atlantic population around 7.5 million animals (Kovacs, 2015). They occur in numerous places throughout Nunavut, including in Lancaster Sound along the coast of Devon Island (Indigenous and Northern Affairs Canada (INAC, 1983 cited in QIA, 2012)). Grise Fiord is located in a recognized high-density area (NPC, 2008, 2023b). Coburg Island, at the mouth of Jones Sound, and the surrounding waters are designated the Nirjutiqavvik NWA, and this area provides important feeding ground for harp seals (Government of Canada, 2022b).

Harp seal local distribution is highly influenced by the ice and this species is reported to come to Grise Fiord in the summer (IQ Workshop 2019 - Amon Akeeagok; IQ Workshop 2019 - Manasie Noah; IQ Workshop 2019 - Marty Kuluguqtuq)[31]. Individuals have been reported to occur July through October, with the species returning at the same time as bearded seals when ice leads start opening up in June (QIA, 2018b). However it is likely that there is some interannual variability as harp seals have also been reported as only present during *Aujaq* (early August and August) (QIA, 2018b). As with the bearded seals, harp seals are known to summer at a number of sites, including near Coburg Island in the mouth of Jones Sound (QIA, 2018b). Harp seals are regularly seen around Jones Sound and Grise Fiord from August to October, before returning to their wintering grounds around the Gulf of St. Lawrence and Newfoundland.

6.4.5.2 Ecology and Reproductive Behaviour

Harp seal live their entire lives (approximately 30 years) at sea - never touching land (Goodwin, 1990). They are highly migratory, traveling about 4,800 km per year - one of the longest known animal migrations (Goodwin, 1990). This species travels to the Arctic during the open-water season feeding grounds each year, and returns south to the Gulf of St. Lawrence, southern Labrador and northern

[31] See Figure 22 in the Grise Fiord NCRI Report for a depiction of 'probability of occurrence' for harp seal https://www.gov.nu.ca/sites/default/files/documents/2022-07/ncri_grise_fiord_en.pdf

Newfoundland for the winter. Their annual movements appear to follow fluctuations of the ice pack, as they forage at the ice edge during the year (Stenson, 2015).

Harp seals forage along the ice edge throughout the year, feeding mainly on a variety of fish such as capelin, Arctic cod, polar cod, herring, sculpin, Greenland halibut and plaice among others (Bluhm, B.A. & Gradinger, R., 2008; DFO, 2005b). Euphausiids and pelagic amphipods have also been reported as common prey species mainly in pups and juvenile animals, based on stomach contents (Haug *et al.*, 2000; Nilssen *et al.*, 2001). According to Wallace and Lawson (1997), at least 67 fin fish species and 70 species of invertebrates have been documented as prey species for harp seals. Foraging dives are typically shallow (<100m) and last less than 15 minutes (Lydersen & Kovacs, 1993), although Folkow *et al.* (2004) reported on a single individual diving to a maximum depth of 568 m.

Harp seals are extremely social, except for the first year of life, when the pups must migrate alone (Godwin, 1990). Pups are born from late-February to early-March on the pack ice in their southern wintering grounds. Pupping is followed by the annual moult, which occurs from April to May (DFO, 2012). Coastal locations of Bylot Island in Lancaster Sound and Baffin Bay have been identified by Inuit as harp seal pupping sites (Baffinland Iron Mines Corporation, 2012). Harp seals have a variety of calls including growls, grunts, squeaks and knocks in a frequency range <16 kHz (Todd *et al.*, 2015).

6.4.5.3 Harvesting

By the early 1970s, commercial hunting for oil and later pelts drastically reduced the number of harp seals and led to a low of 1.8 million, but the population has since recovered (Kovacs, 2015). Now, harp seals are the most abundant pinniped in the northern hemisphere and the Northwest Atlantic population is stable at around 7.5 million animals (Kovacs, 2015). By-yearly quotas are set at 400,000; however, only half of this number is killed in Greenland and Canada combined (Kovacs, 2015). Currently, harp seals can be harvested in subsistence hunts without permit by Indigenous people as well as anyone living north of 53 degrees' latitude (Kovacs, 2015).

Harp seals are harvested in Nunavut, with hunts occurring out of Grise Fiord during the summer to fall months of July through to October, with variation in the monthly timing and numbers taken annually (Priest & Usher, 2004). An average of 46 animals are killed annually in Grise Fiord (Priest & Usher, 2004) and are used as dog food and for their skin (IQ Workshop 2019 - Amon Akeeagok).Harp seals occur in this region during the summer and fall months, based on life history, ecology, habitat use, IQ, and harvest reports.. Predators include polar bears, killer whales and Greenland sharks (Kovacs, 2015). Threats include reduction of prey availability, entanglement, oil spills, vessel traffic, contamination, and climate change.

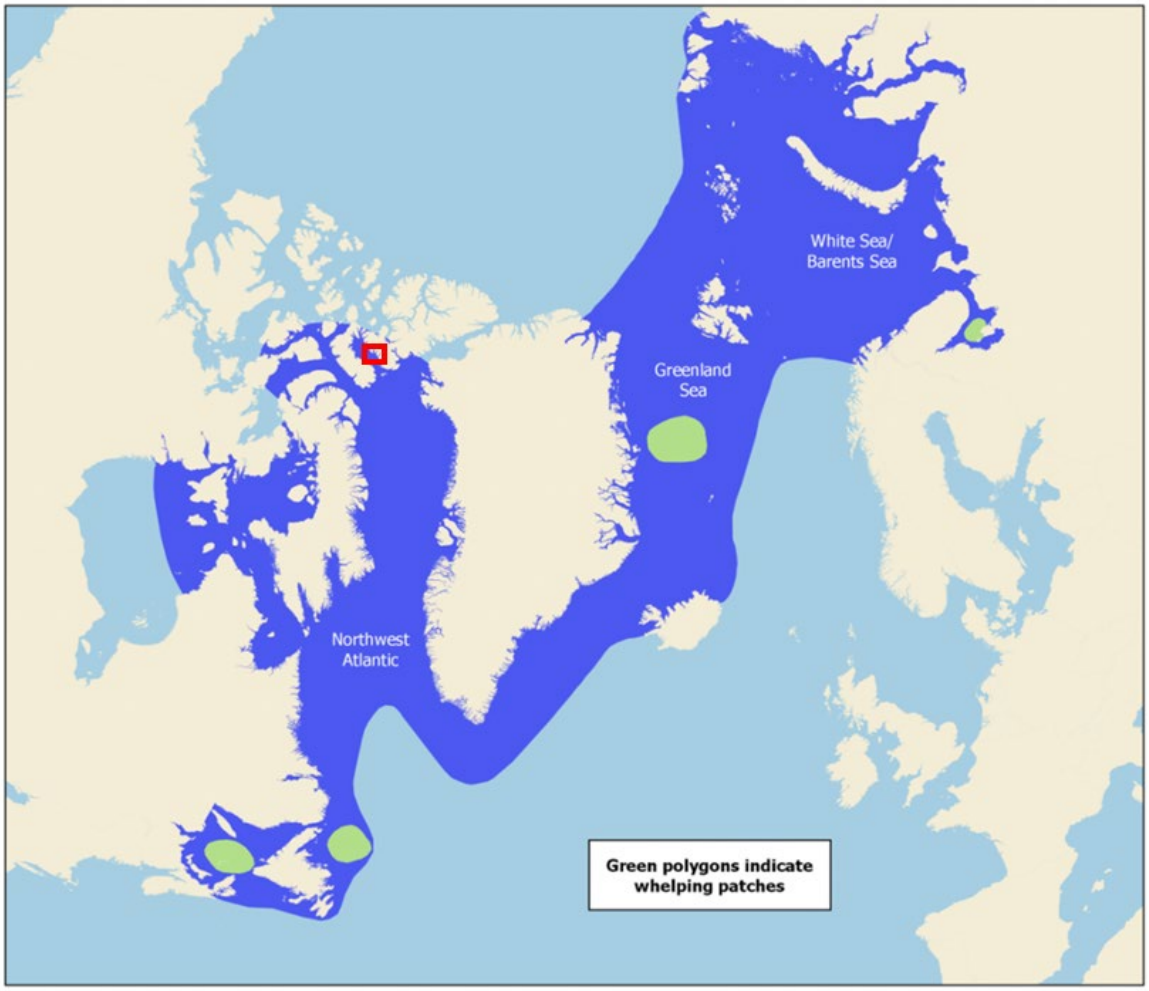


Figure 6-11: Global Range and Whelping Locations of Harp Seals

Source: NAMMCO (2021a)
Note: Red square depicts Grise Fiord location

6.4.6 Hooded seal

The hooded seal (*Cystophora cristata*) is an Arctic resident and referred to by Inuit as 'natsivak' (Inuktut Tusaalanga & GN, 2024).

6.4.6.1 Biogeographic Distribution

Summer distribution and whelping areas for hooded seals in the Canadian Arctic can be seen on Figure 6-5, Panel f. Hooded seals can be found in the North Atlantic and seasonally in the Arctic ocean (Figure 6-12), and is native to the waters of Canada, Greenland, Iceland, and Norway (Kovacs, K.M, 2016). Globally, hooded seals are listed as *Vulnerable* by the IUCN (Kovacs, K.M, 2016), due in part to changing

sea ice conditions, and are recommended for re-evaluation once new data becomes available. Three separate breeding populations are recognized; Lancaster Sound is within range of the Davis Strait population (Campbell, 1997; Kovacs, K.M, 2016). Last assessed in Canada in 1997 and determined to be *Not At Risk* (Campbell, 1997), hooded seals have recently been identified by COSEWIC as a high priority Candidate Species to be scientifically re-assessed (COSEWIC, 2025). The global population is thought to be in the hundreds of thousands, though no recent estimate is available, and likely declining due to reduction in pack ice required for breeding (Kovacs, K.M, 2016). One of four main pupping areas is located in central Davis Strait, and was assessed in 1984 at 19,000 pups and again in 2005 at 3,346 indicating a significant decline (Kovacs, K.M, 2016).

Hooded seals distribution is influenced by sea ice availability and they tend to move south in winter and north in summer (Campbell, 1997; Kovacs, K.M, 2016). The hooded seal is considered uncommon in the Lancaster and north Baffin Bay region (Andersen *et al.*, 2013; QIA, 2012). This species is described as sometimes being present in the summer but is not common (IQ Workshop 2019 - Amon Akeeagok; IQ Workshop 2019 - Manasie Noah; IQ Workshop 2019 - Marty Kuluguqtuq)[32].

6.4.6.2 Ecology and Reproductive Behaviour

Hooded seals prefer drifting on ice floes over deep water habitats and are solitary animals outside the breeding season (Godwin, 1990). In February, mature individuals congregate near the ice prior to pupping and mating (Campbell, 1997). Pups are born on pack ice (in Davis Strait) in the late spring, when break-up has begun (Campbell, 1997; Godwin, 1990; Kovacs, K.M, 2016). Pups nurse for only four days—the shortest lactation period of any mammal—before transitioning to an adult diet (Godwin, 1990). This is followed by a compressed breeding season lasting only about 2.5 weeks, with mating occurring in the water (Campbell, 1997; Kovacs, K.M, 2016). Animals move northward after the mating season (Campbell, 1997), congregating again for the summer moult (Campbell, 1997; Godwin, 1990; Kovacs, K.M, 2016). These seals can remain submerged for up to 30 minutes, though longer dives have been recorded (Kovacs, K.M, 2016). Hooded seals are generalists and eat a diverse range of prey that includes zooplankton, benthic and pelagic fish, crustaceans, molluscs, and squid (Kovacs, K.M, 2016). The vocal frequency range for this species is <6 kHz (Todd *et al.*, 2015).

6.4.6.3 Harvesting

Hooded seals are a harvested species in Nunavut but are not reported in the Grise Fiord hunt statistics collated by Priest and Usher (Priest & Usher, 2004). Natural predators include polar bears, killer whales and Greenland sharks (Kovacs, K.M, 2016).

Hooded seals are not expected to occur in this region with any regularity based on life history, ecology, habitat use, IQ, and harvest reports; however, if they were to occur it would likely be during the open-water season. Threats include harvesting, by-catch/entanglement, competition for food with local fisheries, pollution, and climate change and associated reduced pack ice habitat required for pupping and molting.

[32] See Figure 21 in the Grise Fiord NCRI Report for a depiction of 'probability of occurrence' for hooded seal https://www.gov.nu.ca/sites/default/files/documents/2022-07/ncri_grise_fiord_en.pdf

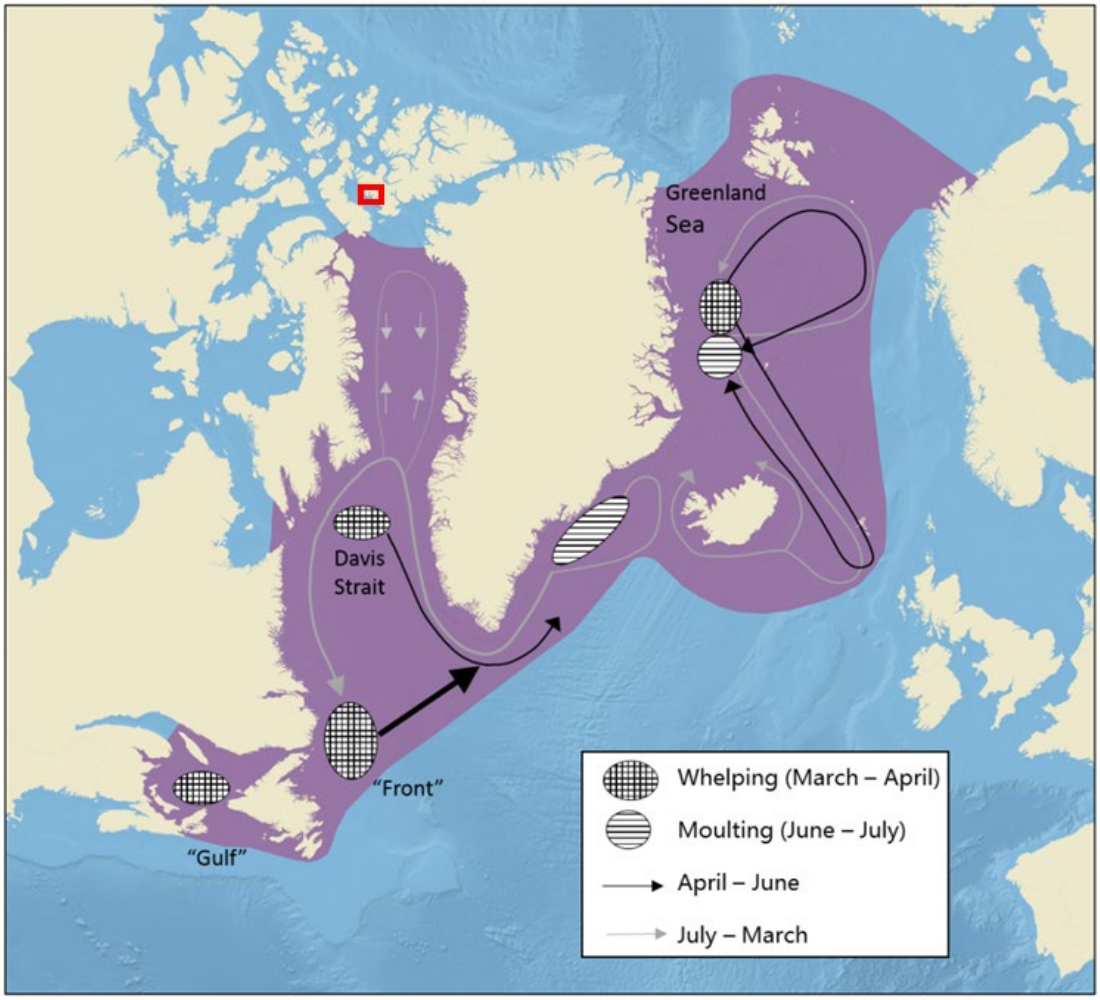


Figure 6-12: North Atlantic Distribution, Whelping Zones, Moulting Zones and Migration Patterns of Hooded Seals (Gulf and Front Populations)

Source: NAMMCO (2021b)
Notes: Red square depicts Grise Fiord location

6.4.7 Killer whale

The killer whale (*Orcinus orca*) is an Arctic visitor and referred to by Inuit as 'Aarluk' (Inuktut Tusaalanga & GN, 2024).

6.4.7.1 Biogeographic Distribution

Killer whales are a cosmopolitan species found throughout the world's oceans, and are known to be native to more than 150 countries (Reeves *et al.*, 2017). Globally listed as *Data Deficient* by the IUCN (Reeves *et al.*, 2017), the species consists of many distinct populations or ecotypes which do not

interbreed. It is important to note that taxonomic complexity exist, and it should be noted that classification of this species may be refined as research continues (Taylor *et al.*, 2013).

Killer whales are seen throughout the Lancaster Sound region, generally in small pods, with occasional sightings of single animals (Ferguson *et al.*, 2012). Higdon *et al.* (2012) compiled historical data to document the occurrence of killer whales in the Arctic. Higdon (2007) notes that the highest number of killer whale sightings to date are from southwest Greenland and Lancaster Sound, with prominent areas in the Lancaster region being the Pond Inlet/Bylot Island area, Lancaster Sound, and Admiralty Inlet (see Figure 6-13)(Higdon, 2007). Areas of occurrence for killer whales in the Canadian Arctic can be seen on Figure 6-5, Panel g.

IQ informs that killer whales arrive in Grise Fiord in *Upirngaaq* (late spring - arriving in July), are present throughout *Aujaq* (summer) and leave in September in *Ukiassaaq* (early fall) (QIA, 2018b). The killer whale is not present during *Ukiaq* (fall/early winter), *Ukiuq* (winter) and *Upirngasaaq* (early spring) (QIA, 2018b).

Killer whales have recently had an increased presence and range expansion in the Arctic; likely increased accessibility as the climate changes and sea ice declines, which could influence the distribution of other marine mammals (Ferguson *et al.*, 2010; Higdon *et al.*, 2012; Reeves *et al.*, 2017). Killer whales are usually seen in the summer ice-free months, often near groups of other marine mammals (Laidre *et al.*, 2006).

6.4.7.2 Ecology and Reproductive Behaviour

Five separate killer whale populations are recognized in Canada, with four occurring in the Pacific off British Columbia (BC). The fifth, the Northwest Atlantic/Eastern Arctic population found around Lancaster Sound, is listed as *Special Concern* under COSEWIC (COSEWIC, 2008; NPC, 2017), but has no listing under SARA (population is considered *Data Deficient*) (COSEWIC, 2008; Government of Canada, 2024g). The small size of this population and their susceptibility to disturbance, contributes to their COSEWIC designation. Relatively little is known about the range and distribution of the Northwestern Atlantic/Eastern Arctic killer whales, and there is no population estimate available (COSEWIC, 2008).

Killer whales are social animals capable of communicating over large distances underwater, using a variety of clicks and whistles. The frequency range is broad, ranging from 0.5 to 75 kHz (Todd *et al.*, 2015). Killer whales that eat marine mammals have relatively short dive times of less than about 15 minutes (Morton, 1990).

Given their predatory nature, there is interest in determining their abundance and distribution in Arctic waters. Ferguson *et al.* (2012) conducted a series of IQ interviews, and it is believed that killer whales inhabiting eastern Canadian Arctic waters are primarily predators of marine mammals, as no interviewees have observed them eating fish. Results of this survey state that killer whales are predators of narwhal, beluga whale, bowhead whale, and ringed and bearded seals. Reported predation events on narwhals and beluga whales far outnumbered those on bowhead whales or pinnipeds, with the majority reported in Lancaster Sound, and bowhead whale predation more frequently reported in Davis Strait-

Baffin Bay in the late spring, summer and early fall (Higdon *et al.*, 2012). Killer whale sightings from the Lancaster Sound region represent 24.2 % of all reported sightings (Higdon *et al.*, 2012).

6.4.7.3 Harvesting

Grise Fiord residents do not harvest killer whales (IQ Workshop 2019 - Amon Akeeagok; IQ Workshop 2019 - Manasie Noah; IQ Workshop 2019 - Marty Kuluguqtuq). Threats include harvesting (in Greenland), anthropogenic disturbance (acoustic and physical), prey depletion, vessel strikes, interaction with commercial fisheries, and contaminants (COSEWIC, 2008).

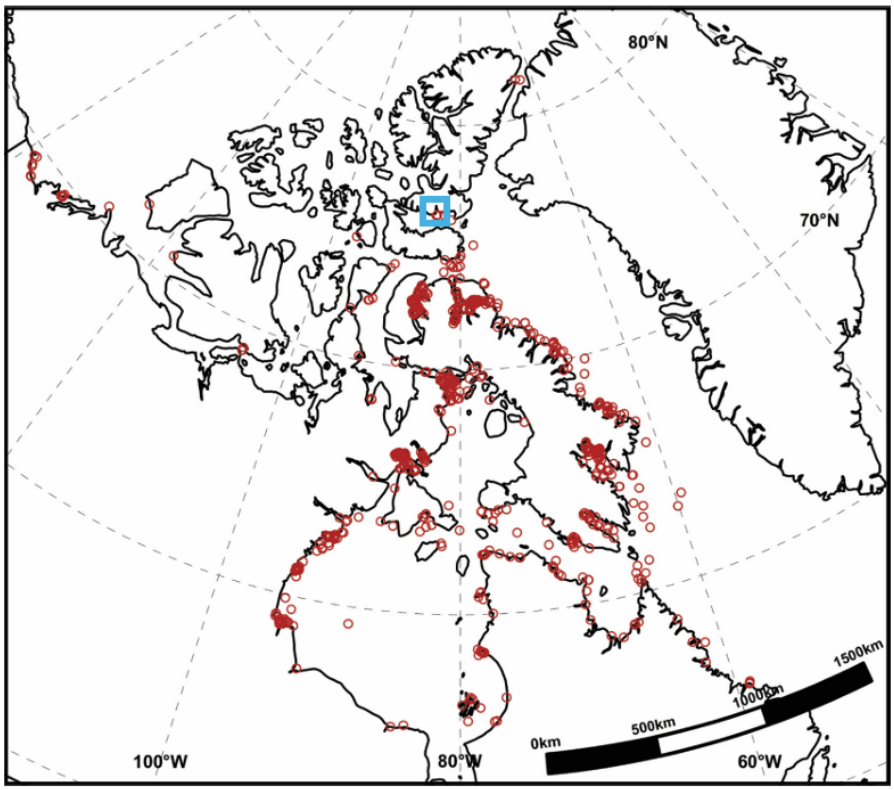


Figure 6-13: Killer Whale Sightings Between 1850 -2018

Source: Figure 2 in Lefort *et al.* (2020)
Note: Blue square depicts Grise Fiord location

6.4.8 Narwhal

The narwhal (*Monodon monoceros*) is an Arctic resident and is referred to by Inuit as 'Allanguaq' or 'Tuugaalik' (Inuktut Tusaalanga & GN, 2024).

6.4.8.1 Biogeographic Distribution

Narwhal are the most northerly of all cetaceans (Ellis, 1980), and occur in Arctic waters throughout Canada, Greenland, Russian Federation, Svalbard and Jan Mayen (Jefferson *et al.*, 2012). Only one species of narwhal has been identified globally, though 12 populations exist (Jefferson *et al.*, 2012). Narwhal are globally listed by the IUCN as *Least Concern* (Lowry *et al*., 2017a). Narwhals summering in the Eastern Arctic are listed as *not at risk* by COSEWIC (COSEWIC, 2024b), and no status under SARA (Government of Canada, 2024g). Approximately 45,000-50,000 narwhals from the Baffin Bay population are estimated to summer in Canadian waters of the High Arctic (COSEWIC, 2024a). This population consists of at least four summering subpopulations, with the Jones Sound subpopulations most likely to be seen around Grise Fiord (DFO, 2010; Watt *et al.*, 2013). The seasonal distribution and ranges of narwhal in the Canadian Arctic can be seen on Figure 6-5, Panel h. Grise Fiord is within general narwhal range (NPC, 2017).

Grise Fiord is located to the west of the Eastern Jones Sound EBSA, where narwhal have been seen visiting a nearby area of open-water close to Coburg Island (DFO, 2015a). Coburg Island and the surrounding waters are designated the Nirjutiqavvik National Wildlife Area, and this area provides important feeding ground for narwhal (Government of Canada, 2022b).The waters of the TI NMCA provides essential habitat for up to 75 % of the global narwhal population during the open-water season (Parks Canada, 2024c).

Narwhal from the Jones Sound subpopulation summer in Jones Sound and the fiords of western Ellesmere Island (see Figure 6-14). Large numbers of narwhal are reported throughout the area around Grise Fiord from spring through the fall, with the earliest report from January at the eastern end of Jones Sound (GN, 2012; QIA, 2018b). IQ informs that narwhal are not present year-round in Grise Fiord, but rather are seasonally present from May and October in Jones Sound, and the coastal waters of Ellesmere Island (QIA, 2018b)[33]. In October they move to the North Water Polynya, and interannual variability exists in their presence in Grise Fiord (QIA, 2018b). When they are in the area the narwhal pass through to feed in Grise Fiord (IQ Workshop 2019 - Manasie Noah) at the end of July, when they can be seen and heard, but not accessed (IQ Workshop 2019 - Amon Akeeagok). In August, they move in very close to shore to feed on cod (IQ Workshop 2019 - Marty Kuluguqtuq). Large numbers of narwhal have been reported with over 200 sometimes (IQ Workshop 2019 - Marty Kuluguqtuq). Calves are seen from *Upirngaaq* (June/July) through to *Ukiaksaaq* (September to mid-October) (QIA, 2018b), and hunters from this area have reported seeing calves in August and September (Higdon, 2017). Narwhal are not present in Grise Fiord from *Ukiaq* (November and December) through *Ukiuq* (January and February) (QIA, 2018b).The winter range and population status are unknown (Lowry *et al.*, 2017a). Inter-annual

[33] See Figure 26 in the Grise Fiord NCRI Report for a depiction of 'probability of occurrence' for narwhal https://www.gov.nu.ca/sites/default/files/documents/2022-07/ncri_grise_fiord_en.pdf

variability in this species presence has been noted as three to four years may elapse when they are not seen in and around Grise Fiord (QIA, 2018b).

6.4.8.2 Ecology and Reproductive Behaviour

The deep diving narwhal has a broad diet that includes benthic and pelagic fish, squid, and crustaceans (Bluhm, B.A. & Gradinger, R., 2008; Elijah Panipakochoo Transcript, 2007). Diet varies seasonally with a winter emphasis on benthic prey (Jefferson *et al.*, 2012). Narwhals likely target ice edges for foraging, based on comparison of stomach samples taken at the ice edge or from ice cracks, compared with those from open-water (Bradstreet, 1982; COSEWIC, 2024a). Narwhal are a social and vocal species with a diversity of calls and clicks (Ellis, 1980). The frequency range is broad, ranging from 0.3 to 48 kHz (Todd *et al.*, 2015). DFO Science has expressed concerns about potential masking of shipping sounds and the effect that would have on narwhal in the area, especially in narrow bodies of water (DFO, 2014c). Narwhal can remain submerged for up to about 15 minutes (Martin *et al.*, 1994), and can make forays under the ice. Killer whales are known to avoid areas with ice, thus IQ studies indicate narwhals may congregate in these areas to avoid being hunted (Ferguson *et al.*, 2012; Morell, 2012).

6.4.8.3 Harvesting

Narwhal are currently harvested by some indigenous communities in Canada and Greenland (Lowry *et al.*, 2017a; NWMB, 2012), including in Nunavut (QIA, 2018b). Hunting for narwhal has been reported from July to October, with inter-annual variation in the timing and numbers taken (Priest & Usher, 2004). Grise Fiord has two narwhal quota areas based on the two subpopulations of narwhal nearby - in town the quota is 76 for the Jones Sound subpopulation, and another 77 for the next subpopulation which is about 40 km away (IQ Workshop 2019 - Marty Kuluguqtuq). As with beluga whale, harvesting takes place along the floe edge and more open waters (QIA, 2018b). Narwhal are also hunted by polar bear in and around Grise Fiord, but killer whale and shark predation has not been seen (QIA, 2018b).

A narwhal hunting event was observed by the marine team on 05 September 2024. In this event between 10 and twelve boats were seen pursuing and shooting at an unknown number of narwhal (see Photo 6-1).

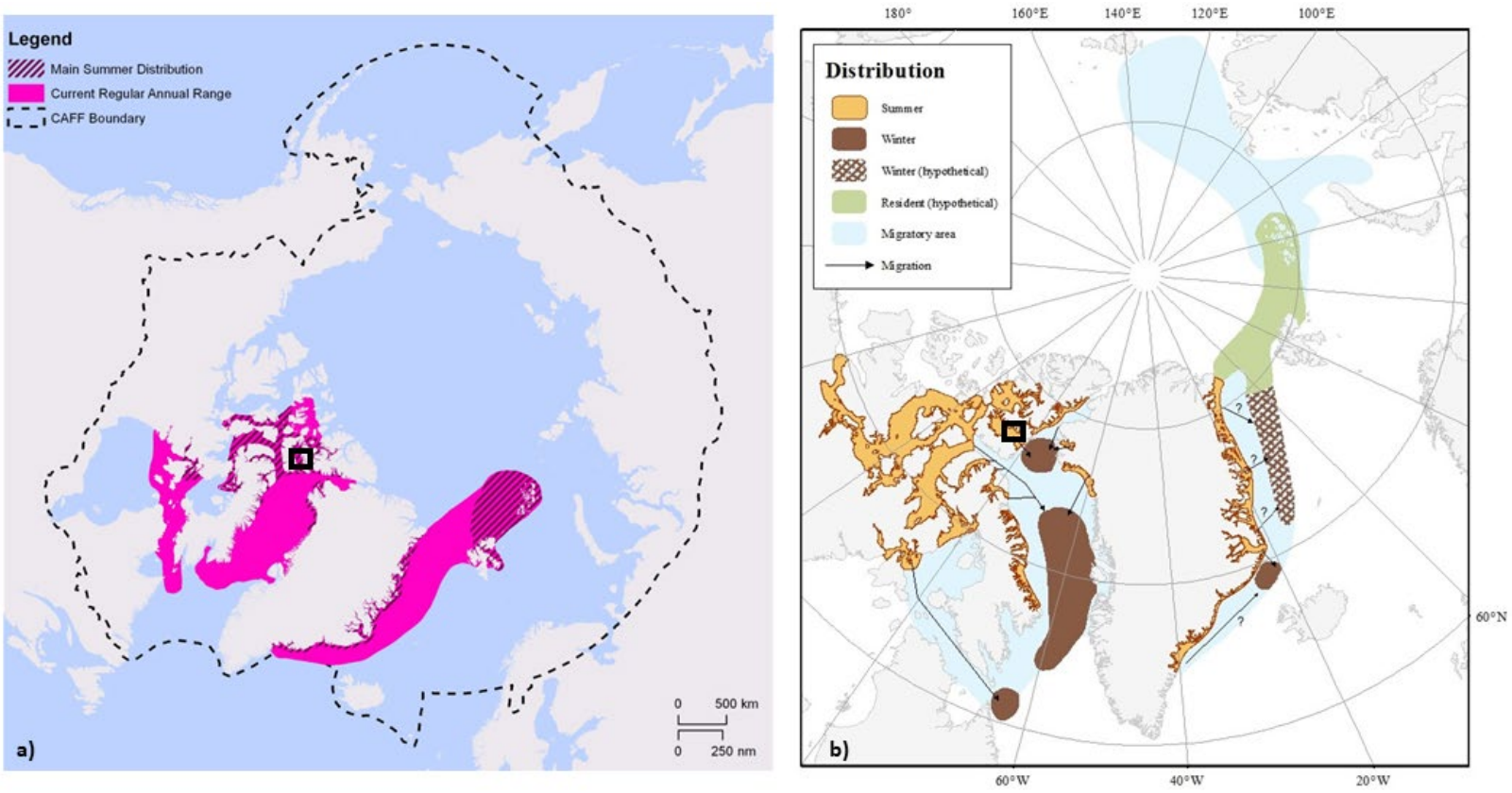


Figure 6-14: a) Narwhal Global Distribution Map and High-Density Summering Grounds; b) Distribution (Summer & Wintering Grounds) and Migration Patterns of Narwhal

Source: a) Figure 2 in Reeves *et al.* (2014); b) Figure 2 in Hobbs *et al.* (2019)
Note: Black square depicts Grise Fiord location



Photo 6-1: Representative Panel of Narwhal Hunting Activities: a) Single Hunting Vessel Pursuing Groups of Surfacing Narwhal; b) Nine Hunting Vessels off the Shore of Grise Fiord

Note: Red circles show locations of surfacing narwhal groups in Panel a

6.4.9 Polar bear

The polar bear (*Ursus maritimus*) is an Arctic resident and referred to by Inuit as 'Nauit' or 'Nanuk' (Inuktut Tusaalanga & GN, 2024).

6.4.9.1 Biogeographic Distribution

Polar bears are circumpolar and can be found throughout the Arctic (Figure 6-15), with a preference for shallow, ice-covered areas of productive upwelling (Wiig *et al.*, 2015). Habitat selection is most closely related to sea ice concentration. Polar bears are native to Canada, Greenland, Norway, the Russian Federation, Svalbard and Jan Mayen, the United States (i.e., Alaska), and are occasionally spotted in Iceland (Wiig *et al.*, 2015). Globally classified as *Vulnerable* under the IUCN, there are 19 recognized subpopulations of polar bears (Wiig *et al.*, 2015), 14 of which can be found in Canada (COSEWIC, 2018). The Lancaster Sound subpopulation (Lancaster Sound Management Unit) overlaps with Grise Fiord and the Norwegian Bay, and Kane Basin subpopulations are adjacent (Government of Canada, 2024d). Polar bears are listed as *Special Concern* under COSEWIC (COSEWIC, 2018) and *Special Concern* on Schedule 1 of SARA (Government of Canada, 2024g). Seasonal ranges and denning areas of polar bears in the Canadian Arctic can be seen on Figure 6-5, Panel i, and Figure 6-15, Panel b.

Polar bears are found throughout the Grise Fiord area (QIA, 2018b) (IQ Workshop 2019 - Amon Akeeagok) with most sightings occurring from March to June, and occasionally into the early fall (GN, 2012)[34]. Polar bears are attracted to the Grise Fiord dump and human food caches found along the shoreline, leading to increased potential for human-polar bear conflict (IQ Workshop 2019 - Amon Akeeagok). Sightings of female bears with one or two juvenile-youth sized cubs have been documented (IQ Workshop 2019 - Amon Akeeagok). Polar bears are also common along the ice edge in Jones Sound (GN, 2012).

[34] See Figure 28 in the Grise Fiord NCRI Report for a depiction of 'probability of occurrence' for polar bear https://www.gov.nu.ca/sites/default/files/documents/2022-07/ncri_grise_fiord_en.pdf

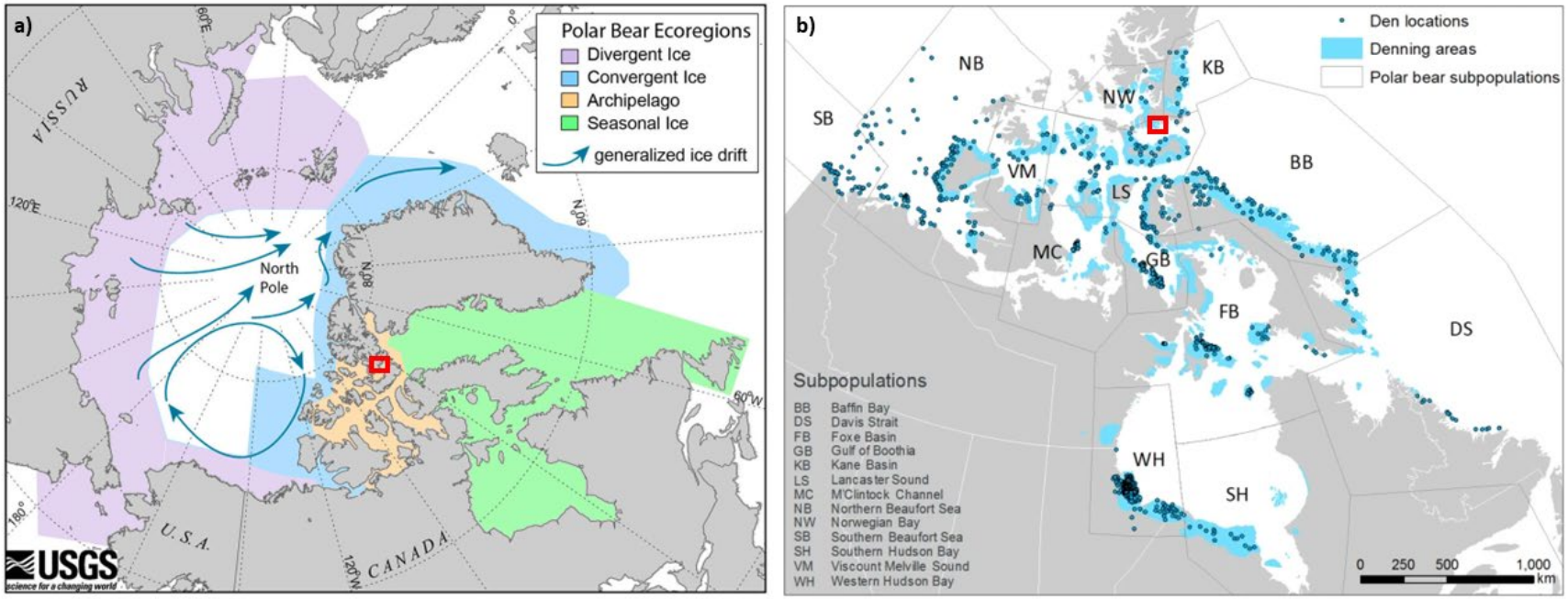


Figure 6-15: a) Global Range of Polar Bear Associated with the Seasonal Ice Ecoregions and Motion; b) Observed Polar Bear Maternity Dens (blue points) and Denning Areas (blue polygons) in Canadian Arctic

Source: a) Figure 1 in Atwood *et al.* (2014); b) Figure 1 in Florko *et al.* (2020)
Note: Red square depicts Grise Fiord Location

6.4.9.2 Ecology and Reproductive Behaviour

Polar bears occur at low densities and have low reproductive rates, with mating occurring in the spring and implantation delayed until autumn (Wiig *et al.*, 2015). Female bears move to dens in late autumn and pups, usually twins, are born in December or January, leaving the den in early spring (Wiig *et al.*, 2015). Preferred diet consists of ringed seals, bearded seals, harp seals, hooded seals, walrus, narwhal and beluga whale (COSEWIC, 2018; Wiig *et al.*, 2015). The life history of polar bears is closely tied to that of the ringed seal (their primary prey species) (QIA, 2018b). Polar bears have their cubs in dens before ringed seals give birth, and then hunt ringed seal pups found in dens, or out on open ice (QIA, 2018b). Coburg Island, and the surrounding waters are designated the Nirjutiqavvik National Wildlife Area, and this area provides important feeding ground for polar bears (Government of Canada, 2024f).

Polar bears show site fidelity to feeding and denning areas, based on sea-ice concentration, type, bathymetry, distance to edge, and distance to land (COSEWIC, 2018). Bear migration patterns of the polar bear show deliberate movements on drifting ice to stay within productive habitats (Vard Marine Inc., 2016). Southern subpopulations have seen significant decline in sea-ice habitat and the polar bears have shifted northward and landward (COSEWIC, 2018).

6.4.9.3 Harvesting

In Nunavut, only Inuit (or an assignee) can harvest polar bears (based on set restrictions), otherwise they can only be killed in defense of human life or property (COSEWIC, 2018). Harvest sites are located in Jones Sound and along the shores of Ellesmere Island, as well as throughout the contiguous waterways of the high Arctic (QIA, 2018b). An average of 19 animals are killed annually in Grise Fiord from October to May (Priest & Usher, 2004), with multiple reports of bears in the area in a local online community group (Grise Fiord News - Facebook Page, 2019). The allowable harvest for 2018 was 85 bears/year in the Lancaster Sound Management Unit (COSEWIC, 2018). Polar bears have long been harvested in the Arctic, and Thule polar bear traps have been located in the Grise Fiord area (Innuit Heritage Trust, 2016; Innuit Places, 2019).

Based on this species' life history, ecology, habitat use, IQ, and harvest reports, polar bears can occur in this region throughout the year. Threats to polar bear survival include loss of sea ice due to climate change, human-caused mortality, pollution, oil development (pollution as well as human interactions), and shipping (COSEWIC, 2018; Wiig *et al.*, 2015).

6.4.10 Ringed Seal

6.4.10.1 Biogeographic Distribution

Ringed seals, the most common seal in the Arctic, have a circumpolar distribution (Figure 6-16) (COSEWIC, 2019; Goodwin, 1990). Native to Canada, Estonia, Finland, Greenland, Japan, Latvia, Norway, Russian Federation, Svalbard and Jan Mayen, Sweden, and the United States, these are the smallest pinnipeds in the world (COSEWIC, 2019; Lowry, 2016a). The five recognized subspecies of ringed seal have been assessed individually by the IUCN, with a global listing of *Least Concern* (Lowry, 2016a).

The Arctic ringed seal subspecies (*P. h. hispida*) (Lowry, 2016a) can be spotted near every community in Nunavut in the spring (Canadian Northern Economic Development Agency, 2019). Ringed seals are listed as *Special Concern* under COSEWIC, and are consideration for addition under SARA (Government of Canada, 2024g). A 2016 IUCN Red List assessment found 1,450,000 mature individuals in the Arctic population, with a likely total population greater than three million animals (Lowry, 2016a).

Ringed seals are a non-migratory species, that remain in the Arctic, and can be found in Lancaster Sound and the contiguous waterways, including Jones Sound and Grise Fiord year-round (COSEWIC, 2019; Goodwin, 1990; Natures Edge, 2015)[35]. The distribution of ringed seals and their pupping habitat in the Canadian Arctic can be seen on Figure 6-5, Panel j. Grise Fiord is located within the Eastern Jones Sound EBSA (DFO, 2011a), just west of the ringed seal high density area that crosses the mouth of Jones Sound (NPC, 2017). Coburg Island (at the mouth of the Sound) and the surrounding waters are designated the Nirjutiqavvik National Wildlife Area, and this area provides important feeding ground for ringed seals (Government of Canada, 2024f).

The resident ringed seal population in Jones Sound is abundant year-round (QIA, 2018b). Tens of thousands of ringed seals are reported in from the area, with most sightings occurring from March to May with several pupping areas in the vicinity of Grise Fiord (GN, 2012). Seals are reported to be everywhere in this region (IQ Workshop 2019 - Amon Akeeagok; IQ Workshop 2019 - Manasie Noah; IQ Workshop 2019 - Marty Kuluguqtuq). The resident seal population is augmented by the migratory animals that come from Baffin Bay, with the migratory animals returning in *Upirngasaaq* (April) during the breeding season (QIA, 2018b). Ringed seals are also found in the fiords near Grise Fiord during the open-water season (QIA, 2018b). During the winter months and up until *Upirngaaq* (mid May to early July) this species makes use of the floe edge and breathing holes, whereas during *Aujaq* (early July to August) and *Ukiassaaq* (Sepember and October) they make use of the open-water (QIA, 2018b).

6.4.10.2 Ecology and Reproductive Behaviour

The seasonal distribution of this species is highly influenced by the ice. Bradstreet (1982) observed in Lancaster Sound that seals were in noticeably higher densities within 24 km of the ice edge than farther away. Ringed seals use landfast ice and pack ice during the winter, maintaining breathing holes (Kingsley, 1986), and can also be found in multiyear ice (GN, 2012). In mid-May, ringed seals haul out to moult, fasting during this time (McLaren, I.A., 1958). Most mating occurs in April shortly after pups are born (Goodwin, 1990). Pups are born in lairs on fast ice around April and are nursed for 30 days, and parental care lasts until break-up (McLaren, I.A., 1958).

Ringed seals forage in both shallow coastal waters and offshore waters as deep as 150 m, feeding on a variety of fish and invertebrates, and planktonic, nektonic, and benthic prey (Bluhm, B A. & Gradinger, R R., 2008; Goodwin, 1990; McLaren, I A., 1958). In Grise Fiord, seals are reported to feed on cod in July (IQ Workshop 2019 - Manasie Noah).

[35] See Figure 30 in the Grise Fiord NCRI Report for a depiction of 'probability of occurrence' for ringed seal https://www.gov.nu.ca/sites/default/files/documents/2022-07/ncri_grise_fiord_en.pdf

The ringed seal produces sounds that range from 0.4 kHz to 16 kHz (Stirling, 1973; Todd *et al.*, 2015) with vocalizations consisting of barks, yelps, and growls that can be heard year-round, with peaks during winter and spring (Barbosa *et al.*, 2024; Halliday *et al.*, 2017; Halliday *et al.*, 2019; Jones *et al.*, 2014). Individuals can remain submerged for up to 17 minutes (Lydersen, 1991).

6.4.10.3 Harvesting

Ringed seals are harvested year round with variation in the monthly effort and numbers taken (Priest & Usher, 2004). An average of 653 ringed seals are killed annually in Grise Fiord, with the majority killed in the summer (Priest & Usher, 2004). Local areas where harvesters wait for seals are identified Figure 2-1 as well as along cracks in the ice where they are harvested until the ice breakup in the spring (IQ Workshop 2019 - Manasie Noah). Natural predators include killer whales, walrus, polar bears and Arctic foxes, and predation on pups by birds such as gulls and ravens has been observed (COSEWIC, 2019). Other threats include pollution, climate change (habitat loss with reduced sea ice and snow cover), and anthropogenic disturbance (Lowry, 2016a).



Figure 6-16: Geographic Range of Ringed Seal in Canadian Adjacent Waters

Source: COSEWIC (2019)
Note: Red square depicts Grise Fiord location

7 Fish and Fish Habitat - Field Program

Quantitative surveys were undertaken during the Feasibility (15 to 17 August 2019) and detailed design (3 to 6 September 2024) phases to characterize habitat of the intertidal and subtidal areas of the Community Harbour Study Areas in Grise Fiord. For a description of Study Areas in Grise Fiord see Section 1.4, Figure 1-1, and for weather details on each field program see Table 1-4.

Program objectives for fish and fish habitat are provided in Section 1.5 (Table 1-1).

7.1 Field Methodology

Fish and fish habitat conditions were characterized within the Community Harbour Study Area and surrounding reference sites. The marine habitat was surveyed using a combination of survey techniques to assess intertidal, subtidal and surface conditions as summarized below with survey dates provide in Section 1.5.2 (Table 1-3), and weather conditions (including tidal state) are provided in Table 1-4 (2024) and Table 1-5 (2019). Fish and fish habitat surveys conducted include:

- Intertidal transect surveys at low tide in out-of-water tidal conditions (2019, 2024).
- Subtidal surveys using a remote operated vehicle (ROV) (2019, 2024).
- Aerial surveys with a drone which targeted low slack tide (2024).
- Plankton tow surveys (2024).
- Surface current survey with a drogue (2019, 2024).

The survey zones are defined as follows:

- Intertidal: High Water Line (HWL) to the Low Water Line (LWL).
- Subtidal: All water below LWL.

Freshwater habitats, when present in proximity to the Project Study Area, were documented qualitatively.

For data that is depicted from 2019, only those performed in proximity to the design selected to be the community harbour are presented, therefore those surveys that occurred in proximity to Option 2 and Option 3 were not included in this report (see Figure 1-2 in the PSIR Report (Dynamic Ocean & Worley Consulting, 2025a)).

