Kivalliq-Baffin Connector Project – Marine Survey

Environmental Management Plan

Revision Date: 03-Jun-2025

Document Number: PLN-GN-01.1-GN Fibre Optic Project EMP-0001-25.R3

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Rev	Date	Reason for Issue
3	03-Jun-2025	For Use
2	02-Jun-2025	For Use
1	30-May-2025	For Client Review
0	22-May-2025	For Client Review
B	15-May-2025	Internal Review
A	02-May-2025	Internal Review

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Any questions concerning the information or its interpretation should be directed to Victoria Burdett-Coutts.

Acronyms and Abbreviations

Acronyms/Abbreviation	Definition
AHJ	Authority Having Jurisdiction
AISR	Aquatic Invasive Species Regulations
AOI	Area Of Interest
BMP	Best Management Practices
BU	Branching Unit
CCG	Canadian Coast Guard
CCME	Canadian Council of Ministers of the Environment
CD	Chart Datum
CEPA	*Canadian Environmental Protection Act*
CEQG	Canadian Environmental Quality Guidelines
CIRNAC	Crown Indigenous Relations and Northern Affairs Canada
CMZ	Compliance Monitoring Zone
CPT	Cone Penetration Test
CRTC	Canadian Radio-television and Telecommunications Commission
CWS	Canadian Wildlife Services
dB	Decibel
DFO-FFHPP	Fisheries and Oceans Canada - Fish and Fish Habitat Protection Plan
DoE	Department of Environment
Dynamic Ocean	Dynamic Ocean Consulting Ltd.
EAUFON	Eastern Arctic Underwater Fibre Optic Network
EBSA	Ecologically and Biologically Significant Areas
ECCC	Environment and Climate Change Canada
Edgewise	Edgewise Environmental
EI	Environmental Investigator
EM	Environmental Monitor
EMP	Environmental Management Plan
EnMCP	Environmental Monitoring Compliance Program
EZ	Exclusion Zone
FAA	*Fisheries Act* Authorization
GN	Government of Nunavut
HADD	Harmful Alteration Disruption or Destruction
HDD	Horizontal Direction Drilling
HFC	High-Frequency Cetacean
HFTO	Hunting, Fishing and Trapping Organization
HTA	Hunters and Trappers Association

Acronyms/Abbreviation	Definition
HTO	Hunters and Trappers Organization
KBC	Kivalliq-Baffin Connector
KIA	Kivalliq Inuit Association
KRG	Kativik Regional Government
LFC	Low Frequency Cetacean
LoA	Letter of Advice
LUP	Land Use Permit
MBCA	*Migratory Birds Convention Act*
MBES	Multibeam Echosounder
MBS	Migratory Bird Sanctuaries
MMO	Marine Mammal Observer
MMR	Marine Mammal Regulations
MPA	Marine Protected Area
NIRB	Nunavut Impact Review Board
NMR	Nunavik Marine Region
NMRPC	Nunavik Marine Regional Planning Commission
NMRIRB	Nunavik Marine Regional Impact Review Board
NOAA	National Oceanic and Atmospheric Administration
NRI	Nunavut Research Institute
NPC	Nunavut Planning Commission
NS	Nova Scotia
NSA	Nunavut Settlement Area
NTU	Nephelometric Turbidity Units
NuPPAA	*Nunavut Planning and Project Assessment Act*
NWB	Nunavut Water Board
PAM	Passive Acoustic Monitoring
PO	Punch Out
PPE	Personal Protective Gear
PoE	Pathways of Effects
PW	Phocids-in Water
QP	Qualified Professional
RFR	Request for Review
RPL	Route Positioning List
RNLUP	Recommended Nunavut Land Use Plan
SAR	Species At Risk
SARA	*Species At Risk Act*

Acronyms/Abbreviation	Definition
SBP	Sub-Bottom Profiler
SCOP	Standards and Codes of Practice
SDR	Screening Decision Report
SDS	Safety Data Sheet
SEL	Sound Exposure Level
SERP	Spill and Emergency Response Plan
SSS	Side Scan Sonar
SVP	Sound Velocity Profiler
TIN	Transportation and Infrastructure Nunavut
TTS	Temporary Threshold Shift
the KBC Project	Kivalliq-Baffin Connector Fibre Optic Cable Project
VHF	Very High Frequency
WHS	Western Hudson Strait
WQG	Water Quality Guidelines