Georeferenced maps were made in advance of the field program, which documented the community harbour footprints, Project Study Area. The field team geospatially referenced field program locations using the Avenza App on an iPad.

7.1.1 Intertidal Surveys

7.1.1.1 Traditional

Intertidal surveys were undertaken using traditional (on foot, out of water) and novel (drone) techniques to determine habitat characteristics along the foreshore of the Community Harbour Study Area (see Section 1.4 for Study Area definitions). The surveys were undertaken at low tide with the intention of observing the benthic habitat (seabed) in out of water tidal conditions. Transection locations for the intertidal surveys are provided in Table 7-1, and tide information is provided in Figure 7-1.

Perpendicular to shore transects were established from the HWM to the accessible water line, with five transects performed in 2019 and 16 in 2024. Transect were spaced between 35 m and 210 m apart across the Project Footprint shoreline. A Qualified Professional (QP) considered this distance apart was acceptable based on the probability of relatively homogenous habitat types, differentiated by soft or hard substrates for the heterogeneity.

Transects established perpendicular to the shore were selected to assess for the variability in habitat from the high to low intertidal area. In advance of the transect survey, a QP assessed the intertidal area to confirm the number of habitat bands along with their characteristics. A habitat band was defined as an observable differentiation on biophysical features (substrate, vegetation, fauna). The QP also confirmed whether there were differences in the number of habitat bands along each transect. A transect was established from the HWL to the accessible portion of the LWL. Quadrats were spaced along the transect according to habitat variability (as per habitat bands), as determined by the Qualified Professional (QP), to ensure systematic sampling. A minimum of three equidistant quadrats were performed per transect line.

The transects' start and stop locations were georeferenced using the Avenza App on an iPad. The transect total length and the length of individual habitat bands within each transect was measured. At the start of each transect, seaward and landward photographs were taken, and a broad-scale photograph of the intertidal was taken on the iPad. For each quadrat, an overhead photograph was taken. Photographs of organisms present on the transect were taken with an object for scale, when relevant. Broad scale photographs across the intertidal landscape were taken to facilitate the identification of habitat bands.

Photographs from the intertidal survey were analyzed by the enumeration techniques described in Table 7-7 for substrate and Table 7-8 for categorizations of marine organisms and vegetation. Habitat was categorized by the quality definitions provided in Table 7-6. Sessile and motile organism abundance estimates included counts, percent cover, or relative estimates, depending on the organism being assessed. Marine vegetation was assessed through a percent cover estimate and sessile invertebrates were assessed through a combination of counts and aerial coverage (m^2), depending on their abundance. Identification of reference and controls for surveyed sites will be determined during the detailed design phase.

Table 7-1: Information on Intertidal Transects Conducted at the Community Harbour Study Area

Type	Transect No.	Start		Transect Length (m)	Number of Quadrats	Quadrat Spacing (m)	Distance from Previous Transect (m)
		Latitude (N)	Longitude (W)				
05-Sept-24							
Reference	1[1]	76° 25.075	82° 54.197	31.0	6	6.2	31
Reference	2[1]	76° 25.089	82° 54.294	29.0	6	5.8	29
Community Harbour	3[1]	76° 25.109	82° 54.380	33.5	6	6.7	34
Community Harbour	4[1]	76° 25.121	82° 54.435	32.5	7	5.4	33
Community Harbour	5[2]	76° 25.153	82° 54.487	65.0	9	8.0	73
04-Sept-24							
Community Harbour	6[2]	76° 25.170	82° 54.548	96.0	15	7.0	96
Community Harbour	7[2]	76° 25.193	82° 54.577	182.0	15	12.0	182
Community Harbour	8[1]	76° 25.214	82° 54.461	27.0	5	6.8	27
Community Harbour	9[1]	76° 25.245	82° 54.417	23.5	5	4.7	24
Community Harbour	10[1]	76° 25.273	82° 54.447	27.5	5	6.8	28
Community Harbour	11[1]	76° 25.296	82° 54.501	26.0	5	6.5	26
Community Harbour	12[1]	76° 25.320	82° 54.564	22.0	5	5.5	22
Community Harbour	13[1]	76° 25.341	82° 54.635	23.5	5	4.7	24
Community Harbour	14[1]	76° 25.361	82° 54.697	25.0	5	6.3	25
Community Harbour	15[1]	76° 25.379	82° 54.786	22.5	5	5.6	23
Community Harbour	16[1]	76° 25.396	82° 54.889	23.5	5	2.7-6.7	24

Type	Transect No.	Start		Transect Length (m)	Number of Quadrats	Quadrat Spacing (m)	Distance from Previous Transect (m)
		Latitude (N)	Longitude (W)				
17-Aug-19							
Community Harbour	1[2]	76° 25.116	82° 54.420	25.0	6	5.0	-
Community Harbour	2[2]	76° 25.208	82° 54.523	25.0	6	5.0	210
Community Harbour	3[2]	76° 25.246	82° 54.406	25.0	6	5.0	90
Community Harbour	4[2]	76° 25.293	82° 54.484	20.0	6	4.0	90
Community Harbour	5[2]	76° 25.336	82° 54.617	20.0	6	4.0	105

Note:

1. Transect starting at HWL
2. Transect starting at LWL

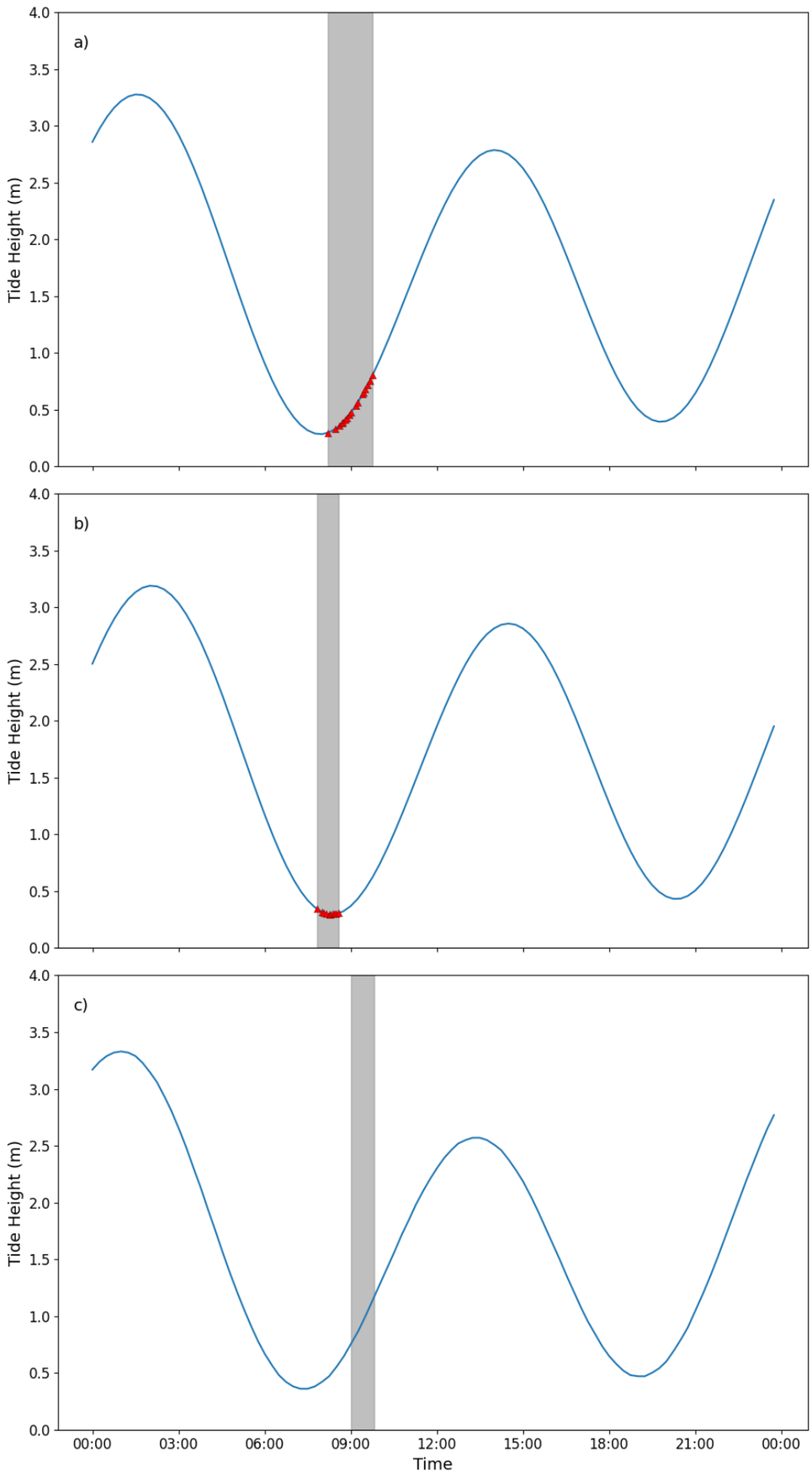


Figure 7-1: Intertidal Survey Time and Tide Information: a) 4 September 2024; b) 5 September 2024; c) 17 August 2019

Source: Grise Fiord Station (06570) in CHS (2019, 2024)
Note: Duration of intertidal program represented by grey column and red triangles represent the time of each transect

7.1.1.2 Drone

The drone survey within the Community Harbour Study Area was performed by Underhill Geomatics Ltd. (Underhill) during the terrestrial 2024 field program. The drone imagery, while intended for detailed design purposes, has been used to further document habitat conditions within Community Harbour Study Area (in addition to Haul Road freshwater crossings as described in Section 7.1.5).

Pre-flight planning was carried out using Google Earth, with careful consideration given to potential aviation hazards and the terrain characteristics of the Project Study Area. A DJI Mavic 3 Enterprise RTK was utilized with the survey conducted at approximately 12:00 on 28 August 2024 (see Table 1-3 and Table 1-4). This timing coincided with the rising tide, as optimal low-tide conditions were not achievable due to weather-related constraints. Following data collection, the imagery was post-processed using Agisoft Metashape to generate georeferenced orthophotos of the harbour areas. This process ensured accurate spatial representation and alignment with the Project's geospatial requirements.

7.1.2 Subtidal Remote Operated Vehicle Survey

Remote operated vehicle (ROV) surveys were undertaken within the Community Harbour Study Area to delineate seabed conditions, where a VideoRay Pro 4 ROV (2019) and Blue Robotics ROV2 (2024) were used. Transects were performed from a stational platform (vessel of a local), where the length of the transect was known based on the length of tether run out (marked in 1 m increments). The transect start position was delineated and georeferenced using the Avenza App on an iPad, with the end position marked using the Avenza measure tool. The number of transects conducted at each site and other descriptive characteristics are provided in Figure 7-3 and Table 7-2, and tide information is provided in Figure 7-2.

In 2019, a total of 26 ROV transects were conducted. Transect length varied from 30 m to 65 m, with start depths varying from 1.8 m to 4.7 m, chart datum (CD). In 2024, a total of 18 ROV transects were conducted. Transect length varied from 45 m to 95 m, with start depths varying from 0.4 m to 23.5 m, CD.

Video recordings were later analyzed by the enumeration techniques as described in Table 7-6 for substrate and Table 7-7 for categorizations of marine fauna/flora. Habitat was categorized by the quality definitions provided in Table 7-8. Sessile and motile fauna abundance estimates are counts, percent cover, or relative estimates, depending on the organism being assessed. Additional images were taken either during survey, or as video snapshots using the program Adobe Premiere Pro CC 2019 (Version 24.6.1). Where possible, exact counts were provided but were otherwise in relative abundance. When there was uncertainly in the species identification, an indication of 'possible' (poss) or 'probable' (prob) is provided.

Table 7-2: Information on Subtidal Transects Conducted at the Community Harbour Study Area (2024)

Date	Transect No.	Start		Time	Tide Height (m)	Depth (m)		Distance (m) and Direction
		Latitude (N)	Longitude (W)	Start		ROV (Gauge)	Chart Datum (m, CD)	
Community Harbour								
03-Sep-24	T1*	76° 25.066	82° 54.160	15:16	2.2	25.1	23.5	95 W
	T2	76° 25.063	82° 54.167	15:31	2.1	3.0	1.5	60 N
	T3	76° 25.060	82° 54.158	15:41	1.9	6.4	5.1	50 SE
	T4*	76° 25.113	82° 54.523	15:59	1.8	25.0	23.9	60 SW
	T5	76° 25.107	82° 54.540	16:14	1.6	3.2	2.2	50 W
	T6	76° 25.107	82° 54.534	16:22	1.5	4.0	3.1	50 SE
	T7*	76° 25.138	82° 54.906	16:40	1.3	6.2	5.4	90 WSW
	T8	76° 25.137	82° 54.908	17:02	1.2	3.0	2.3	60 SW
	T9*	76° 25.139	82° 54.902	17:09	1.0	2.9	2.3	80 NW
	T10	76° 25.140	82° 54.908	17:23	0.9	2.9	2.4	90 WNW
	T11*	76° 25.221	82° 55.437	17:38	0.8	15.4	15.0	85 WSW
	T12*	76° 25.220	82° 55.434	17:48	0.8	5.3	4.9	70 SW
	T13	76° 25.222	82° 55.438	17:57	0.7	2.9	2.5	70 NE
	T14	76° 25.222	82° 55.441	18:04	0.7	3.7	3.3	70 NE
06-Sep-24	T15	76° 25.300	82° 55.783	12:34	2.0	8.0	5.4	60 E
	T16*	76° 25.310	82° 55.389	12:46	2.7	3.4	0.7	45 ESE
	T17	76° 25.310	82° 55.383	12:53	2.7	2.3	-0.4	48 NE
	T18*	76° 25.309	82° 55.386	13:02	2.7	4.0	1.3	-

Table 7-3: Information on Subtidal Transects Conducted at the Community Harbour Study Area (2019)

Date	Transect No.	Start		Time	Tide Height (m)	Depth (m)		Length (m)
		Latitude (N)	Longitude (W)	Start		ROV (Gauge)	Chart Datum (m, CD)	
Community Harbour								
15-Aug-19	T1	76° 25.175	82° 54.622	11:49	1.8	0.5	-1.3	62
	T2	76° 25.213	82° 54.620	12:06	2.2	1.7	-0.5	56
	T3	76° 25.267	82° 54.584	12:21	2.2	2.3	0.1	50
	T4	76° 25.234	82° 54.491	12:34	2.2	1.6	-0.6	55
	T5	76° 25.247	82° 54.627	12:59	2.2	2.3	0.1	56
	T6	76° 25.167	82° 54.696	13:06	2.4	1.2	-1.2	50
	T7*	76° 25.131	82° 54.575	13:12	2.4	1.2	-1.2	51
	T8*	76° 25.194	82° 54.821	13:23	2.4	2.1	-0.3	51
	T9	76° 25.181	82° 54.584	13:40	2.4	0.6	-1.8	30
	T10	76° 25.228	82° 55.487	14:16	2.4	5.7	3.3	60
	T11	76° 25.282	82° 55.484	14:57	2.4	4.1	1.7	60
	T12	76° 25.278	82° 55.336	15:12	2.0	2.4	0.4	55
	T13	76° 25.288	82° 55.153	15:23	2.0	1.6	-0.4	55
	T14	76° 25.285	82° 54.956	15:35	2.0	1.8	-0.2	60
	T15	76° 25.319	82° 54.812	15:46	2.0	1.8	-0.2	50
	T16	76° 25.267	82° 55.631	22:11	1.8	6.5	4.7	65
	T17	76° 25.246	82° 55.429	22:30	1.8	4.0	2.2	50

Date	Transect No.	Start		Time	Tide Height (m)	Depth (m)		Length (m)
		Latitude (N)	Longitude (W)	Start		ROV (Gauge)	Chart Datum (m, CD)	
	T18	76° 25.292	82° 55.271	22:47	1.8	2.2	0.4	50
	T19	76° 25.283	82° 55.065	23:17	2.4	2.5	0.1	55
	T20	76° 25.297	82° 54.872	23:27	2.4	2.7	0.3	50
	T21	76° 25.332	82° 54.769	23:38	2.4	2.8	0.4	50
	T22	76° 25.308	82° 54.622	23:49	2.4	2.8	0.4	50
	T23	76° 25.243	82° 54.778	23:59	2.4	2.9	0.5	60
	T24	76° 25.232	82° 54.984	00:13	3.0	2.9	-0.1	50
Reference								
15-Aug-19	T1	76° 24.976	82° 53.597	12:26	2.2	1.0	-1.2	55
	T2	76° 24.907	82° 53.496	12:34	2.2	3.0	0.8	50

Note: * Transect perpendicular to shore

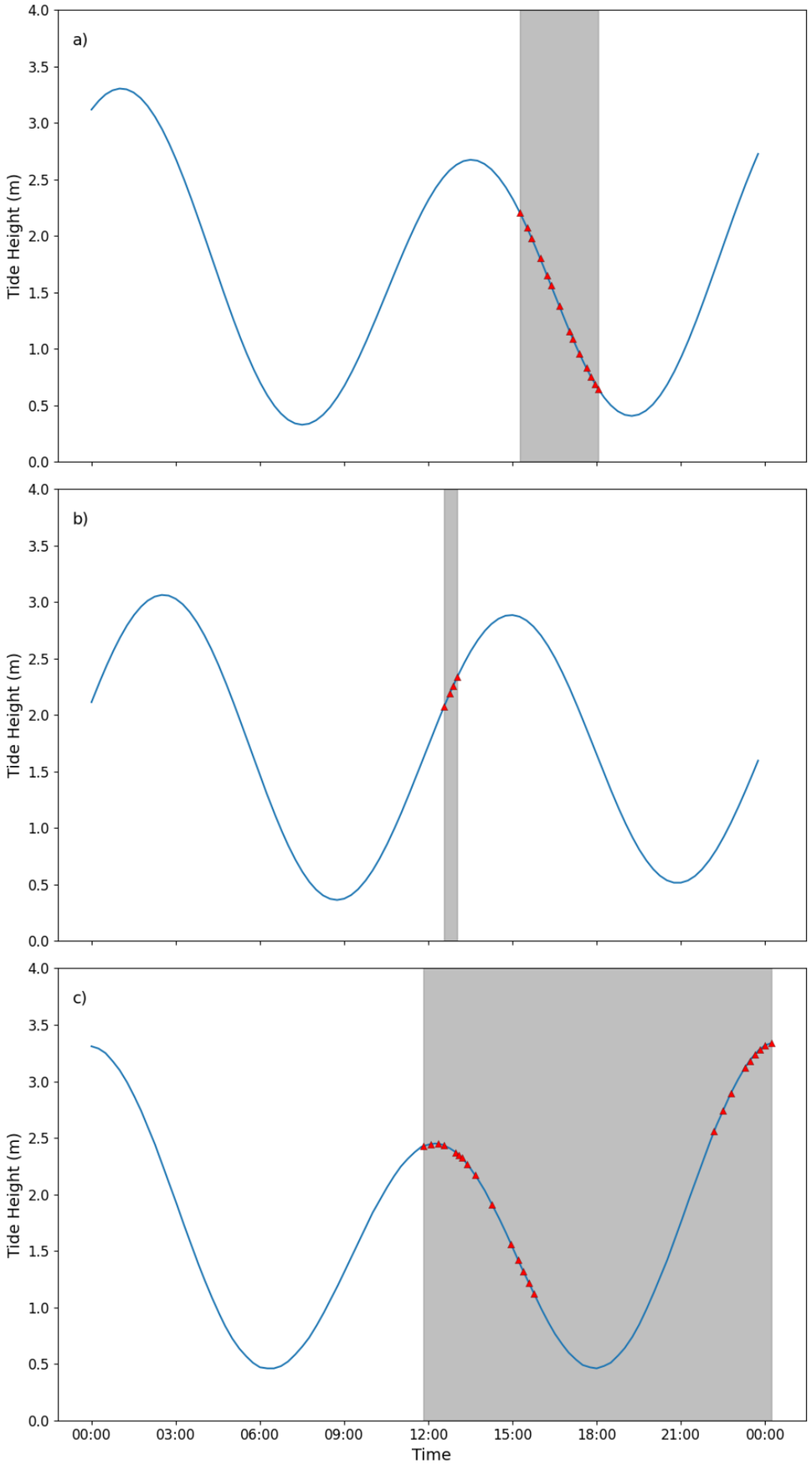
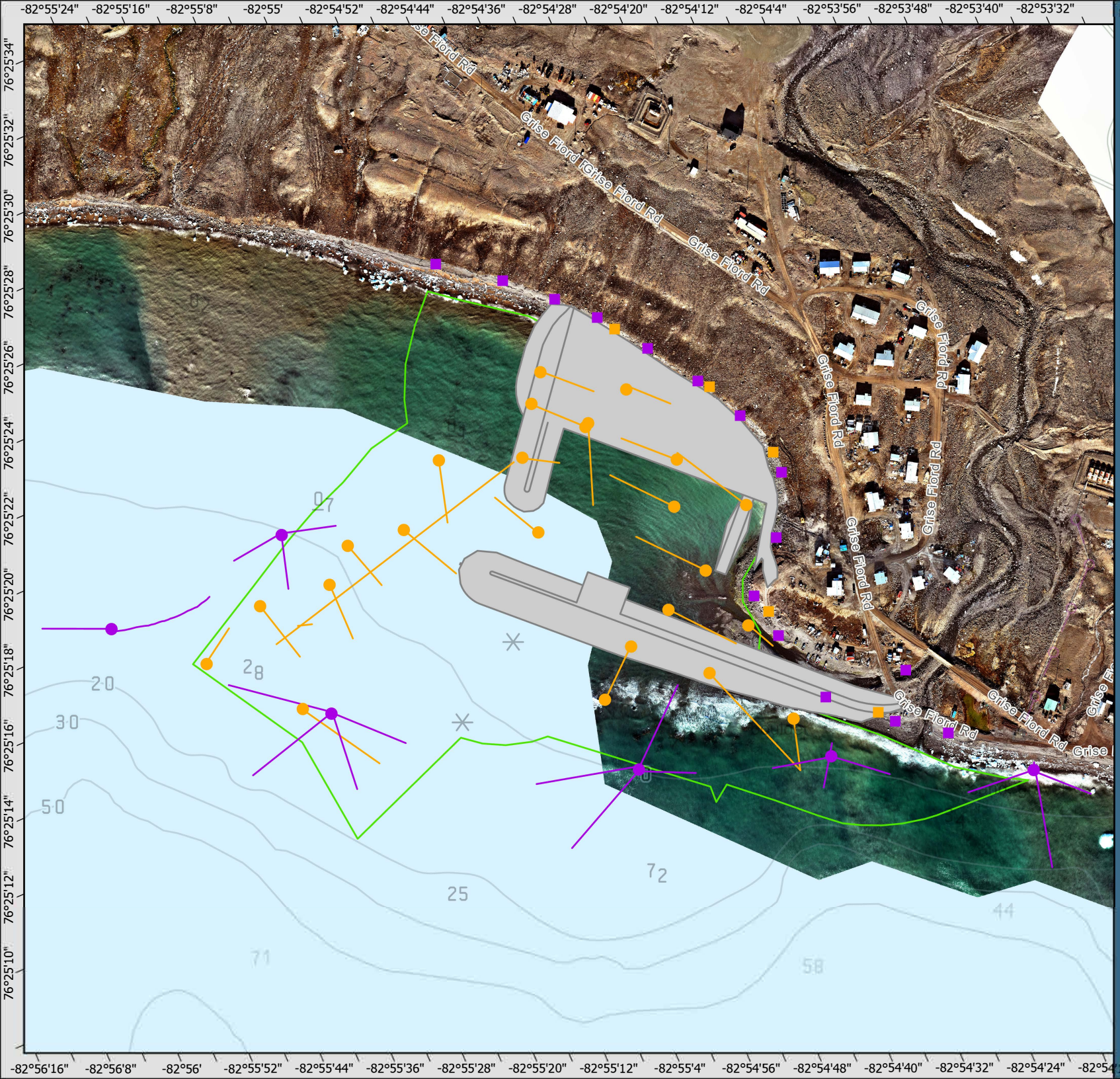


Figure 7-2: ROV Survey Time and Tide Information: a) 3 September 2024; b) 6 September 2024; c) 15 August 2019

Source: Grise Fiord Station (06570) in CHS (2019, 2024)
Note: Duration of ROV program represented by grey column and red triangles represent the time of each transect



Community Harbour

Community Harbour Study Area

ROV Transect Locations

2024 2019

Intertidal Transect Locations

2024 2019



N

Scale: 1:4,400

0 40 80 160 m

Spatial Reference
Name: WGS 1984 Arctic Polar Stereographic
GCS: GCS WGS 1984
Datum: WGS 1984
Projection: Stereographic North Pole
Map Units: Meter
Drawn: C. Laidlaw

Figure 7-3

Community Harbour Study Area Fish Habitat (Intertidal & ROV (2019,2024))

7.1.3 Amphipod

The survey was performed as part of the intertidal survey at low tide, with searching under rocks in areas identified as 'ideal amphipod habitat'. Ideal amphipod habitat was considered areas that offered some form of multi-dimensional habitat which consisted of either hard substrate (e.g. boulder, cobble) or rockweed. Samples were collected and preserved in 95 % ethanol, then packaged, and provided to the University of British Columbia (UBC) for species analysis (see Section 7.4.5).

7.1.4 Plankton

7.1.4.1 Tow Methodology

During the 2024 field program, a plankton survey was carried out in the Community Harbour Study Area, where six sites with two replicates each for a total of 12 tows. Information on tides at the time of the survey is provided in Table 7-4 and depicted in Figure 7-5. Representative photos of a similar plankton field program are provided in Photo 7-1, as photographs on the date of the field program were not achievable due to weather conditions.

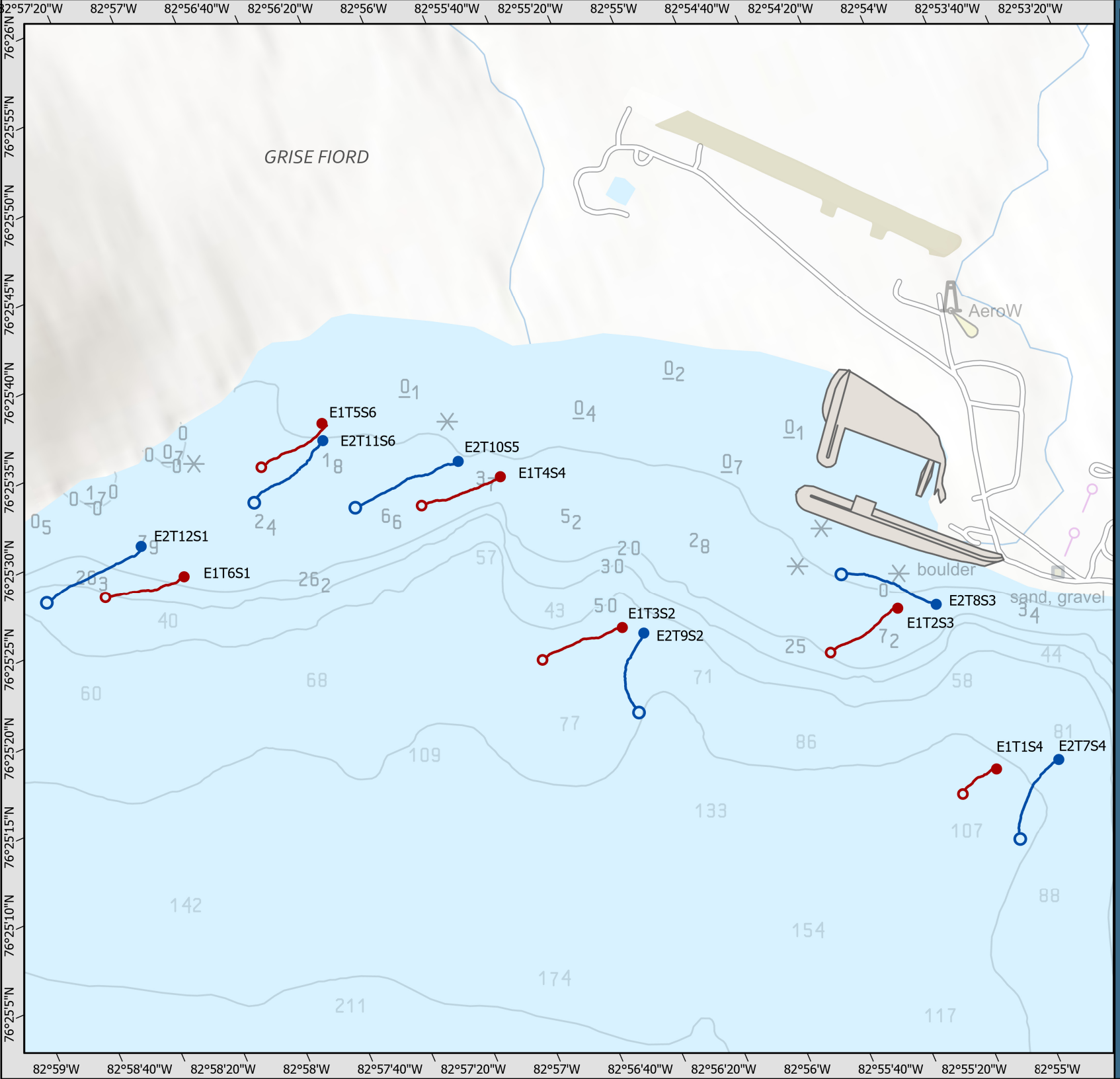
A 200 µm, 1 m wide and 2 m long mesh net was used for the plankton survey. The boat travelled at approximately 1 knot to 1.5 knots in a straight line for a five-minute period. The net was deployed over the side of the boat, and the start of tow was considered to be when the net drag was felt by the boat crew and the tow line became tight. The tow line was approximately eight m long, and a float was attached to the net ring with a two m line to confirm the net depth remained at two m from the water surface. GPS coordinates were taken at the start and stop of the tow, and a track (georeferenced using an iPad) was run during the tow to confirm the position during the tow. The tow duration was five minutes. Once the tow was terminated, the boat operator put the boat into neutral and slowly reversed as the net was pulled toward the boat. Once at the boat, the ring of the net was kept out of the water. One local assistant gently sprayed the outside part of the net with a pressurized water hose to rinse the plankton into the cod-end (bottom of the net). The second local assistant pulled the net into the boat as it was sprayed. The cod-end was then removed from the net and emptied into a 200 µm sieve. The cod-end was rinsed with water (from the outside). All the plankton were concentrated into one end of the sieve with a water bottle (only spraying from underneath). A funnel was used to rinse the plankton into a 250 ml jar containing 95 % ethanol. Jars were filled to a maximum of 50 % plankton, and thus multiple jars were used as required.

Samples were packaged (lid sealed with electrical tape) and provided to UBC for analysis (visual and genetic identification, quantification of species composition and abundance, see Section 7.4.4). Two randomized tow samples were sub-sampled to estimate total abundance, and to visually identify species with light microscopy. The rest were sub-sampled for Deoxyribonucleic Acid (DNA) barcoding analysis (see Section 7.2.2).

Table 7-4: Plankton Tow Survey Times (4 September 2024 and 5 September 2024)

Site No.	Event No.	Tow No.	Start		Time of Tow	Tide Height at time of Tow (m)
			Latitude (N)	Longitude (W)		
1	1	6	76° 25.441	82° 57.996	14:10	2.5
	2	12	76° 25.462	82° 58.234	NR	-
2	1	3	76° 25.208	82° 56.357	13:16	2.8
	2	9	76° 25.126	82° 56.090	13:02	2.8
3	1	2	76° 25.099	82° 55.195	12:54	2.8
	2	8	76° 25.165	82° 55.012	12:42	2.8
4	1	1	76° 24.915	82° 54.911	12:38	2.7
	2	7	76° 24.853	82° 54.772	12:30	2.7
5	1	4	76° 25.396	82° 56.232	13:30	2.8
	2	10	76° 25.426	82° 56.839	13:19	2.9
6	1	5	76° 25.503	82° 57.144	13:43	2.7
	2	11	76° 25.476	82° 57.237	13:43	2.9

Note: Event 1 occurred on 4 September 2024, and Event 2 occurred on 5 September 2024



Nunavut

worley
DELIVERING SUSTAINABLE CHANGE

Dynamic Ocean Consulting Ltd.

Community Harbour

Plankton Survey Event 1
Start Stop

Plankton Survey Event 2
Start Stop



N

Scale: 1: 9,377

0 100 200 400 m

Spatial Reference
PCS: WGS 1984 Arctic Polar Stereographic
GCS: GCS WGS 1984
Datum: WGS 1984
Map Units: Meter
Date Exported: 24-02-2025
Drawn: C. Laidlaw

Figure 7-4

Plankton Tow Locations

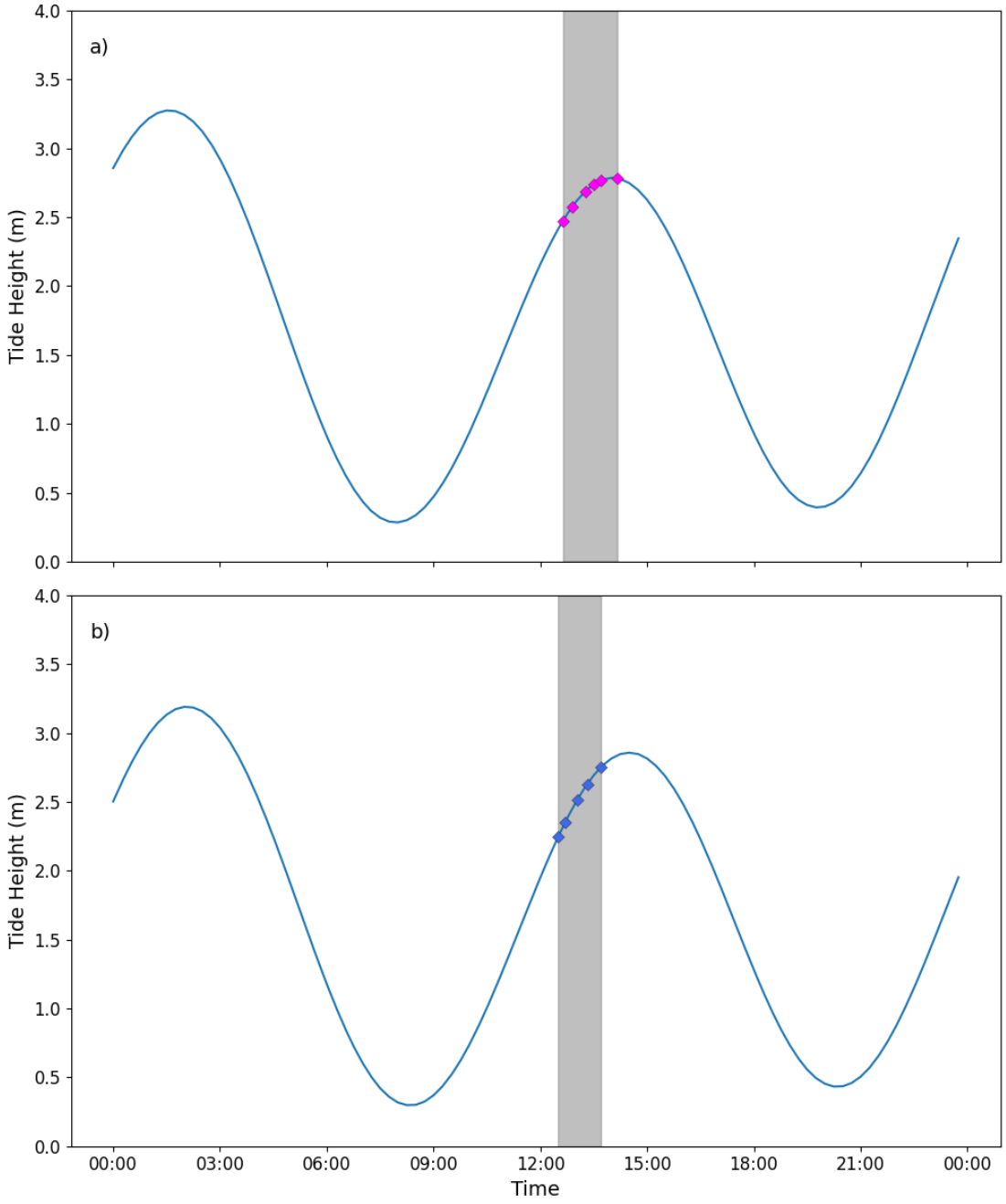


Figure 7-5: Plankton Tow Survey Time and Tide Information: a) 4 September 2024; b) 5 September 2024

Source: Grise Fiord Station (06570) in CHS (2024)
Note: Duration of plankton program represented by grey column, and blue squares represent the time of each tow, with pink for Event 1 and blue for Event 2



Photo 7-1: Representative Photo Panel from a Similar Plankton Tow Survey: a) Sample; b) Field Personnel Emptying Plankton Net; c) Sample Processing Close-up; d) Sample Processing

Source: Dynamic Ocean

7.1.4.2 Physiochemical

Physicochemical analysis was undertaken in 2024 with a YSI Pro4 DSS probe and taken along side with plankton tow at each site. The YSI was lowered over the side of the vessel to document a vertical profile of the water column. The YSI was programmed to take a reading every half second, and recording was undertaken on the descent through the water column.

7.1.5 Fresh Water Assessment

Potential freshwater 'interactions' were identified in advance of the field program with the use of Google Earth and KML's of the Project Study Area. The Hamlet of Grise Fiord Master Drainage Plan (Tetra Tech,

2021) was also used as a cross reference. An interaction is considered a freshwater course ‘intersecting’ a project component, such as one that would require culverts (or confirmation of functioning culverts) during use of the haul road, or the potential to require stream diversion for the community harbour.

During IQ and consultation, the potential for any of the creeks/rivers to be fish-bearing watercourses was asked. During the field program, a qualitative assessment was undertaken on 5 September 2024, to assess freshwater habitat conditions at the ’target areas’ identified. Photograph and GPS positions were documented. This assessment was further supported with a review of the Underhill drone data (described in Section 7.1.1.2). Freshwater sources (all non fish-bearing) in proximity to the Project components are summarized in Table 7-5 and Figure 7-10.

Table 7-5: Freshwater Courses in Proximity to Project Components

Creek Name	Creek Location (Foreshore)		Creek Description	In Proximity to		Fish Bearing
	Latitude (N)	Longitude (W)		Project Component	Distance and Direction away	
Kuuraaluk Creek – northern arm	76° 25.170	82° 54.565	Fed by glacier northeast of the Project, flows through the community and splits into two arms. The northern arm drains into community harbour.	Community Harbour	Within the footprint	No
				Haul Road	Intersect east of community harbour	
Kuuraaluk Creek – southern arm	76° 25.097	82° 54.364	Fed by glacier northeast of the Project, flows through the community and splits into two arms. The southern arm drains east of the community harbour footprint.	Community Harbour	Adjacent to footprint, east of south breakwater	No
				Haul Road	Intersect east of community harbour	
Valley Creek	76° 25.518	82° 55.890	Fed by glacier northwest of the Project, flows down the valley and drains into the beach west of the airport runway.	Community Harbour	1 km northwest of footprint	No
				Haul Road	Intersect northwest of community harbour	
				Quarry Location 2B	Intersect north of the area	
				Quarry Location 2C	Intersect south of the area	
				Quarry Location 2D	0.1 km north of the area	

7.2 Laboratory and Office Methodology

7.2.1 Habitat Characterization

Substrate categories for both surveys were as defined by DFO (1990); see Table 7-6). Marine plant observations were recorded as a percent areal cover (DFO, 1990, addition of 'infrequent' category specific to this program). Sessile and motile fauna observed abundance estimates are counts, percent cover, or relative estimates, depending on the organism being assessed. When using relative estimates, the categories defined in Table 7-7 are used. Habitat was categorized by the quality definitions defined in Table 7-8.

Table 7-6: Substrate Categories for the Marine Fish and Fish Habitat Field Assessment

Substrate	Definition	Size (mm)
Silt, clay, mud	Loose sedimentary deposit.	<0.0625
Sand	Loose granular material.	0.0625 - 2
Gravel	Loose fragments of rock.	2 - 64
Cobble	Loose stone larger than gravel, smaller than a boulder.	64 - 256
Boulder	Detached mass of rock.	>256
Bedrock	Solid rock underlying unconsolidated surface material.	
Shell hash	Shell fragments of various organisms.	

Source: DFO (1990)

Table 7-7: Categorizations of Marine Fauna when Enumerated with Estimates

Category	Definition	Quantified Area Estimate	
		Percent Cover (%)	Area (m^2) estimates
Abundant	Organisms distributed as the primary flora or fauna.	Distribution that covered an area >50 % of available suitable habitat.	20 to 50
Moderate	Organisms either clustered in groups or sporadic within the habitat zone.	Distribution covering 25 % to 50 % of available habitat.	10 to 20
Infrequent	Combination of moderate and trace, patchy and ephemeral in nature, occurring in more frequent clusters than trace.		
Trace	Relatively small cluster of colonizing organisms.	(<10 % to 25 %) of assessed area.	5 to 10

Source: Adapted from percent cover estimates in DFO (1990).
Note: 'Infrequent' and area estimates are adapted by Dynamic Ocean based on Qualified Professional (QP) expertise

Table 7-8: Habitat Categories for Marine Seabed Classification

Category	Description
High	High value habitat that contributes to a critical life stage or function (e.g. feeding, nursery, reproductive, migratory route) of a marine species, or that are of high social or cultural significance. Additionally, loss of the habitat in question is limited or could result in decreased connectivity of a marine species or population.
Moderate	Habitat that may contribute to critical life stages or function of a marine species but is not limited.
Low	Habitat does not contribute to life stages and functions of marine species and is not limited. Habitat may be used for migratory purposes of marine species, but alternative migratory routes are available.

7.2.2 Species Identification and Morphometrics Methodology

7.2.2.1 Amphipod

Amphipods were identified using visual identification and a dichotomous key (Carlton, 2007). Body lengths were measured with a digital ruler embedded in the display of the light microscope camera.

7.2.2.2 Plankton

A two-fold approach to identify species diversity and abundance of plankton was undertaken. Ten percent of the total volume of each preserved plankton tow sample was set aside for counting and microscopy. This allowed for estimating of the relative abundance of each plankton species per litre of seawater. Species identification through DNA metabarcoding was also performed. Samples were sent to the Canadian Centre for DNA Barcoding at the University of Guelph (UoG) in Ontario for sequencing of the cytochrome oxidase subunit 1 (CO1) gene, which is commonly used to identify animal species. Five sequencing primers targeted the CO1 gene in crustaceans, molluscs, annelids, and fish. Next-generation sequencing was conducted on a Torrent Ion S5 system. The combined higher taxonomic resolution from Barcode of Life Data (BOLD) and Silva databases was used to assign taxonomies.

7.3 Quality Assurance/Quality Control

7.3.1 Field

- Intertidal photographs and subtidal ROV footage (video, photographs) were recorded and backed up on field laptops and uploaded to company networks.
- The video feed was monitored throughout the survey to verify the camera was not obstructed and that the recording was of sufficient quality for later analysis.

7.3.2 Laboratory

The laboratory QA/QC measures for processing included procedures to reduce the risk of contamination, particularly in chemical reactions involved in the fatty acid and DNA metabarcoding analyses. The following QA/QC procedures were incorporated during laboratory processing to ensure the highest quality results:

- Prevention of cross-contamination by rinsing instruments with 95 % ethanol and wearing a new pair of nitrile gloves for each sample when handling samples and sampling equipment.
- Maintaining an organized work area by providing labels for each species.
- For drone survey post-processing, ground-truthing measurements were taken over the mapping flight mission area. The elevations for these measurements were compared to the generated 3D point cloud.

7.3.3 Plankton

The field QA/QC measures for the plankton survey included procedures to reduce the risk of cross-contamination. The following QA/QC procedures were incorporated during sampling to ensure the highest quality results:

- Using qualified environmental staff experienced in plankton sampling and field supervision of local assistants.
- Prevention of cross-contamination by washing down equipment and wearing a new pair of nitrile gloves for each sampling location when handling samples and sampling equipment.
- Storing samples in appropriately cleaned pre-treated and labelled sample containers.
- Maintaining a clean and organized work area.
- A regimented process for sample documentation was used, including:
    - Labelling all field sample containers and field data sheets with pencil/indelible ink and waterproof labels.
    - Backing up electronic data (i.e., positional data from GPS, photographs), in duplicate, at the end of each field day and labelling electronic files.
    - Keeping thorough notes, including photographs, GPS coordinates, tidal/weather conditions, and recording potential confounding factors observed during field days and at sites.

7.3.4 Amphipods

A local field assistant was instructed on the identification requirements of amphipods. Each sampler wore nitrile gloves. No additional QA/QC measures were necessary as the amphipods were collected exclusively for species identification and no other quantitative metrics were measured.

7.4 Results

Details from the fish habitat, freshwater, drone and plankton surveys and fish diet study are summarized as below:

- Intertidal Survey (Traditional)
  - Section 7.4.1, Appendix A (Table A-4) and Appendix B (Photo B-1).
  - Representative photo panel of the intertidal transects in the Community Harbour Study Area is provided in Photo 7-2 and Photo 7-3.
- Intertidal Survey (Drone)
  - Section 7.4.2.
  - Drone imagery of the Community Harbour Study Area is provided in Figure 7-7.
- Subtidal Survey
  - Section 7.4.3, Appendix A (Table A-6, Table A-7) and Appendix B (Photo B-3, Photo B-4).
  - Representative photo panel of the subtidal transects in the Community Harbour Study Area is provided in Photo 7-4 and Photo 7-5.
- Plankton
  - Section 7.4.4
  - Representative photo panel of the plankton species observed in the Community Harbour Study Area is provided in Photo 7-6.
- Amphipod
  - Section 7.4.5.
  - Representative photo panel of amphipod sample collection in the Community Harbour Study Area is provided in Photo 7-7.
- Freshwater
  - Section 7.4.6.
  - Representative photo panel of freshwater crossings in the Community Harbour Study Area is provided in Photo 7-8.

7.4.1 Intertidal (Transect)

The tidal exchange on the dates of the survey was 0.8 m in 2024 and 2.9 m in 2019 (see Table 1-4), where Grise Fiord can experience a maximum tide of 4.0 m (see Section 4.7, Table 4-2).

7.4.1.1 Transect Surveys – 2024

The exposed tidal area ranged from 22 m to 182 m in length (see Table 7-1). A single habitat band was observed at most transects, except Transect 13 and 14, where two habitat bands were observed. Substrate characteristics were predominantly gravel with mixtures of boulder and cobble. A mix of sand

and cobble was found in quadrats closer to LWL, forming the second habitat band on Transects 13 and 14. (see Figure 7-6, Panel a and b). Tide data on the day of the intertidal survey is represented in Figure 7-1, Panel a and Panel b.

Rockweed was observed in trace to moderate density on nice transects, though most were found detached from substrate. Other marine vegetation observed included brown filamentous algae and kelp blade. Amphipods were observed at seven transect in the trace density. No marine fish were observed.

7.4.1.2 Transect Surveys – 2019

The exposed tidal area ranged from 90 m to 210 m in length (see Figure 7-1), where just a single habitat band was observed. Substrate characteristics was dominated by gravel areas that consistently had moderate densities of boulders and infrequently density of sand/mud or other soft substrates (see Figure 7-6, Panel c. Tide data on the day of the intertidal survey is represented in Figure 7-1, Panel c.

Rockweed was the only vegetation observed, which was observed in trace density and detached. Amphipods were observed in infrequent densities in the lower intertidal areas, and their presence was often associated with sand depressions that remained moist or when boulders were present (demonstrative photo in Photo 7-3, photo of amphipod in Photo 7-7). No marine fish were observed.

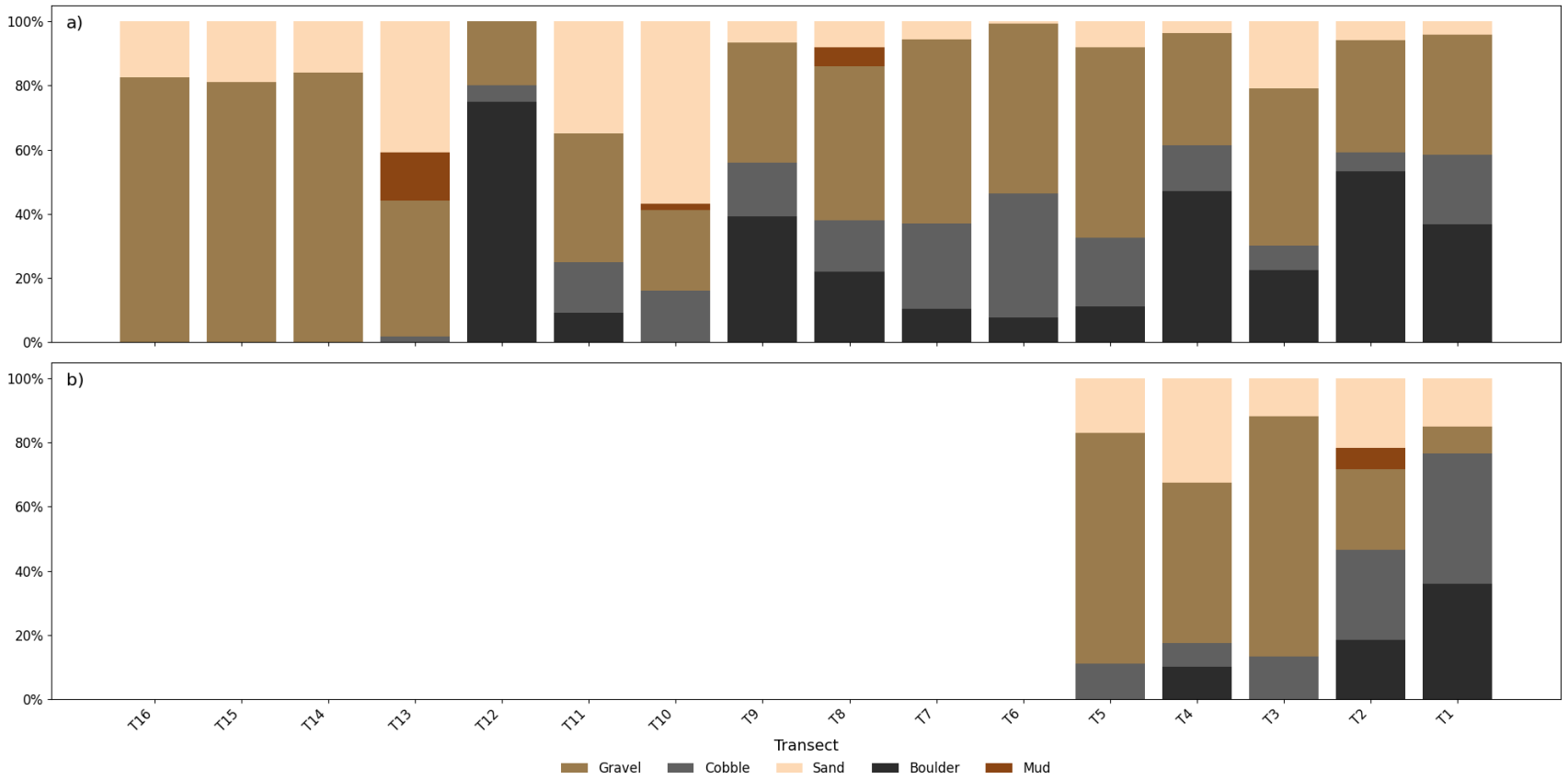


Figure 7-6: Substrate distribution of the Intertidal Survey Area from West to East: a) 2024; b) 2019

Note: See Figure 7-3 for transect location



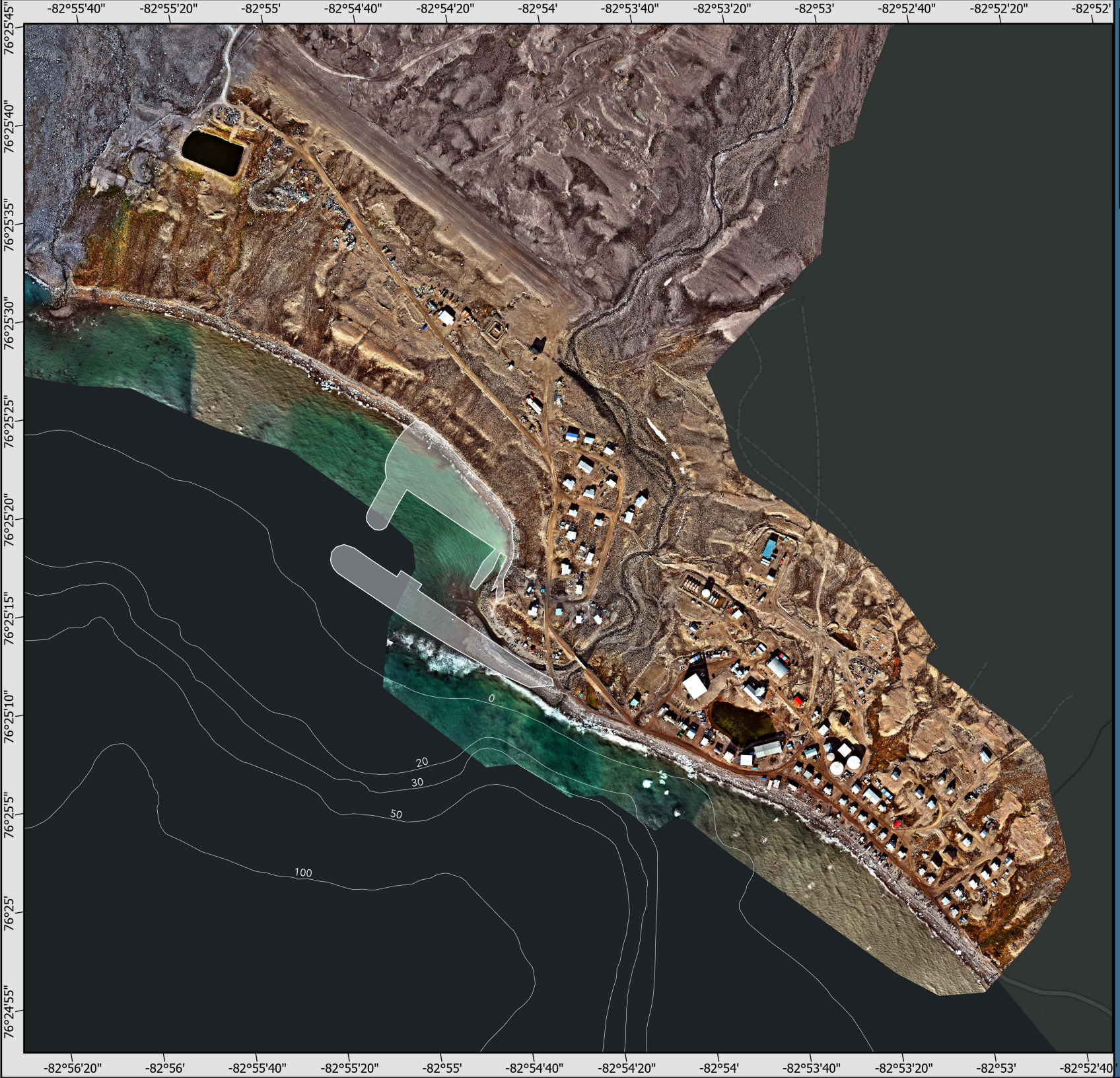
Photo 7-2: Grise Fiord Intertidal Foreshore from the Community Harbour Study Area by foot (2024): a) Looking Northwest; b) Looking North; c) Looking Southeast; d) Looking Southeast



Photo 7-3: Grise Fiord Intertidal Foreshore of the Community Harbour Study Area by foot (2019): a) Looking Southeast; b) Looking Northwest; c) Looking Southeast; d) Looking Northwest

7.4.2 Intertidal (Drone)

Based on drone imagery (Figure 7-7), the substrates within the Community Harbour Study Area intertidal zone was observed to be relatively uniform, primarily consisting of gravel or cobble with moderate densities of boulders and infrequent density of sand/mud or other soft substrates, similar to observations from the intertidal survey. A band of cobble or boulder were observable from Drone imagery close to LWM.



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N

Scale: 1:8,000

0 80 160 320 m

Spatial Reference
GCS: GCS WGS 1984
Datum: WGS 1984
Projection: Stereographic North Pole
Map Units: Meter
Date Exported: 26-02-2025
Drawn: C. Laidlaw

Figure 7-7

Orthomosaic Drone Image of Grise Fiord Community Harbour Study Area in 2024

7.4.3 Subtidal

Subtidal 2024 ROV survey data is provided in Appendix A Table A-6; Appendix B Photo B-3. Subtidal 2019 ROV Video Analysis Data is provided in Appendix B Photo B-4. Demonstrative photo panels of the subtidal areas are provided in Photo 7-4 and Photo 7-5.

7.4.3.1 Remotely Operated Vehicle Transects -- 2024

The substrate distribution in the Community Harbour Study Area was sand predominantly observed further from shore, and higher cobble and boulders presence observed closer to shore (Transects 1-3, 7-18, see Figure 7-3). Ten species of marine vegetation were observed within the Community Harbour Study Area, typically presenting in higher density where hard substrates (e.g., boulder, cobble or gravel) were prevalent. Rockweed (*Fucus sp.*), sugar kelp (*Saccharina latissima*) and clumped brown algae were the most observed species across the Community Harbour Study Area, presenting in trace to moderate density on 14 transects, coinciding with the frequently presence of boulders and cobbles. Additional vegetation observed included:

- Branching brown algae (present in trace density on two transects).
- Coralline algae (present in trace to moderate density on four transects).
- Red algae (present in trace density on Transect 9).
- Sea Collander (*Agarum clathratum*, present in trace to moderate density on five transects).
- Winged kelp (*Alaria sp.*, present in trace densities on Transect 4 and moderate density on Transects 6 and 17).
- Unidentified red algae (present in trace density on Transect 4).
- Unidentified algae (present in trace density on Transects 1 and 15, and moderate density on Transects 9 and 16).

Marine invertebrate species diversity did not differ substantially with variations in substrate characteristics and were observed in trace amounts across the Community Harbour Study Area. The most commonly observed marine invertebrate are jellies, including comb jelly (*Mertensia ovum*), beroe jelly (*beroe sp.*), double bubble jellies (*Halitholus cirratus*), and some unidentifiable species, presenting in trace to moderate density on 14 transects. The most common benthic species observed was green urchin (*Strongylocentrotus droebachiensis*), which presented in trace to moderate density on nine transects, associating with loose and granular substrate habitats such as cobble, gravel, and sand. Additional marine invertebrates observed included:

- Brittle star (*Ophiocten sp.,* present in trace density on two transects).
- Clams (present in trace density on Transect 4).
- Helicid Pteropod (*Limacina helicina,* present in trace density on three transects).
- Limpet (*Tectura sp.*, present in trace density on Transect 15).

- Sea angel (*Clione limacine*, present in trace density on Transect 18).
- Unidentified sea star (present in trace density on three transects).

Six fish were observed on three transects (T1, T3, and T15), which were all identified as sculpin (*Myoxocephalus sp.*).

7.4.3.2 Remotely Operated Vehicle Transects -- 2019

In 2019, substrates observed were similar between community harbour and reference sites, which were primarily cobble and sand with frequent gravel and occasional boulder, which were observed in clusters. The most abundant marine vegetation was brown filamentous algae (possibly *Chordaria sp.*), which was observed in trace and moderate density on 23 transects. Rockweed (*Fucus sp.*) was also a prominent species observed in the Community Harbour Study Area, observed in trace to moderate density in 21 transects in shallower area. Two kelp species were identified: winged kelp (*Alaria sp.*) and sea colander (*Agarum clathratum*). Kelp species were observed in moderate density in areas where the sounder depth was greater than 3 m. Encrusting coralline algae was observed at infrequent to moderate density on boulders in three transects.

All invertebrate species in the Community Harbour Study Area were present in trace to infrequent density. Truncate soft-shell clams (*Mya truncate*) were the most abundant invertebrate observed, occurring in trace to infrequent density on 15 transects. Green urchins (*Strongylocentrotus drobachiensis*) were also a prominent invertebrate observed, presenting in trace to infrequent density on three transects. Other marine invertebrates observed included:

- Limpet (*Tectura sp.*, present in trace density on one transect).
- Brittle star (*Ophiura sarsi*, present in trace to infrequent density on two transects).
- Anemone (UNID, present in trace density on one transect).
- Pipe cleaner hydroid (*Lafoeina maxima*, present in infrequent density on one transect).

Marine fish observed included the shorthorn sculpin and the banded gunnel in low densities.

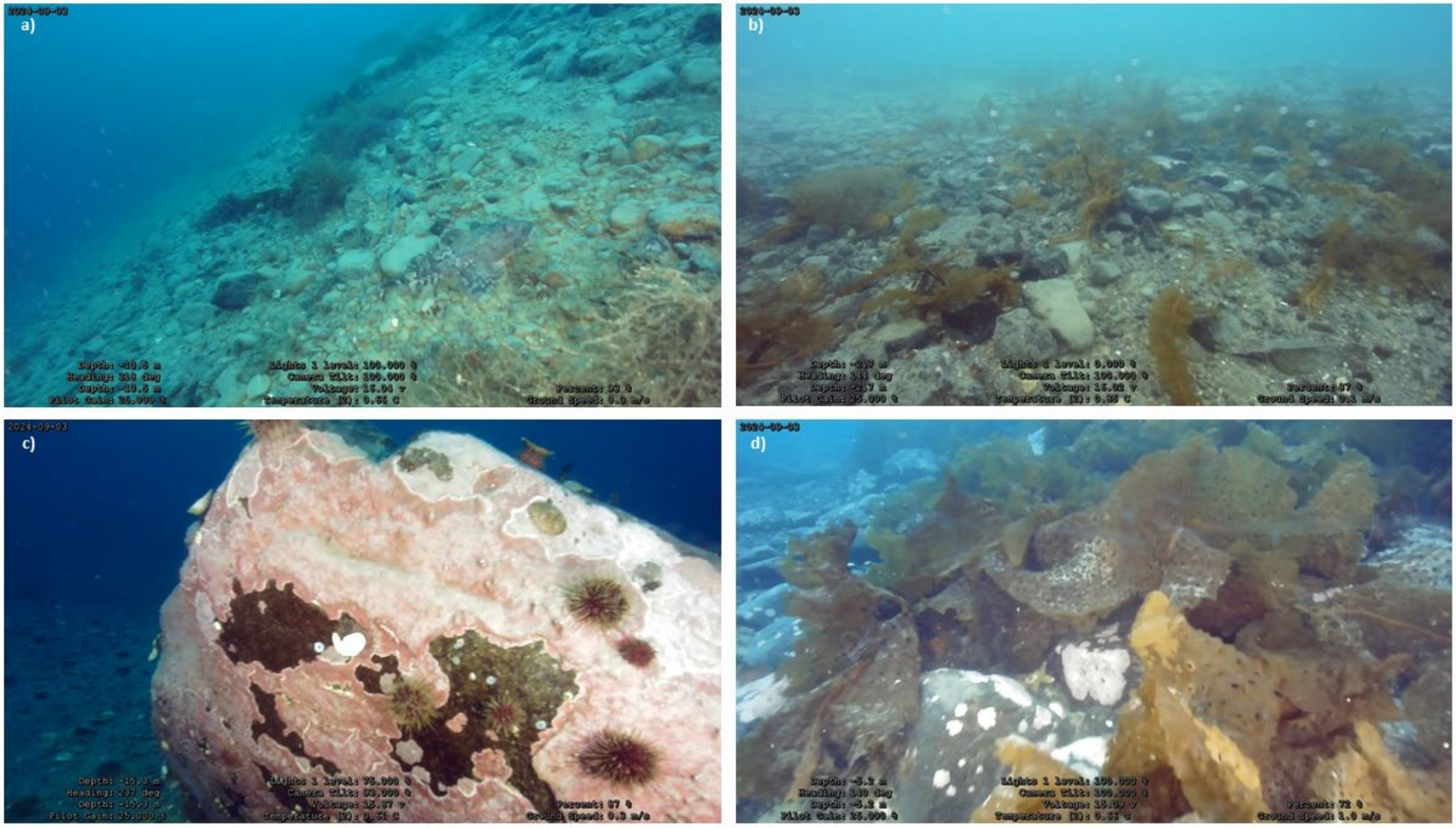


Photo 7-4: Demonstrative Photo Panel of the Subtidal Community Harbour Study Area (2024): a) T1, Sculpin; b) T7, Kelp; c) T11, Green urchin on encrusting coralline algae; d) T12, Sea colander

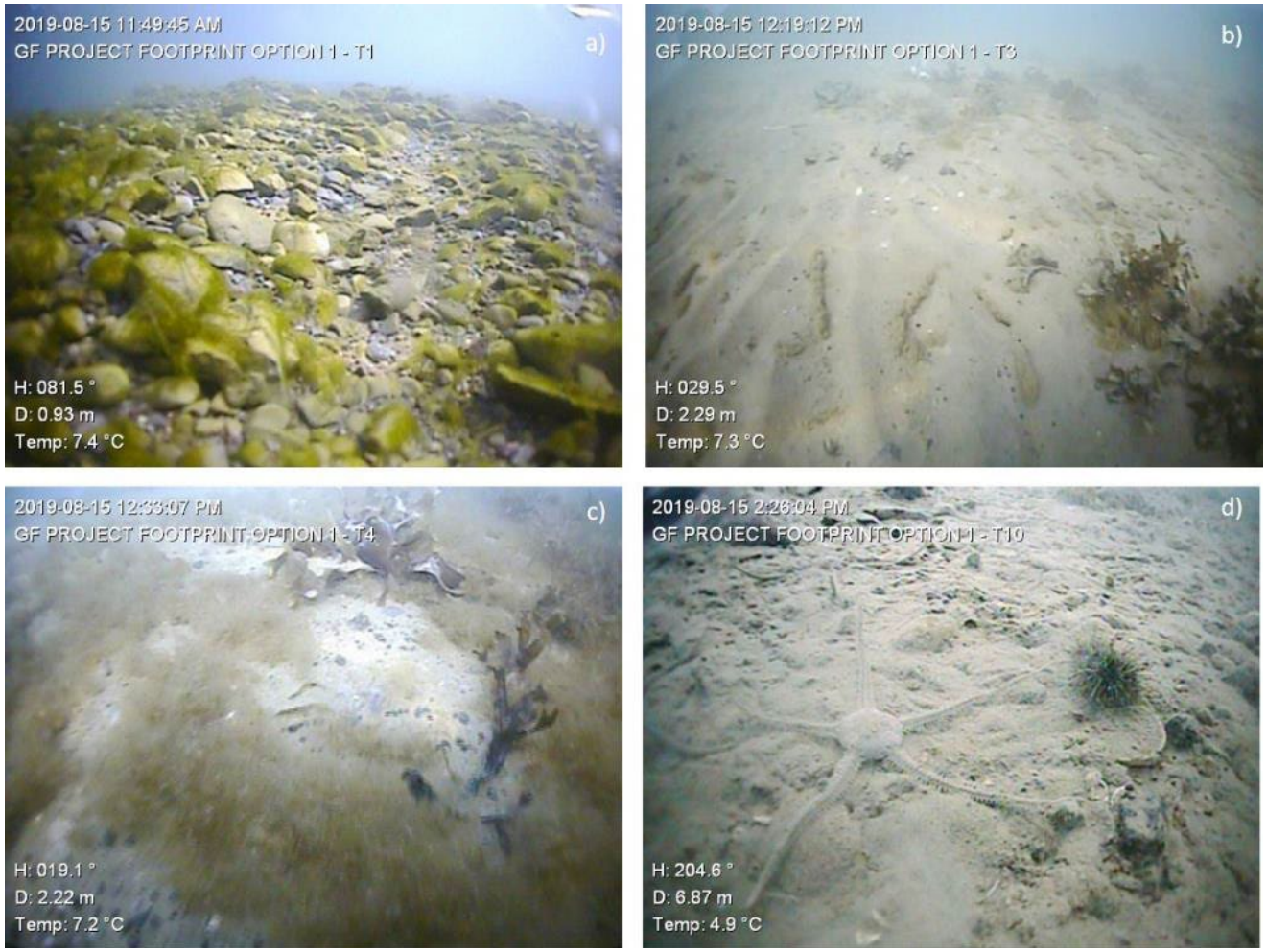
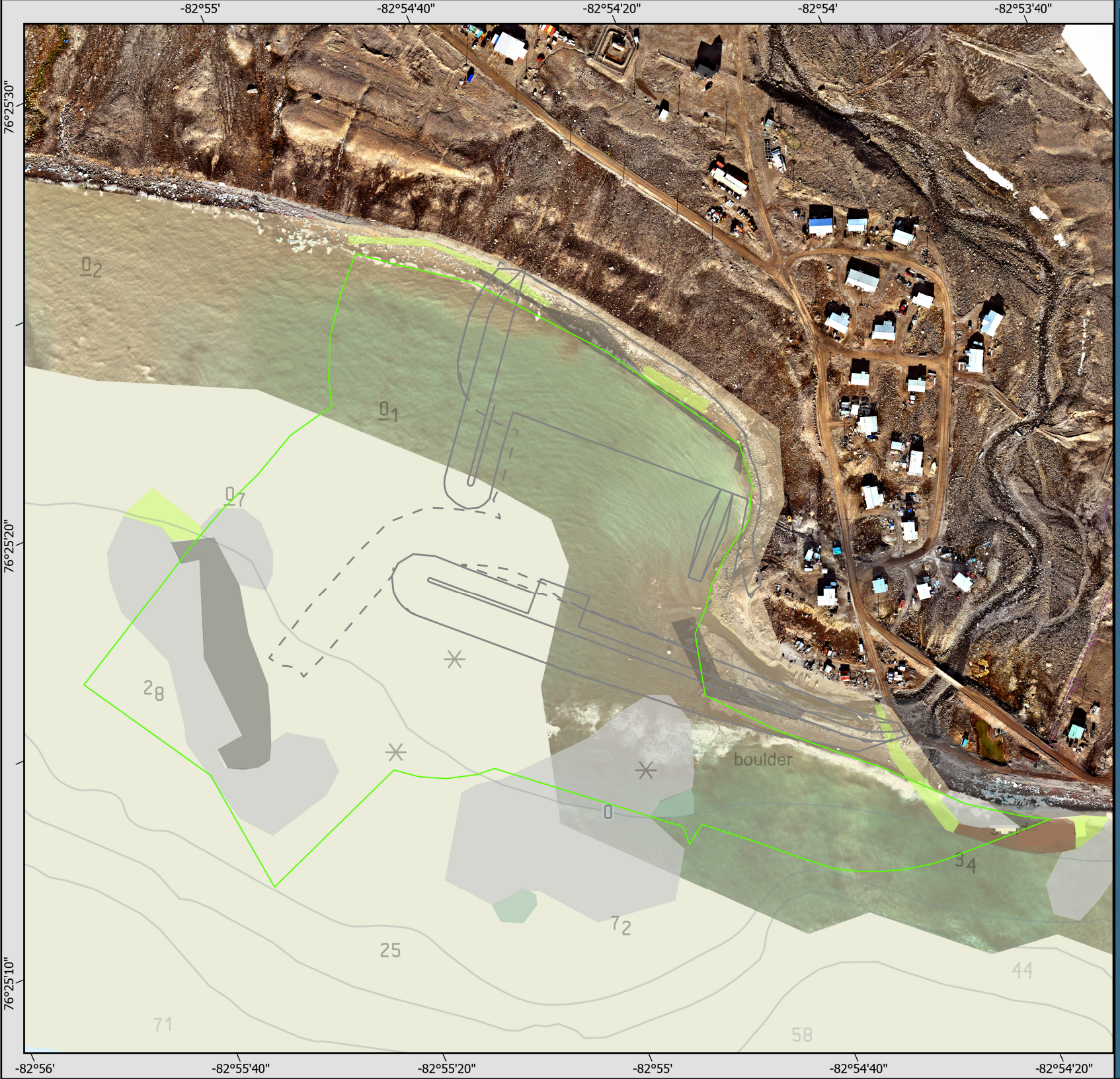


Photo 7-5: Demonstrative Photo Panel of the Subtidal Community Harbour Study Area (2019): a) T1, Filamentous Green Algae; b) T2, Overview; c) T4, Filamentous Brown Algae; d) T10, Brittle Star and Sea Urchin



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- Boulder
- Cobble/Gravel
- Kelp
- Brown Filamentous Algae
- Rockweed
- Sand
- Harbour Footprint Infill Area
- Harbour Footprint Dredged Area
- Study Area



N

Scale: 1:5,000

0 37.5 75 150 m

Spatial Reference
GCS: GCS WGS 1984
Datum: WGS 1984
Projection: Stereographic North Pole
Map Units: Meter
Date Exported: 27-02-2025
Drawn: C. Laidlaw

Figure 7-8

Grise Fiord Community Harbour Habitat Map

7.4.4 Plankton

7.4.4.1 Species ID (2024)

Throughout the 12 plankton tows, a total of 24 distinct taxonomic groupings of plankton were identified using light microscopy (see Photo 7-6). Identified species spanned across 10 phyla, including Chromista, Cnidaria, Ctenophora, Polychaeta, Crustacea, Insecta, Gastropoda, Chaetognatha, Echinodermata and Tunicata. Identified species included multiple life stages of Copepods, Jellyfish, and barnacles as well as multiple species of jellyfish, larvae of brittle stars, and free-swimming tunicates. Plankton observation and corresponding abundance are summarized in Table 7-9.

Table 7-9: Summary of Plankton Relative Abundance and Broad Taxonomic Richness from Two Representative Tow Samples as Determined with Light Microscopy

Order	Taxon	Common name	Average abundance per ml
Chromista	*Arthracanthida*	Marine Protozoan	105.5
Cnidaria	*Aglantha digitale*	Hydrozoan	6.3*
	Aegina sp.	Jellyfish	0.3*
	Sarsia sp.	Jellyfish	0*
	Pandeidae	Hydrozoan	0*
	Cnidaria (polyp)	Jellyfish (polyp stage)	0.6*
	Cnidaria A	Jellyfish	0.2*
	Scyphozoa (Cnidaria B)	True jellyfish	0*
Ctenophora	*Beroe cucumis*	Comb Jellyfish	0.5*
Polychaeta	*Polychaeta (larva)*	Bristle worms	0.1*
Crustacea	*Calanoida*	Calanoid Copepods	28.8
	Calanoida (Copepodite)	Calanoid Copepods (Juveniles)	22.7
	Calanoida (nauplii)	Calanoid Copepods (Nauplii)	9.8
	Harpacticoida	Harpacticoid Copepod	0*
	Cirripedia (cyprid)	Barnacle	3.8*
	Cirripedia (nauplii)	Barnacle (Nauplii)	0.3*
	Gammarus setosus	Gammarid amphipod	0**
	Onisimus litoralis		0*
Gastropoda	*Clione limacina*	Common clione	0*
	Limacina helicina	Swimming sea snail	1.1*
Chaetognatha	*Chaetognatha*	Marine worm	0*
Echinodermata	*Asteroidea*	Sea star	0*

Order	Taxon	Common name	Average abundance per ml
	Ophiuroidea (larva)	Brittle star (larva)	0.8*
Tunicata	*Appendicularia*	Tunicates	36.1

Note:

* The average was obtained by dividing 50 to the number counted in 50mL subsample, due to their larger size. At least two individuals were counted in each 50mL sample

** The average across all twelve samples were zero for these species since only one individual was found in full 50mL. Notably *Beroe cucumis* and *Chaetognatha* are physically larger species and therefore all were counted but are likely underestimated in subsampling

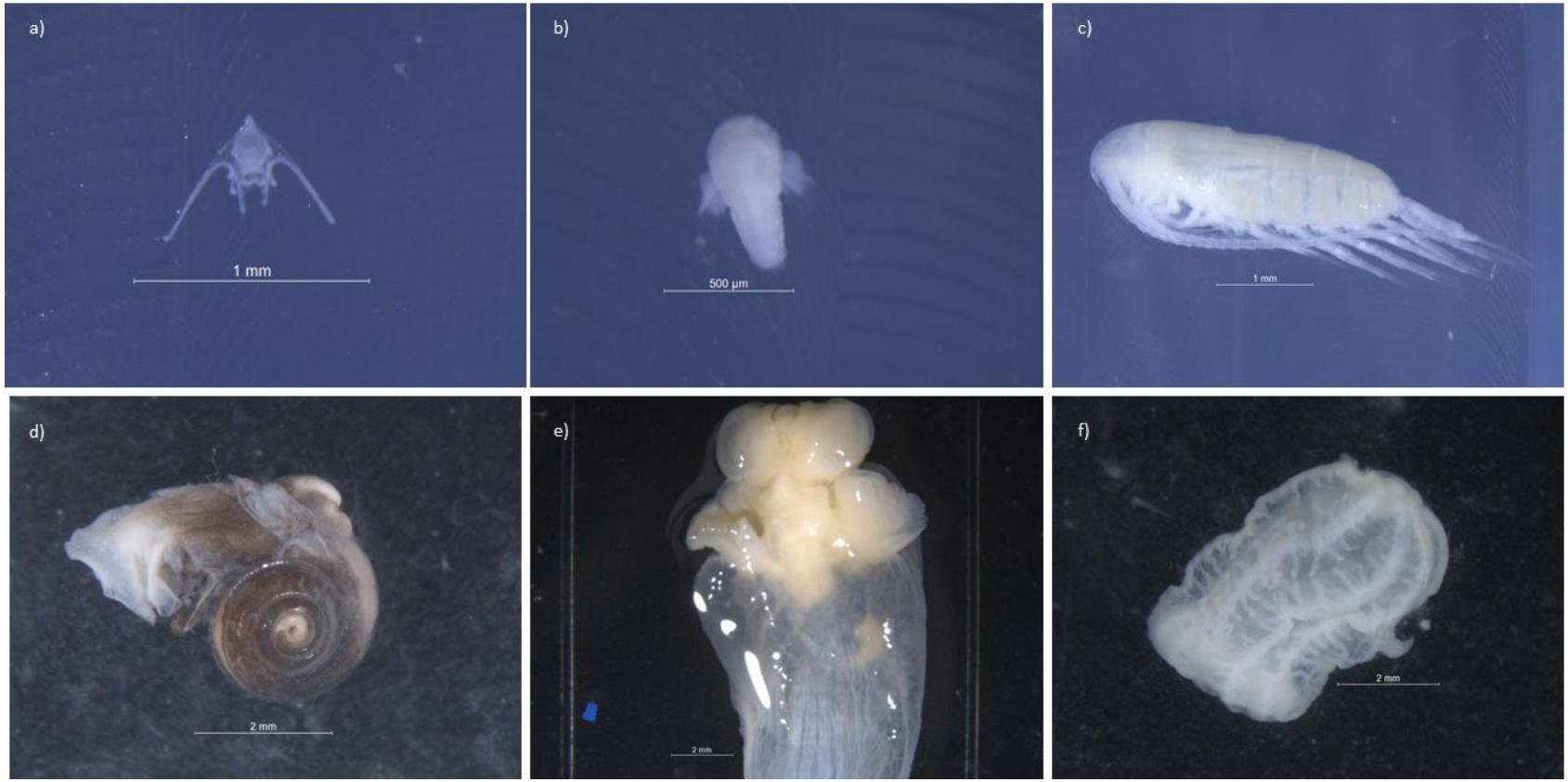


Photo 7-6: Light Microscopy Photos of Representative Individuals from Grise Fiord Plankton Tow: a) *Ophiuroidea* (larva); b) *Clanoida* (nauplii); c) *Calanoida;* d) *Limacina halicina;* e) *Cione limacine*; f) *Beroe cucumis*

Source: UBC, 2024

7.4.4.2 Physiochemical Water Quality

YSI vertical profile measurements were collected at each plankton tow survey sites across two events. 12 in-situ depth profiles were collected, with depths ranging from 2.2 m to 97.3 m, CD. Water temperature, pH, specific conductivity, and turbidity were recorded at each depth profile. Results are provided in Figure 7-9 and summarized below:

- Water temperature ranged from -1.15°C to 2.01°C, with higher temperatures generally occurring at the surface, and decline with increasing depth.
- pH was slightly basic, ranging from 8.25 to 9.07, and was generally stable along the depth profile, trending slightly acidic with increasing depth.
- Specific conductance ranged from 2,800 µS/cm to 51,201 µS/cm, with higher conductivity occurring in near-bottom than at the surface, with all locations showing a gradual increase in conductivity with depth.
- Turbidity ranged from 0.18 NTU to 2.29 NTU, with increased turbidity shown near surface samples. The profiles for turbidity are relatively stable through depth at all locations.

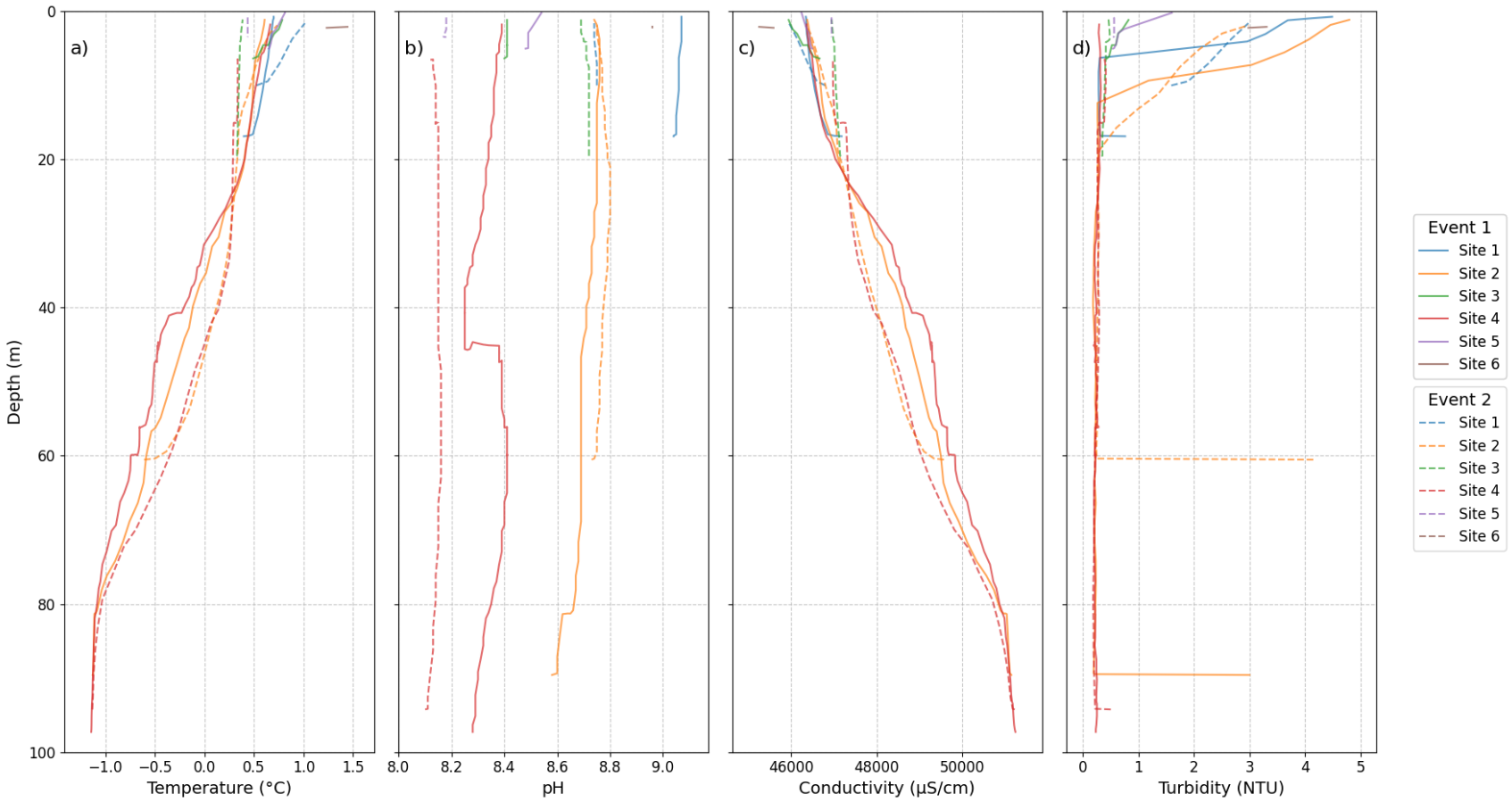


Figure 7-9: YSI In-Situ Depth Profiles: a) Temperature; b) pH; c) Specific Conductivity; d) Turbidity

7.4.5 Amphipods

60 amphipods were collected for analysis. The amphipods were visually identified as belonging to the taxa *Gammarus setosus* (see Photo 7-7). The mean body length was 13.89 mm with a standard deviation of 2.82. Maximum and minimum body length were 21 mm and 9 mm, respectively. Mean C:N atomic ration was 2.57 with a standard deviation of 0.28. Results of the stable isotope analysis is summarized in Table 7-10.

Table 7-10: Metrics of Stable Isotope Analysis

Metric	Mean (n= 60)	Standard Deviation (n=60)
d15N	9.6	0.45
d13C	*-19.5*	0.91
%N	*16.48*	0.53
%C	*36.18*	3.98
C/N ratio	2.57	0.28



Photo 7-7: a) Representative Photo of an Amphipod Specimen Collected in the Community Harbour Study Area; b) Amphipod from 2019 Transect 1

Note: Sample from Panel a was preserved in 95 % ethanol

7.4.6 Fresh Water Assessment

Two creeks (Valley Creek, Kuuraaluk Creek, see Figure 1-1, Figure 7-10) drain into Jones Sound in proximity of the community harbour. Neither of these creeks are fish bearing, and this was confirmed during the IQ Workshops.

- Valley Creek, located northwest of the community harbour has a culvert under repair, and is fed by glacier northeast of Grise Fiord and flows into Jones Sound west of the Hamlet. An existing culvert was under repair during the field program (see Photo 7-8, Panel c).
- Kuuraaluk Creek (pronounced Kuu-Raa-Luk) (IQ Workshop 2019 - Marty Kuluguqtuq), located on the southeast corner of the community harbour, splits into two arms before draining into the harbour. Kuuraaluk Creek is not considered fish bearing and there was no mention of fish during the IQ workshop (Amon Akeeagok, HTA Chair. pers. comm. December 2019). The northern arm of Kuuraaluk Creek will drain into the river, with the southern breakwater installed adjacent to the creek and a sediment basin installed in the intertidal area (see Photo 7-8, Panel a and Panel b).

See Table 7-11 for a summary of all freshwater crossing locations along the haul road.

Table 7-11: Freshwater Crossing Locations Impacted by Project Component

Watercourse	Crossing Location		Project Component in Proximity to	Existing Crossing Mechanism
	Latitude (N)	Longitude (W)		
Kuuraaluk Creek – northern arm	76° 25.131	82° 54.379	Haul Road, Community Harbour	Culvert (partially damaged)[1]
Kuuraaluk Creek – southern arm	76° 25.108	82° 54.337		Culvert (functional)[1]
Valley Creek	76° 25.900	82° 56.118	Haul Road, Quarry	Culvert (repairing)

Note:

1. Status of culverts was obtained from Tetra Tech (2021)



Photo 7-8: Demonstrative Photo Panels of Freshwater Crossings at the Haul Road: a) Northern Arm of Kuuraaluk Creek; b) Southern Arm of Kuuraaluk Creek; c) Valley Creek

Source: Panel a and Panel c: Dynamic Ocean, 2024; Panel b: Tetra Tech (2021)

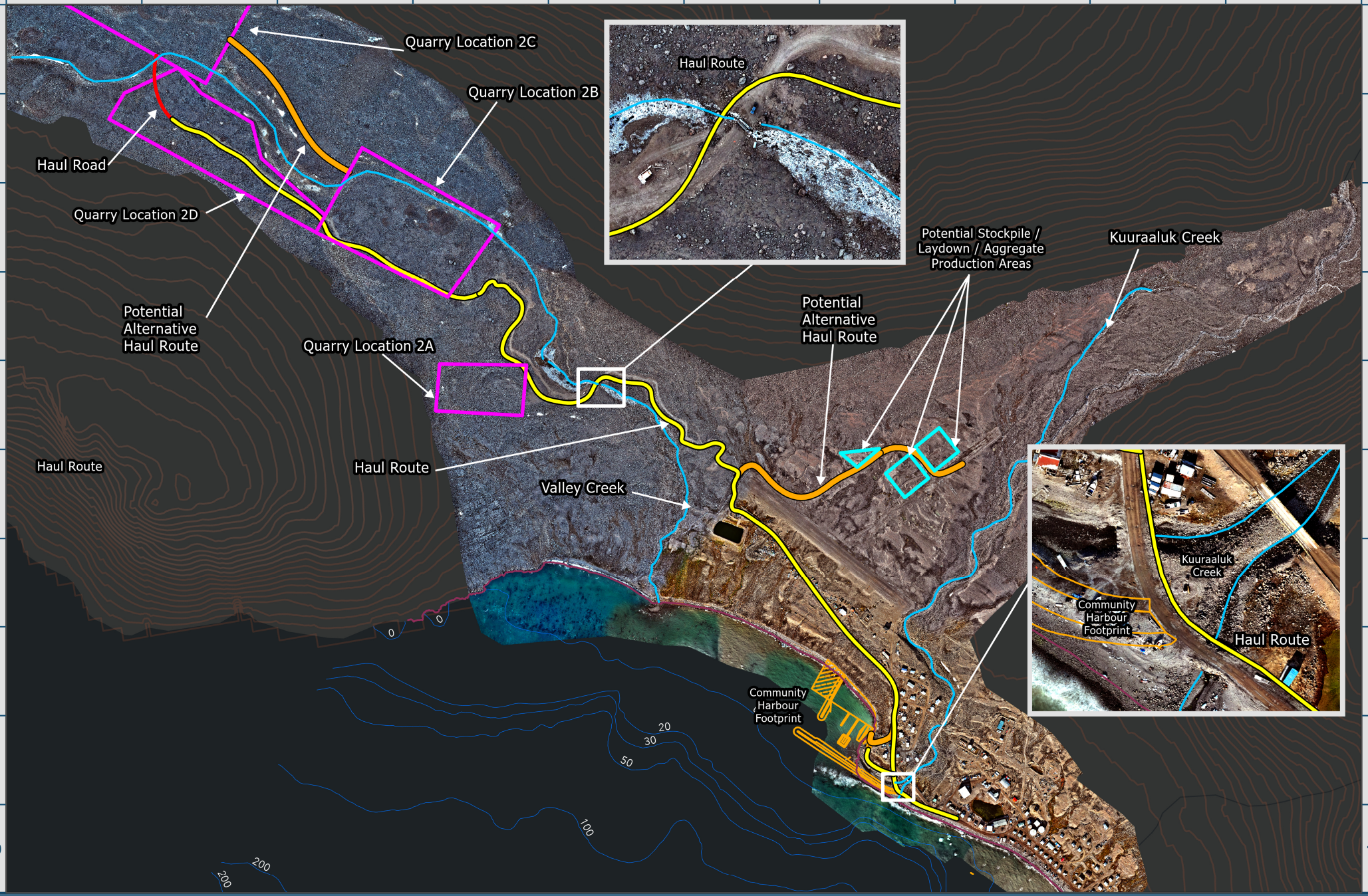


Figure 7-10

Water Courses In Proximity to Project Study Areas

N

Scale: 1:16,465

0 150 300 600 M

Spatial Reference
GCS: GCS North American 1983 CSRS
Datum: North American 1983 CSRS
Projection: Transverse Mercator
Map Units: Meter

Date Saved: 2025-02-27 10:54 AM

Drawn: C. Knight



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7.5 Discussion

Marine and coastal habitat characteristics were generally similar between the community harbour and the reference sites during the 2019 and 2024 surveys. Substrates within the Community Harbour Study Area were similar in both the intertidal and subtidal areas, which were predominantly gravel (intertidal) or sand (subtidal) with cobble and boulders interspersed throughout.

Habitat quality within the community harbour was considered low quality in the intertidal and moderate quality in the subtidal areas. There were minimal observations of marine vegetation and invertebrates in the intertidal zone within the community harbour. Habitat biomass and biodiversity were similar between the community harbour and the reference sites for 2019 and 2024. Intertidal surveys within the community harbour in 2019 and 2024, indicated low habitat quality. Subtidal surveys displayed low to moderate habitat quality from both the 2019 and 2024 field programs.

Fish observation was minimal in both years of surveys and limited to benthic fish species such as sculpin and gunnel.

7.5.1 Intertidal/Subtidal

Habitat exposure during intertidal surveys ranged from 22 m to 210 m. Marine vegetation biodiversity was low in the intertidal areas, with rockweed, often found detached, being the predominant species observed in both 2019 and 2024 surveys. Similarly, marine invertebrate biodiversity and biomass was low, with amphipods being the only marine invertebrate observed in both 2019 and 2024 surveys. Characterization of the intertidal habitat as low quality was supported by the drone imagery taken in during the survey periods (see Figure 7-7).

Amphipods were observed and typically associated with boulder habitat or in sandy depressions which remain inundated at low tide in 2019. As confirmed in the IQ Workshop '*there are lots of amphipods around'* (IQ Workshop 2019 - Marty Kuluguqtuq), and in GN (2012), where the amphipod 'areas of occurrence' are 'everywhere' around the Grise Fiord foreshore. When intertidal habitat characteristics are appropriate, amphipods are common in the Nunavut. A recent study to identify amphipods in Iqaluit's Koojesse Inlet, revealed that the benthic amphipod species was *Gammarus setosus* (Dynamic Ocean, in prep-b). Amphipods are considered an important diet item of Arctic char and have been documented as diet in studies conducted in Iqaluit (Dynamic Ocean, in prep-a), and are likely also preyed upon by Arctic cod (GN, 2012).

The depth of the area observed during the subtidal field surveys ranged from 0.6 m to 6.5 m, CD, for the community harbour, and to a maximum of 3.0 m for the Community Harbour Study Area, with a tidal range of 4.0 m (see Section 4.7) for the 2019 survey. In 2024, the depth of the area observed during the subtidal field surveys ranged from 0.4 m to 23.5 m, CD, for the community harbour, with a tidal range of 2.7 m (see Section 4.7). Species diversity across transects was generally low, with a maximum species richness of nine (observed on Transects 1 and 3 in the 2024 study). Marine vegetation compositions were similar in 2019 and 2024, with rockweed and kelp being the predominant species, exhibiting infrequent to moderate to abundant density on most transects. Rockweed and kelp are considered

abundant in Grise Fiord as confirmed through the IQ Workshop; *'its everywhere'* (IQ Workshop 2019 - Amon Akeeagok). Marine vegetation was most prevalent in areas with hard substrates (i.e., cobble and boulder) where presumably there would be more attachment point availability. The presence of kelp is confirmed in the waters fronting Grise Fiord by the GN (2012). Kelp is being harvested in Grise Fiord; '*some people harvest kelp in the clam area, while others wait for it to be pushed ashore*' (IQ Workshop 2019 - Amon Akeeagok).