Terms and Definitions

Term	Definition
Beach Manhole (BMH)	A concrete chamber, buried into the beach or road behind the landing point, and is the transition point between marine cable and terrestrial cable.
Branching Unit (BU)	An undersea body serving as a "Y" joint in the cable that allows fiber pairs to be directed away from the main trunk cable for additional connectivity (the "branch"). The branch may be initially installed with a short length of cable called a "stub" which is accessible in the future to reach a landing at a later point in time.
Chart Datum (CD)	The reference level to which tidal heights and water depths on nautical charts are measured.
Decibels (dB)	Logarithmic unit used to measure the intensity of a sound or the power level of a signal relative to a reference value.
Horizontal Direction Drilling (HDD)	Horizontal Directional Drilling is a trenchless construction technique involving a bore hole drilled in a shallow arc along a predetermined path.
Multibeam Bathymetry	Uses a fan of sound beams to map the seafloor (aka seabed)
Punch-In (PI)	Terrestrial-based entrance point for Horizontal Direction Drilling (HDD).
Punch-Out (PO)	Marine-based exit point for HDD.
Pathways of Effects (PoE)	Developed by Fisheries and Oceans Canada (DFO) as a resource to conceptualize the pathways between human activities and stressors with their effect on fish and fish habitat.
Sub-Bottom Profiler (SBP)	A geophysical survey tool which uses sound waves to map the layers of sediment and geological structures beneath the seafloor (aka seabed).
Screening Decision Report (SDR)	Determines whether a proposed project in Nunavut may proceed as is, requires further environmental and socio-economic review, or should not proceed due to potential impacts.
Side Scan Sonar (SSS)	Uses sound waves to create detailed images of the seafloor (aka seabed) by emitting acoustic pulses.

1 Introduction

1.1 Background

Dynamic Ocean Consulting Ltd. (Dynamic Ocean) has been retained by the Government of Nunavut's (GN) Department of Transportation and Infrastructure Nunavut (TIN) as the regulatory specialist to support the permitting for the Kivalliq-Baffin Connector (KBC) Fibre Optic Cable Project (the KBC Project).

The GN-TIN has been awarded funding by the Canadian Radio-television and Telecommunications Commission (CRTC) to support the construction of a 1,066 km fibre optic cable in southern Nunavut (Figure 1-1). The KBC Project will connect four Nunavut communities to high-speed internet: Iqaluit, Kimmirut, and Kinngait on the southern coast of Baffin Island (Qikiqtani Region), and Salliq [Coral Harbour] on Southampton Island (Kivalliq Region). The KBC Project will connect to an existing Branching Unit (BU) in Salluit (Nunavik) built for the Kativik Regional Government's (KRG) Eastern Arctic Underwater Fibre Optic Network (EAUFON) Project (hereafter referred to as the KRG Project). Three of the Nunavut communities will be serviced through a marine approach (Kimmirut, Kinngait, Salliq [Coral Harbour]), with Iqaluit's approach being a terrestrial cable lay (from Kimmirut).

Prior to finalization of the detailed design phase of the KBC Project, a marine survey (the KBC Marine Survey) along the marine fibre cable route will need to be completed.

The KBC Marine Survey will occur in the waters of the Nunavut Settlement Area (NSA) or the Nunavik Marine Region (NMR), between the Qikiqtani and Kivalliq Regions on the south coast of Nunavut and the north coast of Nunavik (Figure 1-1). The KBC Marine Survey will be carried out by Seaforth Geosurveys Inc. (Seaforth) who were the successful contractor to complete the survey requirements.

1.2 Kivalliq-Baffin Connector Marine Survey Project Description

The intention of the KBC Marine Survey is to assess seabed conditions to support the detailed design phase of the KBC Project. The marine component sits entirely in either the NSA or the NMR.

The KBC Marine Survey will be composed of three main survey types as summarized below and further described in Section 2:

- Geophysical Program.
- Geotechnical Program.
- Biological Program.

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Nunavut

- Landings
- Route

Nunavut Regional Boundaries

- Kitikmeot
- Kivalliq
- Qikiqtaaluk
- Nunavut Settlement Area
- Nunavik

N

0 75 150 300 Km

Spatial Reference
GCS: GCS WGS 1984
Datum: WGS 1984
Projection: Mercator Auxiliary Sphere
Map Units: Meter
Drawn: C. Knight

Figure 1-1

Kivalliq-Baffin Connector Project Cable Route

1.3 Footprint and Survey Area

The Project footprint for the KBC Marine Survey will encompass the full extent of the marine cable route. Depending on the survey type, the survey corridor will range between 500 m to 900 m with the cable footprint as its centreline. A Study Area of 1 km lineal distance on both sides of the Project footprint (i.e., marine cable) has been defined based on the potential environmental effects that the KBC Marine Survey will generate. The Nunavut landings are described by the location of the Horizontal Direction Drilling (HDD) entry point in the marine environment and exit point on land. The marine entry point is referred to as Punch-Out (PO) and the land-based exit point is referred to as Punch-In (PI). The Nunavik landing is described by the location of the Branching Unit (BU) stub, as there is no land-based construction associated with this location (described in Section 1.1).

Spatial areas for KBC Marine Survey are described in Table 1-1. The location of the landings is provided in Table 1-2.