Results from the ROV surveys might not precisely reflect the habitat condition since it is not known how mobile species may react to the presence of the ROV, and some mobile species may take shelter behind rocks or under seaweed, avoiding detection. Jelly species were most often observed in 2024 survey, while truncated soft-shell clam was the most observed species in 2019. Although minimal clam was observed in 2024 ROV survey, this might not precisely reflect the habitat condition due to variation of visibility, since clams were usually observed burrowed in soft sediments, with only the siphons exposed to the surface. Clam harvesting areas are documented along the entire foreshore of Grise Fiord, although little to no harvesting occurs in the vicinity of the Community Harbour Study Area, due to contamination concerns from the wastewater outfall, where clam densities are also considered lower than other areas (IQ Workshop 2019 - Manasie Noah). Meanwhile, green urchins were prevalent in both surveys, presenting in around 13 % and 50 % of transects within the community harbour in the respective years. Observation of green urchins were often associated with loose substrate such as sand, gravel, and cobble. The presence of a similar urchin species (pale sea urchin, *Strongylocentrotus pallidus*) were recorded in and around Grise Fiord, often found in shallow areas, caught in seal nets, or in seal and walrus stomachs (GN, 2012). Other benthic invertebrates observed included brittle stars, anemones, limpets, sea stars and hydroid.

7.5.2 Plankton

Microscopy of plankton tow samples detected at least 24 distinct zooplankton taxonomic groups in the water column near the community harbour, including protozoans, hydrozoans, multiple life stages of copepods, jellyfish, barnacles, multiple species larvae of brittle stars, and free-swimming tunicates. Marine protozoans were the most commonly observed plankton in Grise Fiord, exhibiting >100 individual observed per millilitre of sample.

Physicochemical parameters and trends were generally consistent across sampling locations, except for pH which showed variability at all sampling locations. Temperature decreased at a similar rate with depth across all sites, while specific conductivity increased at a similar rate with depth across all sites. Turbidity remained low throughout the depth profile at all sites. The results indicated uniform physicochemical properties across the Community Harbour Study Area.

7.5.3 Amphipods

Amphipods collected in 2019 and 2024 were identified as belonging to the taxa *Gammarus setosus*. This finding was consistent with the literature, which indicated that benthic environments are typically dominated by the *Gammaridae* family (Oceans North Conservation Society *et al.*, 2018). Average body size of sampled amphipods was 13.89 mm in 2024, which was smaller that the average of 20 mm (Census of Marine Life, 2017). Although there is no direct harvesting of amphipods, they are an integral

part in the Arctic food web and are a significant food source for marine fish, mammals and bird (Coad & Reist, 2017; Oceans North Conservation Society *et al.*, 2018).

7.5.4 Freshwater Assessment

Three freshwater crossings, comprising of two creeks, were identified within the Project Study Area. All identified creeks were not considered to be fish bearing, and anadromous fish are generally absent from the area. All freshwater courses would intersect with the haul road.

Kuuraaluk Creek, to the south of the community harbour, is fed from the glacier northeast of Grise Fiord. The northern arm of the creek has five large culverts, assessed to be partially damaged (Tetra Tech, 2021). The southern arm of the creek has a functional culvert (Tetra Tech, 2021).

Valley Creek is located northwest of the community harbour, near the quarry locations. Culverts would be installed at this haul road crossing. Since all haul road intersections have existing culverts, these culverts will likely remain as mechanisms for freshwater crossing.

8 Terrestrial Vegetation

Program objectives for vegetation are provided in Section 1.5, Table 1-1. Vegetation studies focused on the terrestrial environment, within the HRQ Study Area (Figure 8-1).

8.1 Desktop Review

To support the assessment of the existing conditions of vegetation, a desktop review of existing literature and public databases was conducted to determine vegetation species with historical occurrences, or the potential to occur within the HRQ and Community Harbour Study Areas. Desktop information and IQ (see Section 2.3 for methodology details) was used to inform the field program, identify data deficiencies, and focus the information required to complete a baseline study of plant species and communities and species at risk. For pre-mapping, aerial imagery was reviewed to identify and delineate potential distinct vegetation communities to be confirmed in the field. Prior to field programs, the SAR Public Registry (Government of Canada, 2024g) was searched for rare vascular and non-vascular plants with geographic ranges that encompass the HRQ Study Area. Available research on species distributions and habitats was evaluated to determine the likelihood of occurrence (see Table 3-2).

Most of Nunavut is located within the Tundra Biome and the Northern and Southern Arctic Ecozones (Ecological Stratification Working Group [ESWG, 1995]). The Northern Arctic Ecozone incorporates the coldest and driest landscapes in Canada. In addition to the harsh climate, the high winds and shallow soils result in sparse and dwarfed plant life. Herb and lichen communities are the dominant vegetative cover. Lichen communities are associated with rock fields and hilly upland areas. Vegetation cover is higher on wetter sites, sheltered valleys, and moist corridors along creeks and rivers that typically are more nutrient rich. Specifically, the Project is located within Ecoregion 13 - Lancaster Plateau, which is associated with southeastern Ellesmere Island. Exposed bedrock is common in the Ecoregion and the High Arctic ecoclimate supports only a very sparse vegetative cover of moss and mixed low-growing herbs and shrubs. Permafrost is deep and continuous throughout the Ecoregion which is inhibitive to deep-rooted vegetation. Typical species include purple mountain saxifrage (*Saxifraga oppositifolia* L.), avens (*Dryas* spp.), arctic willow (*Salix arctica* Pall.), bog sedges (*Kobresia* spp.), sedges (*Carex* spp.), and arctic poppy (*Papaver* spp.). Other species that may be present in the Northern Arctic Ecozone in no particular order include crustose lichens, cotton grasses (*Eriophorum* spp.), moss campion (*Silene acaulis* [L.] Jacq.), entireleaf daisy (*Hulteniella integrifolia* [Richardson] Tzvelev.), Maydell's oxytrope (*Oxytropis maydelliana* Trautv.), marsh fleabane (*Senecio congestus* [R. Br.] DC.), louseworts (*Pedicularis* spp.), pygmy buttercup (*Ranunculus pygmaeus* Wahlenb.), dwarf fireweed (*Chamerion latifolium* [L.] Holub), mouse-ear chickweed (*Cerastium arcticum* Lange), arctic white mountain heather (*Cassiope tetragona* [L.] D. Don), alpine mountainsorrel (*Oxyria digyna* [L.] Hill), and bog blueberry (*Vaccinium uliginosum* L.) (Aun *et al.*, 2002).

8.1.1 Vegetation Species at Risk

The review of the Species at Risk Public Registry (Government of Canada, 2024g) showed one rare plant species whose mapped range overlaps the HRQ Study Area:

- Porsild's bryum (*Haplodontium macrocarpum* [Hooker] Spence), listed as Threatened under COSEWIC and Schedule 1 under SARA.

Porsild's bryum is a non-vascular bryophyte species. It has a broad, but disjunct distribution in Canada, including sites in Alberta, BC, the island of Newfoundland, and Nunavut (specifically Ellesmere Island). This species has been designated as threatened since 2003, because of its fragmented distribution and few confirmed population locations. There are 19 known populations in Canada, which accounts for about 40 % of known global occurrences. Three of the Canadian populations are located in proximity within Quttinirpaaq National Park, Ellesmere Island, Nunavut (ECCC, 2016a, 2016d). Porsild's bryum are found in the High Arctic but also in other treeless vegetation zones such as the sub-alpine and along barren coastlines. Microhabitats for most populations are associated with waterfalls or sheltered calcareous rock crevices or faces near water seepages. Narrow substrate (calcareous rock) and habitat requirements (waterfalls and seepages) limit this species distribution (2016a, 2016d; Government of Canada, 2019b).

No historical occurrences of Porsild's bryum have been recorded in the HRQ Study Area, and based on a review of aerial imagery, the HRQ Study Area appears not to contain microhabitats that could support Porsild's bryum. Therefore, the HRQ Study Area was predicted to have low potential to support populations of Porsild's bryum.

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GD-11
GD-12
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RP-158
RP-156
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RP-153
RP-152
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RP-151
RP-147
RP-149
GD-16
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GD-15
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RP-137
RP-135
RP-138
RP-132
RP-126
RP-127
RP-124
RP-120
RP-117
RP-119
RP-116
RP-118
GD-14
RP-115
RP-114
GD-13
RP-112
RP-113

Imagery Source: CHS

Legend

- Vegetation Study Area
- Ground Plot
- Rare Plant Search
- Quarry
- Stockpile/Laydown Area
- Alternate/Additional Haul Route
- Haul Road on Existing Road/Track

Location approximated.

N

0 275 550 1,100 Meters

GOVERNMENT OF NUNAVUT
GRISE FIORD COMMUNITY
HARBOUR DEVELOPMENT

Figure 8-1

VEGETATION STUDY AREA

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8.1.2 Harvesting

Twenty plant species have been identified as having traditional uses in the High Arctic ecoclimate (Baffinland Iron Mines Corporation, 2010b). Uses for these species include food, medicine, tools, and household items (Baffinland Iron Mines Corporation, 2010a). These species along with their traditional use are identified in Table 8-1.

IQ indicates that berry picking activities occur near the Hamlet but only for leisure and not a massive harvest amount. No special areas identified for traditional plant use have been identified within the HRQ Study Area (IQ Workshop 2019 - Amon Akeeagok; IQ Workshop 2019 - Manasie Noah; IQ Workshop 2019 - Marty Kuluguqtuq).

Table 8-1: Traditionally Used Vegetation Species

Latin Name and Authority	Common Name	Traditional Use
Shrubs		
Cassiope tetragona (L.) D. Don	white arctic mountain heather	mattresses, firewood
Empetrum nigrum L. ssp. *Nigrum*	black crowberry	edible
Ledum palustre L. ssp. *decumbens* (Aiton) Hultén	marsh Labrador tea	Tea
Salix arctica Pall.	arctic willow	edible, firewood, tools
Salix richardsonii Hook.	Richardson's willow	edible
Saxifraga oppositifolia L.	purple mountain saxifrage	edible, tea
Saxifraga tricuspidata Rottb.	three toothed saxifrage	edible, tea
Vaccinium uliginosum L.	bog blueberry	edible
Graminoids		
Alopecurus alpinus Lam.	alpine meadow-foxtail	used to make whistling noises
Carex spp.	sedges	not specified
Eriophorum spp.	arctic cotton grass	lamp wick
Forbs		
Oxytropis maydelliana Traitv.	Maydell's oxytrope	edible
Oxyria digyna (L.) Hill	alpine mountain sorrel	edible
Pedicularis lanata Cham. & CHltdl.	woolly lousewort	edible
Pedicularis sudetica Wild.	sudetic lousewort	not specified
Polygonum viviparum L.	alpine bistort	edible

Latin Name and Authority	Common Name	Traditional Use
Pyrola grandiflora Radius	large-flowered wintergreen	tea
Silene uralensis (Rupr.) Bocquet ssp. *uralensis*	apetalous catchfly	not specified
Non-Vasculars		
Dicranum spp.	cushion mosses	used to treat pinworm infections
Racomitrium lanuginosum (Hedw.) Brid.	racomitrium moss	used to construct sleeping shelter

Source: Baffinland Iron Mines Corporation (2010a)

8.2 Field Program

8.2.1 Methodology

Field programs were conducted from 15 to 16 August 2019, by an experienced vegetation ecologist and a local Inuit field assistant. An ecological land classification (ELC) survey was completed to identify the vegetation communities in the HRQ Study Area. Field studies also focussed on identifying each species encountered to collect an inventory for the area.

Field programs were conducted within Quarry Location 4 and haul road. Due to time-constraints, only one location was surveyed in Quarry Locations 1 and 2, and no vegetation surveys were conducted in Quarry Location 3. Despite the limitation, no unique vegetation communities were mapped in Quarry Locations 1-3, so data from the numerous surveys conducted in Quarry Location 4 and haul road were extrapolated to characterize the vegetation communities and assess rare plant habitat potential.

8.2.1.1 Ecological Land Classification

During the ELC survey, quantitative data on ecosystems were collected to assist in classification of vegetation communities throughout the HRQ Study Area. As there was no official vegetation classification system used in Nunavut, vegetation communities were grouped based on similar characteristics such as species composition, topographical position, moisture regime, and percent cover of bedrock. Vegetation communities were identified using a combination of field verification and interpretation of desktop aerial imagery (Google Earth, 2022).

Within the HRQ Study Area, vegetation plots (0.5 x 0.5 m^2) were sited within each vegetation community identified during pre-mapping and in the field (Ground Plot; Figure 8-1). Plots were orientated to contain a homogeneous assemblage of plants representative of the typical vegetation community composition. Vegetation data collected at each plot included:

- General site characteristics such as slope, aspect, and surface substrate.

- Vegetation species identification and canopy percent cover.
- GPS coordinates.
- Photographs.

8.2.1.2 Terrestrial Vegetation Inventory and Rare Plant Assessment

A rare plant survey was completed within the HRQ Study Area between 15 to 16 August 2019. Surveys were targeted in areas where desktop pre-mapping had identified potentially unique habitats or vegetation communities. Each area identified was surveyed using a random meander technique, and all vascular and non-vascular species encountered were inventoried (or collected for identification). Figure 8-1 displays the data points collected along the random meander coverage in and around the HRQ Study Area (Rare Plant Search). Given that no standards existed for Nunavut, the Alberta Native Plant Council (2012) standards were used as a guideline for survey methodology. The standard states that if rare plants are identified, a 50 m diameter buffer from the plant location is to be investigated to determine the extent and size of the population. Detailed habitat and population information, photographs, and GPS coordinates are further documented, as per the standards, if rare plants are observed.

The following guidebooks were used to identify vegetation species:

- Common Plants of Nunavut (Mallory & Aiken, 2013).
- Macrolichens of the Pacific Northwest (McCune & Geiser, 2000).
- Mosses and Liverworts of Britain and Ireland a Field Guide (Atherton *et al*., 2010).
- Mosses, Lichens and Ferns of Northwest North America (Vitt *et al*., 1988).
- Mosses, Liverworts, and Hornworts, a Field Guide to Common Bryophytes of the Northeast (Pope, 2016).
- The Arctic Guide: Wildlife of the Far North (Chester, 2016).
- Vascular Plants of Continental Northwest Territories (Porsild & Cody, 1980).

If a species could not be identified in the field, a voucher sample was collected for identification by an expert. A total of ten bryophyte samples were collected and sent for identification to Terry McIntosh, Ph.D., and Steven Joya (bryologists) from the Department of Botany at UBC. Nomenclature and authorities for each plant species recorded followed the United States Department of Agriculture Plants Database (USDA, 2019). Non-native and invasive species were defined according to GN (2012).

8.2.2 Field Results

During the rare plant survey, 65 vegetation species were identified, including five shrub, 15 graminoid, 15 forb, and 12 bryophytes and 18 lichen species. At total of 48 rare plant searches were conducted (Figure 8-1). A list of the species identified is provided in Table 8-2.

None of the species identified during the field program are listed as species at risk or as invasive. All remaining vegetation data collected in the field are provided in Appendix A (Table A-8, Table A-9, Table A-10).

Seven distinct vegetation communities were identified and mapped within the HRQ Study Area (see Figure 8-2) and six ELC ground plots were assessed to characterize these communities. Vegetation communities identified within the HRQ Study Area included:

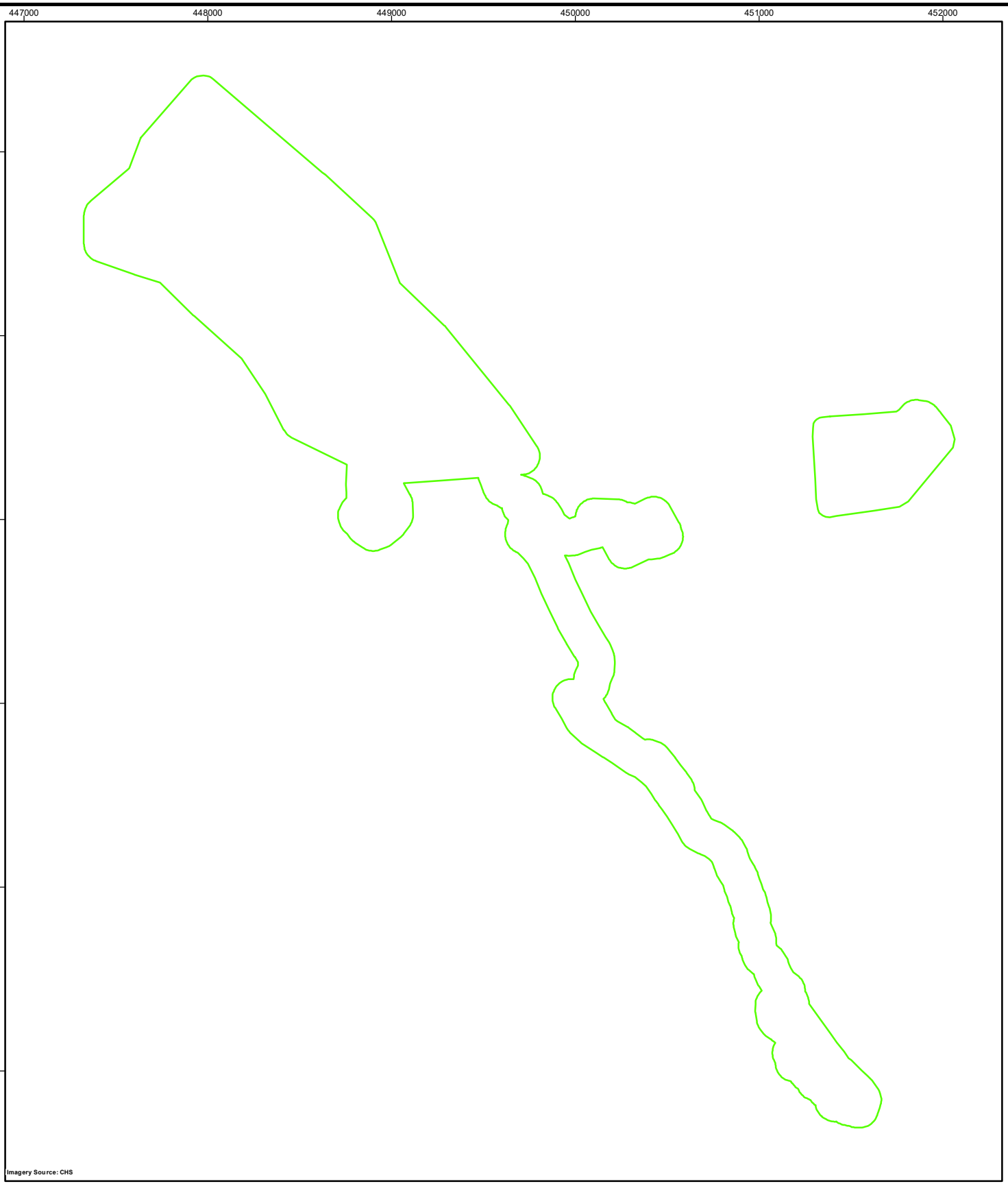
- Upland Lichen Barren (ULB) - 270 ha (77 % of HRQ Study Area).
- Upland Dwarf Shrub (UDS) - 31 hectares (ha) (9 % of HRQ Study Area).
- Open Water (OW) - 19 ha (6 % of the HRQ Study Area).
- Disturbed Human-Caused (DHC) - 14 ha (4 % of HRQ Study Area).
- Wetland Graminoid-Moss Drainage (WGD) - 7 ha (2 % of HRQ Study Area).
- Coastal Shoreline and Flats (CSF) - 5 ha (1 % of HRQ Study Area).
- Upland Graminoid Meadow (UGM) - 3 ha (1 % of HRQ Study Area)

The HRQ Study Area was covered predominantly by the ULB community, which was particularly dominant in Quarry Locations 1 and 2. The ULB community mostly consisted of boulder fields and talus slopes with crustose lichens on rock surfaces. The boulder field was interspersed with some drainages which supported the WGD community. The WGD community had a diverse bryophyte (moss) population, which are common on rock and soil substrates in the Arctic. Descriptions for each community are provided below. Quarry Location 4 and haul road were in a diverse area containing all the identified communities, but the area was primarily dominated by the UDS and DHC community. Quarry Location 3 was located primarily within the ULB and UDS communities.

The CSF community was mapped in the HRQ Study Area and is described below but no vegetation data was collected in ELC plots. The CSF and DHC communities had high levels of disturbance (human [DHC] and marine intertidal [CSF]) and generally lacked vegetation. General characteristics noted in the field are presented below and in Appendix A (Table A-9). The OW area was mapped but not surveyed and is not described as a vegetation community below because it is considered a marine environment.

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Legend

- Vegetation Study Area

Vegetation Mapping

- Coastal Shoreline and Flats
- Disturbed Human-Caused
- Open Water
- Upland Dwarf Shrub
- Upland Graminoid Meadow
- Upland Lichen Barren
- Wetland Graminoid-Moss Drainage

N

0 250 500 1,000 Meters

GOVERNMENT OF NUNAVUT
GRISE FIORD COMMUNITY
HARBOUR DEVELOPMENT

Figure 8-2

VEGETATION COMMUNITIES

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8.2.2.1.1.1 Upland Dwarf Shrub

The UDS community was characterized as a mosaic of vegetated and frost shattered rocky outcrop areas (Photo 8-1). Vegetated areas between rocks were dominated by dwarf shrub species, including white arctic mountain heather, entireleaf mountain-avens (*Dryas integrifolia* Vahl), arctic willow, purple mountain saxifrage, and bog blueberry (Table 8-2). Forbs included species such as alpine mountainsorrel, hairy lousewort (*Pedicularis hirsuta* L.), alpine bistort (*Polygonum viviparum* L.), moss campion (*Silene acaulis* [L.] Jacq.), nodding saxifrage (*Saxifraga cernua* L.), and alpine saxifrage (*Saxifraga nivalis* L.). Graminoids were sparse and predominantly included, northern woodrush (*Luzula confusa* Lindeberg), spike sedge (*Carex nardina* Fr.), shortleaved sedge (*Carex misandra* R. Br.), arctic bluegrass (*Poa arctica* R. Br.), and alpine fescue (*Festuca brachyphylla* CHult. ex CHult. & CHult. f.). Bryophytes included species such as racomitrium moss (*Racomitrium lanuginosum* [Hedw.] Brid.), and lichen cover predominantly consisted of witch's hair lichen (*Alectoria ochroleuca* [Hoffm.] A. Massal.), snow lichens (*Flavocetraria* spp.), and crustose lichens (Table 8-2, Appendix A(Table A-9)).



Photo 8-1: Upland Dwarf Shrub Community at GD-12 (16 August 2019)

Source: Worley Consulting, 2019

8.2.2.1.1.2 Upland Lichen Barren

The ULB community was characterized by barren, rocky areas with crustose lichens being the dominant vegetation type (Photo 8-2). These were typically the higher elevation areas within the HRQ Study Area and consisted of boulder fields, rock debris, taluses, and scree slopes. Species identified included sparse shrubs such as entireleaf mountain-avens, lichens (*Arctoparmelia* spp.), map lichens (*Rhizocarpon* spp.), and navel lichens (*Umbilicaria* spp.) (Table 8-2, Appendix A(Table A-9)).



Photo 8-2: Upland Lichen Barren Community at GD-11 (15 August 2019)

Source: Worley Consulting, 2019

8.2.2.1.1.3 Upland Graminoid Meadow

The UGM community was characterized by mostly flat terrain and intermittent graminoid dominant areas with bare rock (Photo 8-3). Vegetation predominantly included shortleaved sedge, spike sedge, and alpine fescue. Species in trace amounts included alpine bistort, mouse-ear chickweed, nodding saxifrage, moss campion, entireleaf mountain-avens, arctic willow, and purple mountain saxifrage (Table 8-2, Appendix A(Table A-9)).



Photo 8-3: Upland Graminoid Meadow Community at GD-16 (16 August 2019)

Source: Worley Consulting, 2019

8.2.2.1.1.4 Coastal Shoreline and Flats

The CSF community was characterized by a mostly cobble and boulder shoreline leading to the ocean. Extensive, open, areas with little vegetation cover were common (Photo 8-4). Vegetation was sparse, and species predominantly included mouse-ear chickweed, Danish scurvygrass (*Cochlearia groenlandica* L.), and arctic bluegrass (*Poa arctica* R. Br.) (Table 8-2, Appendix A(Table A-9)).



Photo 8-4: Coastal Shoreline and Flats Community at 450654 m E, 8482089 m N (16 August 2019)

Source: Worley Consulting, 2019

8.2.2.1.1.5 Wetland Graminoid-Moss Drainage

The WGD community was characterized by saturated ground and vegetation dominated by wetland graminoid species (Photo 8-5). This community type was in drainage draws and lowland areas. Vegetation was dominated by cotton grasses (*Eriophorum* spp.), fragile sedge (*Carex misandra* R. Br.), wideleaf polargrass (*Arctagrostis latifolia* [R. Br.] Griseb.), alpine meadow-foxtail (*Alopecurus magellanicus* Lam.), and bryophytes. Some forbs were present and predominantly included nodding saxifrage and alpine saxifrage (Table 8-2, Appendix A(Table A-9)).



Photo 8-5: Wetland Graminoid-Moss Drainage Community at GD-14 (16 August 2019)

Source: Worley Consulting, 2019

8.2.2.1.1.6 Disturbed Human-Caused

The DHC community was characterized by levelled and graded areas mostly devoid of vegetation (Photo 8-6). The DHC areas within the HRQ Study Area consisted of road networks, ditches, and Hamlet buildings. Vegetation was sparse, but where present, predominantly included species such as mouse-ear chickweed, alpine mountain sorrel, and nodding saxifrage (Table 8-2, Appendix A(Table A-9)).



Photo 8-6: Disturbed Human-Caused Community at 450737 m E, 8482370 m N (10 August 2019)

Source: Worley Consulting, 2019

Table 8-2: List of Vegetation Species Identified During Field Program

Species Name	Common Name	Vegetation Community[1] Association and Richness					
		CSF	DHC	UDS	UGM	ULB	WGD
Shrubs		**0**	**2**	**5**	**3**	**3**	**5**
Cassiope tetragona (L.) D. Don *	white arctic mountain heather	---	---	Y	---	---	Y
Dryas integrifolia Vahl	entireleaf mountain-avens	---	---	Y	Y	Y	Y
Salix arctica Pall. *	arctic willow	---	Y	Y	Y	Y	Y
Saxifraga oppositifolia L. *	purple mountain saxifrage	---	Y	Y	Y	Y	Y
Vaccinium uliginosum L. *	bog blueberry	---	---	Y	---	---	Y
Forbs		**2**	**10**	**10**	**4**	**0**	**7**
Cerastium arcticum Lange	mouse-ear chickweed	Y	Y	Y	Y	---	Y
Chamerion latifolium (L.) Holub	dwarf fireweed	---	Y	---	---	---	---
Cochlearia groenlandica L.	Danish scurvygrass	Y	Y	---	---	---	---
Erysimum pallasii (Pursh) Fernald	Pallas' wallflower	---	---	Y	---	---	---
Minuartia rubella (Wahlenb.) Hiern.	beautiful sandwort	---	Y	---	---	---	---
Oxyria digyna (L.) Hill *	alpine mountainsorrel	---	Y	Y	---	---	Y
Papaver sp.	arctic poppy	---	Y	Y	---	---	Y
Parrya arctica R. Br.	arctic false wallflower	---	Y	---	---	---	---
Pedicularis capitata M.F. Adams *	capitate lousewort	---	---	---	---	---	Y
Pedicularis hirsuta L. *	hairy lousewort	---	---	Y	---	---	---
Polygonum viviparum L. *	alpine bistort	---	Y	Y	Y	---	Y
Saxifraga cernua L.	nodding saxifrage	---	Y	Y	Y	---	Y
Saxifraga nivalis L.	alpine saxifrage	---	---	Y	---	---	Y

Species Name	Common Name	Vegetation Community[1] Association and Richness					
		CSF	DHC	UDS	UGM	ULB	WGD
Silene acaulis (L.) Jacq.	moss campion	---	---	Y	Y	---	---
Silene uralensis (Rupr.) Bocquet *	apetalous catchfly	---	Y	Y	---	---	---
Graminoids		**1**	**2**	**5**	**3**	**1**	**12**
Alopecurus magellanicus Lam. *	Alpine Meadow-Foxtail	---	---	---	---	---	Y
Arctagrostis latifolia (R. Br.) Griseb.	wideleaf polargrass	---	---	---	---	---	Y
Carex aquatilis Wahlenb. *	water sedge	---	---	---	---	---	Y
Carex membranacea Hook. *	fragile sedge	---	---	---	---	---	Y
Carex misandra R. Br. *	shortleaved sedge	---	---	Y	Y	---	---
Carex nardina Fr. *	spike sedge	---	---	Y	Y	Y	Y
Eriophorum angustifolium Honck. *	tall cottongrass	---	---	---	---	---	Y
Eriophorum CHeuchzeri Hoppe *	white cottongrass	---	---	---	---	---	Y
Festuca brachyphylla CHult. ex CHult. & CHult. f.	alpine fescue	---	Y	Y	Y	---	---
Juncus albescens (Lange) Fernald	northern white rush	---	---	---	---	---	Y
Luzula confusa Lindeberg	northern woodrush	---	---	Y	---	---	Y
Poa alpina L.	alpine bluegrass	---	Y	---	---	---	Y
Poa arctica R. Br.	arctic bluegrass	Y	---	Y	---	---	---
Poa glauca Vahl	glaucous bluegrass	---	---	---	---	---	Y
Poa pratensis L. ssp. colpodea (Th. Fr.) Tzvelev	Kentucky bluegrass	---	---	---	---	---	Y
Bryophytes		**0**	**0**	**2**	**0**	**0**	**10**
Aulacomnium turgidum (Wahlenb.) CHwÃ¤gr.	turgid aulacomnium moss	---	---	---	---	---	Y
Bryum pallens (Brid.) Sw.	bryum moss	---	---	---	---	---	Y

Species Name	Common Name	Vegetation Community[1] Association and Richness					
		CSF	DHC	UDS	UGM	ULB	WGD
Calliergon richardsonii (Mitt.) Kindb.	Richardson's calliergon moss	---	---	---	---	---	Y
Distichium capillaceum (Hedw.) Bruch & CHimp.	distichium moss	---	---	Y	---	---	---
Ditrichum flexicaule (CHwÃ¤gr.) Hampe	ditrichum moss	---	---	---	---	---	Y
Limprichtia cossonii (CHimp.) L.E. Anderson, H.A. Crum & W.R. Buck	Cosson's limprichtia moss	---	---	---	---	---	Y
Limprichtia revolvens (Sw.) Loeske	limprichtia moss	---	---	---	---	---	Y
Orthothecium chryseum (CHwÃ¤gr.) CHimp.	orthothecium moss	---	---	---	---	---	Y
Philonotis fontana (Hedw.) Brid.	philonotis moss	---	---	---	---	---	Y
Racomitrium lanuginosum (Hedw.) Brid. *	racomitrium moss	---	---	Y	---	---	---
Scapania sp.	liverwort	---	---	---	---	---	Y
Scorpidium scorpioides (Hedw.) Limpr.	scorpidium moss	---	---	---	---	---	Y
Lichens		**0**	**0**	**13**	**1**	**10**	**3**
Alectoria ochroleuca (Hoffm.) A. Massal.	witch's hair lichen	---	---	Y	---	Y	---
Aspicilia spp.	lichens	---	---	---	---	Y	---
Cladonia spp.	lichens	---	---	Y	---	---	---
Coelocaulon aculeatum (CHreb.) Link	lichen	---	---	Y	---	---	---
Collema undulatum Laurer ex Flotow	undulate jelly lichen	---	---	---	---	Y	---
Flavocetraria cucullata (Bellardi) Karnefelt & A. Thell	snow lichen	---	---	Y	---	Y	---
Flavocetraria nivalis (L.) Karnefelt & A. Thell	snow lichen	---	---	Y	---	---	---

Species Name	Common Name	Vegetation Community[1] Association and Richness					
		CSF	DHC	UDS	UGM	ULB	WGD
Lepraria neglecta (Nyl.) Erichsen	dust lichen	---	---	Y	---	Y	Y
Melanelia septentrionalis (Lynge) Essl.	melanelia lichen	---	---	Y	---	---	---
Ochrolechia upsaliensis (L.) A. Massal.	Upsala crabseye lichen	---	---	Y	---	---	---
Parmelia centrifuga (L.) Ach.	lichen	---	---	Y	---	---	---
Rhizocarpon spp.	map lichens	---	---	Y	Y	Y	Y
Stereocaulon alpinum Laurer ex Funck	alpine snow lichen	---	---	Y	---	---	---
Thamnolia subuliformis (Ehrh.) W.L. Culb.	whiteworm lichen	---	---	Y	---	---	---
Umbilicaria spp.	lichens	---	---	Y	---	Y	Y
Verrucaria spp.	lichens	---	---	---	---	Y	---
Xanthoparmelia spp.	lichens	---	---	---	---	Y	---
Xanthoria elegans (Link) Th. Fr.	elegant orange wall lichen	---	---	---	---	Y	---

Notes:

1 Vegetation communities included coastal shoreline and flats (CSF), disturbed human caused (DHC), upland dwarf shrub (UDS), upland graminoid meadow (UGM), upland lichen barren (ULB), and wetland graminoid-moss drainage (WGD).

'Y' denotes species was identified within vegetation community.

--- denotes species was not identified within vegetation community.

* denotes species has been identified as traditionally used.

8.3 Discussion

The survey team focussed on the largest of the quarry locations and haul road and was unable to access all potential quarries due to time-constraints on assessing multiple location options. Therefore, field ELC and rare plant surveys focused on vegetation communities within Quarry Location 4 and haul road, the most diverse area, and the data was extrapolated to describe similar vegetation communities within the Quarry Locations 1-3. This was considered an acceptable practice because all mapped vegetation communities were common within the HRQ Study Area and no unique vegetation communities were observed. It is assumed that the numerous surveys conducted in Quarry Location 4 and haul road

captured the necessary information to characterize the vegetation communities and assess rare plant habitat potential using extrapolated data.

Vegetation communities identified during field studies (ULB [77 %], UDS [9 %], DHC [4 %], UGM [1 %], WGD [2 %]) appeared to be typical of the Lancaster Plateau Ecoregion within the Northern Arctic Ecozone of the Tundra Biome (ESWG, 1995). Vegetation was overall sparse throughout the HRQ Study Area and dwarfed due to harsh climate conditions, exposure to wind, and frost damage. The WGD community had the highest percent cover of vegetation and the least amount of exposed rock.

Of the 20 traditionally used species identified during desktop review, 12 were identified within the HRQ Study Area during the field programs. These species include white arctic mountain heather, arctic willow, purple mountain saxifrage, bog blueberry, alpine mountainsorrel, louseworts, alpine bistort, apetalous catchfly, alpine meadow-foxtail, sedges, cottongrasses, and racomitrium moss (*Racomitrium lanuginosum* [Hedw.] Brid.) (Table 8-2 and (Table A-9)). The WGD community contained the most traditionally-used plants (13 species) and the UDS community had the second most traditionally-used plants (10 species). Traditional uses of these plants have included berry picking and edibles, lamp wicks, whistle construction, firewood, tool construction, mattress construction, and sleeping shelter construction. Berry picking and plucking leaves for tea still occurs as part of culture in the Arctic though traditional plant uses in the HRQ Study Area is likely mostly opportunistic or for leisure, and occurs during travel and when hunting (Baffinland Iron Mines Corporation, 2018; IQ Workshop 2019 - Amon Akeeagok; IQ Workshop 2019 - Manasie Noah; IQ Workshop 2019 - Marty Kuluguqtuq).

As with any species inventory, some less abundant species may have been missed during the vegetation field program. However, all species observed were common in the Northern Arctic Ecozone and enabled the characterization of vegetation communities, identification of traditional use plants, and assessment of rare plant habitat potential.

The only vegetation SAR potentially present in the HRQ Study Area was Porsild's bryum. Environmental conditions to support this species were present given that this species has been found in the High Arctic on Ellesmere Island. It was not identified during the field program but there is potential that the species could grow in the WGD community. As such, it is possible that Porsild's bryum could occur within the HRQ Study Area.

Overall, the HRQ Study Area was dominated by ULB community, contained regionally common plant species, and had no regionally unique habitat. Given the project is located on Ellesmere Island with water seepages on steep rock, rare plant (Porsild's bryum) presence is possible. The WGD community contained the most traditionally-used plants, had the highest rare plant potential, and occurred sporadically within Project development areas. Disturbances to the WGD community may potentially impact rare plants or habitat, if present, but because the WGD community was distributed throughout the HRQ Study Area, cumulative impacts are considered low. In addition, the majority of the HRQ Study Area was dominated by the ULB and UDS communities, which contained large, dry, unvegetated, rocky areas that are common in the Northern Arctic Ecozone. The potential haul road footprint was also primarily proposed along an existing road (within the DHC community). As a result, overall Project related disturbances to vegetation communities, traditionally-used plants, and species at risk are considered low.

9 Terrestrial Wildlife

Program objectives for terrestrial wildlife are provided in Section 1.5, Table 1-1.

Baseline information was determined through historical information gathered as part of a desktop study including a literature review and IQ Workshop (see Section 2.3 for methodology details). This desktop study was then validated through a field-based habitat assessment and wildlife reconnaissance survey (referred hereafter as the field program) conducted in conjunction with the vegetation field program. These results enabled refinement of a list of species likely to inhabit the HRQ Study Area.

Migratory birds including marine birds are identified in Section 10. Considering polar bears spend most of their time on sea ice and rely heavily on marine habitats for food, the species is categorized under marine mammals in this document (see Section 6.4.9).

9.1 Desktop Review

The desktop review was conducted to determine species with historical recorded presence near the Project. Furthermore, protected areas or known high value habitats (e.g. Wildlife Sanctuaries) were identified. In addition to identifying historical recorded presence, a list of species that could potentially occupy the HRQ Study Area was generated. This list was determined by examining available habitat using aerial imagery (Google Earth, 2022) and comparing it to habitat requirements for species whose ranges overlap with the Project area. Range maps and habitat information were determined by field guides, peer-reviewed literature, and other reference sources.

Terrestrial wildlife occurrences were primarily based on the NWHS (Priest & Usher, 2004). Species identified as having potential to inhabit the HRQ Study Areas were further inferred from range maps, habitat requirements, aerial imagery, IQ (IQ Workshop 2019 - Amon Akeeagok; IQ Workshop 2019 - Manasie Noah; IQ Workshop 2019 - Marty Kuluguqtuq), and results of the vegetation review and community mapping.

There are eight terrestrial mammal species, ranging from Peary Land collared lemmings (*Dicrostonyx groenlandicus*) to muskoxen (*Ovibos moschatus*) that have historical occurrences or have the potential to occur within the HRQ Study Area (Table 9-1). Two species are listed as at risk: wolverine (*Gulo gulo*) and Peary caribou (*Rangifer tarandus pearyi*). Peary caribou are federally listed as Threatened by COSEWIC and federally listed as Endangered on Schedule 1 of the Species at Risk Act. Wolverine are federally-listed as Special Concern (Government of Canada, 2024g). IQ indicates that no dens or burrows are known within the HRQ Study Area (IQ Workshop 2019 - Amon Akeeagok; IQ Workshop 2019 - Manasie Noah; IQ Workshop 2019 - Marty Kuluguqtuq).

Table 9-1: Terrestrial Wildlife that have Potential to Inhabit the HRQ Study Area

Common Name	Scientific Name	Habitat[1]
Small Mammals (Rodents and Lagamorphs)		
Peary Land collared lemming	*Dicrostonyx groenlandicus*	• Dry (xeric), rocky tundra
Arctic hare	*Lepus arcticus*	• Typically willow-dominated tundra but also rocks and broken terrain for cover
Medium Mammals (Canids and Mustelids)		
Arctic fox	*Alopex lagopus*	• Likely determined more by prey availability (i.e. small mammals and geese) than vegetation • Dens are large, complex burrow systems with multiple entrances
Arctic wolf	*Canis lupus arctos*	• Likely determined more by prey availability (e.g. caribou) than vegetation • Dens typically located along eskers
Wolverine[2]	*Gulo gulo*	• Wide ranging species whose habitat is likely determined more by prey availability (i.e. carcasses and small mammals) than vegetation • Den within snow or under snow-covered rocks
Ermine	*Mustela ermine*	• Habitat generalist likely determined more by prey availability than vegetation • Uses subnivean grass nests, rock piles and burrows often commandeered from prey
Large Mammals		
Muskox	*Ovibos moCHatus*	• Low-lying areas like river valleys and tussock graminoid tundra • Wet sedge areas and wind-swept areas that provide efficient foraging during snow-covered seasons.
Peary caribou[3]	*Rangifer tarandus pearyi*	• Mesic to xeric tundra with snow-free or shallow snow-covered ridges with sparse-moderate vegetation cover at intermediate-high elevations

Note:

1. Habitat information from: (Chesemore, 1969; Chester, 2016; COSEWIC, 2011, 2014a, 2016; Duchesne *et al.*, 2011; Garrott *et al.*, 1983; Gauthier & Berteaux, 2011; Gray, 1993; King, 1983; King & Powell, 2007; Klein & Bay, 1994; McLoughlin *et al.*, 2004; Parker, 1977; Sale, 2006; Sittler, 1995a)
2. Wolverine are listed as Vulnerable by the GN, listed by COSEWIC as Special Concern, and are listed on Schedule 1 as Special Concern under SARA (CESCC, 2016; Government of Canada, 2024g)

3. Peary caribou are listed as Apparently Secure by the GN, are listed by the COSEWIC as Threatened, and are listed under the SARA as Endangered (CESCC, 2016; Government of Canada, 2024g)

9.1.1 Small Mammals (Rodents and Lagomorphs)

Small mammals are defined in this report as those species belonging to the following mammalian orders: Rodentia (rodents) and Lagomorpha (hares and rabbits). Peary Land collared lemmings are considered a keystone species within Quttinirpaaq National Park at the northern end of Ellesmere Island (Laing, 2008). Lemmings are an important part of High Arctic ecosystems because they are an important herbivore and are an important prey source for predators. Populations of lemmings typically fluctuated in low-high oscillations (Gruyer, 2010), and they are the primary prey of species such as arctic fox (*Alopex lagopus*), ermine (*Mustela ermine*), snowy owl (*Bubo scandiacus*), and long-tailed jaegers (*Stercorarius longicaudus*) (McLennan, 2012).

IQ indicated that arctic hares are present near the Hamlet (IQ Workshop 2019 - Amon Akeeagok; IQ Workshop 2019 - Manasie Noah; IQ Workshop 2019 - Marty Kuluguqtuq). According to the NWHS (Priest & Usher, 2004), arctic hare (*Lepus arcticus*) is the only small mammal reported to be harvested by hunters from the Hamlet, and mean annual harvest was 28 individuals per year (Table 6-2).

9.1.2 Medium Mammals (Canids and Mustelids)

For this report, medium-sized mammals have been identified as those species belonging to the following mammalian orders: Canidae (dog family) and Mustelidae (weasel family). The NWHS (Priest & Usher, 2004) identified that arctic wolf (*Canis lupus arctos*) and arctic fox have been harvested by hunters in the Hamlet. However, location data for these species have not been collected and IQ confirms that arctic fox are present (IQ Workshop 2019 - Amon Akeeagok; IQ Workshop 2019 - Manasie Noah; IQ Workshop 2019 - Marty Kuluguqtuq). It cannot be determined whether these species were distributed and harvested near the HRQ Study Area. On average, 20 arctic fox and 1 arctic wolf were harvested each year by hunters from the Hamlet (Table 6-2).

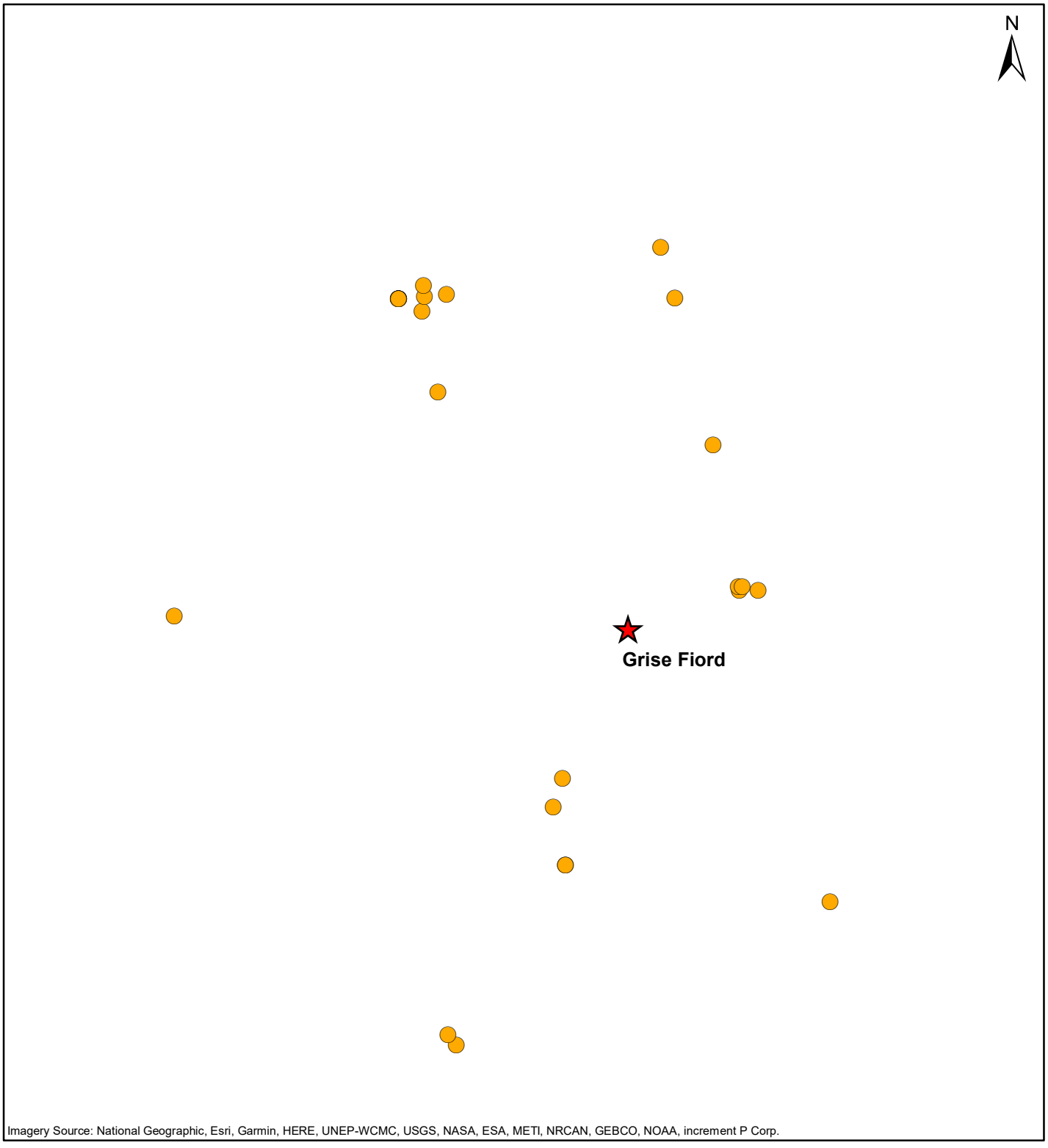
In addition to foxes and wolves, ermine and wolverine could potentially be present in or near the HRQ Study Area. Although no surveys have been conducted near the Hamlet, ermine may be common in coastal lowlands (Miller, 1955). Though the mapped distribution for wolverine overlaps with the HRQ Study Area, wolverine have a low 'Probability of Occurrence' as observations are rare in the region and not documented locally (Mallory, 2001).

9.1.3 Large Mammals (Caribou and Muskoxen)

Peary caribou are a main source of country food, and between 1996 and 2001, the mean annual harvest of caribou was 41 individuals per year (Table 6-2). Location data collected as part of the survey revealed that caribou were historically hunted largely north and west, roughly 80 kilometres from the Hamlet (Figure 9-1). Most harvests have focussed on the Bjorne Peninsula, the south shore of Baumann Fiord, and Graham Island (COSEWIC, 2015).This population of caribou is recognized as the Eastern Queen Elizabeth subpopulation which has increased overall since the mid-1990s, though baseline levels are not well known (COSEWIC, 2015). The number of mature individuals in this subpopulation is estimated to be

around 3,000 (COSEWIC, 2015), but estimates on southern Ellesmere Island are approximately 183 (± SE 128) and the population is believed to be presently stable (Anderson & Kingsley, 2015). On southern Ellesmere Island, petroleum exploration in the 1970s is believed to have caused herds to shift their ranges and movements, and there is IQ concern that future industrial activity could be detrimental to the herds (Anderson & Kingsley, 2015).

Muskoxen are vitally important to the Hamlet community and have been hunted in the area since the government ban on muskoxen hunting was lifted in 1969. Tags are currently set aside for domestic/commercial use and sport hunts (Anderson & Kingsley, 2015). Between 1996 and 2001, the mean annual harvest of muskoxen was 7 (Table 6-2). Location data collected as part of the survey revealed that muskoxen were historically hunted largely near the south shore of Baumann Fiord, approximately 80 kilometres north of the Hamlet (Figure 9-2). Recent estimates of the overall population on southern Ellesmere Island are around 3,200 muskoxen (Anderson & Kingsley, 2015), and the total population on Ellesmere Island is estimated to be over 11,000 and increasing (Cuyler *et al.*, 2019). Some fluctuations in the population have been noted and linked to freezing rain and ground-fast ice in the early 2000s. This may have reduced muskoxen condition, survival, and reproduction at the time, but since then, the population has recovered (Anderson & Kingsley, 2015). A summary of harvest data described from the NWHS is provided in Table 6-2.



Imagery Source: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

Legend

Animal Species

- Muskox

0 12.5 25 50 Kilometers

Locations approximate.

GOVERNMENT OF NUNAVUT
GRISE FIORD COMMUNITY
HARBOUR DEVELOPMENT

Figure 9-1

HARVESTED MUSKOX LOCATIONS (1996-2001)

Date:	Drawn by:	Edited by:	App'd by:
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Project No. 317086-54170

FIG No **10-2**

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Imagery Source: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

Legend

Animal Species

- Peary Caribou

0 12.5 25 50 Kilometers

Locations approximate.

GOVERNMENT OF NUNAVUT
GRISE FIORD COMMUNITY
HARBOUR DEVELOPMENT

Figure 9-2 **HARVESTED CARIBOU LOCATIONS (1996-2001)**

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		FIG No **10-1**	REV 0

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9.2 Field Program

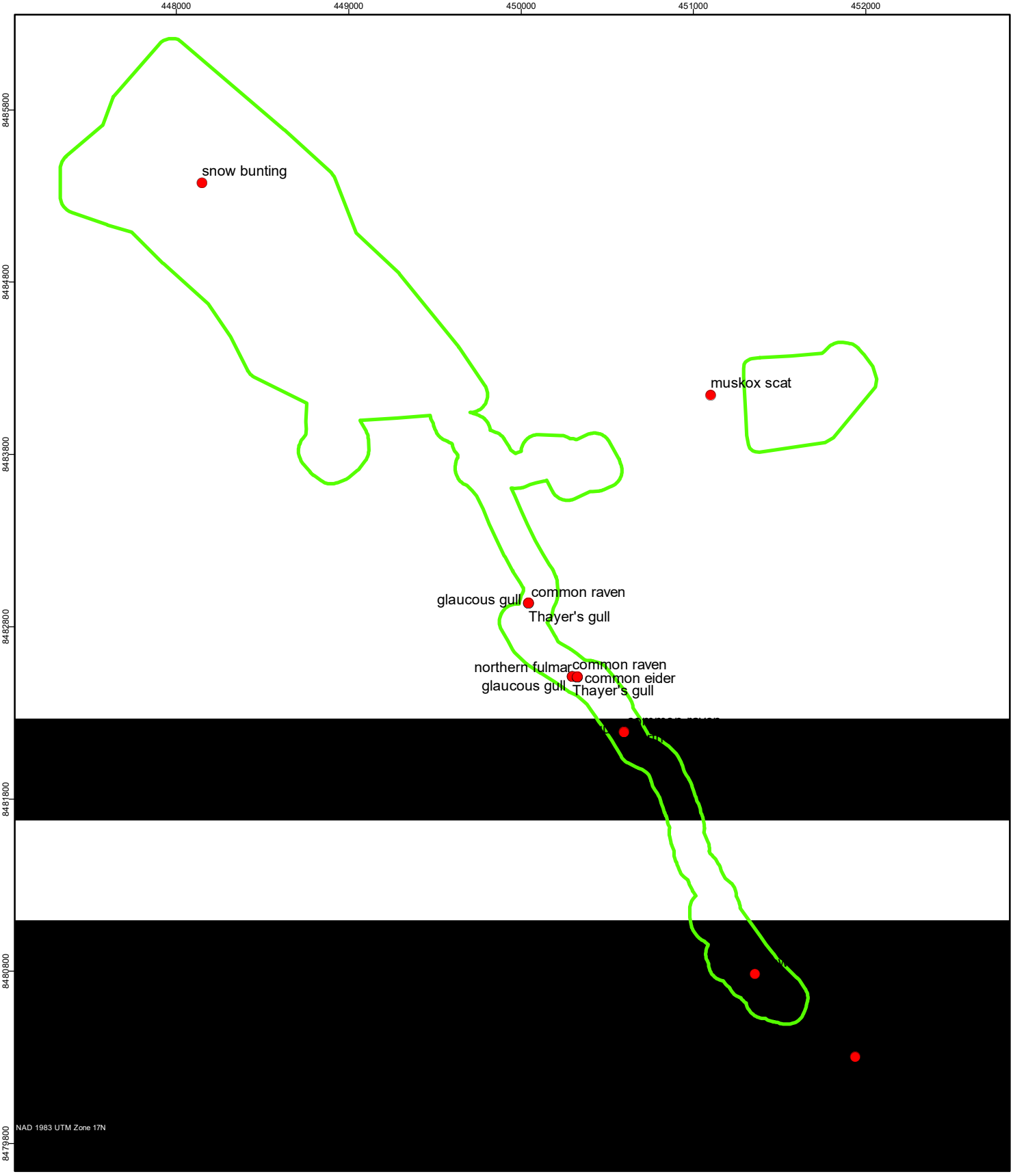
9.2.1 Methodology

Fieldwork was conducted in conjunction with the vegetation survey from 15 to 16 August 2019. Wildlife species observed or detected by sign (scat, pellets, tracks, etc.) were identified, photographed (if possible), and georeferenced using a handheld GPS. In addition to individual wildlife, wildlife features (e.g. dens, burrows, diggings) were similarly photographed and georeferenced. The focus of the field program included Quarry Locations 1-4 and Location 4 haul road plus a 100 m buffer, but incidental observations were also recorded outside this area, because some terrestrial wildlife are migratory or nomadic and travel long distances and have large home ranges. Terrestrial wildlife can be cryptic and difficult to detect without repeat visits and targeted surveys. Given logistical constraints, repeat visits and targeted surveys were not conducted. As such, a lack of observation does not preclude the potential for species occurrence within the Project Study Area. A general reconnaissance survey was the focus of the wildlife fieldwork and information collected during the vegetation survey were used to further refine the list of species with potential to inhabit the HRQ Study Area. Weather conditions during the field programs are provided in Section 1.5.2, Table 1-5.

9.2.2 Results

Muskoxen were the only wildlife species detected during the field program. Muskoxen scat was found near the quarry to the east (Figure 9-3). All wildlife data collected, including coordinate locations are provided in Appendix A (Table A- 11, Table A- 12). Wildlife species observed or detected are also shown in Figure 9-3.

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Legend

- Wildlife Study Area
- Incidental Wildlife Observation or Detection

Location approximated.

N

0 250 500 1,000 Meters

GOVERNMENT OF NUNAVUT
GRISE FIORD COMMUNITY
HARBOUR DEVELOPMENT

WILDLIFE AND WILDLIFE FEATURES OBSERVED OR DETECTED DURING FIELD SURVEY

Figure 9-3

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FIG No 10-3 | REV 0

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9.3 Discussion

9.3.1 Habitat Value

In general, habitat near the Community Harbour Study Area is of limited value for terrestrial wildlife. Human development in the Hamlet extends to the edge of the ocean. The beach is developed and has structures and boats along its length. Dogs were also tied up along the shoreline and likely deter wildlife. The buildings along the beach and Hamlet area may provide cover for small mammals and weasels. At low tide, the intertidal zone likely provides foraging opportunities. However, the value of these areas for habitat is low given the amount of disturbance and frequent human activity.

Habitat available for wildlife in proximity to the haul route and quarry areas are similarly of low quality for terrestrial wildlife. Most of the terrain is comprised of rock and outcrop areas with sparse dwarf shrubs and crustose lichens. Patches of wetland and graminoid-moss communities are also present but are infrequent and small. Security, escape, and thermal cover for some small mammals is present. More information about vegetation community descriptions and land cover types are provided in Section 8.

9.3.2 Small Mammals

9.3.2.1 Artic Hare Presence in the HRQ Study Area

Arctic hare typically inhabit willow-dominated communities in winter and summer (Klein & Bay, 1994) where they forage on twigs, bark, and other plant material (Sale, 2006) such as willow, avens, graminoids, and forbs (Parker, 1977). Willow-dominated communities were not identified in the HRQ Study Area, although willows were present and may provide limited forage opportunities. Parker (1977) suggests that arctic hare also commonly inhabit elevated, dry gravel slopes, which support a sparse but diverse vegetation community. In addition, arctic hare commonly seek shelter behind rocks during winter. It is believed that this type of broken terrain provides appropriate escape cover and sheltering habitat. With confirmed presence of arctic hare (IQ Workshop 2019 - Amon Akeeagok; IQ Workshop 2019 - Manasie Noah; IQ Workshop 2019 - Marty Kuluguqtuq), portions of the HRQ Study Area, particularly east of the Hamlet and around Quarry Location 3 may provide habitat for a low density of arctic hare.

9.3.2.2 Lemming Presence in the HRQ Study Area

Peary Land collared lemmings occupy a variety of tundra types and den in complex micro-habitat with an abundance of deciduous shrubs and mosses, which provide opportunities for deep snow cover and thermal protection (Duchesne *et al.*, 2011; Sale, 2006). Much of the HRQ Study Area is dry and composed of upland, open, and barren areas with very little vegetation. Portions of the HRQ Study Area may support a low density of lemmings, but overall likely provide little value for this species.

9.3.3 Medium Mammals

9.3.3.1 Ermine Presence in the HRQ Study Area

Ermine are considered to be habitat generalists (King, 1983; King & Powell, 2007). Like many other mustelids, habitat is likely determined primarily by prey availability rather than vegetation associations (Klemola *et al.*, 1999). In the Arctic, ermine primarily eat lemmings. When lemming populations are low, ermine use other food sources such as ptarmigan and eggs (King & Powell, 2007). Therefore, their likelihood of inhabiting the HRQ Study Area depends on the availability of prey. No lemmings were identified and habitat in the HRQ Study Area was considered limited. Ermine are known to occupy lemming nests during winter in tundra environments (Sittler, 1995b), and they also nest in rock piles and burrows (King, 1983). Given the rock outcrops in the HRQ Study Area, there is suitable cover and escape habitat available. Home ranges of ermine in the tundra span from 35 to 66 ha for females and 121 to 207 ha for males (King & Powell, 2007). Consequently, only one or two pairs (male and female) of weasels would be likely to inhabit the HRQ Study Area, if any. Though security cover is not limiting, prey availability could be a limiting factor for ermine.

9.3.3.2 Wolverine Presence in the HRQ Study Area

Although federally-listed as Special Concern in Canada, wolverine populations appear to be increasing in Nunavut (COSEWIC, 2014a). No wolverines were reported to have been harvested on Ellesmere Island between 1996 and 2001 (Priest & Usher, 2004). Wolverine habitat use in the Arctic is likely determined more by prey availability (rodents, hare, and ungulate carcasses) rather than by vegetation cover (COSEWIC, 2014a). Wolverines are a wide-ranging, generally nomadic species, found in low densities in remote areas away from human disturbance (COSEWIC, 2014a; Sale, 2006). As such, wolverine occurrence within the HRQ Study Area is unlikely and would only be transient if present.

9.3.3.3 Fox Presence in the HRQ Study Area

Similar to weasels, arctic fox appears to be less closely tied to vegetation associations than to other factors such as prey availability. Cycles in arctic fox populations are closely tied with lemming abundance (Gauthier & Berteaux, 2011). Arctic fox home range and movements also increase during periods (or in territories) of low food abundance (Gauthier & Berteaux, 2011). There are likely few places for fox to den within the HRQ Study Area. Arctic fox home ranges are large and studies in other coastal areas indicated that they may be around 10 km^2 (males) and 4 km^2 (females) (Anthony, 1997). With confirmed presence (IQ Workshop 2019 - Amon Akeeagok; IQ Workshop 2019 - Manasie Noah; IQ Workshop 2019 - Marty Kuluguqtuq) and based upon expected home range sizes, the HRQ Study Area might only partially support one pair or family group of foxes.

9.3.3.4 Arctic Wolf Presence in the HRQ Study Area

Although it is possible that arctic wolves could pass through the HRQ Study Area, it is unlikely. Arctic wolves have large home ranges, and similar to other carnivores, base their habitat utilization upon prey availability. In the case of arctic wolves on Ellesmere Island, their primary prey are caribou and muskoxen (Anderson & Kingsley, 2015; McLoughlin *et al.*, 2004). Given that it is expected that wolves

follow caribou herds (Krizan, 2006) and muskoxen infrequent the Hamlet, it is unlikely that wolves would frequent this area.

9.3.4 Large Mammals

9.3.4.1 Peary Caribou Presence in the HRQ Study Area

The current Peary caribou range does not overlap with the Hamlet area, as such, caribou are not expected to occupy the HRQ Study Area.

9.3.4.2 Muskoxen Presence in the HRQ Study Area

With the identification of muskoxen scat east of the Hamlet, as well as willows for browse and graminoid meadows, muskoxen could potentially occupy the HRQ Study Area for short periods of time, but the likelihood is low.

10 Migratory Birds (Including Marine Birds)

Program objectives for migratory and marine birds are provided in Section 1.5, Table 1-1.

Many marine birds are pelagic and spend most of their life at sea, for the purposes of this Program, marine birds are considered together with migratory birds given that they nest terrestrially (a critical life history stage), and most are also migratory. Migratory bird field programs focused on the Community Harbour and HRQ Study Areas, but incidental observations were also recorded outside this area.

10.1 Desktop Review

To support assessment of the existing condition of migratory and marine birds, existing literature and databases were reviewed to determine species with historical occurrences near the Project. Protected areas (e.g. wildlife sanctuaries) or known high-value habitats (e.g. IBAs) were identified (Sections 3.2.8 and 3.2.9). In addition to identifying historical occurrences, a list of species that could potentially occupy the Project Study Area was generated. This list was determined by examining available habitat using aerial imagery (Google Earth, 2022) and comparing it with habitat requirements for species whose ranges overlaps with the Project. Range maps and habitat information were determined by field guides and other reference sources.

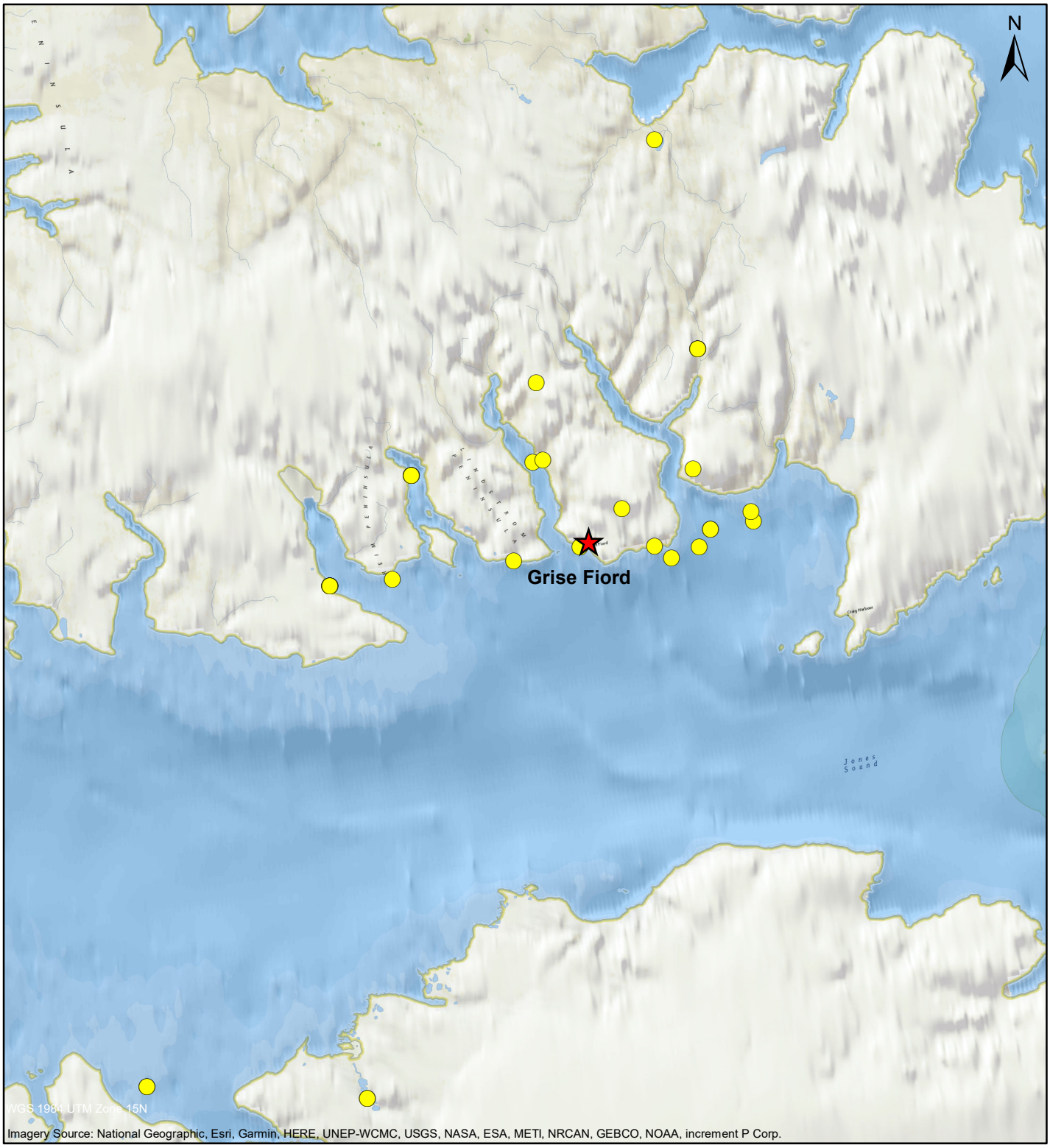
10.1.1 Migratory, Marine, and Other Birds Likely to be Present

A review of the NWHS (Priest & Usher, 2004), revealed that several bird species are harvested by hunters in the Hamlet, confirming their presence and breeding in the surrounding area (Table 6-2). The species most harvested are ptarmigan (*Lagopus muta*), snow goose (*Chen caerulescens*), eider ducks (*Somateria spp.*), and Canada goose (*Branta canadensis*), respectively. Location data for harvested birds were not collected for most species. Hunters in the Hamlet hunt both common eiders (*S. mollissima)* and king eiders (*S. spectabilis)* and information on the location of harvests for these species was collected. Although no bird harvests have been recorded within the Project Study Area, eider hunting has historically occurred in nearby fiords (South Cape Fiord, Harbour Ford, Grise Fiord, and Starness Fiord) and at the mouths of these areas towards Jones Sound.

There are at least 56 bird species who have potential to be present in the region, but 35 were considered unlikely to nest within or near the Community Harbour and HRQ Study Areas (Table 3-2, Figure 10-1). Seven were considered likely to nest based on habitat, during the breeding season. These include: arctic tern (*Sterna paradisaea*), Baird's sandpiper (*Calidris bairdii*), common raven (*Corvus corax*), hoary redpoll (*Acanthis hornemanni*), northern wheatear (*Oenanthe oenanthe*), red knot (*Calidris canutus*), and snow bunting (*Plectrophenax nivalis*) (Appendix B, Table C-3). The likelihood of nesting for the remaining potential species is either low or moderate.

Inuit Qaujimajatuqangit indicates that northern fulmars (*Fulmarus glacialis*), eider ducks, and sandpipers use the intertidal areas of the Community Harbour Study Area. Snow buntings are present in the HRQ Study Area, and no nesting sites have been identified within the HRQ or Community Harbour Study Areas (IQ Workshop 2019 - Amon Akeeagok; IQ Workshop 2019 - Manasie Noah; IQ Workshop 2019 - Marty Kuluguqtuq).

Bird SAR that have potential to be present include ivory gull (*Pagophila eburnean*), buff-breasted sandpiper (*Tryngites subruficollis*), peregrine falcon (Falco peregrinus), red knot, red-necked phalarope (*Phalaropus lobatus*), and Ross's gull (*Rhodostethia rosea*) (see 3.1 and Appendix B, Table C-3). Ivory gull and Ross's gull are not likely to nest within or near the Community Harbour and HRQ Study Areas, but ivory gull colonies are known to breed in the region (see Important Bird Areas section). The potential for buff-breasted sandpiper and red-necked phalarope to nest in the area is low. It is likely that red knot could nest in the HRQ Study Area and the likelihood that peregrine falcon breed in the area is moderate. The territorial and federal status listings of these species at risk are provided in Table 3-1 and Appendix C (Table C-3). These species are discussed further in Section 10.3.



Legend

Animal Species

- Common Eider

0 5 10 20
Kilometers

Locations approximate.

GOVERNMENT OF NUNAVUT
GRISE FIORD COMMUNITY
HARBOUR DEVELOPMENT

Figure 10-1 **HARVESTED COMMON EIDER DUCK AND COMMON EIDER EGG LOCATIONS (1996-2001)**

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FIG No 11-1

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10.1.2 Important Bird Areas and Key Bird and Habitat Sites

Important Bird Areas are described in Section 3.2.8 with their relevance to migratory birds described below.

10.1.2.1 Sydkap Ice Field

The Sydkap Ice Field is mostly covered by an ice cap, except for a small limestone plateau where about 300 ivory gulls (approximately 12 %) of the Canadian population breed and nest. Ivory gull is a protected species (Endangered) under Schedule 1 of SARA. Ivory gulls typically occupy the area from late-May to late-August. Little to no sign of other birds, mammals, or plants have been documented at this IBA. The area is remote and relatively inaccessible, which limits direct risk to the colony from human disturbance (Bird Studies Canada, 2024).

10.1.2.2 Eastern Devon Island Nunataks

The Devon ice cap covers most of the land in this IBA except for nunataks (rock outcrops rising above the ice fields) reaching elevations of up to 1,500 m (Bird Studies Canada, 2024). It is presumed that ivory gulls breed in the area, but this has not been confirmed. There are four separate, small, well-spaced (20-30 km) colonies of ivory gulls with a total estimate of approximately 90 birds. The area is remote and relatively inaccessible, which limits direct risk to the colony from human disturbance (Bird Studies Canada, 2024). Outside the breeding season, adjacent to this IBA, the area of Jones Sound supports large numbers of foraging seabirds (Mallory & Fontaine, 2004).

10.1.2.3 Inglefield Mountains

Most of the area is covered by ice fields and nunataks are present throughout the area. Rocky cliffs also border the coastal areas. The nunataks in this large area support large ivory gull colonies. No recent estimates have been conducted, but historical estimates suggest there are between 730 and 830 adults and 14 colonies of ivory gulls. They occupy the area from about late-May to late-August and are thought to likely feed in the polynyas around southern Ellesmere Island. Few signs of other birds or mammals have been documented in the IBA.

10.1.2.4 Cambridge Point

Cambridge Point is an IBA located 94 km east of the Project, containing and surrounding Coburg Island, which lies at the east end of Jones Sound (Bird Studies Canada, 2024). Topography on the Island is rugged with prominent cliffs along the coastline, especially near Cambridge Point at the south end. An estimated 160,000 pairs of thick-billed murres (*Uria lomvia*) nest on Cambridge Point. Black-legged kittiwakes (*Rissa tridactyla*) also nest on the Island and there are an estimated 30,000 breeding pairs, which is the largest colony in Nunavut (Mallory & Fontaine, 2004). Other species that nest on the Island include glaucous gulls (*Larus hyperboreus*), black guillemots (*Cepphus grylle*), and dovekie (*Alle alle*). King eiders and long-tailed ducks (*Clangula hyemalis*) reportedly stage in the bays along the south end of the Island in the spring (Bird Studies Canada, 2024) A small islet located 17 kilometres east of Cambridge Point known as Princess Charlotte Monument supports about 3,000 northern fulmars (*Fulmarus*

glacialis), about 200 black guillemots, and about 20 glaucous gulls. Atlantic puffins (*Fractercula arctica*) also nest on Princess Charlotte Monument and is one of the few known breeding sites for this species in Nunavut (Mallory & Fontaine, 2004; Robards, 2000). Other species documented in the area include snow goose, brant, common eider, common ringed plover (*Charadrius hiaticula*), ruddy turnstone (*Arenaria interpres*), sanderling (*Calidris alba*), long-tailed jaeger (*Stercorarius longicaudus*), red-throated loon (*Gavia stellate*), gyrfalcon (*Falco rusticolus*), common raven, and snow bunting (*Plectrophenax nivalis*) (Bird Studies Canada, 2024). A portion of the North Water polynya is located immediately south of Coburg Island and is a critical foraging area during the early part of the breeding season and some seabirds overwinter in the IBA (Mallory & Fontaine, 2004). Coburg Island is a Key Migratory Bird Terrestrial Habitat site and is within Nirjutigavvik NWA, which is described in Section 3.2.7. It has also been identified as a significant site under the International Biological Program (Bird Studies Canada, 2024).

10.2 Field Program

10.2.1 Methodology

Fieldwork was conducted in conjunction with the vegetation survey from 15 to 16 August 2019. Given logistical constraints (i.e. ice break-up), this timing was largely outside the breeding season for migratory and marine birds, which is from approximately 5 June to 25 July in the Arctic (ECCC, 2018). Birds could nest past this period up until around 15 August in the Arctic, although likelihood is lower (ECCC, 2018). As such, fieldwork focused on gathering habitat data that could be used to generate a list of species with potential to breed within the Project Study Area. All birds observed and features that were detected (e.g. whitewash, pellets, nests, perches) were identified, photographed, and georeferenced using a handheld GPS unit.

In addition, a visual survey with a series of five-minute point counts spaced approximately 400 m apart were conducted by following transects along the shoreline in the Community Harbour Study Area (Figure 10-2). This distance spacing was used to minimize counting the same individual twice. This survey methodology followed a combination of the BC Coastal Waterbird Survey Protocol (Bird Studies Canada, 2013) and Alberta Sensitive Species Inventory Guidelines (Government of Alberta, 2013) because no government-recommended protocols existed in Nunavut for migratory or marine bird inventories. Each point count included a wait period of two minutes and listening and observing period of five minutes. Point counts were started no more than 30 minutes before sunrise and were completed before 10:00, when possible (in some cases this was not possible because of poor weather or logistical constraints). All birds observed or heard were identified and recorded. Weather conditions during the field programs are provided in Section 1.5.2, Table 1-5.

10.2.2 Results

Six bird species were identified during the field program from 15 to 16 August 2019 (Table 10-1). No nesting or breeding behaviour was identified. The lack of breeding behaviour does not preclude the potential for birds to nest in the area.

Flocks of glaucous gulls, northern fulmars, and snow buntings were identified within the HRQ and Community Harbour Study Area (Figure 10-2 and Appendix A, (Table A- 11, Table A- 12). In addition, a flock of common eiders were identified approximately 500 metres offshore from the Community Harbour Study Area (Figure 10-2). Field-collected data for migratory and marine birds including coordinates are reported in Appendix A (Table A- 11, Table A- 12), with other wildlife observations and detections.

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Legend

- Point Count Locations
- Community Harbour Study Area

Location approximated.

N

0 62.5 125 250 Meters

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Figure 10-2
BIRD POINT COUNT LOCATIONS DURING FIELD SURVEY

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Table 10-1: Bird Species Observed during Point Counts and Field Program

Common Name	Species Name
Point Count Observations	
Common raven	*Corvus corax*
Glaucous gull	*Larus hyperboreus*
Northern fulmar	*Fulmarus glacialis*
Thayer's gull	*Larus thayeri*
Incidental Observations	
Common eider	*Plectrophenax nivalis*
Snow bunting	*Plectrophenax nivalis*

10.3 Discussion

10.3.1 Habitat Value

In general, terrestrial habitat in the Community Harbour Study Area is of limited value to migratory and marine birds. Human development dominates the Community Harbour Study Area with structures and boats along its length. Moreover, teams of dogs were tied up along its length. Species breeding in the Community Harbour Study Area are likely those that nest on bare ground and gravelly areas (e.g. snow buntings) and are relatively tolerant of human disturbance (e.g. common raven). However, human use and dogs likely discourage birds from nesting. At low tide, the intertidal zone provides foraging opportunities, but only for those species tolerant of human activity (e.g. gulls and ravens). Consequently, the value of these habitats is likely low given disturbance and human activity.

The HRQ Study Area offer more natural habitat including wet or moist areas, dry and barren areas with cliffs, and sparsely vegetated areas. Therefore, the HRQ Study Area offers some value for nesting birds. More information about vegetation community descriptions and land cover types are provided in Section 8.

10.3.2 Migratory Birds

The upland dwarf shrub and wetland areas identified in the HRQ Study Area (see Section 8) potentially offer nesting and foraging habitat for snow buntings, hoary redpoll, northern wheatear, and red knot (Table 3-2). There is also moderate to likely potential for gyrfalcons, peregrine falcons, and common ravens to nest on the cliffs near the Hamlet and HRQ Study Area (Appendix C, Table C-3).

According to ECCC, the general nesting season for the region (N10: Arctic Plains and Mountains, Bird Conservation Region 3) is between late-May and mid-August, and the primary season (61-100 % of birds nesting) is from early-June to late-July (ECCC, 2018) . It should be noted these are estimated breeding dates and that the exact timing can vary according to the species occurrence, climate, elevation, and

habitat type. Timing could also vary according to micro-sites or factors such as early or late spring. Because of natural variability in nesting, the timing could vary by up to ten days; moreover, the period above does not include a nest building phase which typically is initiated two weeks prior to the general nesting season (ECCC, 2018).

10.3.3 Marine Birds

The majority of marine birds that have historical occurrences or whose range overlaps the HRQ Study Area are unlikely to nest there. Most of these bird species nest in large colonies on remote, precipitous cliffs and remote islands that are inaccessible to predators (Cornell Lab of Ornithology, 2015, 2019; The Cornell Lab of Ornithology, 2022). Although not likely to breed, 27 species of marine birds could potentially use inter-tidal, marine coast, and nearshore habitats in the Community Harbour Study Area and Jones Sound area for foraging and staging. The use of this habitat likely peaks between mid-July and October during ice free periods at the Hamlet (Mallory & Fontaine, 2004).

10.3.4 Species at Risk

Bird SAR status and designations are shown in Table 3-2.

10.3.4.1 Ivory Gull

Ivory gulls breed where the ocean is free (or partly free) of ice in late-May and early June: the Project Study Area therefore do not support breeding and nesting habitat (COSEWIC, 2006). The nearest known breeding colony is within the Sydkap Icefield IBA, approximately 50 km to the west and discussed above. Given the proximity to ice edge and availability of food for scavenging, including historical observations, it is likely ivory gulls forage near the Hamlet, particularly during the breeding season as there are multiple colonies known in the region (Bird Studies Canada, 2024). The timing and extent of sea ice likely plays a large role in ivory gull distribution and migratory timing (Spencer *et al.*, 2014).

10.3.4.2 Buff-Breasted Sandpiper

Buff-breasted sandpiper occur in tundra regions, primarily in wet/lowland habitat, often near a wetland, pond, or lake with sedge-dominated vegetation (COSEWIC, 2012). Habitat use varies depending on breeding stage. In spring, males often display on barren ridges but as the snow melts, they may display in moister areas. Nests have been documented on the drier parts of the tundra including slopes with sedge tussocks and moss-willow-varied grass areas and in sedge-graminoid meadows close to creeks or open-water wetlands (COSEWIC, 2012). These communities were not identified within the HRQ Study Area, and the Project is at the northern extent of the mapped breeding range of this species. Therefore, the likelihood of buff-breasted sandpipers nesting in the HRQ and Community Harbour Study Area is low.

10.3.4.3 Peregrine Falcon

The likelihood of peregrine falcon inhabiting the Project Study Area is moderate. Suitable nesting habitat (cliffs with open gulfs of air) capable of supporting this species is near the HRQ and Community Harbour

Study Area. Further, peregrine falcons breed in a wide variety of land types and use coastal areas for hunting avian prey (COSEWIC, 2017b). On average, the density of breeding pairs in Nunavut ranges from 0.7 km to 3.3 km (White, 2002). As such, one or two breeding pairs of peregrine falcons could occupy the Project Study Area.

10.3.4.4 Red Knot

Three subspecies of red knot (*Calidris canutus*) are considered to be at-risk in Canada: rufa (Endangered), roselaari (Threatened), and islandica (Special Concern). The islandica subspecies is the most likely to overlap the Project Study Area (ECCC, 2016e). Red knots breed on windswept ridges, slopes, and plateaus with sparse (<5 %) vegetation cover, often on south-facing sites in proximity to freshwater such as wetlands and lakes (COSEWIC, 2007a). No critical habitat for this species has been identified near the Project Study Area (ECCC, 2016e). Vegetation community types that may support breeding were identified within the HRQ Study Area; therefore, it is likely that this species occupies and nests in the HRQ Study Area during the breeding season.

10.3.4.5 Red-Necked Phalarope

Red-necked phalarope typically breed in low-Arctic tundra near freshwater (e.g. ponds, lakes, and creeks) in vegetation dominated by graminoids (COSEWIC, 2014b). The likelihood of red-necked phalarope being present is low because this species is an accidental visitor to the region (LePage *et al.*, 1998) and the Project Study Area is not within the mapped breeding range. However, nesting habitat within the HRQ Study Area may be present, particularly in the wetland and graminoid communities identified in Section 8.

10.3.4.6 Ross's Gull

Ross's gulls are distributed across the Arctic, but breed primarily in Siberia and overwinter in the Bering Sea (COSEWIC, 2007c). They may nest in a wide variety of habitats including marshy tundra and gravel reefs but always close to water. The Project Study Area do not support their preferred nesting habitat, and it is unlikely that this species would be present.

11 Socio-Economic Environment

This section provides an overview of the existing socio-economic environment of the Hamlet of Grise Fiord including demographics; housing and accommodation; labour force and economic activity; community infrastructure and services; local businesses; and land and resource use. Its main objective is to describe the socio-economic conditions that may interact with the construction of the community harbour. Program objectives for the Socio-Economic survey are provided in Section 1.5, Table 1-1.

11.1 Methodology

Data collection for this socio-economic baseline survey was obtained through a combination of field research (primary data) and desktop research (secondary data). Field research involved interviews and meetings with community leaders and key stakeholders including Mayor and Council, the local Senior Administrative Officer (SAO), Royal Canadian Mounted Police (RCMP), business owners, health centre personnel and other key community members. A local interpreter was hired to facilitate discussions as required.

Desktop research consisted of the review and analysis of data provided by relevant government and industry reports and websites, including but not limited to:

- Statistics Canada (Statistics Canada, 2023).
- Nunavut Bureau of Statistics.
- The Hamlet of Grise Fiord ICSP Vol.1 and Vol. 2 (GN, 2024a).
- The Hamlet of Grise Fiord 2024/2025 Infrastructure Plan (GN, 2024a).
- Review of the Nunavut Adult Learning Strategy (GN, 2019b).
- The NPC's Public Hearings Report on the 2021 Draft Nunavut Land Use Plan; (NPC, 2023b).
- Nunavut Tourism.
- Nunavut Housing Corporation's (NHC) 2023-24 Annual Report (NHC, 2018, 2024).

11.2 Socio-Economic Profile

The Hamlet of Grise Fiord is known locally as Aujuittuq which means the "place that never thaws" in Inuktitut. The community is located at the entrance to a fiord on the southern shores of Ellesmere Island at Jones Sound. It is the northernmost community in Canada and is one of the coldest inhabited places in the world. Grise Fiord is surrounded by the Arctic Cordillera Mountain range which shields the community from harsh winds. The nearest communities are Resolute Bay, Arctic Bay and Pond Inlet.

Grise Fiord was founded during the High Arctic Relocation when the Federal government moved several Inuit families from Pond Inlet and northern Quebec to Grise Fiord and Resolute Bay from 1953 to 1955. The original settlement was located 8 km west of the present-day location. The Inuit residents followed the RCMP to a new site at Grise Fiord in 1962, where the community remains today (GN, 2024a).

11.2.1 Demographics

11.2.1.1 Population

According to 2021 census data from Statistics Canada, the total population of Grise Fiord is 144 people, representing an increase of 11.6 % since 2016. The population is young with a median age of 28 years old and children aged 0-14 years representing nearly a quarter (24.1 %) of the total population. A breakdown of key population statistics provided by Statistics Canada for Grise Fiord is presented in Table 11-1. The Nunavut Bureau of Statistics estimated the population of Grise Fiord as of 1 July 2023 to be 160 (GN, 2023a).

11.2.1.2 Indigenous Identity

The total Inuit population is 135 or 93.8 % of the total population according to Statistics Canada 2021 census data (Table 11-1).

11.2.1.3 Educational Attainment and Language

Table 11-1 shows that in 2021, of the total population 15 years old and over in Grise Fiord: nearly a third (30 individuals) held a secondary school diploma (or equivalent) as their highest educational attainment. An additional 30 individuals held a postsecondary certificate, diploma or degree. Of the 30 individuals with postsecondary accreditations, one third (10 individuals) held apprenticeship or trades certificates; and another third graduated with a University Bachelor's degree. Nearly half (50 individuals) of the total population 15 years old and over held no certificate, diploma or degree.

Low levels of literacy and numeracy present a challenge to labour force development across Nunavut (GN & NTI, 2022).

> "*…the largest group of adult learners in Nunavut needs programming that focuses on literacy, life skills, completion of high school or high school equivalency, adult basic education, and personal empowerment,"* (GN & NTI, 2022).

Individuals with low levels of literacy are prevented from gaining meaningful employment, *"while others are dead-ended in positions from which they can't progress without additional education and training*" (GN & NTI, 2022).

Inuktitut is the prevalent language in Grise Fiord reported as the mother tongue for 65.5 % of residents. However, just over one quarter (26.6 %) of employed residents in Grise Fiord work in settings where Inuktitut is the language most often used at work (Statistics Canada, 2023). A majority of the total population in Grise Fiord also speak English (135 residents or 93.1 %).

11.2.2 Housing and Accommodation

The 2021 census reported Grise Fiord having a total of 60 occupied private dwellings. Of the 60 occupied dwellings, 75 % (45) were rented. All rented dwellings were publicly subsidized housing. Nearly half (41.6 %) of the occupied dwellings were also in need of major repairs (Statistics Canada, 2023).

The Nunavut Housing Corporation's Annual report for 2023-2024 listed Grise Fiord's housing need as a percentage of stock at 29 % indicating a less critical need for housing compared to other communities in the territory (NHC, 2018).

Accommodation in Grise Fiord is limited and is currently provided by the Grise Fiord Lodge with nine rooms and capacity for nineteen guests total (Grise Fiord Inuit Co-op and Lodge Manager. pers. comm. Aug 2024).

11.2.3 Labour Force and Economic Activity

Table 11-1 presents the participation, employment and unemployment rates of the total population in Grise Fiord according to the 2021 Census. Grise Fiord experiences higher participation rates and higher unemployment rates compared to Nunavut as a whole. Of the population 15 years old and over (110), 70 people or 63.6 % participate in the labour force in Grise Fiord compared to 58.6 % participation for the territory. The unemployment rate was reported as 21.4 % in Grise Fiord compared to 16.9 % for Nunavut (Statistics Canada, 2023).

According to the community's 2024/25 Infrastructure Plan, the community has been without a daycare facility for over 5 years. The absence of a daycare facility has far reaching effects on the families specifically, and the community general. Many parents in Grise Fiord find it hard to find care for their young children during work hours because the community lacks a licensed daycare.

Table 11-1: Grise Fiord Demographics

Census Data	Total
Population	
Population in 2021	144
Population in 2016	129
Median age of the population	28
% of the population < 15 years of age	24.1
% of the population 15-64 years of age	65.5
% population change from 2016	11.6
Indigenous Population	
Inuit - single response	135
Non-Indigenous identity	10
Highest Educational Attainment	
Total population 15 years and over	110
No certificate, diploma or degree	50
Secondary (high) School diploma or equivalency certificate	30
Postsecondary certificate, diploma or degree	30

Census Data	Total
Apprenticeship or trades certificate or diploma	10
College; Collège d'enseignement général et professionnel (English translation - General and Vocational College) (CEGEP) or other non-university certificate or diploma	15
University certificate or diploma below the bachelor level	0
University certificate or degree at bachelor level or above	10
Labour Force Activity	
Total population 15 years and over	110
In the labour force	70
Employed	55
Unemployed	15
Not in the labour force	40
Participation rate	63.6 %
Employment rate	50 %
Unemployment rate	21.4 %

Source: Statistics Canada (2023)

Please note that in order to ensure the confidentiality of an individual's census response, Statistics Canada rounds values up or down, including totals, to a multiple of '5' or '10'. As stated by Statistics Canada, "*as a result, when these data are summed or grouped, the total value may not match the individual values since totals and sub-totals are independently rounded*" (Statistics Canada, 2025). Any discrepancy noted in the totals for various data categories is due to random rounding and does not affect the accuracy of the data set in a significant way. Similarly, percentages may not necessarily add up to 100 % because they are calculated on rounded data.

At the territorial level, according to Nunavut's Bureau of Statistics' 2023 Annual Labour Force Update, both Inuit and non-Inuit employment in Nunavut increased between 2022 and 2023. Although Inuit accounted for about 80.0 % of the working-age population in Nunavut, on average, they accounted for only 66.0 % of the total employed individuals in the territory that year. This disparity is also represented with an employment rate of 44.7 % for Inuit compared to 89.6 % for non-Inuit in 2023 (Nunavut Bureau of Statistics, 2024).

Given the size of the community, income data for Grise Fiord for the 2021 Census have been suppressed to meet the confidentiality requirements of the Statistics Act.

The economy in Grise Fiord can be characterized as a combination of traditional subsistence activities (including hunting, fishing, trapping and gathering) and wage based economic activities. Key employers in the region include the Hamlet of Grise Fiord, the GN (education, power, and health centre) and the Grise Fiord Inuit Co-op and Lodge. Tourism is a growing sector in the economy and Grise Fiord is a

frequent destination for polar expeditions and cruise ships travelling the Northwest Passage. Many residents continue to rely heavily on fish, seal and whale hunting, both for subsistence and as a cultural activity, including customary resource sharing practices.

A breakdown of how the current labour force in Grise Fiord is allocated across various industries is provided in Table 11-2. Residents participate in a variety of occupations including: fishing and hunting; utilities; and educational services. Public administration accounted for the largest industry, occupying one third (33.3 %) of the total labour force activity in Grise Fiord (Statistics Canada, 2023).

Table 11-2: Total Labour Force Population Aged 15 Years and Over by Industry - North American Industry Classification System (NAICS) 2012

NAICS Category	Total (Count)
11 Agriculture, forestry, fishing and hunting	10
22 Utilities	10
53 Real estate and rental and leasing	10
56 Administrative and support, waste management and remediation services	10
61 Educational services	10
75 Public administration	25

Source: Statistics Canada (2023)

11.2.4 Community Infrastructure and Services

11.2.4.1 Hamlet-Owned Infrastructure

According to the GN-CGS, the Hamlet of Grise Fiord currently owns the following infrastructure:

- Hamlet Office.
- Gymnasium / Community Hall.
- Fire Hall.
- Cold Storage Building.
- Three-bay Maintenance Garage.
- Two-Bay Garage.
- Water Reservoir
- Sewage Lagoon
- Landfill Site

11.2.4.2 Hamlet Equipment and Vehicle Inventory

The following equipment and vehicles are currently owned by the Hamlet (David General, SAO. pers. comm. December 2024, see Table 11-3).

Table 11-3: 2023 Hamlet Equipment and Vehicle Inventory

Year	Model	Type
1997	Cummins	Champion Grader 710A
2010	GM1500	GM Silverado Pick-up Truck
2016	Cat	Cat Loader 938K
1995	Cat	Cat Loader 928
2004	Cat	Cat Loader IT38GII
2006	Sterling	Sterling Fire Truck
2016	Chevy	Chevy Silverado
2007	Ford	F150 Truck
2011	Ford	F550 Garbage Truck
2016	Sterling	Sterling Water Truck
2016	Sterling	Sterling Sewage Truck
2016	Sterling	Sterling Gravel Dump Truck
2016	Case	Case Back Hoe/Loader
2008	Sterling	Sterling Sewage Truck
2008	Sterling	Sterling Water Truck
2019	Ford	F150 Truck

11.2.4.3 Utilities and Communications

The Hamlet of Grise Fiord is responsible for water, sewage and solid waste collection.

11.2.4.3.1 Water

Water is collected from glacial run-off creeks from the mountain, gathered in a holding pond and gravity fed to two 3.7 million L holding tanks with the community using about 5 million L annually. The Hamlet monitors water levels daily to ensure adequate and supply and confirmed that there are no current concerns regarding the capacity and reliability of the source water for the community.

Water is treated with chlorine before being loaded into trucks at the fill station for distribution to holding tanks in each building and residence. Currently, there is one water truck that delivers water daily to residences and commercial operations and one back-up water truck. A new water treatment plant is currently being planned and expected to be operational by 2028/29.

11.2.4.3.2 Sewage

Sewage and municipal wastewater are collected by a sewage truck on a daily basis (David General, SAO. pers. comm. Dec 2024). There is a back-up sewage truck, however, it currently requires major repairs.

The community has a non-engineered sewage lagoon with a capacity of 19,360 m³ that receives the trucked sewage from holding tanks for each building. The sewage lagoon is located approximately 800 m away from the Hamlet next to the solid waste landfill. The lagoon is a single cell retention system where effluent undergoes natural treatment prior to being discharged into the ocean. According to the Hamlet, the sewage lagoon is relatively small and its capacity is strained during years with higher-than-average snow and rain. The lagoon is decanted once per year, typically in late June or early July. While the lagoon has functioned adequately to meet current community demands, an influx of approximately 30 additional people could pose capacity challenges (David General, SAO pers. comm. Dec 2024).

11.2.4.3.3 Solid Waste Management

The municipal waste facilities include a domestic solid waste area and a bulk metal waste area located approximately 800 m away from the Hamlet near the sewage lagoon and close to the Arctic Ocean. These non-engineered facilities lack adequate fencing and are nearing capacity. The Hamlet stated that they have insufficient equipment for sorting waste at the landfill and emphasized the need for proper fencing to contain debris and manage the risks posed by polar bears.

The bulk metal waste site contains appliance waste (white goods) and construction bulk metal waste. T A 2018 INAC inspection reported that hazardous waste was present at both solid waste sites, with a significant amount located within the bulk metal waste site. The inspection report recommended the consolidation of the hazardous waste into a single segregated area (INAC, 2011). The Hamlet stated that they have insufficient equipment for sorting waste at the landfill and emphasized the need for proper fencing to contain debris and manage the risks posed by polar bears (David General, SAO. pers. comm. Dec 2024). The GN's 2023-2024 supplementary capital budg*et al*locates just over $1M for upgrades to the solid waste facility under the Small Communities Fund (SCF) (GN, 2023c). These upgrades aim to address existing capacity and operational challenges at the facility.

The Hamlet operates one garbage truck to collect municipal solid waste within the community and transfer it to the solid waste facility. A front-end loader is used to haul metal objects such as old automobiles and fridges to the metal dump. The community is connected to the sewage lagoon, the domestic solid waste site and the bulk metal site by an 800 m access road. The road is adequately maintained for all types of vehicles throughout the year.

11.2.4.3.4 Electricity and Fuel

Electricity is provided by diesel generators owned and operated by Qulliq Energy Corporation (QEC), a territorial corporation wholly owned by the GN. QEC is the sole generator, transmitter, and distributor of electrical energy in Nunavut. A new 10 kW solar power system with net metering was installed on the west side of the Hamlet/community complex in 2022. According to the Hamlet, an additional 100kW

solar power system for the community is expected to be installed by 2025. Fuel for electricity generation and other needs is imported, stored, and distributed by the GN Petroleum Products Division (GN-PPD).

Fuel is stored at a tank farm located less than 500m from the centre of town. Although there have been no significant issues with fuel delivery or storage capacity (see Table 11-4) in the community in recent years (except for a jet fuel shortage in 2022), the community often runs low before the annual resupply in mid-August. The fuel storage tanks have not been cleaned for many years. Condensation within the diesel tank has caused issues in the past resulting in milky diesel supply that impacted heavy equipment (Marty Kuluguqtuq, SAO. pers. comm. Dec 2024). According to the Hamlet's 2024/25 Infrastructure Plan, the community plans to expand diesel tank capacity, as there is currently only one diesel tank, and renovate the tank farm, as the existing fuel tanks are old and showing signs of aging.

Table 11-4: Bulk Fuel Storage Capacity for Grise Fiord

Total Diesel (L)	Total Gasoline (L)	Total Jet A-1 (L)
1,289,828 L	274,386 L	182,738 L

Source: Nunavut Maligaliurvia (2023)

11.2.4.3.5 Communications

Landline and mobile phone services are provided by NorthwesTel/Bell Mobility. Historically, internet services were provided by Qiniq. However, as of 2019, a new open-access network by Northwestel and Bell called Tamarmik Nunaliit now services Grise Fiord and delivers 15 megabits per second (Mbps) internet and LTE wireless service to the community. Operating on Telesat ka-Band satellite technology, the network provides up to 20 times more internet capacity than previously available, making high-speed internet and wireless service possible in the community.

There is a local community radio that broadcasts daily in Inuktitut and English and a Canada Post office in the Co-op store.

11.2.4.4 Education Services

Education services in Grise Fiord are provided through Umimmak school.

Umimmak school offers kindergarten to Grade 12 education. The 2024/2025 Infrastructure Plan for Grise Fiord identifies the need to renovate the gymnasium. Presently, the gym is located in the Hamlet Office building and students have to walk to the gym during the school day, which is time consuming. The municipal council would like to build a new gym in the school to accommodate ease of access and to support new activities, such as weightlifting, yoga, gymnastics, stationary cycles and ping pong tables.

According to the 2024/2025 Infrastructure Plan for Grise Fiord, the community has been without a day care for several years and needs a new facility. The old Saimavik Day Care was condemned by the Fire Marshall's Office and the Department of Health because it contained mold.

Across Nunavut, a variety of organizations currently offer adult education and training programs. However, the delivery of programs and courses is fragmented and inconsistently applied, leading to frustration and lack of engagement by adult learners. As a result, course and program completion rates are low and the system often falls short of meeting its stated objectives (GN & NTI, 2022).

Nunavut Arctic College (NAC) offers programs in communities across the territory through its 5 regional campuses and Community Learning Centres in each of the 25 communities. The programs and services offered by NAC aim to respond to local demands, including courses that provide the work force with the skills required to respond to local employment opportunities. Not all programs are offered every year, and they vary according to need and demand. According to NAC, many applicants require academic upgrading to be eligible to participate in their programs and although NAC offers preparatory programs, funding constraints means these programs are only able to be offered in a few communities. As a result, many adult learners would have to leave their communities to access these programs.

Nunavut Arctic College has a presence in Grise Fiord and offers courses intermittently such as Adult Basic Education - Essential Skills, Pathway to Adult Secondary School Diploma and Getting Ready for Employment and Training.

11.2.4.5 Transportation

Grise Fiord is serviced twice a week by scheduled commercial flights on Kenn Borek Air Ltd. (currently on Mondays and Thursdays).

The roads in Grise Fiord are gravel surface with no walkways. Pedestrians, all-terrain vehicles, snow machines, cars and trucks all share the road. The Hamlet manages snow clearing and dust suppression on roads.

The Hamlet has identified a need for a pedestrian walkway to connect the two halves of the community and minimize risk from polar bears (GN, 2024a). The community is currently divided by commercial buildings, the school, and municipal infrastructures on one end of town and the majority of residences on the other. In order to get from one side to the other, pedestrians have to walk along the main road to get to school and work. This is concerning especially in the dark season and with the presence of polar bears that commonly travel along the shoreline.

Sealift is a vital link for all communities in Nunavut that supply residents with their annual cargo of goods and materials. Sealift ships travel from several southern Canadian ports with a variety of goods ranging from housewares, non-perishable items, construction materials, vehicles, and heavy equipment. Nunavut Sealink and Supply Inc. (NSSI) and Nunavut Eastern Arctic Shipping Inc. (NEAS) are the current providers of sealift carriage and associated services. Sealift ships usually arrive in Grise Fiord at the end of August or beginning of September, with the last boat of the year leaving sometime around middle to late September.

11.2.4.6 Emergency and Protection Services

Fire protection is the responsibility of the Hamlet and currently relies on 8 volunteer fire fighters that may respond to fires once a year, if at all (Marty Kuluguqtuq, SAO. pers. comm. Dec 2024). The Hamlet reports they have sufficient resources for fire response. However, there is no firehall and one of the Hamlet's buildings currently houses the fire truck, fire-fighter bunker gear, and air compressor. This building serves as the "Firehall " since no other building was made available for this purpose. It does not have washroom facilities, nor running water and requires a renovation (GN, 2024a).

The RCMP detachment office is staffed with two full time officers on 2-year rotations.

11.2.4.7 Public Health

The Health Centre in Grise Fiord was built in 1990 and is adequately resourced with two nurses and equipped to meet most health care needs from the community. According to the most recent data, Grise Fiord Health Centre had a total of 1,642 visits in 2016 and 9.8 visits per capita (GN, 2018c).

The Health Centre has the ability to provide X-rays and sutures; prescribe drugs; intubate patients; and, in emergency cases, stabilize patients to be medevacked by plane to hospitals in Iqaluit or further south. The Health Centre offers 24-hour on-call emergency service. Given the remote location of Grise Fiord, fly-in specialists are not a regular occurrence; however, an occupational therapist and speech therapist visit once a year. In addition, nurses have access to tele-help to access specialists.

While the Health centre has never felt strained by southern workers using their services, the community has faced challenges when cruise ships deplete supplies from the co-op store. The Health Centre occasionally closes during holidays when staffing is insufficient. Due to weather and remoteness, delays for medical evacuations can take up to 6 days in some circumstances, emphasizing the need for the contractor to plan accordingly (Supervising nurse. pers. comm. Dec 2024). Workers are also advised to bring all required medication with them and to have first aid response capacity and supplies such as bandages, antiseptic, over the counter medications etc.

11.2.5 Local Businesses

The following businesses presented in Table 11-5 are registered for the current financial year.

Table 11-5: Registered Businesses for the Current Financial Year

Name of Business	Type
Ausuittuq Adventures	Outfitting - Tourism
Grise Fiord Co-op	Store/Hotel
Oogliit Sannavik	Convenience Store

11.2.6 Land and Resource Use

11.2.6.1 Harvesting and Food Security

Food security, as defined by the United Nation's Food and Agriculture Organization (FAO), exists "*when all people, at all times, have physical, social and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (FAO, 2023)*.

Inuit in Canada face the highest documented prevalence of food insecurity of any Indigenous people living in a developed country (ITK, 2021). In 2021, 46.1 % of people in Nunavut lived in food-insecure households (Statistics Canada, 2023).

Hunting remains essential to life in Grise Fiord. Harvesting of seal and narwhal are of particular importance. The availability of traditionally harvested foods in Grise Fiord is crucial because it lowers the demand for imported food which is expensive and most often less nutritious. Additionally, the harvesting, preparation, and sharing of meat and skins offers important opportunities for community members to maintain Inuit cultural practices. Residents also obtain food at the Co-Op and convenience store, and through sealift. However, "*Low incomes and high food prices mean most Inuit households can afford less than half the cost of a healthy food basket, while very low-income households can afford only 6–13 % of the cost of a healthy food basket*" (ITK, 2021) Additionally, the AFA vessel comes in annually to supply the community with food and hunting supplies. There are often community sales of AFA supplied goods that are priced lower than items at the Co-op store or from sealift (Jaypetee Akeeagok, AFA Chairman. Nov 2018).

Harvesting locations identified during the IQ program have been provided in the Land Use and Occupancy map (Figure 2-1).

Harvesting in the community mainly occurs along the shoreline fronting town and to the East. A large clam bed is harvested on the east side of the community (Figure 2-1). Some people also harvest kelp in this area and some wait for it to be pushed onshore (IQ Workshop 2019 - Amon Akeeagok). Although a smaller bed of clams occurs to the west in the area of the community harbour, no clam harvesting or any kind of plant harvesting is conducted there due to the wastewater outfall (IQ workshop 2024).

Fishing for sculpin is conducted along the tide line east of the community and near shore in an area southwest of the community (see Figure 2-1). Fishing is done by jigging, there are no gillnets placed (IQ Workshop 2019 - Amon Akeeagok; IQ Workshop 2019 - Manasie Noah; IQ Workshop 2019 - Marty Kuluguqtuq)(IQ workshops - 2024).

Hunters wait for seals and other marine mammals (including narwhal) all along the shoreline fronting the community, to the east of the community and, to a lesser extent, in an area southwest of the community (see Figure 2-1).

> *"The seal waiting area to the southwest was used more a long time ago, now many of the young won't walk all that way and mostly stay all along the shore closer to the community"* (IQ Workshop 2019 - Amon Akeeagok)

Belugas are commonly observed and harvested close to shore, west of the community, in the area of the community harbour. Additionally, hunting for seals along ice cracks that form at rocky outcrops along the shoreline is common:

> *"the ice will have cracks and seals will make holes, as soon as freeze up happens it creates cracks and then we hunt along these cracks until breakup in Spring"* (IQ Workshop 2019 - Manasie Noah)

Trapping does not occur anywhere within the municipal boundaries of Grise Fiord, including in the areas where Arctic fox and Arctic Hare are present enroute to the ptarmigan hunting area (Grise Fiord IQ Workshop 2019 and 2024).

> *"People feel that animals are too close to the dump and sewage lagoon to harvest them. There used to be fox traps in the area but not so today. However, if a hare or fox is clean and away from refuse, one may harvest if he/she so choses."* (IQ Workshop 2019 - Marty Kuluguqtuq)

Polar bear tracks are commonly sighted at the dump and all along the shoreline where there are food caches ((IQ Workshop 2019 - Amon Akeeagok).

Although small blueberry patches are picked for leisure near the seal waiting area southwest of the community (see Figure 2-1) (IQ Workshop 2019 - Manasie Noah), there are no specific or significant plant harvesting areas to avoid in or around the Study Areas (Grise Fiord IQ Workshop 2019 and 2024).

A known Thule site east of the community and a potential archaeological site west of the community were marked on the map by knowledge holders. There were no other known cultural sites identified by knowledge holders in or around the Study Areas (Grise Fiord IQ Workshop 2019 and 2024).

11.2.6.2 Travel Routes and Access

Boats and skidoos are critical for subsistence harvesting in the Arctic. The majority of harvesting activities are conducted far from Grise Fiord and require boats and skidoos for access, as made evident by a local hunter:

> *"The community depends on boating for our food, livelihoods, to harvest healthy country food for our kids and grandkids"* (Jaypetee Akeeagok, AFA Chairman. Nov 2018).

Currently, Grise Fiord does not have an established boat harbour. Boat owners moor their boats in a rudimentary mooring basin in one of two arms at the mouth of the Kuuraaluk Creek to protect their boats from storm waves. Kuuraaluk Creek is the major creek that runs through the middle of the Hamlet. Access into and out of the mooring basin is restricted at low tide. The only marine infrastructure consists of two mooring bollards for the fuel re-supply tanker.

Dry cargo from sealift is lightered to shore in the conventional manner, that is, using small tugs and barges that are carried on board the arriving ship. The barges are brought into the beach immediately in front of the RCMP detachment building and temporarily stored in the area surrounding the road that

also fronts the RCMP detachment. When the AFA vessel arrives with their annual stores, a GN supplied float is deployed for lightering and brought into the sealift beach area, which is close to the community freezer. Local boat activities are generally segregated from sealift.

The community has been building a road to Nuvuk along the beach by extending the community's main road along the valley behind the Greenlander mountain (see Figure 2-1). Progress on the road has been gradual and currently reaches the quarry area. The road aims to provide critical access for hunters to the fjord. The fjords thaw earlier in the spring and freeze faster in the fall extending the ability to hunt and fish during these transitional seasons (IQ workshop 2024).

In general, ice is accessed all along the shoreline and is considered fairly easy most years (IQ workshop 2019 and 2024). Ice trails and access locations change from year to year depending on where the ice has rafted that year. In the spring, when the ice gets too fractured, ice access points continue to move east along the coast to access hunting grounds (see Figure 2-1) (IQ Workshop 2019 and 2024).

11.2.6.3 The Nauttiqsuqtiit Program

In July 2018, QIA launched the TI Nauttiqsuqtiit pilot program (otherwise known as the pilot Guardian Program) in Arctic Bay as an early benefit from the Inuit Impact and Benefit Agreement (IIBA) required to establish the TI NMCA. The program is made possible through funding from Parks Canada and has now expanded to other communities, including Grise Fiord. The Grise Fiord Nauttiqsuqtit provide local stewardship of the TI NMCA to monitor the ecological health of the region and maintain cultural sites. Four Inuit from Grise Fiord have been hired as Nauttiqsuqtit to be the stewards of the marine areas in and around the community.

Their activities include the following:

- Monitor sea ice, snow conditions, wildlife and ship traffic.
- Assist with search and rescue efforts.
- Harvesting to provide country food for the community.
- Contribute to land and marine planning and management.
- Promote intergenerational sharing of Inuit knowledge by taking youth out on the land and sea.
- Engage with community members and act as a bridge between Elders and youth.
- Act as cultural liaisons and interpreters for the TI NMCA.
- Gather IQ.

11.2.6.4 Recreation and Tourism

11.2.6.4.1 Recreation Services

The only recreational facilities in Grise Fiord are the gymnasium located in the Hamlet and the community playground. The 2024/25 Infrastructure Plan for Grise Fiord identifies the need for a multi-

purpose building that houses an Arena, Youth Centre and Cultural & Heritage Centre. As stated in the Plan:

"The community would benefit greatly from having a multi-purpose building… It would be particularly valuable in Grise Fiord where so many necessities of life are lacking. This infrastructure would help in a significant way to enhance the quality of life of the people." (GN, 2024a).

There is also an interest in building a swimming pool, however the municipality must assess the liability risks and costs of a swimming pool.

11.2.6.4.2 Tourism

Grise Fiord is Canada's most northern community, located 1,160 km from the Arctic Circle. It is nestled among majestic mountains at the end of the stunning fiord that offers a unique tourist experience. Grise Fiord is the closest community to Quttinirpaaq National Park - Canada's second largest and most northern National Park. The Nirjutiqavvik National Wildlife is also located nearby.

Tourist experiences include:

- A guided visit to Quttinirpaaq National Park and to Nirjutiqavvik NWA.
- Local Inuit arts and crafts and locally made traditional clothing.
- Wildlife viewing of beluga whales, narwhals, walrus, seals, muskox and polar bears.

Ausuittuq Adventures run by Terry Noah[36] is a 100 % locally owned Inuit outfitting business providing several tours in and around Grise Fiord, including iceberg viewing, dog team rides, seal hunting and photography tours among many others. The HTA can also arrange for local Inuit guides to support tourists.

Cruise ship and private pleasure craft visits to the community have steadily increased over recent years. According to the Hamlet, the community now receives an average of seven cruise ship visits annually.

[36] See Ausuittuq Adventures website https://www.ausuittuqadventures.com

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Appendix A: Supporting Tables (Field Program)

Appendix A: Water Quality Field Results (ESEB Report Section 5)

Table A-1: Water Quality (General Water Chemistry (2019))

Site	Date	pH	Hardness (as CaCO3) - Total Calculated	Hardness (as CaCO3) - Dissolved	Total Organic Carbon	Total Suspended Solids	Nitrate as N	Nitrate plus nitrite as N	Nitrite as N	Ammonia as N	Filter and HNO3 Preservation	Sulphur - Dissolved	Sulphur - Total	Orthophosphate	Total Phosphorus
CCME (2007)		**(pH units)**	**(mg/L)**	**(mg/L)**	**(mg/L)**	**(mg/L)**	**(mg/L)**	**(mg/L)**	**(mg/L)**	**(mg/L)**	**(none)**	**(mg/L)**	**(mg/L)**	**(mg/L)**	**(mg/L)**
		(7 - 8.7)	**---**	**---**	**---**	**---**	**3.6**	**---**	**---**	**---**	**---**	**---**	**---**	**---**	**---**
GF 1 DEEP	16-Aug-19	7.89	5630	5910	93 [1]	7.6	---	---	---	0.85	FIELD	919	847	0.021	0.024
GF 1 SHALLOW	16-Aug-19	7.98	4530	4510	73 [1]	6.8	---	---	---	0.85	FIELD	687	678	0.0086	0.011
GF 2 DEEP	16-Aug-19	7.99	4480	4620	75 [1]	9.2	---	---	---	1.0	FIELD	737	667	0.0085	0.011
GF 3 DEEP	16-Aug-19	7.83	5790	5950	100 [1]	12.4	---	---	---	0.58 [#7]	FIELD	939	872	0.024	0.027
GF 3 SHALLOW	16-Aug-19	8.00	4430	4660	70 [1]	12.4	---	---	---	0.86	FIELD	740	668	0.0075	0.011
GF 4 DEEP	16-Aug-19	**4.96** [2]	< 0.50	< 0.50	< 10 [1]	< 4.0	---	---	---	< 0.015	FIELD	< 20	< 20	< 0.0030	< 0.0030
GF 5 SHALLOW	16-Aug-19	7.96	4780	4970	86 [1]	6.4	---	---	---	0.70	FIELD	785	718	0.0087	0.012
GF 6 SHALLOW	16-Aug-19	8.00	4910	4940	84 [1]	5.2	---	---	---	0.83	FIELD	749	734	0.0084	0.011

Note:

1. Detection Limit raised due to sample matrix
2. parameters above applied guideline/criteria

Table A-2: Water Quality (Total Metals (2019))

Site[1]	Date	pH	Aluminum	Antimony	Arsenic	Barium	Beryllium	Bismuth	Boron	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Lithium	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Phosphorus	Potassium	Selenium	Silicon	Silver	Sodium	Strontium	Thallium	Tin	Titanium	Uranium	Vanadium	Zinc	Zirconium
	(dd-mmm-yy)	(pH units)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(mg/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(mg/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(mg/L)	(ug/L)	(ug/L)	(ug/L)	(mg/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)
CCME Marine Water Aquatic Life (2007)		**(7 - 8.7)**	---	---	**12.5**	---	---	---	---	**0.12**	---	**1.5**	---	---	---	---	---	---	---	**0.016**	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
GF 1 D	16-Aug-19	7.89	33	< 0.50	2.85	8.1	< 1.0	< 1.0	3810	< 0.050	371	< 0.50	< 0.10	< 0.50	< 10	< 0.10	159	1140	< 0.50	< 0.0020	10.4	0.32	---	347	< 0.50	< 1000	< 0.050	---	7790	< 0.10	< 1.0	< 10	2.80	< 10	< 5.0	< 10
GF 1 S	16-Aug-19	7.89	33	< 0.50	2.85	8.1	< 1.0	< 1.0	3810	< 0.050	371	< 0.50	< 0.10	< 0.50	< 10	< 0.10	159	1140	< 0.50	< 0.0020	10.4	0.32	---	347	< 0.50	< 1000	< 0.050	---	7790	< 0.10	< 1.0	< 10	2.80	< 10	< 5.0	< 10
GF 2 D	16-Aug-19	7.99	47	< 0.50	2.16	9.0	< 1.0	< 1.0	3120	< 0.050	291	< 0.50	< 0.10	< 0.50	16	0.19	129	912	1.30	< 0.0020	7.7	0.53	---	272	< 0.50	< 1000	< 0.050	---	6150	< 0.10	< 1.0	< 10	2.39	< 10	< 5.0	< 10
GF 3 D	16-Aug-19	7.83	34	< 0.50	2.63	8.6	< 1.0	< 1.0	3910	0.060	376	0.62	< 0.10	< 0.50	< 10	< 0.10	163	1180	< 0.50	< 0.0020	10.4	0.56	---	353	< 0.50	< 1000	< 0.050	---	7890	< 0.10	< 1.0	< 10	3.00	< 10	< 5.0	< 10
GF 3 S	16-Aug-19	8.00	45	< 0.50	1.80	9.0	< 1.0	< 1.0	2990	< 0.050	287	< 0.50	< 0.10	1.00	15	0.11	128	902	1.12	< 0.0020	7.9	0.32	---	274	< 0.50	< 1000	< 0.050	---	6050	< 0.10	< 1.0	< 10	2.31	< 10	< 5.0	< 10
GF 4 D	16-Aug-19	**4.96**[1]	31	< 0.50	< 0.50	< 1.0	< 1.0	< 1.0	< 50	< 0.050	< 1.0	< 0.50	< 0.10	< 0.50	< 10	< 0.10	< 20	< 1.0	< 0.50	< 0.0020	< 1.0	< 0.20	---	< 1.0	< 0.50	< 1000	< 0.050	---	< 10	< 0.10	< 1.0	< 10	< 0.050	13	< 5.0	< 10
GF 5 S	16-Aug-19	7.96	43	< 0.50	2.10	8.5	< 1.0	< 1.0	3280	< 0.050	313	< 0.50	< 0.10	< 0.50	48	< 0.10	136	971	1.30	< 0.0020	8.7	0.37	---	291	< 0.50	< 1000	< 0.050	---	6540	< 0.10	< 1.0	< 10	2.53	< 10	< 5.0	< 10
GF 6 S	16-Aug-19	8.00	41	< 0.50	1.81	8.5	< 1.0	< 1.0	3310	< 0.050	316	< 0.50	< 0.10	1.66	14	0.14	139	1000	0.77	< 0.0020	8.8	0.32	---	297	< 0.50	< 1000	< 0.050	---	6700	< 0.10	< 1.0	< 10	2.54	< 10	< 5.0	< 10

Note:

1. D= Deep and S = Shallow
2.

	parameters above applied guideline/criteria		non-detect parameters above applied guideline/criteria.		parameters at applied guideline/criteria

1. Matrix Spike outside acceptance criteria due to sample matrix interference.
2. Values exceeding Canadian Environmental Quality Guidelines for the Protection of Aquatic Life (CCME, 1999 and Updates, last update v7 2007) *Chromium:* Standard is for Chromium VI as it is the most conservative value

Table A-3: Water Quality (Dissolved Metals (2019))

Site	Date	pH	Aluminum	Antimony	Arsenic	Barium	Beryllium	Bismuth	Boron	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Lithium	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Phosphorus	Potassium	Selenium	Silicon	Silver	Sodium	Strontium	Thallium	Tin	Titanium	Uranium	Vanadium	Zinc	Zirconium
	(dd-mmm-yyyy)	(pH units)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(mg/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(mg/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(mg/L)	(ug/L)	(ug/L)	(ug/L)	(mg/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)
CCME Marine Water Aquatic Life (2007)		**(7 - 8.7)**	---	---	**12.5**	---	---	---	---	**0.12**	---	**1.5**	---	---	---	---	---	---	---	**0.016**	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
GF 1 DEEP	16-Aug-2019	7.89	11	< 0.50	3.19	9.6	< 1.0	< 1.0	4070	< 0.050	410	< 0.50	< 0.10	< 0.50	< 10	< 0.10	169	1190	< 0.50	< 0.0020	10.8	0.28	---	357	< 0.50	< 1000	< 0.050	---	7950	< 0.10	1.7	< 10	2.93	< 10	< 5.0	< 10
GF 1 SHALLOW	16-Aug-2019	7.98	27	< 0.50	2.98	9.5	< 1.0	< 1.0	3210	< 0.050	297	0.82	0.13	0.61	< 10	0.36	132	914	2.32	< 0.0020	8.1	0.45	---	274	< 0.50	< 1000	< 0.050	---	6140	< 0.10	< 1.0	< 10	2.38	10	9.7	< 10
GF 2 DEEP	16-Aug-2019	7.99	14	< 0.50	2.63	11.8	< 1.0	< 1.0	3180	0.084	334	< 0.50	< 0.10	< 0.50	< 10	< 0.10	131	920	1.02	< 0.0020	8.5	1.00 3	---	278	< 0.50	< 1000	< 0.050	---	6250	< 0.10	< 1.0	< 10	2.37	10	< 5.0	< 10
GF 3 DEEP	16-Aug-2019	7.83	11	< 0.50	3.30	11.2	< 1.0	< 1.0	4030	**0.129** [2]	428	< 0.50	< 0.10	< 0.50	< 10	< 0.10	164	1180	< 0.50	< 0.0020	10.8	0.59	---	358	< 0.50	< 1000	< 0.050	---	7870	< 0.10	< 1.0	< 10	3.01	< 10	< 5.0	< 10
GF 3 SHALLOW	16-Aug-2019	8.00	13	< 0.50	2.73	12.0	< 1.0	< 1.0	3190	0.066	335	< 0.50	< 0.10	< 0.50	< 10	< 0.10	129	928	1.07	< 0.0020	8.5	0.65	---	276	< 0.50	< 1000	< 0.050	---	6230	< 0.10	< 1.0	< 10	2.40	10	< 5.0	< 10
GF 4 DEEP	16-Aug-2019	**4.96** [2]	18	< 0.50	1.01	< 1.0	< 1.0	< 1.0	< 50	< 0.050	< 1.0	1.09	< 0.10	1.24	16	< 0.10	< 20	< 1.0	< 0.50	< 0.0020	< 1.0	< 0.20	---	< 1.0	< 0.50	< 1000	< 0.050	---	< 10	< 0.10	1.2	< 10	< 0.050	17	< 5.0	< 10
GF 5 SHALLOW	16-Aug-2019	7.96	13	< 0.50	3.08	7.7	< 1.0	< 1.0	3450	0.085	356	< 0.50	< 0.10	< 0.50	41	< 0.10	139	992	1.20	< 0.0020	9.1	1.64 [3]	---	300	< 0.50	< 1000	< 0.050	---	6630	< 0.10	< 1.0	< 10	2.54	< 10	< 5.0	< 10
GF 6 SHALLOW	16-Aug-2019	8.00	16	< 0.50	2.67	8.2	< 1.0	< 1.0	3490	< 0.050	319	0.51	< 0.10	< 0.50	< 10	< 0.10	140	1010	0.66	< 0.0020	8.9	0.48	---	301	< 0.50	< 1000	< 0.050	---	6770	< 0.10	< 1.0	< 10	2.52	10	6.0	< 10

Note:

1. D= Deep and S = Shallow
2.

	parameters above applied guideline/criteria.		non-detect parameters above applied guideline/criteria.		parameters at applied guideline/criteria.

1. Matrix Spike outside acceptance criteria due to sample matrix interference.
2. Values exceeding Canadian Environmental Quality Guidelines for the Protection of Aquatic Life (CCME, 1999 and Updates, last update v7 2007) *Chromium:* Standard is for Chromium VI as it is the most conservative value

Appendix A: Fish and Fish Habitat Field Results (ESEB Report Section 7)

Table A-4: Fish and Fish Habitat (Intertidal Survey Data 2024)

Transect No.	Transect Length (m)	Quadrat No.	Transect Distance (m)	Substrate		Vegetation		Invertebrate			Fish		Transect Used (Y/N)	Amphipods Present (Y/N)
				Type	Cover	Species	Abundance	Species	Abundance	Measurement	Species	Abundance		
04-Sep-24														
6	96	Q1	96	GR	50	-	-	-	-	-	-	-	N	Y
				CO	25	-	-	-	-	-	-	-		
				BO	25	-	-	-	-	-	-	-		
		Q2	89	GR	85	-	-	-	-	-	-	-		
				CO	15	-	-	-	-	-	-	-		
		Q3	82	GR	20	-	-	-	-	-	-	-		
				CO	60	-	-	-	-	-	-	-		
				BO	20	-	-	-	-	-	-	-		
		Q4	75	GR	50	-	-	-	-	-	-	-		
				CO	50	-	-	-	-	-	-	-		
		Q5	68	GR	50	-	-	-	-	-	-	-		
				CO	50	-	-	-	-	-	-	-		
		Q6	61	GR	85	-	-	-	-	-	-	-		
				CO	15	-	-	-	-	-	-	-		
		Q7	54	GR	70	-	-	-	-	-	-	-		
				CO	20	-	-	-	-	-	-	-		
				BO	10	-	-	-	-	-	-	-		
		Q8	47	SA	5	-	-	-	-	-	-	-		
				GR	25	-	-	-	-	-	-	-		
				CO	65	-	-	-	-	-	-	-		
				BO	5	-	-	-	-	-	-	-		
		Q9	40	SA	5	-	-	-	-	-	-	-		
				GR	60	-	-	-	-	-	-	-		

Transect No.	Transect Length (m)	Quadrat No.	Transect Distance (m)	Substrate		Vegetation		Invertebrate			Fish		Transect Used (Y/N)	Amphipods Present (Y/N)
				Type	Cover	Species	Abundance	Species	Abundance	Measurement	Species	Abundance		
				CO	20	-	-	-	-	-	-	-		
				BO	15	-	-	-	-	-	-	-		
		Q10	33	GR	10	-	-	-	-	-	-	-		
				CO	90	-	-	-	-	-	-	-		
		Q11	26	GR	25	-	-	-	-	-	-	-		
				CO	45	-	-	-	-	-	-	-		
				BO	30	-	-	-	-	-	-	-		
		Q12	19	GR	75	-	-	-	-	-	-	-		
				CO	25	-	-	-	-	-	-	-		
		Q13	12	GR	95	-	-	-	-	-	-	-		
				CO	5	-	-	-	-	-	-	-		
		Q14	5	CO	90	-	-	-	-	-	-	-		
				BO	10	-	-	-	-	-	-	-		
		Q15	0	GR	95	-	-	-	-	-	-	-		
				CO	<5	-	-	-	-	-	-	-		
7	182	Q1	182	GR	5	-	-	-	-	-	-	-	N	N
				CO	95	-	-	-	-	-	-	-		
		Q2	170	SA	10	rockweed	50	-	-	-	-	-		
				CO	40	-	-	-	-	-	-	-		
				BO	50	-	-	-	-	-	-	-		
		Q3	155	GR	40	-	-	-	-	-	-	-		
				CO	60	-	-	-	-	-	-	-		
		Q4	143	GR	30	-	-	-	-	-	-	-		
				CO	45	-	-	-	-	-	-	-		
				BO	25	-	-	-	-	-	-	-		

Transect No.	Transect Length (m)	Quadrat No.	Transect Distance (m)	Substrate		Vegetation		Invertebrate			Fish		Transect Used (Y/N)	Amphipods Present (Y/N)
				Type	Cover	Species	Abundance	Species	Abundance	Measurement	Species	Abundance		
		Q5	131	GR	75	-	-	-	-	-	-	-		
				CO	25	-	-	-	-	-	-	-		
		Q6	119	SA	5	-	-	-	-	-	-	-		
				GR	60	-	-	-	-	-	-	-		
				CO	35	-	-	-	-	-	-	-		
		Q7	107	GR	75	-	-	-	-	-	-	-		
				CO	25	-	-	-	-	-	-	-		
		Q8	95	GR	95	-	-	-	-	-	-	-		
				CO	5	-	-	-	-	-	-	-		
		Q9	83	SA	10	rockweed	10	-	-	-	-	-		
				GR	75	-	-	-	-	-	-	-		
				CO	15	-	-	-	-	-	-	-		
		Q10	71	SA	5	-	-	-	-	-	-	-		
				GR	90	-	-	-	-	-	-	-		
				CO	5	-	-	-	-	-	-	-		
		Q11	59	GR	50	-	-	-	-	-	-	-		
				CO	50	-	-	-	-	-	-	-		
		Q12	47	SA	45	-	-	-	-	-	-	-		
				GR	45	-	-	-	-	-	-	-		
				CO	10	-	-	-	-	-	-	-		
		Q13	35	GR	95	-	-	-	-	-	-	-		
				CO	5	-	-	-	-	-	-	-		
		Q14	23	SA	5	-	-	-	-	-	-	-		
				GR	95	-	-	-	-	-	-	-		
		Q15	11	SA	10	-	-	-	-	-	-	-		

Transect No.	Transect Length (m)	Quadrat No.	Transect Distance (m)	Substrate		Vegetation		Invertebrate			Fish		Transect Used (Y/N)	Amphipods Present (Y/N)
				Type	Cover	Species	Abundance	Species	Abundance	Measurement	Species	Abundance		
				GR	90	-	-	-	-	-	-	-		
		Q16	0	CO	10	-	-	-	-	-	-	-		
				BO	90	-	-	-	-	-	-	-		
8	27	Q1	0	GR	25	-	-	-	-	-	-	-	Y	Y
				BO	75	-	-	-	-	-	-	-		
		Q2	6.75	SA	25	-	-	-	-	-	-	-		
				GR	15	-	-	-	-	-	-	-		
				CO	25	-	-	-	-	-	-	-		
				BO	35	-	-	-	-	-	-	-		
		Q3	13.5	M	30	-	-	-	-	-	-	-		
				GR	25	-	-	-	-	-	-	-		
				CO	45	-	-	-	-	-	-	-		
		Q4	20.25	SA	5	-	-	-	-	-	-	-		
				GR	95	-	-	-	-	-	-	-		
		Q5	27	SA	10	-	-	-	-	-	-	-		
				GR	80	-	-	-	-	-	-	-		
				CO	10	-	-	-	-	-	-	-		
9	23.5	Q1	0	GR	40	-	-	-	-	-	-	-	Y	N
				CO	10	-	-	-	-	-	-	-		
				BO	50	-	-	-	-	-	-	-		
		Q2	4.7	SA	5	-	-	-	-	-	-	-		
				GR	50	-	-	-	-	-	-	-		
				CO	25	-	-	-	-	-	-	-		
				BO	20	-	-	-	-	-	-	-		
		Q3	9.4	GR	20	-	-	-	-	-	-	-		

Transect No.	Transect Length (m)	Quadrat No.	Transect Distance (m)	Substrate		Vegetation		Invertebrate			Fish		Transect Used (Y/N)	Amphipods Present (Y/N)
				Type	Cover	Species	Abundance	Species	Abundance	Measurement	Species	Abundance		
				BO	80	-	-	-	-	-	-	-		
		Q4	14.1	CO	50	unidentified brown algae	70	-	-	-	-	-		
				BO	50	kelp blade	<5	-	-	-	-	-		
		Q5	18.8	SA	15	rockweed	5	-	-	-	-	-		
				GR	40	unidentified brown algae	5	-	-	-	-	-		
				CO	10	-	-	-	-	-	-	-		
				BO	35	-	-	-	-	-	-	-		
		Q6	23.5	SA	20	unidentified brown algae	20	-	-	-	-	-		
				GR	75	-	-	-	-	-	-	-		
				CO	5	-	-	-	-	-	-	-		
10	27.5	Q1	0	SA	99	rockweed, loose	25	-	-	-	-	-	Y	N
				GR	>1	brown filamentous algae	5	-	-	-	-	-		
		Q2	6.8	SA	90	rockweed, loose	25	-	-	-	-	-		
				GR	5	brown filamentous algae	5	-	-	-	-	-		
				CO	5	-	-	-	-	-	-	-		
		Q3	13.6	SA	35	rockweed	<5	-	-	-	-	-		
				GR	50	-	-	-	-	-	-	-		
				CO	15	-	-	-	-	-	-	-		

Transect No.	Transect Length (m)	Quadrat No.	Transect Distance (m)	Substrate		Vegetation		Invertebrate			Fish		Transect Used (Y/N)	Amphipods Present (Y/N)
				Type	Cover	Species	Abundance	Species	Abundance	Measurement	Species	Abundance		
		Q4	20.4	SA	60	-	-	-	-	-	-	-		
				GR	30	-	-	-	-	-	-	-		
				CO	10	-	-	-	-	-	-	-		
		Q5	26.8	M	10	brown filamentous algae	10	-	-	-	-	-		
				GR	40	-	-	-	-	-	-	-		
				CO	50	-	-	-	-	-	-	-		
11	26	Q1	0	SA	5	rockweed, loose	5	-	-	-	-	-	Y	N
				GR	60	-	-	-	-	-	-	-		
				CO	10	-	-	-	-	-	-	-		
				BO	25	-	-	-	-	-	-	-		
		Q2	6.5	SA	40	-	-	-	-	-	-	-		
				GR	60	-	-	-	-	-	-	-		
		Q3	13	SA	80	unidentified brown algae	<5	-	-	-	-	-		
				CO	10	-	-	-	-	-	-	-		
				BO	10	-	-	-	-	-	-	-		
		Q4	19.5	SA	30	-	-	-	-	-	-	-		
				GR	60	-	-	-	-	-	-	-		
				BO	10	-	-	-	-	-	-	-		
		Q5	26	SA	20	-	-	-	-	-	-	-		
				GR	20	-	-	-	-	-	-	-		
				CO	60	-	-	-	-	-	-	-		
12	22	Q1	0	GR	75	-	-	-	-	-	-	-		

Transect No.	Transect Length (m)	Quadrat No.	Transect Distance (m)	Substrate		Vegetation		Invertebrate			Fish		Transect Used (Y/N)	Amphipods Present (Y/N)
				Type	Cover	Species	Abundance	Species	Abundance	Measurement	Species	Abundance		
				BO	25	-	-	-	-	-	-	-	Y	N
		Q2	5.5	GR	20	rockweed, loose	<5	-	-	-	-	-		
				CO	10	-	-	-	-	-	-	-		
				BO	70	-	-	-	-	-	-	-		
		Q3	11	CO	15	-	-	-	-	-	-	-		
				BO	85	-	-	-	-	-	-	-		
		Q4	16.5	GR	5	-	-	-	-	-	-	-		
				BO	95	-	-	-	-	-	-	-		
		Q5	22	BO	100	rockweed	90	-	-	-	-	-		
				-	-	brown filamentous algae	5	-	-	-	-	-		
13	23.5	Q1	0	GR	100	rockweed	<5	-	-	-	-	-	Y	N
		Q2	4.7	SA	75	rockweed	10	-	-	-	-	-		
				GR	25	-	-	-	-	-	-	-		
		Q3	9.4	GR	100	rockweed	5	-	-	-	-	-		
		Q4	14.1	SA	85	-	-	-	-	-	-	-		
				GR	10	-	-	-	-	-	-	-		
				CO	5	-	-	-	-	-	-	-		
		Q5	18.8	SA	85	-	-	-	-	-	-	-		
				GR	10	-	-	-	-	-	-	-		
				CO	5	-	-	-	-	-	-	-		
		Q6	23.5	M	90	-	-	-	-	-	-	-		
				GR	10	-	-	-	-	-	-	-		
14	25	Q1	0	GR	100	-	-	-	-	-	-	-	Y	N

Transect No.	Transect Length (m)	Quadrat No.	Transect Distance (m)	Substrate		Vegetation		Invertebrate			Fish		Transect Used (Y/N)	Amphipods Present (Y/N)
				Type	Cover	Species	Abundance	Species	Abundance	Measurement	Species	Abundance		
		Q2	6.25	GR	100	rockweed	10	-	-	-	-	-		
				-	-	unidentified red tubular algae	<5	-	-	-	-	-		
				-	-	unidentified red bladed algae	5	-	-	-	-	-		
		Q3	12.5	SA	10	rockweed, loose	<5	-	-	-	-	-		
				GR	90	-	-	-	-	-	-	-		
		Q4	18.75	SA	60	-	-	-	-	-	-	-		
				GR	40	-	-	-	-	-	-	-		
		Q5	25	SA	10	-	-	-	-	-	-	-		
				GR	90	-	-	-	-	-	-	-		
15	22.5	Q1	0	GR	100	-	-	-	-	-	-	-	Y	N
		Q2	5.6	SA	95	rockweed, loose	<5	-	-	-	-	-		
				GR	5	-	-	-	-	-	-	-		
		Q3	11.2	GR	100	-	-	-	-	-	-	-		
		Q4	16.8	GR	100	-	-	-	-	-	-	-		
		Q5	22.5	GR	100	rockweed, loose	<5	-	-	-	-	-		
16	23.5	Q1	0	SA	15	rockweed, loose	5	-	-	-	-	-	Y	N
				GR	85	-	-	-	-	-	-	-		
		Q2	6.7	GR	100	rockweed, loose	10	-	-	-	-	-		

Transect No.	Transect Length (m)	Quadrat No.	Transect Distance (m)	Substrate		Vegetation		Invertebrate			Fish		Transect Used (Y/N)	Amphipods Present (Y/N)
				Type	Cover	Species	Abundance	Species	Abundance	Measurement	Species	Abundance		
		Q3	9.4	SA	5	-	-	-	-	-	-	-		
				GR	95	-	-	-	-	-	-	-		
		Q4	14.1	SA	80	-	-	-	-	-	-	-		
				GR	20	-	-	-	-	-	-	-		
		Q5	18.8	GR	100	-	-	-	-	-	-	-		
		Q6	23.5	SA	5	rockweed	5	-	-	-	-	-		
				GR	95	-	-	-	-	-	-	-		
05-Sept-24														
5	73	Q1	73	SA	50	-	-	-	-	-	-	-	N	Y
				CO	50	-	-	-	-	-	-	-		
		Q2	64	GR	30	-	-	-	-	-	-	-		
				CO	40	-	-	-	-	-	-	-		
				BO	30	-	-	-	-	-	-	-		
		Q3	56	SA	10	-	-	-	-	-	-	-		
				CO	10	-	-	-	-	-	-	-		
				BO	80	-	-	-	-	-	-	-		
		Q4	48	GR	50	-	-	-	-	-	-	-		
				CO	50	-	-	-	-	-	-	-		
		Q5	40	SA	15	-	-	-	-	-	-	-		
				GR	85	-	-	-	-	-	-	-		
		Q6	32	SA	5	-	-	-	-	-	-	-		
				GR	95	-	-	-	-	-	-	-		
		Q7	24	GR	100	-	-	-	-	-	-	-		
		Q8	16	GR	50	-	-	-	-	-	-	-		
				CO	50	-	-	-	-	-	-	-		

Transect No.	Transect Length (m)	Quadrat No.	Transect Distance (m)	Substrate		Vegetation		Invertebrate			Fish		Transect Used (Y/N)	Amphipods Present (Y/N)
				Type	Cover	Species	Abundance	Species	Abundance	Measurement	Species	Abundance		
		Q9	8	GR	100	-	-	-	-	-	-	-		
		Q10	0	GR	85	-	-	-	-	-	-	-		
				CO	15	-	-	-	-	-	-	-		
4	32.5	Q1	0	SA	10	-	-	-	-	-	-	-	Y	Y
				GR		-	-	-	-	-	-	-		
				CO	5	-	-	-	-	-	-	-		
		Q2	5.4	GR	95	-	-	-	-	-	-	-		
				CO	5	-	-	-	-	-	-	-		
		Q3	10.8	GR	30	-	-	-	-	-	-	-		
				CO	70	-	-	-	-	-	-	-		
		Q4	16.2	GR	5	-	-	-	-	-	-	-		
				BO	95	-	-	-	-	-	-	-		
		Q5	21.6	SA	5	-	-	-	-	-	-	-		
				GR	10	-	-	-	-	-	-	-		
				CO	5	-	-	-	-	-	-	-		
				BO	80	-	-	-	-	-	-	-		
		Q6	27	SA	10	-	-	-	-	-	-	-		
				GR	10	-	-	-	-	-	-	-		
				CO	15	-	-	-	-	-	-	-		
				BO	65	-	-	-	-	-	-	-		
		Q7	32.4	GR	10	brown filamentous algae	20	-	-	-	-	-		
3	33.5	Q1	0	GR	100	-	-	-	-	-	-	-	Y	N
		Q2	6.7	SA	90	-	-	-	-	-	-	-		
				CO	10	-	-	-	-	-	-	-		

Transect No.	Transect Length (m)	Quadrat No.	Transect Distance (m)	Substrate		Vegetation		Invertebrate			Fish		Transect Used (Y/N)	Amphipods Present (Y/N)
				Type	Cover	Species	Abundance	Species	Abundance	Measurement	Species	Abundance		
		Q3	13.4	GR	70	-	-	-	-	-	-	-		
				CO	30	-	-	-	-	-	-	-		
		Q4	20.1	SA	10	-	-	-	-	-	-	-		
				GR	50	-	-	-	-	-	-	-		
				BO	40	-	-	-	-	-	-	-		
		Q5	26.8	SA	10	-	-	-	-	-	-	-		
				GR	45	-	-	-	-	-	-	-		
				CO	5	-	-	-	-	-	-	-		
				BO	40					-	-	-		
		Q6	33.5	SA	15	brown filamentous algae	10	-	-	-	-	-		
				GR	30	-	-	-	-	-	-	-		
				BO	55	-	-	-	-	-	-	-		
2	29	Q1	0	GR	100	-	-	-	-	-	-	-	Y	Y
		Q2	5.8	GR	95	-	-	-	-	-	-	-		
				CO	5	-	-	-	-	-	-	-		
		Q3	11.6	SA	5	-	-	-	-	-	-	-		
				CO	15	-	-	-	-	-	-	-		
				BO	80	-	-	-	-	-	-	-		
		Q4	17.4	SA	20	-	-	-	-	-	-	-		
				GR	10	-	-	-	-	-	-	-		
				CO	5	-	-	-	-	-	-	-		
				BO	65	-	-	-	-	-	-	-		
		Q5	23.2	SA	5	-	-	-	-	-	-	-		
				GR	5	-	-	-	-	-	-	-		

Transect No.	Transect Length (m)	Quadrat No.	Transect Distance (m)	Substrate		Vegetation		Invertebrate			Fish		Transect Used (Y/N)	Amphipods Present (Y/N)
				Type	Cover	Species	Abundance	Species	Abundance	Measurement	Species	Abundance		
				CO	5	-	-	-	-	-	-	-		
				BO	85	-	-	-	-	-	-	-		
		Q6	28.8	SA	5	brown filamentous algae	10	-	-	-	-	-		
				CO	5	-	-	-	-	-	-	-		
				BO	90	-	-	-	-	-	-	-		
1	31	Q1	0	GR	100	-	-	-	-	-	-	-	Y	Y
		Q2	6.2	GR	85	-	-	-	-	-	-	-		
				CO	15	-	-	-	-	-	-	-		
		Q3	12.4		10	-	-	-	-	-	-	-		
				CO	80	-	-	-	-	-	-	-		
				BO	10	-	-	-	-	-	-	-		
		Q4	18.6	SA	5	-	-	-	-	-	-	-		
				GR	10	-	-	-	-	-	-	-		
				CO	10	-	-	-	-	-	-	-		
				BO	75	-	-	-	-	-	-	-		
		Q5	24.8	SA	10	-	-	-	-	-	-	-		
				GR	30	-	-	-	-	-	-	-		
				CO	25	-	-	-	-	-	-	-		
				BO	35	-	-	-	-	-	-	-		
		Q6	31	BO	100	brown filamentous algae	5			-	-	-		

Note: SA = sand, GR = gravel, CO = cobble, BO = boulder

Table A-5: Fish and Fish Habitat (Intertidal Survey Data (2019))

Transect No.	Transect Length (m)	Quadrat No.	Transect Distance (m)	Substrate		Vegetation		Invertebrate			Fish		Transect Used (Y/N)	Amphipods Present (Y/N)
				Type	Cover	Species	Abundance	Species	Abundance	Measurement	Species	Abundance		
17-Aug-19														
1	25	Q1	0	BO	100	-	-	-	-	-	-	-	Y	Y
		Q2	5	BO	50	-	-	amphipod	21	count	-	-		
				CO	40	-	-	-	-	-	-	-		
				GR	10	-	-	-	-	-	-	-		
		Q3	10	BO	60	-	-	-	-	-	-	-		
				CO	35	-	-	amphipod	3	count	-	-		
				GR	5	-	-	-	-	-	-	-		
		Q4	15	BO	5	-	-	-	-	-	-	-		
				CO	90	-	-	-	-	-	-	-		
				GR	5	-	-	-	-	-	-	-		
		Q5	20	CO	80	-	-	-	-	-	-	-		
				GR	20	-	-	-	-	-	-	-		
		Q6	25	GR	10	-	-	-	-	-	-	-		
				SA	90	-	-	-	-	-	-	-		
2	25	Q1	0	CO	10	-	-	amphipod	1	count	-	-	Y	Y
				GR	20	-	-	-	-	-	-	-		
				SA	30	-	-	-	-	-	-	-		
				MD	40	-	-	-	-	-	-	-		
		Q2	5	CO	10	-	-	-	-	-	-	-		
				GR	10	-	-	-	-	-	-	-		
				SA	80	-	-	-	-	-	-	-		
		Q3	10	BO	10	-	-	-	-	-	-	-		
				CO	30	-	-	-	-	-	-	-		

Transect No.	Transect Length (m)	Quadrat No.	Transect Distance (m)	Substrate		Vegetation		Invertebrate			Fish		Transect Used (Y/N)	Amphipods Present (Y/N)
				Type	Cover	Species	Abundance	Species	Abundance	Measurement	Species	Abundance		
				GR	40	-	-	-	-	-	-	-		
				SA	20	-	-	-	-	-	-	-		
		Q4	15	BO	30	-	-	-	-	-	-	-		
				CO	30	-	-	-	-	-	-	-		
				GR	40	-	-	-	-	-	-	-		
		Q5	20	BO	40	-	-	-	-	-	-	-		
				CO	40	-	-	-	-	-	-	-		
				GR	20	-	-	-	-	-	-	-		
		Q6	25	BO	30	-	-	-	-	-	-	-		
				CO	50	-	-	-	-	-	-	-		
				GR	20	-	-	-	-	-	-	-		
3	25	Q1	0	CO	40	-	-	amphipod	28	count	-	-	Y	Y
				GR	60	-	-	-	-	-	-	-		
		Q2	5	CO	10	-	-	-	-	-	-	-		
				GR	90	-	-	-	-	-	-	-		
		Q3	10	CO	10	-	-	-	-	-	-	-		
				GR	40	-	-	-	-	-	-	-		
				SA	50	-	-	-	-	-	-	-		
		Q4	15	CO	10	-	-	-	-	-	-	-		
				GR	70	-	-	-	-	-	-	-		
				SA	20	-	-	-	-	-	-	-		
		Q5	20	CO	10	-	-	-	-	-	-	-		
				GR	90	-	-	-	-	-	-	-		
		Q6	25	GR	100	Rockweed, loose	<5 %	-	-	-	-	-		

Transect No.	Transect Length (m)	Quadrat No.	Transect Distance (m)	Substrate		Vegetation		Invertebrate			Fish		Transect Used (Y/N)	Amphipods Present (Y/N)
				Type	Cover	Species	Abundance	Species	Abundance	Measurement	Species	Abundance		
4	20	Q1	0	CO	10	-	-	-	-	-	-	-	Y	N
				GR	90	-	-	-	-	-	-	-		
		Q2	4	CO	10	Rockweed, loose	<5 %	-	-	-	-	-		
				GR	90	-	-	-	-	-	-	-		
		Q3	8	CO	5	-	-	-	-	-	-	-		
				GR	10	-	-	-	-	-	-	-		
				SA	85	-	-	-	-	-	-	-		
		Q4	12	BO	60	-	-	-	-	-	-	-		
				CO	10	-	-	-	-	-	-	-		
				GR	30	-	-	-	-	-	-	-		
		Q5	16	GR	70	Rockweed, loose	<5 %	-	-	-	-	-		
				SA	30	-	-	-	-	-	-	-		
		Q6	20	CO	10	-	-	-	-	-	-	-		
				GR	10	-	-	-	-	-	-	-		
				SA	80	-	-	-	-	-	-	-		
5	20	Q1	0	CO	20	Rockweed, loose	<5 %	-	-	-	-	-	Y	N
				GR	80	-	-	-	-	-	-	-		
		Q2	4	CO	20	-	-	-	-	-	-	-		
				GR	70	-	-	-	-	-	-	-		
				SA	10	-	-	-	-	-	-	-		
		Q3	8	CO	10	Rockweed, loose	<5 %	-	-	-	-	-		

Transect No.	Transect Length (m)	Quadrat No.	Transect Distance (m)	Substrate		Vegetation		Invertebrate			Fish		Transect Used (Y/N)	Amphipods Present (Y/N)
				Type	Cover	Species	Abundance	Species	Abundance	Measurement	Species	Abundance		
				GR	70	-	-	-	-	-	-	-		
				SA	10	-	-	-	-	-	-	-		
		Q4	12	CO	10	-	-	-	-	-	-	-		
				GR	85	-	-	-	-	-	-	-		
				SA	5	-	-	-	-	-	-	-		
		Q5	16	CO	5	-	-	-	-	-	-	-		
				GR	20	-	-	-	-	-	-	-		
				SA	75	-	-	-	-	-	-	-		
		Q6	20	GR	100	Rockweed, loose	<5 %	-	-	-	-	-		

Note: SA = sand, GR = gravel, CO = cobble, BO = boulder, MD = mud

Table A-6: Fish and Fish Habitat (Subtidal ROV Video Data Analysis (2024))

Survey Time	Transect No.	ROV Maximum Depth (m)	Tide Height (m)	Depth (CD, m)	Substrate		Vegetation					Invertebrates					Fish			
Start					Type	Percent Cover	Species Name		Abundance	Categorization	Confidence	Species Name		Abundance	Metric	Categorization	Species Name		Abundance	Categorization
							Common	Scientific				Common	Scientific				Common	Scientific		
03-Sep-24																				
15:16	T1	-25.1	1.64	-23.46	SA	30	Rockweed	*Fucus sp.*	5	trace	possibly	Unidentified Jelly		45	count	abundant	Sculpin	Myoxocephalus sp	4	trace
					GR	40	Unidentified algae		5	trace	possibly	Comb Jelly	*Mertensia ovum*	18	count	moderate	-	-	-	-
					CO	20	Clumped brown algae		10	trace	possibly	Brittle star	*Ophiocten sp.*	1	count	trace	-	-	-	-
					BO	10	Sugar Kelp	*Saccharina latissima*	5	trace	possibly	Helicid Pteropod	*Limacina helicina*	5	count	trace	-	-	-	-
							Branching brown algae		20	moderate	possibly						-	-	-	-
15:31	T2	-3.0	1.48	-1.52	GR	20	Rockweed	*Fucus sp.*	10	trace	possibly	Unidentified Jelly		20	count	moderate	-	-	-	-
					CO	20	Unidentified algae		30	moderate	possibly	Comb Jelly	*Mertensia ovum*	1	count	trace	-	-	-	-
					BO	60	Clumped brown algae		10	trace	possibly	-	-	-	-	-	-	-	-	-
							Branching brown algae		10	trace	possibly	-	-	-	-	-	-	-	-	-
15:41	T3	6.4	1.33	5.07	SA	10	Unidentified algae		30	moderate	possibly	Unidentified Jelly		10	count	trace	Sculpin	Myoxocephalus sp	1	trace
					GR	20	Clumped brown algae		20	moderate	possibly	Comb Jelly	*Mertensia ovum*	5	count	trace	-	-	-	-
					CO	50	Rockweed	*Fucus sp.*	10	trace	possibly	Beroe Jelly	*Beroe sp.*	1	count	trace	-	-	-	-
					BO	20	unidentified red algae		<5	trace	possibly						-	-	-	-
							Winged Kelp	*Alaria sp.*	<5	trace	possibly						-	-	-	-
15:59	T4	-25	1.18	-23.82	SA	75	Sugar Kelp	*Saccharina latissima*	20	moderate	possibly	Unidentified Jelly		15	count	trace	-	-	-	-
					GR	15	Clumped brown algae		10	moderate	possibly	Comb Jelly	*Mertensia ovum*	4	count	trace	-	-	-	-
					CO	5	Rockweed		<5	trace	possibly	Beroe Jelly	*Beroe sp.*	3	count	trace	-	-	-	-
					BO	5						Clams		<5	density	trace	-	-	-	-
16:14	T5	-3.2	1.03	-2.17	SA	90	Clumped brown algae		5	trace	possibly	Unidentified Jelly		8	count	trace	-	-	-	-
					GR	<5	Sugar kelp	*Saccharina latissima*	10	moderate	possibly	Comb Jelly	*Mertensia ovum*	1	count	trace	-	-	-	-
					CO	<5	Winged Kelp		10	moderate	possibly						-	-	-	-
					BO	5											-	-	-	-
16:22	T6	-4	0.9	-3.10	SA	75	Clumped brown algae		15	moderate	possibly	Unidentified Jelly		10	count	trace	-	-	-	-
					GR	10	Sugar kelp	*Saccharina latissima*	25	moderate	possibly	Comb Jelly	*Mertensia ovum*	2	count	trace	-	-	-	-
					CO	<5	Winged Kelp	*Alaria sp.*	25	moderate	possibly						-	-	-	-
					CO	15											-	-	-	-
16:40	T7	-6.2	0.77	-5.43	SA	5	Sugar kelp	*Saccharina latissima*	15	moderate	possibly	Unidetified Jelly		25	count	moderate	-	-	-	-
					GR	45	Clumped brown algae		<5	trace	possibly	Comb Jelly	*Mertensia ovum*	5	count	trace	-	-	-	-
					CO	45	Coralline algae	*Coralline sp.*	5	trace	possibly	Beroe Jelly	*Beroe sp.*	2	count	trace	-	-	-	-
					BO	5	Sea Collander	*Agarum Clathratum*	10	moderate	possibly	Green Sea Urchin	*Strongylocentrotus droebachiensis*	15	count	moderate	-	-	-	-
					-	-	-	-	-	-	-	Sea Star		1	count	trace	-	-	-	-
17:02	T8	-3	0.67	-2.33	GR	45	Clumped brown algae		15	infrequent	possibly	Comb Jelly	*Mertensia ovum*	5	count	trace	-	-	-	-
					CO	50	Sugar kelp	*Saccharina latissima*	15	infrequent	possibly	Unidetified Jelly		15	count	moderate	-	-	-	-
					BO	5	Branching brown algae		5	trace	possibly	Beroe Jelly	*Beroe sp.*	2	count	trace	-	-	-	-
					-	-	-	-	-	-	-	Green Sea Urchin	*Strongylocentrotus droebachiensis*	5	density	moderate	-	-	-	-
17:09	T9	-2.9	0.57	-2.33	GR	15	Sugar kelp	*Saccharina latissima*	10	trace	possibly	Green Sea Urchin	*Strongylocentrotus droebachiensis*	5	density	trace	-	-	-	-
					CO	75	Rockweed	*Fucus sp*	10	moderate	possibly	Unidetified Jelly		8	count	trance	-	-	-	-
					BO	10	Red algae		<5	trace	possibly	Comb Jelly	*Mertensia ovum*	2	count	trace	-	-	-	-
					-	-	Clumped brown algae		5	trace	possibly	helicid pteropod	*Limacina helicina*	2	count	trace	-	-	-	-
					-	-	Unidentified algae		20	moderate	possibly						-	-	-	-
17:23	T10	-2.9	0.5	-2.40	GR	60	Sugar kelp	*Saccharina latissima*	15	infrequent	possibly	Green Sea Urchin	*Strongylocentrotus droebachiensis*	10	density	Infrequent	-	-	-	-
					CO	15	Rockweed	*Fucus sp*	10	infrequent	possibly	Comb Jelly	*Mertensia ovum*	5	count	trace	-	-	-	-
					BO	5	Clumped brown algae		10	infrequent	possibly	Unidetified Jelly		8	count	trace	-	-	-	-
							Sea Collander	*Agarum Clathratum*	15	infrequent	possibly	Helicid Pteropod	*Limacina helicina*	2	count	trace	-	-	-	-
17:38	T11	-15.4	0.45	-14.95	SA	70	Sea Collander	*Agarum Clathratum*	15	infrequent	possibly	Comb Jelly	*Mertensia ovum*	15	count	trace	-	-	-	-
					GR	20	Rockweed	*Fucus sp*	<5	trace	possibly	Green Sea Urchin	*Strongylocentrotus droebachiensis*	15	density	moderate	-	-	-	-
					CO	5	Branching brown algae		<5	trace	possibly	Beroe Jelly	*Beroe sp.*	6	count	trace	-	-	-	-

Survey Time	Transect No.	ROV Maximum Depth (m)	Tide Height (m)	Depth (CD, m)	Substrate		Vegetation					Invertebrates					Fish			
Start					Type	Percent Cover	Species Name		Abundance	Categorization	Confidence	Species Name		Abundance	Metric	Categorization	Species Name		Abundance	Categorization
							Common	Scientific				Common	Scientific				Common	Scientific		
					BO	5	Coralline algae	*Coralline sp.*	<5	trace	possibly	Unidetified Jelly		7	count	trace	-	-	-	-
					-	-	-	-	-	-	-	Sea Star		2	count	trace	-	-	-	-
17:48	T12	-5.3	0.45	-4.85	GR	65	Sea Collander	*Agarum Clathratum*	30	moderate	possibly	Comb Jelly	*Mertensia ovum*	13	count	trace	-	-	-	-
					CO	15	Coralline algae	*Coralline sp.*	20	moderate	possibly	Green Sea Urchin	*Strongylocentrotus droebachiensis*	15	density	moderate	-	-	-	-
					BO	20	-	-	-	-	possibly	Unidetified Jelly		6	count	trace	-	-	-	-
					-	-	-	-	-	-	-	Beroe Jelly	*Beroe sp.*	5	count	trace	-	-	-	-
					-	-	-	-	-	-	-	Sea Star		1	count	trace	-	-	-	-
17:57	T13	-2.9	0.42	-2.48	GR	15	Sea Collander	*Agarum Clathratum*	10	infrequent	possibly	Green Sea Urchin	*Strongylocentrotus droebachiensis*	10	density	moderate	-	-	-	-
					CO	80	Coralline algae	*Coralline sp.*	15	infrequent	possibly	Comb Jelly	*Mertensia ovum*	10	Count	infrequent	-	-	-	-
					BO	5	Sugar kelp	*Saccharina latissima*	10	infrequent	possibly	Double Bubble Jelly	*Halitholus cirratus*	2	Count	trace	-	-	-	-
18:04	T14	-3.7	0.41	-3.29	SA	40	Sea Collander	*Agarum Clathratum*	5	trace	possibly	Green Sea Urchin	*Strongylocentrotus droebachiensis*	15	density	moderate	-	-	-	-
					GR	40	Sugar kelp	*Saccharina latissima*	5	trace	possibly	Comb Jelly	*Mertensia ovum*	10	count	trace	-	-	-	-
					CO	20	-	-	-	-	-	Unidentified Jelly		17	count	infrequent	-	-	-	-
							-	-	-	-	-	Double Bubble Jelly	*Halitholus cirratus*	2	count	trace	-	-	-	-
06-Sep-24																				
12:34	T15	-8	2.56	-5.44	SA	70	Coralline algae	*Coralline sp.*	10	infrequent	possibly	Brittle star	*Ophiocten sp.*	1	count	trace	Sculpin	Myoxocephalus sp	1	trace
					CO	10	Sugar kelp	*Saccharina latissima*	5	trace	possibly	Green Sea Urchin	*Strongylocentrotus droebachiensis*	5	count	trace	-	-	-	-
					BO	20	Sea Collander	*Agarum Clathratum*	5	trace	possibly	Limpet	*Tectura sp.*	1	count	trace	-	-	-	-
							Rockweed	*Fucus sp*	5	trace	possibly	-	-	-	-	-	-	-	-	-
12:46	T16	-3.4	2.66	-0.74	SA	50	Rockweed	*Fucus sp*	20	moderate	possibly	-	-	-	-	-	-	-	-	-
					CO	30	Clumped brown algae		5	trace	possibly	-	-	-	-	-	-	-	-	-
					BO	20	Unidentified algae		10	trace	possibly	-	-	-	-	-	-	-	-	-
12:53	T17	-2.3	2.74	0.44	CO	85	Rockweed	*Fucus sp*	20	moderate	possibly	Unidentified Jelly		1	count	trace	-	-	-	-
					BO	15	Clumped brown algae		5	trace	possibly	-	-	-	-	-	-	-	-	-
							Unidentified algae		20	moderate	possibly	-	-	-	-	-	-	-	-	-
13:05	T18	-4	2.74	-1.26	SA	25	Rockweed	*Fucus sp*	15	infrequent	possibly	Sea Angel	*Clinidae sp.*	1	count	trace	-	-	-	-
					CO	40	Sugar kelp	*Saccharina latissima*	15	infrequent	possibly	-	-	-	-	-	-	-	-	-
					BO	35	Unidentified algae		10	trace	possibly	-	-	-	-	-	-	-	-	-

Note: SA = sand, GR = gravel, CO = cobble, BO = boulder

Table A-7: Fish and Fish Habitat (Subtidal ROV Video Data Analysis (2019))

Survey Time	Transect No.	ROV Depth (m)		Sounder Depth (m)	Tide Height (m)	Depth (CD, m)	Temperature (°C)	Substrate		Vegetation			Invertebrates					Fish			
		Minimum	Maximum					Type	Percent Cover	Species Name		Abundance	Species Name		Abundance	Metric	Categorization	Species Name		Abundance	Categorization
										Common	Scientific		Common	Scientific				Common	Scientific		
15-Aug-19																					
11:49	T1	-0.1	-1.2	-0.5	1.8	+1.2	6.7	GR	30	filamentous green algae		80	-	-	-	-	-	-	-	-	-
								CO	50	-	-	-	-	-	-	-	-	-	-	-	-
								BO	<10	-	-	-	-	-	-	-	-	-	-	-	-
								SA	10	-	-	-	-	-	-	-	-	-	-	-	-
12:06	T2	-1.0	-2.2	-1.7	2.2	+0.5	6.6	GR	20	-	-	-	truncate soft shell clam	*Mya truncata*	5 to 10	density (m^2)	trace	sculpin	Myoxocephalus sp	1	-
								CO	20	-	-	-	-	-	-	-	-	-	-	-	-
								SA	40	rockweed	*Fucus sp*	10	-	-	-	-	-	-	-	-	-
								S	20	thread brown algae	*Chordaria sp (poss)*	20	-	-	-	-	-	-	-	-	-
12:21	T3	-1.9	2.4	-2.3	2.2	0.1	6.7	GR	20	thread brown algae (poss)	*Chordaria sp (poss)*	50	truncate soft shell clam	*Mya truncata*	<5	density (m^2)	trace	-	-	-	-
								CO	10	rockweed	*Fucus sp*	10	-	-	-	-	-	-	-	-	-
								SA	50	-	-	-	-	-	-	-	-	-	-	-	-
								S	20	-	-	-	-	-	-	-	-	-	-	-	-
12:34	T4	-0.8	-2.3	-1.6	2.2	+0.6	6.6	SA	75	Sugar Kelp	*Saccharina latissima*	20	Unidentified Jelly		15	count	trace	-	-	-	-
								GR	15	Clumped brown algae		10	Comb Jelly	*Mertensia ovum*	4	count	trace	-	-	-	-
								CO	5	Rockweed		<5	Beroe Jelly	*Beroe sp.*	3	count	trace	-	-	-	-
								BO	5	-	-	-	Clams		<5	density (m^2)	trace	-	-	-	-
12:49	T5	-1.8	-2.48	-2.3	2.2	-0.1	6.6	SA	90	Clumped brown algae		5	Unidentified Jelly		8	count	trace	-	-	-	-
								GR	<5	Sugar kelp	*Saccharina latissima*	10	Comb Jelly	*Mertensia ovum*	1	count	trace	-	-	-	-
								CO	<5	Winged Kelp		10	-	-	-	-	-	-	-	-	-
								BO	5	-	-	-	-	-	-	-	-	-	-	-	-
13:06	T6	-0.4	-1.3	-1.2	2.4	+1.2	6.6	CO	50	thread brown algae	*Chordaria sp (poss)*	10	-	-	-	-	-	-	-	-	-
								GR	50	-	-		-	-	-	-	-	-	-	-	-
13:12	T7	-0.1	-1.3	-1.2	2.4	+1.2	6.7	CO	50	thread brown algae	*Chordaria sp (poss)*	20	-	-	-	-	-	-	-	-	-
								GR	20	rockweed	*Fucus sp*	5	-	-	-	-	-	-	-	-	-
								SA	20	-	-	-	-	-	-	-	-	-	-	-	-
								BO	<10	-	-	-	-	-	-	-	-	-	-	-	-
17:02	T8	-0.9	-1.9	-2.1	2.4	0.3	6.5	SA	50	rockweed	*Fucus sp*	5	-	-	-	-	-	-	-	-	-
								GR	30	thread brown algae	*Chordaria sp (poss)*	30	-	-	-	-	-	-	-	-	-
								CO	20	-	-	-	-	-	-	-	-	-	-	-	-
								BO	<10	-	-	-	-	-	-	-	-	-	-	-	-
17:09	T9	-0.1	-0.9	-0.6	2.4	1.8	7.0	GR	30	thread brown algae	*Chordaria sp (poss)*	50	-	-	-	-	-	-	-	-	-
								CO	50	rockweed	*Fucus sp*	5	-	-	-	-	-	-	-	-	-
17:23	T10	-4.3	-5.6	-5.7	2.4	-3.3	5.0	CO	30	kelp	*UNID*	<5	green sea urchin	*Strongylocentrotus drobachiensis*	10	count	trace	-	-	-	-
								BO	20	winged kelp (poss)	*Alaria sp*	30	limpet	*Tectura sp*	1	count	trace	-	-	-	-
								S	20	sea colander	*Agarum clathratum*	20	brittle stars	*Ophiura sarsi*	5 to 10	density (m^2)	trace to infreuqent	-	-	-	-
								SA	40	rockweed	*Fucus sp*	<5	anemone	*UNID*	3	count	trace	-	-	-	-
										encrusting coralline algae	*Corallina sp*	20	truncate soft shell clam	*Mya truncata*	<5	density (m^2)	trace				
17:38	T11	-2.9	-3.9	-4.1	2.4	-1.7	5.4	SA	50	thread brown algae	*Chordaria sp (poss)*	20	truncate soft shell clam	*Mya truncata*	<5	density (m^2)	trace	-	-	-	-
								GR	30	branching brown algae	*UNID*	<5	-	-	-	-	-	-	-	-	-
								CO	20	rockweed	*Fucus sp*	<5	-	-	-	-	-	-	-	-	-
										winged kelp (poss)	*Alaria sp*	40	-	-	-	-	-	-	-	-	-
17:48	T12	-1.7	-2.0	-2.4	2.0	-0.4	5.6	CO	40	rockweed	*Fucus sp*	40	-	-	-	-	-	-	-	-	-
								GR	30	thread brown algae	*Chordaria sp (poss)*	40	-	-	-	-	-	-	-	-	-
								SA	20	-	-	-	-	-	-	-	-	-	-	-	-
								BO	30	-	-	-	-	-	-	-	-	-	-	-	-
17:57	T13	-0.5	-1.4	-1.6	2.0	+0.4	6.2	GR	40	thread brown algae	*Chordaria sp (poss)*	40	truncate soft shell clam	*Mya truncata*	<5	density (m^2)	trace	-	-	-	-
								CO	30	rockweed	*Fucus sp*	40	-	-	-	-	-	-	-	-	-
								SA	20	-	-	-	-	-	-	-	-	-	-	-	-
								BO	<10	-	-	-	-	-	-	-	-	-	-	-	-

Survey Time	Transect No.	ROV Depth (m)		Sounder Depth (m)	Tide Height (m)	Depth (CD, m)	Temperature (°C)	Substrate		Vegetation			Invertebrates					Fish			
		Minimum	Maximum					Type	Percent Cover	Species Name		Abundance	Species Name		Abundance	Metric	Categorization	Species Name		Abundance	Categorization
										Common	Scientific		Common	Scientific				Common	Scientific		
18:04	T14	-1.3	-1.8	-1.8	2.0	+0.2	6.3	CO	20	thread brown algae	*Chordaria sp (poss)*	30	truncate soft shell clam	*Mya truncata*	<5	density (m^2)	trace	-	-	-	-
								SA	60	rockweed	*Fucus sp*	15	-	-	-	-	-	-	-	-	-
								GR	20	-	-	-	-	-	-	-	-	-	-	-	-
12:34	T15	-1.7	-1.4	-1.8	2.0	+0.2	6.8	SA	75	thread brown algae	*Chordaria sp (poss)*	30	Pipe cleaner hydroid (poss)	*Lafoeina maxima*	10	density (m^2)	trace	-	-	-	-
								GR	15	sea collander (poss)	*Agarum clathratum*	<5	-	-	-	-	-	-	-	-	-
								BO	<10	rockweed	*Fucus sp*	5	-	-	-	-	-	-	-	-	-
										encrusting coralline algae	*Corallina sp*	10	-	-	-	-	-	-	-	-	-
12:46	T16	-6.1	-9.4	-6.5	1.8	-4.7	5.1	SA	30	sea collander (poss)	*Agarum clathratum*	70	green sea urchin	*Strongylocentrotus drobachiensis*	10 to 15	count	infrequent	banded gunnel	Pholis fasciata	1	-
								BO	50	-	-	-	truncate soft shell clam	*Mya truncata*	5	density (m^2)	trace	-	-	-	-
								CO	20	encrusting coralline algae	*Corallina sp*	20	brittle stars	*Ophiura sarsi*	5 to 10	density (m^2)	trace	Shorthorn sculpin	Myoxocephalus scorpius	1	-
12:53	T17	-3.9	-4.8	-4.0	1.8	-2.2	5.7	SA	50	winged kelp	*Alaria sp.*	20	green sea urchin	*Strongylocentrotus drobachiensis*	5 to 10	count	trace	Shorthorn sculpin	Myoxocephalus scorpius	1	-
								CO	50	Thread brown algae	*Chordaria sp (poss)*	<5	truncate soft shell clam	*Mya truncata*	5	density (m^2)	trace	Fourhorn sculpin	Myoxocephalus quadricornis	1	-
										branching brown algae	*UNID*	10	-	-	-	-	-	-	-	-	-
13:05	T18	-1.3	-2.1	-2.2	1.8	-0.4	6.3	BO	20	Thread brown algae	*Chordaria sp (poss)*	40	-	-	-	-	-	-	-	-	-
								CO	60	rockweed	*Fucus sp*	50	-	-	-	-	-	-	-	-	-
								GR	20				-	-	-	-	-	-	-	-	-
23:17	T19	-1.3	-2.5	-2.5	2.4	-0.1	6.6	SA	40	Thread brown algae	*Chordaria sp (poss)*	30	truncate soft shell clam	*Mya truncata*	5	density (m^2)	trace	-	-	-	-
								GR	30	rockweed	*Fucus sp*	20	-	-	-	-	-	-	-	-	-
								CO	30	-	-	-	-	-	-	-	-	-	-	-	-
23:27	T20	-2.1	-2.8	-2.7	2.4	-0.3	7.2	SA	80	rockweed	*Fucus sp*	5	truncate soft shell clam	*Mya truncata*	5	density (m^2)	trace	-	-	-	-
								GR	<10	-	-	-	-	-	-	-	-	-	-	-	-
								BO	<10	-	-	-	-	-	-	-	-	-	-	-	-
23:38	T21	-2.6	-2.9	-2.8	2.4	-0.4	7.0	SA	80	Thread brown algae	*Chordaria sp (poss)*	40	truncate soft shell clam	*Mya truncata*	5	density (m^2)	trace	Shorthorn sculpin	Myoxocephalus scorpius	1	-
								BO	<10	rockweed	*Fucus sp*	20	-	-	-	-	-	-	-	-	-
								CO	<10	kelp	*UNID*	5	-	-	-	-	-	-	-	-	-
23:49	T22	-1.1	-2.7	-2.8	2.4	-0.4	6.7	SA	20	rockweed	*Fucus sp*	40	truncate soft shell clam	*Mya truncata*	5	density (m^2)	trace	-	-	-	-
								CO	60	-	-	-	-	-	-	-	-	-	-	-	-
								BO	20	Thread brown algae	*Chordaria sp (poss)*	40	-	-	-	-	-	-	-	-	-
23:59	T23	-1.7	-2.7	-2.9	2.4	-0.5	6.4	SA	60	Thread brown algae	*Chordaria sp (poss)*	10	-	-	-	-	-	-	-	-	-
								GR	20	-	-	-	-	-	-	-	-	-	-	-	-
								CO	20	-	-	-	-	-	-	-	-	-	-	-	-
00:13	T24	-2.3	-2.8	-2.9	3.0	+0.1	7.0	SA	70	thread brown algae	*Chordaria sp (poss)*	15	truncate soft shell clam	*Mya truncata*	5	density (m^2)	trace	-	-	-	-
								GR	10	rockweed	*Fucus sp*	10	-	-	-	-	-	-	-	-	-
								CO	10	-	-	-	-	-	-	-	-	-	-	-	-
								BO	<10	-	-	-	-	-	-	-	-	-	-	-	-
12:26	T1	-0.4	-1.7	-1.0	2.2	+1.2	6.2	CO	70	thread brown algae	*Chordaria sp (poss)*	70	-	-	-	-	-	-	-	-	-
								GR	10	-	-	-	-	-	-	-	-	-	-	-	-
								SA	20	-	-	-	-	-	-	-	-	-	-	-	-
12:44	T2	-2.0	-3.0	-3.0	2.2	-0.8	5.7	SA	70	rockweed	*Fucus sp*	20	truncate soft shell clam	*Mya truncata*	5	density (m^2)	trace	-	-	-	-
								GR	30	thread brown algae	*Chordaria sp (poss)*	40	-	-	-	-	-	-	-	-	-

Note: SA = sand, GR = gravel, CO = cobble, BO = boulder, S = silt

Appendix A: Terrestrial Vegetation Field Results (ESEB Report Section 8)

Table A-8: Terrestrial Vegetation (Abiotic Data Collected During Ecological Land Classification (2019))

Plot	Biome	Ecozone	Ecoregion	Community Type	Slope	Aspect	Soil Moisture Regime	Soil Nutrient Regime	Meso Slope Position	Exposure Type	Drainage	Mineral Soil Texture	Organic Soil Texture	Humus Form	Surface Shape	Coarse Fragment Content	Surficial Material
15-Aug-19																	
GD-11	Tundra	Northern Arctic	Lancaster Plateau	Upland Lichen Barren	0->5 %	Variable	Very Xeric	Very Poor	Crest, Upper Slope, Middle Slope	Wind, Frost, Cold Air Drainage	Rapidly	NA	NA	NA	Convex, Straight	>70 %	Colluvial deposits, undifferentiated
16-Aug-19																	
GD-12, GD-13	Tundra	Northern Arctic	Lancaster Plateau	Upland Dwarf Shrub	0->5 %	Variable to level	Subxeric	Poor	Upper Slope, Middle Slope	Wind, Frost, Cold Air Drainage	Moderately Well, Imperfectly	DNC	Fibric	Mor	Straight	>70 %	Colluvial deposits, undifferentiated
GD-14	Tundra	Northern Arctic	Lancaster Plateau	Wetland Graminoid-Moss Drainage	0-2 %	Mostly level	Hydric	Poor	Middle Slope, Lower Slope	Wind, Frost, Cold Air Drainage	Imperfectly, Poorly	DNC	Fibric	Mor	Concave, Straight	35-70 %	Colluvial deposits, undifferentiated
GD-15	Tundra	Northern Arctic	Lancaster Plateau	Disturbed Human-Caused	0->5 %	Mostly level though variable	Submesic	Poor	Level	Wind, Frost, Cold Air Drainage	Well	DNC	NA	NA	Straight	>70 %	Colluvial deposits, undifferentiated
GD-16	Tundra	Northern Arctic	Lancaster Plateau	Upland Graminoid Meadow	0-1 %	Level	Submesic	Poor	Level	Wind, Frost, Cold Air Drainage	Imperfectly	DNC	DNC	DNC	Straight	35-70 %	Colluvial deposits, undifferentiated
NA	Tundra	Northern Arctic	Lancaster Plateau	Coastal Shoreline and Flats	0->5 %	Westerly	Subhydric	Poor	Middle Slope	Wind, Frost, Cold Air Drainage	Moderately Well, Imperfectly	Sandy	Fibric	Mor	Straight	>70 %	Colluvial deposits, undifferentiated

Notes:

NA – means not applicable
DNC – means did not collect
Categories for abiotic conditions that were considered included the following:

- Slope: 0 %, 1 %, 2 %, 2-5 %, >5 %
- Aspect: level, mostly level, rolling, variable, northernly, southerly, easterly, westerly
- Soil Moisture Regime: very xeric, xeric, subxeric, submesic, mesic, subhygric, hygric, subhydric, hydric
- Soil Nutrient Regime: very poor, poor, medium, rich, very rich
- Meso Slope Position: crest, upper slope, middle slope, lower slope, toe, depression, level
- Exposure Type: wind, insolation, frost, cold air drainage, toxicity (atmospheric or soil), not applicable
- Drainage: very rapidly, rapidly, well, moderately well, imperfectly, poorly, very poorly
- Mineral Soil Texture: sandy, loamy, silty, clayey
- Organic Soil Texture: fibric, mesic, humic
- Humus Form: mor, moder, mull
- Surface Shape: concave, convex, straight
- Coarse Fragment Content: <20 %, 20-35 %, 35-70 %, >70 %

Table A-9: Terrestrial Vegetation (Vegetation Ground Plot Data (2019))

Plot	Community Type	Total Tree Layer %	Total Shrub Layer %	Total Forb Layer %	Total Graminoid Layer %	Total Non-vascular Layer %	Litter %	Water %	Mineral Soil %	Rock %	Species Name and Author	Common Name	Foliar Cover (%)
15-Aug-19													
GD-11	Upland Lichen Barren	0	1	3	1	15	3	0	5	80	*Alectoria ochroleuca* (Hoffm.) A. Massal.	witch's hair lichen	3
											Aspicilia spp.	lichen	10
											Carex nardina Fr.	spike sedge	1
											Dryas integrifolia Vahl	entireleaf mountain-avens	5
											Flavocetraria cucullata (Bellardi) Karnefelt & A. Thell	snow lichen	2
											Salix arctica Pall.	arctic willow	1
											Saxifraga oppositifolia L.	purple mountain saxifrage	2
16-Aug-19													
GD-12	Upland Dwarf Shrub	0	5	25	10	35	10	0	5	10	*Carex misandra* R. Br.	shortleaved sedge	10
											Dryas integrifolia Vahl	entireleaf mountain-avens	20
											Distichium capillaceum (Hedw.) Bruch & Schimp.	distichium moss	45
											Polygonum viviparum L.	alpine bistort	2
											Salix arctica Pall.	arctic willow	5
											Saxifraga oppositifolia L.	purple mountain saxifrage	3
GD-13		0	10	5	10	15	5	0	5	60	*Carex nardina* Fr.	spike sedge	10

Plot	Community Type	Total Tree Layer %	Total Shrub Layer %	Total Forb Layer %	Total Graminoid Layer %	Total Non-vascular Layer %	Litter %	Water %	Mineral Soil %	Rock %	Species Name and Author	Common Name	Foliar Cover (%)
	Upland Dwarf Shrub										*Cassiope tetragona* (L.) D. Don	white arctic mountain heather	10
											Coelocaulon aculeatum (Schreb.) Link	lichen	5
											Dryas integrifolia Vahl	entireleaf mountain-avens	5
											Flavocetraria nivalis (L.) Karnefelt & A. Thell	snow lichen	1
											Luzula confusa Lindeberg	northern woodrush	1
											Distichium capillaceum (Hedw.) Bruch & Schimp.	distichium moss	15
											Pedicularis hirsuta L.	hairy lousewort	1
											Polygonum viviparum L.	alpine bistort	1
											Racomitrium lanuginosum (Hedw.) Brid.	racomitrium moss	2
											Salix arctica Pall.	arctic willow	2
											Saxifraga oppositifolia L.	purple mountain saxifrage	2
											Silene acaulis (L.) Jacq.	moss campion	1
GD-14	Wetland Graminoid-Moss Drainage	0	2	5	25	70	5	10	1	2	*Carex aquatilis* Wahlenb.	water sedge	3
											Carex membranacea Hook.	fragile sedge	5
											Eriophorum angustifolium Honck.	tall cottongrass	10
											Eriophorum scheuchzeri Hoppe	white cottongrass	10
											Aulacomnium turgidum (Wahlenb.) SchwÃ¤gr.	turgid aulacomnium moss	40

Plot	Community Type	Total Tree Layer %	Total Shrub Layer %	Total Forb Layer %	Total Graminoid Layer %	Total Non-vascular Layer %	Litter %	Water %	Mineral Soil %	Rock %	Species Name and Author	Common Name	Foliar Cover (%)
											Limprichtia revolvens (Sw.) Loeske	limprichtia moss	20
											Orthothecium chryseum (SchwÃ¤gr.) Schimp.	orthothecium moss	10
											Polygonum viviparum L.	alpine bistort	5
											Salix arctica Pall.	arctic willow	2
GD-15	Disturbed Human-Caused	0	0	5	1	0	0	0	5	90	*Cerastium arcticum* Lange	mouse-ear chickweed	3
											Cochlearia groenlandica L.	Danish scurvygrass	1
											Festuca brachyphylla Schult. ex Schult. & Schult. f.	alpine fescue	1
											Minuartia rubella (Wahlenb.) Hiern.	beautiful sandwort	1
											Oxyria digyna (L.) Hill	alpine mountainsorrel	2
											Papaver sp.	arctic poppy	1
											Polygonum viviparum L.	alpine bistort	1
											Saxifraga cernua L.	nodding saxifrage	1
											Saxifraga oppositifolia L.	purple mountain saxifrage	1
											Silene uralensis (Rupr.) Bocquet	apetalous catchfly	1
GD-16	Upland Graminoid Meadow	0	1	3	10	0	1	0	1	85	*Carex nardina* Fr.	spike sedge	10
											Cerastium arcticum Lange	mouse-ear chickweed	1

Plot	Community Type	Total Tree Layer %	Total Shrub Layer %	Total Forb Layer %	Total Graminoid Layer %	Total Non-vascular Layer %	Litter %	Water %	Mineral Soil %	Rock %	Species Name and Author	Common Name	Foliar Cover (%)
											Dryas integrifolia Vahl	entireleaf mountain-avens	1
											Polygonum viviparum L.	alpine bistort	1
											Salix arctica Pall.	arctic willow	1
											Saxifraga oppositifolia L.	purple mountain saxifrage	1
											Silene acaulis (L.) Jacq.	moss campion	2
NA	Coastal Shoreline and Flats	0	0	0	0	0	0	5	1	95	NA	NA	NA

Table A-10: Terrestrial Vegetation (Vegetation Rare Plant Survey Data (2019))

Community Type	Strata	Species Name and Authority	Common Name
16-Aug-19			
Coastal Shoreline and Flats	Graminoids	*Poa arctica* R. Br.	arctic bluegrass
Coastal Shoreline and Flats	Forbs	*Cochlearia groenlandica* L.	Danish scurvygrass
Coastal Shoreline and Flats	Forbs	*Cerastium arcticum* Lange	mouse-ear chickweed
Disturbed Human-Caused	Shrubs	*Salix arctica* Pall.	arctic willow
Disturbed Human-Caused	Shrubs	*Saxifraga oppositifolia* L.	purple mountain saxifrage
Disturbed Human-Caused	Forbs	*Cerastium arcticum* Lange	mouse-ear chickweed
Disturbed Human-Caused	Forbs	*Chamerion latifolium* (L.) Holub	dwarf fireweed
Disturbed Human-Caused	Forbs	*Cochlearia groenlandica* L.	Danish scurvygrass
Disturbed Human-Caused	Forbs	*Minuartia rubella* (Wahlenb.) Hiern.	beautiful sandwort
Disturbed Human-Caused	Forbs	*Oxyria digyna* (L.) Hill	alpine mountainsorrel
Disturbed Human-Caused	Forbs	*Papaver* sp.	arctic poppy
Disturbed Human-Caused	Forbs	*Parrya arctica* R. Br.	arctic false wallflower
Disturbed Human-Caused	Forbs	*Polygonum viviparum* L.	alpine bistort
Disturbed Human-Caused	Forbs	*Saxifraga cernua* L.	nodding saxifrage
Disturbed Human-Caused	Forbs	*Silene uralensis* (Rupr.) Bocquet	apetalous catchfly
Disturbed Human-Caused	Graminoids	*Festuca brachyphylla* Schult. ex Schult. & Schult. f.	alpine fescue
Disturbed Human-Caused	Graminoids	*Poa alpina* L.	alpine bluegrass
Upland Dwarf Shrub	Shrubs	*Cassiope tetragona* (L.) D. Don	white arctic mountain heather
Upland Dwarf Shrub	Shrubs	*Dryas integrifolia* Vahl	entireleaf mountain-avens
Upland Dwarf Shrub	Shrubs	*Salix arctica* Pall.	arctic willow
Upland Dwarf Shrub	Shrubs	*Saxifraga oppositifolia* L.	purple mountain saxifrage
Upland Dwarf Shrub	Shrubs	*Vaccinium uliginosum* L.	bog blueberry

Community Type	Strata	Species Name and Authority	Common Name
Upland Dwarf Shrub	Forbs	*Cerastium arcticum* Lange	mouse-ear chickweed
Upland Dwarf Shrub	Forbs	*Erysimum pallasii* (Pursh) Fernald	Pallas' wallflower
Upland Dwarf Shrub	Forbs	*Oxyria digyna* (L.) Hill	alpine mountainsorrel
Upland Dwarf Shrub	Forbs	*Papaver* sp.	arctic poppy
Upland Dwarf Shrub	Forbs	*Pedicularis hirsuta* L.	hairy lousewort
Upland Dwarf Shrub	Forbs	*Polygonum viviparum* L.	alpine bistort
Upland Dwarf Shrub	Forbs	*Saxifraga cernua* L.	nodding saxifrage
Upland Dwarf Shrub	Forbs	*Saxifraga nivalis* L.	alpine saxifrage
Upland Dwarf Shrub	Forbs	*Silene acaulis* (L.) Jacq.	moss campion
Upland Dwarf Shrub	Forbs	*Silene uralensis* (Rupr.) Bocquet	apetalous catchfly
Upland Dwarf Shrub	Graminoids	*Carex misandra* R. Br.	shortleaved sedge
Upland Dwarf Shrub	Graminoids	*Carex nardina* Fr.	spike sedge
Upland Dwarf Shrub	Graminoids	*Festuca brachyphylla* Schult. ex Schult. & Schult. f.	alpine fescue
Upland Dwarf Shrub	Graminoids	*Luzula confusa* Lindeberg	northern woodrush
Upland Dwarf Shrub	Graminoids	*Poa arctica* R. Br.	arctic bluegrass
Upland Dwarf Shrub	Bryophytes	*Distichium capillaceum* (Hedw.) Bruch & Schimp.	distichium moss
Upland Dwarf Shrub	Bryophytes	*Racomitrium lanuginosum* (Hedw.) Brid.	racomitrium moss
Upland Dwarf Shrub	Lichens	*Alectoria ochroleuca* (Hoffm.) A. Massal.	witch's hair lichen
Upland Dwarf Shrub	Lichens	*Cladonia* spp.	lichens
Upland Dwarf Shrub	Lichens	*Coelocaulon aculeatum* (Schreb.) Link	lichen
Upland Dwarf Shrub	Lichens	*Flavocetraria cucullata* (Bellardi) Karnefelt & A. Thell	snow lichen
Upland Dwarf Shrub	Lichens	*Flavocetraria nivalis* (L.) Karnefelt & A. Thell	snow lichen
Upland Dwarf Shrub	Lichens	*Lepraria neglecta* (Nyl.) Erichsen	dust lichen
Upland Dwarf Shrub	Lichens	*Melanelia septentrionalis* (Lynge) Essl.	melanelia lichen
Upland Dwarf Shrub	Lichens	*Ochrolechia upsaliensis* (L.) A. Massal.	Upsala crabseye lichen

Community Type	Strata	Species Name and Authority	Common Name
Upland Dwarf Shrub	Lichens	*Parmelia centrifuga* (L.) Ach.	lichen
Upland Dwarf Shrub	Lichens	*Rhizocarpon* spp.	map lichens
Upland Dwarf Shrub	Lichens	*Stereocaulon alpinum* Laurer ex Funck	alpine snow lichen
Upland Dwarf Shrub	Lichens	*Thamnolia subuliformis* (Ehrh.) W.L. Culb.	whiteworm lichen
Upland Dwarf Shrub	Lichens	*Umbilicaria* spp.	lichens
Upland Graminoid Meadow	Shrubs	*Dryas integrifolia* Vahl	entireleaf mountain-avens
Upland Graminoid Meadow	Shrubs	*Salix arctica* Pall.	arctic willow
Upland Graminoid Meadow	Shrubs	*Saxifraga oppositifolia* L.	purple mountain saxifrage
Upland Graminoid Meadow	Forbs	*Cerastium arcticum* Lange	mouse-ear chickweed
Upland Graminoid Meadow	Forbs	*Polygonum viviparum* L.	alpine bistort
Upland Graminoid Meadow	Forbs	*Saxifraga cernua* L.	nodding saxifrage
Upland Graminoid Meadow	Forbs	*Silene acaulis* (L.) Jacq.	moss campion
Upland Graminoid Meadow	Graminoids	*Carex misandra* R. Br.	shortleaved sedge
Upland Graminoid Meadow	Graminoids	*Carex nardina* Fr.	spike sedge
Upland Graminoid Meadow	Graminoids	*Festuca brachyphylla* Schult. ex Schult. & Schult. f.	alpine fescue
Upland Graminoid Meadow	Lichens	*Rhizocarpon* spp.	map lichens
Upland Lichen Barren	Shrubs	*Dryas integrifolia* Vahl	entireleaf mountain-avens
Upland Lichen Barren	Shrubs	*Salix arctica* Pall.	arctic willow
Upland Lichen Barren	Shrubs	*Saxifraga oppositifolia* L.	purple mountain saxifrage
Upland Lichen Barren	Graminoids	*Carex nardina* Fr.	spike sedge
Upland Lichen Barren	Lichens	*Alectoria ochroleuca* (Hoffm.) A. Massal.	witch's hair lichen
Upland Lichen Barren	Lichens	*Aspicilia* spp.	lichen
Upland Lichen Barren	Lichens	*Collema undulatum* Laurer ex Flotow	undulate jelly lichen
Upland Lichen Barren	Lichens	*Flavocetraria cucullata* (Bellardi) Karnefelt & A. Thell	snow lichen
Upland Lichen Barren	Lichens	*Lepraria neglecta* (Nyl.) Erichsen	dust lichen

Community Type	Strata	Species Name and Authority	Common Name
Upland Lichen Barren	Lichens	*Rhizocarpon* spp.	map lichens
Upland Lichen Barren	Lichens	*Umbilicaria* spp.	lichens
Upland Lichen Barren	Lichens	*Verrucaria* spp.	lichens
Upland Lichen Barren	Lichens	*Xanthoparmelia* spp.	lichens
Upland Lichen Barren	Lichens	*Xanthoria elegans* (Link) Th. Fr.	elegant orange wall lichen
Wetland Graminoid-Moss Drainage	Shrubs	*Cassiope tetragona* (L.) D. Don	white arctic mountain heather
Wetland Graminoid-Moss Drainage	Shrubs	*Dryas integrifolia* Vahl	entireleaf mountain-avens
Wetland Graminoid-Moss Drainage	Shrubs	*Salix arctica* Pall.	arctic willow
Wetland Graminoid-Moss Drainage	Shrubs	*Saxifraga oppositifolia* L.	purple mountain saxifrage
Wetland Graminoid-Moss Drainage	Shrubs	*Vaccinium uliginosum* L.	bog blueberry
Wetland Graminoid-Moss Drainage	Forbs	*Cerastium arcticum* Lange	mouse-ear chickweed
Wetland Graminoid-Moss Drainage	Forbs	*Oxyria digyna* (L.) Hill	alpine mountainsorrel
Wetland Graminoid-Moss Drainage	Forbs	*Papaver* sp.	arctic poppy
Wetland Graminoid-Moss Drainage	Forbs	*Pedicularis capitata* M.F. Adams	capitate lousewort
Wetland Graminoid-Moss Drainage	Forbs	*Polygonum viviparum* L.	alpine bistort
Wetland Graminoid-Moss Drainage	Forbs	*Saxifraga cernua* L.	nodding saxifrage
Wetland Graminoid-Moss Drainage	Forbs	*Saxifraga nivalis* L.	alpine saxifrage
Wetland Graminoid-Moss Drainage	Graminoids	*Alopecurus magellanicus* Lam.	Alpine Meadow-Foxtail
Wetland Graminoid-Moss Drainage	Graminoids	*Arctagrostis latifolia* (R. Br.) Griseb.	wideleaf polargrass
Wetland Graminoid-Moss Drainage	Graminoids	*Carex aquatilis* Wahlenb.	water sedge
Wetland Graminoid-Moss Drainage	Graminoids	*Carex membranacea* Hook.	fragile sedge
Wetland Graminoid-Moss Drainage	Graminoids	*Carex nardina* Fr.	spike sedge
Wetland Graminoid-Moss Drainage	Graminoids	*Eriophorum angustifolium* Honck.	tall cottongrass
Wetland Graminoid-Moss Drainage	Graminoids	*Eriophorum scheuchzeri* Hoppe	white cottongrass
Wetland Graminoid-Moss Drainage	Graminoids	*Juncus albescens* (Lange) Fernald	northern white rush

Community Type	Strata	Species Name and Authority	Common Name
Wetland Graminoid-Moss Drainage	Graminoids	*Luzula confusa* Lindeberg	northern woodrush
Wetland Graminoid-Moss Drainage	Graminoids	*Poa alpina* L.	alpine bluegrass
Wetland Graminoid-Moss Drainage	Graminoids	*Poa glauca* Vahl	glaucous bluegrass
Wetland Graminoid-Moss Drainage	Graminoids	*Poa pratensis* L. ssp. colpodea (Th. Fr.) Tzvelev	Kentucky bluegrass
Wetland Graminoid-Moss Drainage	Bryophytes	*Bryum pallescens* Schleich. ex SchwÃ¤gr.	bryum moss
Wetland Graminoid-Moss Drainage	Bryophytes	Aulacomnium turgidum (Wahlenb.) SchwÃ¤gr.	turgid aulacomnium moss
Wetland Graminoid-Moss Drainage	Bryophytes	*Bryum pallens* (Brid.) Sw.	bryum moss
Wetland Graminoid-Moss Drainage	Bryophytes	*Calliergon richardsonii* (Mitt.) Kindb.	Richardson's calliergon moss
Wetland Graminoid-Moss Drainage	Bryophytes	*Ditrichum flexicaule* (SchwÃ¤gr.) Hampe	ditrichum moss
Wetland Graminoid-Moss Drainage	Bryophytes	*Limprichtia cossonii* (Schimp.) L.E. Anderson, H.A. Crum & W.R. Buck	Cosson's limprichtia moss
Wetland Graminoid-Moss Drainage	Bryophytes	*Limprichtia revolvens* (Sw.) Loeske	limprichtia moss
Wetland Graminoid-Moss Drainage	Bryophytes	*Orthothecium chryseum* (SchwÃ¤gr.) Schimp.	orthothecium moss
Wetland Graminoid-Moss Drainage	Bryophytes	*Philonotis fontana* (Hedw.) Brid.	philonotis moss
Wetland Graminoid-Moss Drainage	Bryophytes	*Scapania* sp.	liverwort
Wetland Graminoid-Moss Drainage	Bryophytes	*Scorpidium scorpioides* (Hedw.) Limpr.	scorpidium moss
Wetland Graminoid-Moss Drainage	Lichens	*Lepraria neglecta* (Nyl.) Erichsen	dust lichen
Wetland Graminoid-Moss Drainage	Lichens	*Rhizocarpon* spp.	map lichens
Wetland Graminoid-Moss Drainage	Lichens	*Umbilicaria* spp.	Lichens

Appendix A: Migratory Birds and Wildlife Field Results (ESEB Report Sections 9, 10)

Table A- 11: Wildlife and Migratory Birds (Incidental Wildlife Species Observed or Detected during Field Survey (2019))

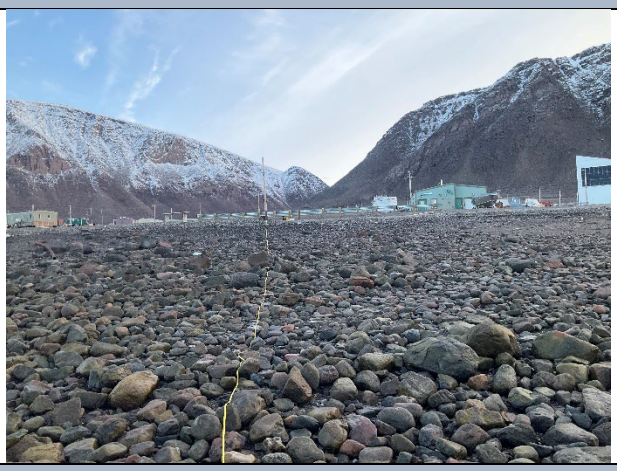
Species Code	Species Name	Common Name	Count	Type	Easting	Northing	Coordinate System	Zone
15-Aug-2019								
CORA	*Corvus corax*	common raven	2	on shore	451939	8480300	UTM NAD83	17X
NOFU	*Fulmarus glacialis*	northern fulmar	7	on water	450325	8482507	UTM NAD83	17X
GLGU	*Larus hyperboreus*	glaucous gull	30	on water	452251	8479388	UTM NAD83	17X
GLGU	*Larus hyperboreus*	glaucous gull	32	on water	450325	8482507	UTM NAD83	17X
THGU	*Larus thayeri*	Thayer's gull	6	on water	450325	8482507	UTM NAD83	17X
THGU	*Larus thayeri*	Thayer's gull	5	on water	450325	8482507	UTM NAD83	17X
MUSK	*Ovibos moschatus*	muskox	1	scat	451101	8484143	UTM NAD83	17X
SNBU	*Plectrophenax nivalis*	snow bunting	1	flyover	448149	8485376	UTM NAD83	17X
COEI	*Somateria mollissima*	common eider	4	on water + 500 m	450325	8482507	UTM NAD83	17X
SNBU	*Plectrophenax nivalis*	snow bunting	5	foraging	451356	8480783	UTM NAD83	17X

Table A- 12: Wildlife and Migratory Birds (Bird Species Observed or Detected During Field Migratory Bird Point Count Survey (2019))

Point Count Name	Time start (5 min)	Wind kmph	Cloud Cover %	Temp C	Precip mm	Species Code	Species Name	Common Name	Count	Easting	Northing	Coordinate System	Zone
16-Aug-19													
GF-PC-11	10:00	1	0	8	0	CORA	*Corvus corax*	common raven	1	450043	8482937	UTM NAD83	10:00
GF-PC-11	10:00	1	0	8	0	GLGU	*Larus hyperboreus*	glaucous gull	21	450043	8482937	UTM NAD83	10:00
GF-PC-11	10:00	1	0	8	0	THGU	*Larus thayeri*	Thayer's gull	2	450043	8482937	UTM NAD83	10:00
GF-PC-12	11:00	1	2	10	0	CORA	*Corvus corax*	common raven	6	450298	8482511	UTM NAD83	11:00
GF-PC-12	11:00	1	2	10	0	GLGU	*Larus hyperboreus*	glaucous gull	25	450298	8482511	UTM NAD83	11:00
GF-PC-12	11:00	1	2	10	0	THGU	*Larus thayeri*	Thayer's gull	3	450298	8482511	UTM NAD83	11:00
GF-PC-13	11:30	2	1	8	0	CORA	*Corvus corax*	common raven	2	450596	8482188	UTM NAD83	11:30
GF-PC-13	11:30	2	1	8	0	GLGU	*Larus hyperboreus*	glaucous gull	2	450596	8482188	UTM NAD83	11:30
GF-PC-13	11:30	2	1	8	0	NOFU	*Fulmarus glacialis*	northern fulmar	3	450596	8482188	UTM NAD83	11:30

Appendix B: Photos (Field Program)

Photo B-1: Intertidal Transects Overview and Quadrats (2024)

Transect No. 1	
Seaward Overview	Landward Overview
	

Quadrats		
Quadrat No. 1	Quadrat No. 2	Quadrat No. 3
		
Quadrat No. 4	Quadrat No. 5	Quadrat No. 6
		

Note: Quadrat photos presented HWL to LWL

Transect No. 2	
Seaward Overview	**Landward Overview**
	
Quadrats	
Quadrat No. 1	Quadrat No. 2
	
Quadrat No. 4	Quadrat No. 5
	

Quadrat No. 3

Quadrat No. 6


Note: Quadrat photos presented HWL to LWL

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Note: Quadrat photos presented HWL to LWL

Transect No. 4	
Seaward Overview	**Landward Overview**
	
Quadrats	
Quadrat No. 1	Quadrat No. 2
	
Quadrat No. 4	Quadrat No. 5
	

Quadrat No. 3

Quadrat No. 6


Quadrat No. 7


Note: Quadrat photos presented HWL to LWL

Transect No. 5	
Seaward Overview	**Landward Overview**
	
Quadrats	
Quadrat No. 10	Quadrat No. 9
	
Quadrat No. 7	Quadrat No. 6
	No photo

Quadrat No. 8	
	
Quadrat No. 5	
	

Quadrat No. 4	Quadrat No. 3	Quadrat No. 2
		

Quadrat No. 1


Note: Quadrat photos presented HWL to LWL

Transect No. 6	
Seaward Overview	Landward Overview
	
Quadrats	
Quadrat No. 15	Quadrat No. 14
	
Quadrat No. 12	Quadrat No. 11
	

Quadrat No. 13	
	
Quadrat No. 10	
	

Quadrat No. 9	Quadrat No. 8	Quadrat No. 7
		
Quadrat No. 6	**Quadrat No. 5**	**Quadrat No. 4**
		
Quadrat No. 3	**Quadrat No. 2**	**Quadrat No. 1**
		

Note: Quadrat photos presented HWL to LWL

Transect No. 7	
Seaward Overview	Landward Overview
	

Quadrats		
Quadrat No. 16	Quadrat No. 15	Quadrat No. 14
		
Quadrat No. 13	Quadrat No. 12	Quadrat No. 11
		

Quadrat No. 10	Quadrat No. 9	Quadrat No. 8
		
Quadrat No. 7	**Quadrat No. 6**	**Quadrat No. 5**
		
Quadrat No. 4	**Quadrat No. 3**	**Quadrat No. 2**
		

Quadrat No. 1


Note: Quadrat photos presented HWL to LWL

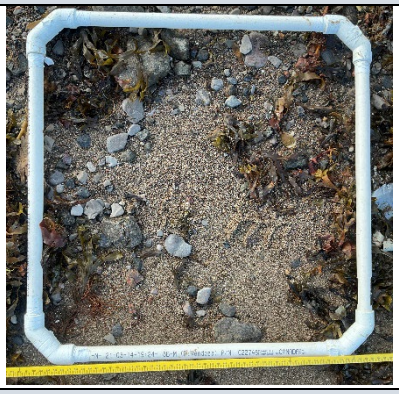
Transect No. 8	
Seaward Overview	Landward Overview
	
Quadrats	
Quadrat No. 1	Quadrat No. 2
	
Quadrat No. 3	
	
Quadrat No. 4	Quadrat No. 5
	

Note: Quadrat photos presented HWL to LWL

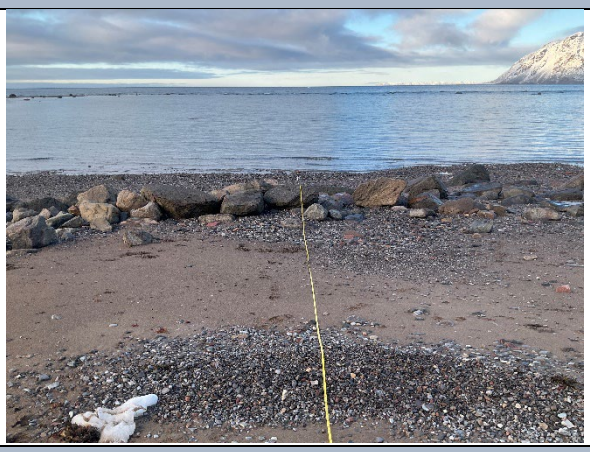
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Note: Quadrat photos presented HWL to LWL

Transect No. 10	
Seaward Overview	**Landward Overview**
	

Quadrats		
Quadrat No. 1	Quadrat No. 2	Quadrat No. 3
		
Quadrat No. 4	Quadrat No. 5	
		

Note: Quadrat photos presented HWL to LWL

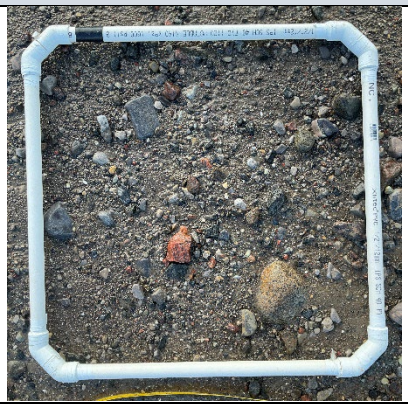
Transect No. 11	
Seaward Overview	Landward Overview
	

Quadrats		
Quadrat No. 1	Quadrat No. 2	Quadrat No. 3
		
Quadrat No. 4	Quadrat No. 5	
		

Note: Quadrat photos presented HWL to LWL

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Note: Quadrat photos presented HWL to LWL

Transect No. 13	
Seaward Overview	**Landward Overview**
	
Quadrats	
Quadrat No. 1	Quadrat No. 2
	
Quadrat No. 4	Quadrat No. 5
	

Quadrat No. 3

Quadrat No. 6


Note: Quadrat photos presented HWL to LWL

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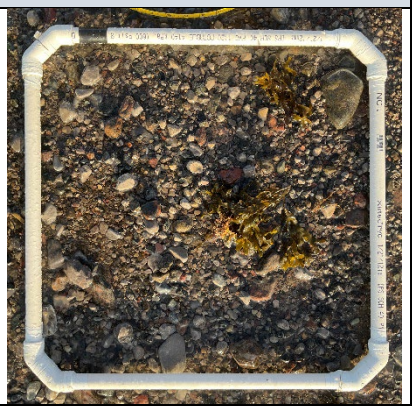
Note: Quadrat photos presented HWL to LWL

Transect No. 15	
Seaward Overview	**Landward Overview**
	
Quadrats	
Quadrat No. 1	Quadrat No. 2
	
Quadrat No. 3	
	
Quadrat No. 4	Quadrat No. 5
	

Note: Quadrat photos presented HWL to LWL

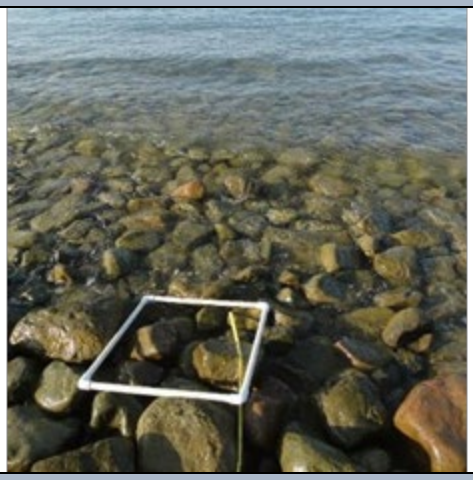
Transect No. 16	
Seaward Overview	**Landward Overview**
	
Quadrats	
Quadrat No. 1	Quadrat No. 2
	
Quadrat No. 4	Quadrat No. 5
	

Quadrat No. 3

Quadrat No. 6


Note: Quadrat photos presented HWL to LWL

Photo B-2: Intertidal Transects Overview and Quadrats (2019)

Transect No. 1	
Seaward Overview	**Landward Overview**
	
Quadrats	
Quadrat No. 1	Quadrat No. 2
	
Quadrat No. 4	Quadrat No. 5
	

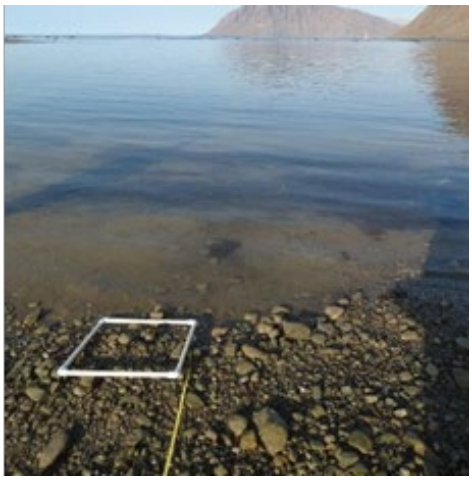
Quadrat No. 3

Quadrat No. 6


Note: Quadrat photos presented HWL to LWL

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Note: Quadrat photos presented HWL to LWL

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</table>

Note: Quadrat photos presented HWL to LWL

Transect No. 4	
Seaward Overview	**Landward Overview**
	
Quadrats	
Quadrat No. 1	Quadrat No. 2
	
Quadrat No. 4	Quadrat No. 5
	

Quadrat No. 3

Quadrat No. 6


Note: Quadrat photos presented HWL to LWL

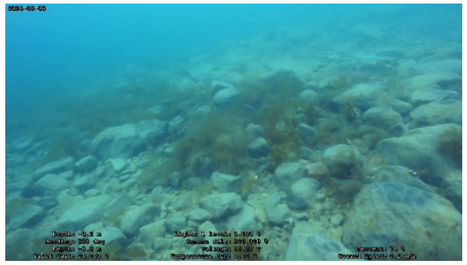
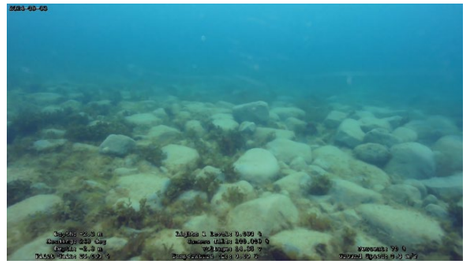
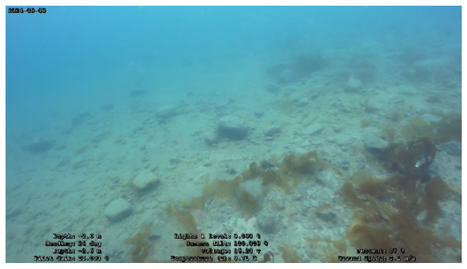
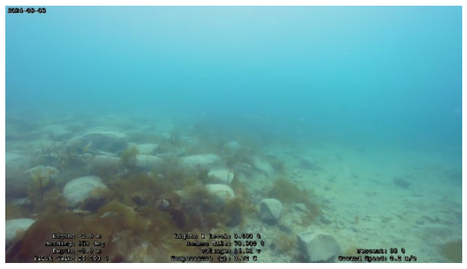
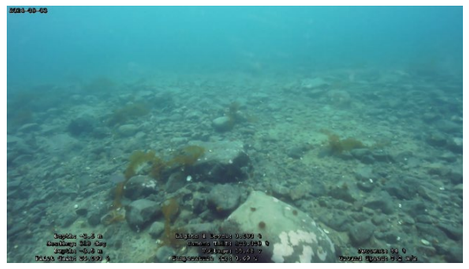
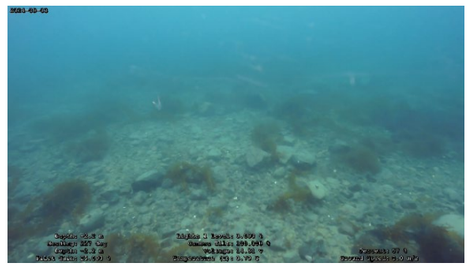
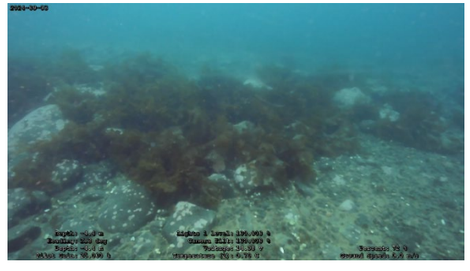
Transect No. 5	
Seaward Overview	**Landward Overview**
	
Quadrats	
Quadrat No. 1	Quadrat No. 2
	
Quadrat No. 4	Quadrat No. 5
	

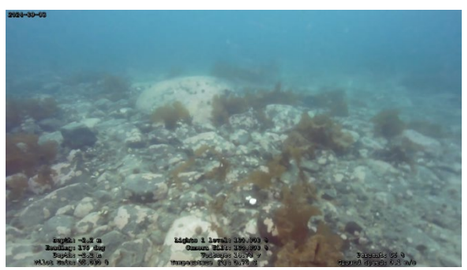
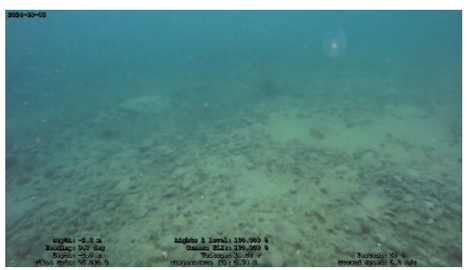
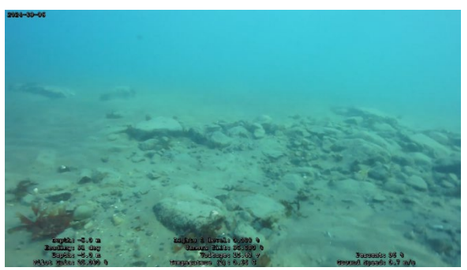
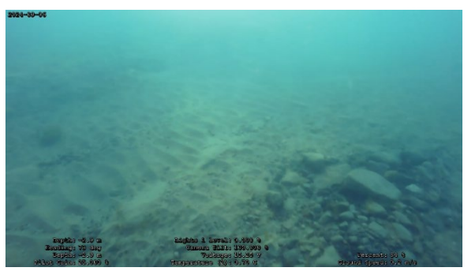
Quadrat No. 3

Quadrat No. 6


Note: Quadrat photos presented HWL to LWL

Photo B-3: Subtidal Transects Overview and Quadrats (2024)

Transect 1 – Photo 1	Transect 2 – Photo 2	Transect 3 – Photo 3	Transect 4 – Photo 4
			
Transect 5 – Photo 5	**Transect 6 – Photo 6**	**Transect 7 – Photo 7**	**Transect 8 – Photo 8**
			
Transect 9 – Photo 9	**Transect 10 – Photo 10**	**Transect 11 – Photo 11**	**Transect 12 – Photo 12**
			

Transect 13 – Photo 13	Transect 14 – Photo 14	Transect 15 – Photo 15	Transect 16 – Photo 16
			

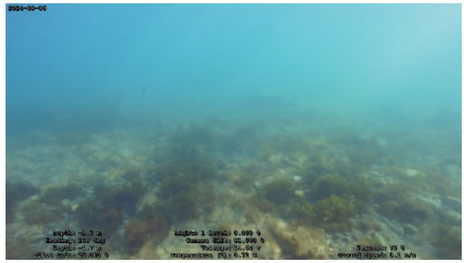
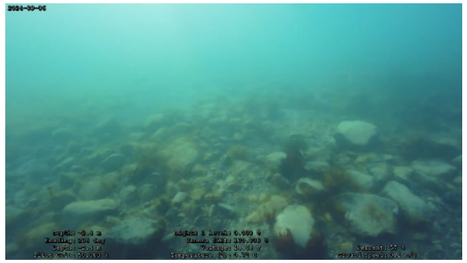
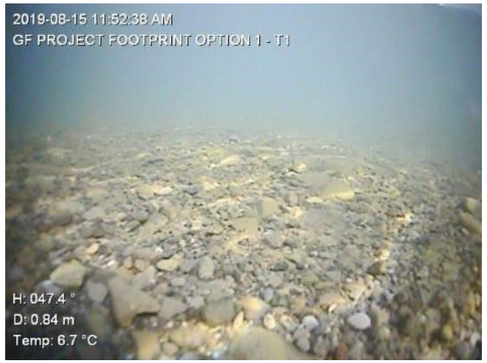
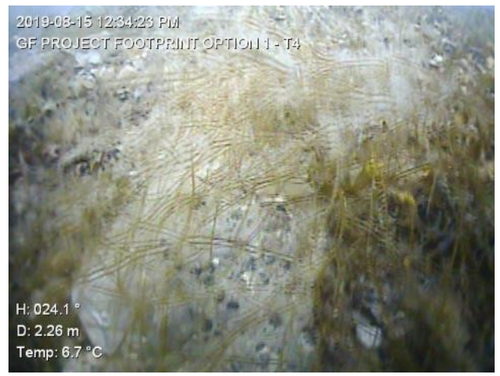
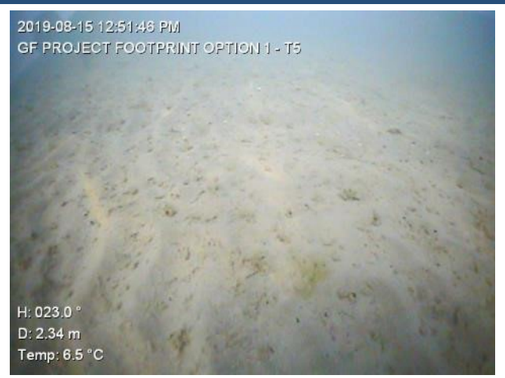
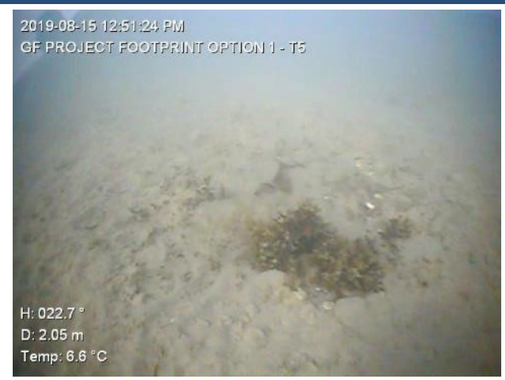
Transect 17 – Photo 17	Transect 18 – Photo 18
	

Photo B-4: Subtidal Transects Overview and Quadrats (2019)

Transect 1 – Photo 1 (filamentous green algae)	Transect 1 – Photo 2	Transect 1 – Photo 3	Transect 1 – Photo 4
			
Transect 2 – Photo 1 (Clam siphons)	**Transect 2 – Photo 2**	**Transect 2 – Photo 3 (Rockweed)**	**Transect 2 – Photo 4**
			

Transect 3 – Photo 1 (Rockweed)	Transect 3 – Photo 2 (Anthropogenic)	Transect 3 – Photo 3	Transect 3 – Photo 4
			

Transect 4 – Photo 1 (Rockweed)	Transect 4 – Photo 2 (filamentous diatoms)	Transect 4 – Photo 3 (Kelp)	Transect 4 – Photo 4 (Branching brown algae)
			

Transect 5 – Photo 1 (Rockweed)	Transect 5 – Photo 2	Transect 5 – Photo 3	Transect 5 – Photo 4
			

Transect 6 – Photo 1



Transect 6 – Photo 2



Transect 6 – Photo 3



Transect 7 – Photo 1



Transect 7 – Photo 2



Transect 7 – Photo 3



Transect 7 – Photo 4



Transect 8 – Photo 1



Transect 8 – Photo 2



Transect 8 – Photo 3



Transect 8 – Photo 4



Appendix C: Supporting Tables (Desktop)

Table C-1: List of Designated Areas in Nunavut

ID	Name		
1	Lower Estuary	*83*	De Salis Bay
8	Western Anticosti Island	*84*	Horton River
15	Outer Shelf Nain Bank	*85*	Western Banks Island
16	Outer Shelf Saglek Bank	*86*	Cape Bathurst / Ballie Island
45	Northern Labrador	*87*	Cape Bathurst Polynya
46	Nain Area	*88*	Darnley Bay Nearshore Migration and Feeding Corridor
52	Southwestern Hudson Bay Estuaries	*159*	Arctic Basin Multi-Year Pack Ice
53	Repulse Bay / Frozen Strait	*160*	Hopedale Saddle
54	Southampton Island	*161*	Lancaster Sound
55	Western Hudson Strait	*162*	Admiralty Inlet
56	Ungava Bay	*163*	Prince Leopold Island
57	Eastern Hudson Strait	*164*	Creswell Bay
58	James Bay	*165*	Bellot Strait
59	Belcher Islands	*166*	Cunningham Inlet
60	Norwegian Bay	*167*	Scott Inlet
61	Ellesmere Island Ice Shelves	*168*	Isabella Bay
62	Nansen-Eureka-Greely Fjord	*169*	Cape Searle
63	Archipelago Multi-Year Pack Ice	*170*	Eastern Cumberland Sound
64	Princess Maria Bay	*171*	Clearwater Fiord
65	Western Hudson Bay Coastline	*172*	Eclipse Sound / Navy Board Inlet
66	Rowley Island	*173*	Prince Regent Inlet
67	Igloolik Island	*174*	Gulf of Boothia
68	Fury and Hecla Strait	*175*	Peel Sound
69	Eastern Hudson Bay Coastline	*176*	Penny Strait
70	King William Island	*177*	Hatton Basin-Labrador Sea-Davis Strait
71	Diamond Jenness	*178*	Baffin Bay Shelf Break
72	Southern Victoria Island Coastline	*179*	Northern Baffin Bay
73	Lambert Channel	*180*	North Water Polynya
74	Viscount Melville Sound	*181*	Eastern Jones Sound
75	Chantrey Inlet	*182*	Resolute Passage
76	Bathurst Inlet	*183*	Cardigan Strait / Hell Gate

ID	Name		
77	Queen Maud Gulf Coastline	*184*	Southern Baffin Bay
78	Beaufort Shelf Break and Slope	*185*	Kugmallit Canyon
82	Southern Amundsen Gulf	*186*	Liverpool Bay

Table C-2: Species Specific observations of Benthic Amphipods in Nunavut (June 1996 to May 2001)

Latin Name	Site
Acanthonotozoma serratum	Upper Frobisher Bay
Aceroides latipes	
Ampelisca eschricti	
Andaniella pectinate	
Anonyx debruyni	
Anonyx nugax	
Arrhinopsis longicornis	
Byplis gaimardi	
Caprella dubia	
Dulichia porrecta	
Ericthonius tolli	
Guernea nordenskioldi	
Haliragen megalops	
Haploops tubicola	
Harpinia serrata	
Hippomedon sp.	
Ischyrocerus megalops	
Melita dentata	
Metopa cariana	

Latin Name	Site
Metopa groenlandica	Upper Frobisher Bay
Monuculodes latinamus	
Monoculodes longirostris	
Monoculodes simplex	
Odius carinatus	
Orchomene groenlandica	
Orchomene minuta	
Orchomene serrata	
Paradulichia typica	
Paraleustes bicuspis	
Paroediceros lynceus	
Phoxocephalus holbolli	
Pleustes media	
Pontoporeia affinis	
Rhachotropis inflata	
Socarnes sp.	
Syrrhoe crenulate	
Tryphosella schneideri	
Unciola leucopis	
Westwoodilla megalops	
Themisto abyssorum	Hudson Strait, Frobisher Bay
Themisto compressum	
Themisto libellula	Hudson Strait, Frobisher Bay, Coats Island
Multiple unnamed amphipod species	Lancaster Sound, Jones Sound, Arctic Bay, Scott Inlet
Calliopus laeviusculus	Belcher Island, Lower Hudson Bay

Latin Name	Site
Ischyrocerus anguipes	
Pontogeneia inermis	
Pseudalibrotus litoralis	
Caprella Spp.	
Weyprechtia pinguis,	Barrow Strait, Resolute
Onisimus litoralis	
Gammarus setosus	
Onisimus spp. Juveniles	
Ischyrocerus anguipes	Chesterfield Inlet, northwest of Hudson Bay
Pontogeneia inermis	
Apherusa megalops	
Weyprechtia pinguis	

Source: Devine *et al.* (2019); Estrada *et al.* (2012); Gaston and Elliott (2014); Pike and Welch (1990); Siferd *et al.* (1997); Wacasey *et al.* (1980)

Table C-3: List of Birds, their Federal and Territorial statuses, their preferred Foraging Strategy, and Potential to Nest (based on season-use) within or near the Project Study Area

Common Name	Scientific Name	COSEWIC Status	SARA Status	Territorial Status	Foraging Location	Period of Use	Nesting Resource Requirements	Nesting Likelihood
American golden plover	*Pluvialis dominica*	Not assessed	Not listed	S3	Shoreline	Breeding and Migration	Elevated on sparse, low vegetation, well-drained rocky slopes	Not Likely
American pipit	*Anthus rubescens*	Not assessed	Not listed	SU	Ground forager	Breeding and Migration	Mesic vegetation along streams, grassy meadows, and dry, dwarf shrub matts	Not Likely
Arctic tern	*Sterna paradisaea*	Not assessed	Not listed	S4	Nearshore	Breeding and Migration	Open country, close to water, no vegetation or low and sparse cover; rocky, gravelly islands, barrier beaches and spits, gravel moraines	Likely
Atlantic puffin	*Fratercula arctica*	Not assessed	Not listed	S3	Offshore	Breeding, Migration, and Overwinter	Burrows on rocky islands with short vegetation and on sea cliffs	Not Likely
Baird's sandpiper	*Calidris bairdii*	Not assessed	Not listed	S5	Shoreline	Breeding and Migration	Dry, well-drained coastal and upland exposed tundra. Beach ridges, terrace banks, bare soil with sparse vegetation	Likely
Black guillemot	*Cepphus grylle*	Not assessed	Not listed	S5	Nearshore	Breeding, Migration, and Overwinter	Colonies on rocky marine coasts of off-shore islands near shallow water	Not Likely
Black-bellied plover	*Pluvialis squatarola*	Not assessed	Not listed	S3	Shoreline	Breeding and Migration	Lowlands in coastal areas and on open, dry, heath tundra, dwarf shrub meadows, and dry exposed ridges, river banks, and beaches	Low
Black-legged kittiwake	*Rissa tridactyla*	Not assessed	Not listed	S5	Nearshore	Breeding and Migration	Colonies on cliff ledges of off-shore islands or inaccessible mainland	Not Likely
Brant	*Branta bernicla*	Not assessed	Not listed	S5	Coastal flats	Breeding and Migration	Colonial near salt marshes, estuaries, and deltas	Not Likely
Buff-breasted sandpiper	*Tryngites subruficollis*	Special Concern	Special Concern	S3	Ground forager	Breeding and Migration	Dry grassy tundra, shorelines, and rarely mudflats	Low
Cackling goose	*Branta hutchinsii*	Not assessed	Not listed	S5	Ground forager	Breeding and Migration	Variety of low Arctic regions with open view and adjacent to permanent freshwater (ponds, lakes, streams, marshes, and muskeg)	Not Likely
Canada goose	*Branta canadensis*	Not assessed	Not listed	S5	Grassy flats	Breeding and Migration	Broad range of habitats but often adjacent to freshwater	Not Likely
Common eider	*Somateria mollissima*	Not assessed	Not listed	S3	Nearshore	Breeding, Migration, Overwinter	Local colonies along marine coasts, islands, and islets	Not Likely
Common loon	*Gavia immer*	Not at Risk	Not listed	S5	Marine coast	Breeding and Migration	Large lakes	Not Likely
Common raven	*Corvus corax*	Not assessed	Not listed	S5	Ground forager	Breeding and Overwinter	Habitat generalist; often on cliffs, trees, and human structures	Likely
Common redpoll	*Acanthis flammea*	Not assessed	Not listed	SU	Foliage gleaner	Breeding and Migration	Dry, rocky or damp substrates on dry heaths or rocky slopes	Not Likely
Dovekie	*Alle alle*	Not assessed	Not listed	S3	Offshore	Breeding, Migration, and Overwinter	Colonies on rocky marine coasts and cliffs	Not Likely
Glaucous gull	*Larus hyperboreus*	Not assessed	Not listed	S4	Nearshore	Breeding and Migration	Often in mixed colonies on marine and freshwater coasts, tundra, islands, cliffs, shorelines, and ice edges	Not Likely
Gyrfalcon	*Falco rusticolus*	Not at Risk	Not listed	S4	Open terrain	Breeding and Migration	Rocky outcrops, cliffs, and seacoasts	Moderate
Hoary redpoll	*Acanthis hornemanni*	Not assessed	Not listed	S3	Foliage gleaner	Breeding and Migration	Similar to common redpoll, but near dwarf or creeping shrubs	Likely
Horned lark	*Eremophila alpestris*	Not assessed	Not listed	SU	Ground forager	Breeding and Migration	Open habitat on bare ground or short grasses	Low
Iceland gull	*Larus glaucoides*	Not assessed	Not listed	S5	Nearshore	Migration	Colonies on rocky cliffs and fjords	Not Likely
Ivory gull	*Pagophila eburnea*	Endangered	Endangered	S1	Nearshore	Breeding, Migration, and Overwinter	Rocky islands and cliffs near pack ice	Not Likely

Common Name	Scientific Name	COSEWIC Status	SARA Status	Territorial Status	Foraging Location	Period of Use	Nesting Resource Requirements	Nesting Likelihood
King eider	*Somateria spectabilis*	Not assessed	Not listed	S3	Nearshore	Breeding, Migration, Overwinter	Variety of tundra habitats, but often on dry and well-drained in vegetation adjacent to freshwater	Not Likely
Lapland longspur	*Calcarius lapponicus*	Not assessed	Not listed	S5	Ground forager	Breeding and Migration	Wet, hummocky meadows; avoids rocky and bare terrain	Low
Long-tailed duck	*Clangula hyemalis*	Not assessed	Not listed	S4	Nearshore	Breeding, Migration, Overwinter	Wetlands or offshore islands with freshwater	Not Likely
Long-tailed jaeger	*Stercorarius longicaudus*	Not assessed	Not listed	S5	Offshore	Migration and Overwinter	Tundra far from sea	Not Likely
Northern fulmar	*Fulmarus glacialis*	Not assessed	Not listed	S5	Offshore	Breeding, Migration, Overwinter	Steep sea-cliffs	Not Likely
Northern wheatear	*Oenanthe oenanthe*	Not assessed	Not listed	SU	Ground forager	Breeding and Migration	Dry, elevated rubble, rocky fields, stony hilltops, and precipices of rocky coasts	Likely
Pacific loon	*Gavia pacifica*	Not assessed	Not listed	SU	Marine coast	Breeding and Migration	Freshwater lakes	Not Likely
Parasitic jaeger	*Stercorarius parasiticus*	Not assessed	Not listed	S4S5	Offshore	Migration and Overwinter	Pelagic bird that nests on low-lying marshy tundra and dry, tussock-heath	Not Likely
Pectoral sandpiper	*Calidris melanotos*	Not assessed	Not listed	S4	Shoreline	Breeding and Migration	Flat, marshy tundra dominated by sedges and grasses	Low
Peregrine falcon	*Falco peregrinus*	Not at Risk	Special Concern	S4	Open terrain	Breeding and Migration	Open landscapes with cliffs or tall human-made structures	Moderate
Pomarine jaeger	*Stercorarius pomarinus*	Not assessed	Not listed	S5	Offshore	Migration and Overwinter	Pelagic bird that nests irregularly in low-lying marshy tundra near small lakes	Not Likely
Purple sandpiper	*Calidris maritima*	Not assessed	Not listed	S3	Shoreline	Breeding and Migration	Inland on mossy tundra, heath, and moorlands but also low tundra near shores on gravel-sand beaches along rivers	Low
Red knot	*Calidris canutus*	Endangered	Endangered	S2	Shoreline	Breeding and Migration	Sparsely vegetated, dry, elevated tundra on ridges or slopes with low shrub cover	Likely
Red phalarope	*Phalaropus fulicarius*	Not assessed	Not listed	S4	Nearshore	Breeding and Migration	Coastal, poorly-drained, hummocky, level terrain on tundra dominated by sedges	Low
Red-breasted merganser	*Mergus serrator*	Not assessed	Not listed	S5	Pursuit Diver	Breeding and Migration	Coastal near fresh, brackish or saltwater wetlands in sheltered bays	Not Likely
Red-necked phalarope	*Phalaropus lobatus*	Special Concern	Special Concern	S3	Nearshore	Breeding and Migration	Mossy hummocks and sedges close to standing water	Low
Red-throated loon	*Gavia stellata*	Not assessed	Not listed	S4	Marine coast	Breeding and Migration	Wetlands and larger ponds, lakes	Not Likely
Rock ptarmigan	*Lagopus muta*	Not assessed	Not listed	S5	Ground forager	Breeding and Overwinter	Well-drained, hummocky tundra with rocky ridges; outcrops and mixed vegetation	Moderate
Ross's gull	*Rhodostethia rosea*	Threatened	Threatened	S1	Nearshore	Breeding and Migration	Moist tundra and deltas with dwarf shrubs	Not Likely
Rough-legged hawk	*Buteo lagopus*	Not at Risk	Not listed	SU	Rolling, open terrain	Breeding and Migration	Open tundra including rocky outcrops, escarpments, and cliffs	Moderate
Ruddy turnstone	*Arenaria interpres*	Not assessed	Not listed	S3	Shoreline	Breeding and Migration	Marshy slopes and flats near freshwater (marshes, streams, ponds) or tidal flats and beaches	Moderate
Sabine's gull	*Xema sabini*	Not assessed	Not listed	S4S5	Nearshore	Breeding and Migration	Moist tundra near fresh water (ponds and lakes), low-lying sea coasts and coastal islands	Not Likely
Sanderling	*Calidris alba*	Not assessed	Not listed	S3	Shoreline	Breeding and Migration	Islands, peninsulas, and coastal tundra with well-vegetated moist to well-drained slopes, ridges, and alluvial plains	Moderate

Common Name	Scientific Name	COSEWIC Status	SARA Status	Territorial Status	Foraging Location	Period of Use	Nesting Resource Requirements	Nesting Likelihood
Sandhill crane	*Grus canadensis*	Not assessed	Not listed	S5	Ground forager	Breeding and Migration	Eskers dominated by lichens	Not Likely
Snow bunting	*Plectrophenax nivalis*	Not assessed	Not listed	S3	Ground forager	Breeding and Migration	Rocky areas and boulder screes near vegetated tundra	Likely
Snow goose	*Chen caerulescens*	Not assessed	Not listed	S5	Coastal flats	Breeding and Migration	Colonial near freshwater (ponds, lakes, streams, and braided deltas) often in wet meadows but also undulating terrain, exposed slopes, or cliff edges	Not Likely
Snowy owl	*Bubo scandiacus*	Not assessed	Not listed	S4	Rolling, open terrain	Breeding and Migration	Variety of tundra environments on distinct promontories	Not Likely
Thayer's gull	*Larus thayeri*	Not assessed	Not listed	S4S5	Marine coast	Breeding and Migration	Colonies on steep cliffs	Not Likely
Thick-billed murre	*Uria lomvia*	Not assessed	Not listed	S5	Offshore	Breeding, Migration, and Overwinter	Large colonies on cliff ledges near deep, offshore waters and land fast ice	Not Likely
Tundra swan	*Cygnus columbianus*	Not assessed	Not listed	S5	Coastal flats	Migration	Tundra lakes, ponds, and coastal deltas	Not Likely
White-rumped sandpiper	*Calidris fuscicollis*	Not assessed	Not listed	S5	Shoreline	Breeding and Migration	Well-vegetated, wet-meadows and low-lying areas near water	Not Likely
Willow ptarmigan	*Lagopus lagopus*	Not assessed	Not listed	S5	Foliage gleaner	Breeding and Overwinter	Abundant shrubby vegetation, flat terrain, and moist areas	Not Likely
Yellow-billed loon	*Gavia adamsii*	Not at Risk	Not listed	S4	Marine coast	Breeding and Migration	Near water on ground, partially hidden in tundra vegetation	Not Likely

Notes:

- Sources: (LePage *et al.*, 1998; Mallory & Fontaine, 2004; Cornell Lab of Ornithology, 2015; CESCC, 2016; Cornell Lab of Ornithology, 2019; Government of Canada, 2019q).
- Likelihood of nesting within HRQ and Community Harbour Study Area was based upon a qualitative assessment of results of the ecological land classification and habitat assessment and potential for the habitat to provide suitable nesting requirements. Similarly, other factors such as breeding range, location of known colonies, etc. were incorporated. Likely: the Study Area is located within the breeding range and the majority of available habitat provides preferred or suitable nesting habitat; Moderate: the Study Area is located within the breeding range and some of the available habitat may provide suitable nesting habitat; Low: the Study Area is located within the breeding range and some of the available habitat may provide marginal nesting habitat; Not Likely: the Study Area is located outside of the breeding range or outside of known colonies (or the species is colonial and such a colony would likely be known to locals given its proximity to the Hamlet), and available habitat is generally not suitable for nesting.

Territorial Rank Descriptions	
SX	Presumed Extirpated
SH	Possibly Extirpated
S1	Critically Imperiled
S2	Imperiled
S3	Vulnerable
S4	Apparently Secure
S5	Secure
SU	Unrankable
SNR	Unranked
SNA	Not Applicable