Table 1-1: Kivalliq-Baffin Connector Marine Survey Spatial Areas

Spatial Area	Definition
Project footprint	The Project footprint is considered the footprint of the marine cable.
Survey Corridor	Considered the 'swathe' distance required on either side of the Project footprint that will be required during the survey for the Geophysical Program. Using the Project footprint as the centreline, this distance will range between 500 m to 900 m depending on survey type.
Study Area	The Project footprint plus a 1 km lineal distance on either side of it (thus 2 km total). The buffer extent is based on potential environmental effects resulting from the KBC Marine Survey.

Table 1-2: Kivalliq-Baffin Connector Project Marine Landings in Nunavut

Location	Location Description	Punch-Out		Punch-In		Branching Unit Stub		Pertinent Water Bodies[3]	Hunter and Trappers Association / Organization
		Latitude	Longitude	Latitude	Longitude	Latitude	Longitude		
Nunavut Settlement Area									
Qikiqtani Region									
Kimmirut	Southern Baffin Island.	62° 50.4840'N	69° 51.6198'W	62° 50.5910'N	69° 52.1321'W	-		Hudson Strait, Glasgow Bay	Mayukalik Hunters and Trappers Organization (HTO).
Kinngait	Dorset Island on southwest coast of Baffin Island.	64° 14.3343'N	76° 32.8946'W	64° 14.1517'N	76° 32.5648'W	-		Foxe Basin, Hudson Strait	Aiviq HTO.
Iqaluit[1]	Frobisher Bay on south end of Baffin Island.	-						-	Amaruq Hunters and Trappers Association (HTA).
Kivaliq Region									
Salliq (Coral Harbour)	Southampton Island.	64° 06.2858 N	83° 13.6779'W	64° 06.8463'N	83° 12.5513'W	-		Hudson Bay	Aiviit HTO.
Nunavik Marine Region									
Makivvik									
Salluit [2]	Northern coast of Quebec, Canada.	-				62° 38.8394'N	76° 30.5777'W	Hudson Strait, Sugluk Inlet	Anguvigaq Hunting, Fishing and Trapping Organization (HFTO).

Note:

1. Not appliable as there is no marine component in Iqaluit as the route between Kimmirut and Iqaluit is terrestrial
2. There is limited construction activity for the Nunavik landing, as there is already a BU installed from the KRG Project
3. See Figure 1-1 for pertinent water bodies

1.4 Document Intention

This document is the Environmental Management Plan (EMP) for the KBC Marine Survey and has the following objectives:

- Target mandates of pertinent Authorities Having Jurisdiction (AHJ) and associated legislation to confirm permit approvals and relevant compliance requirements (see Section 1.4).
- Outline mitigation and monitoring measures to be implemented to minimize negative impacts to the physical, biological, and socio-economic environment associated with construction activities (Sections 5.3, 5.4).
- Confirm adherence to relevant Best Management Practices (BMPs) (see Section 5.1).

The EMP is an evolving document and will be updated if any changes to compliance measures occur as a result of adaptive management or if additional measures are added through permit conditions.

1.5 Regulatory Compliance

A summary of compliance and permitting requirements is provided in this section and further described in Table 1-3.

Table 1-3: List of Compliance Requirements for the Kivalliq-Baffin Connector Marine Survey

Legislation	Regulatory Authority	Marine Survey Activity	Required Authorization/ Permit/Approval
Territorial Requirements			
Institutions of Public Government - Nunavut			
Nunavut Land Claims Agreement Act, Article 11 *Nunavut Planning and Project Assessment Act* (NuPPAA)	Nunavut Planning Commission (NPC)	Development of land and water resources within the NSA. All aspects of the KBC Marine Survey.	Conformity Determination, and referral to Nunavut Impact Review Board (NIRB).
Nunavut Land Claims Agreement Act, Article 12 NuPPAA	NIRB	Any development of land and water resources within the NSA as determined by NPC's Conformity Determination. All aspects of the KBC Marine Survey.	Screening decision and report with conditions.
Institutions of Public Government - Nunavik			
Nunavik Inuit Land Claims Agreement, Articles 6, 7 (Nunavik Agreement)	Nunavik Marine Regional Planning Commission (NMRPC)	Development of land and water resources within the NSA. All aspects of the KBC Marine Survey.	Conformity Determination, and referral to Nunavik Marine Regional Impact Review Board (NMRIRB).
Nunavik Agreement, Part 7	NMRIRB	Any development of land and water resources within the NMR as determined by NMRPC's Conformity Determination. All aspects of the KBC Marine Survey.	Screening decision and report with conditions.
Designated Inuit Organization - Nunavik			
Nunavik Agreement	Makivvik Corporation	Access and entry of the survey vessel operating in waters of the NMR.	Entry and Access approval.

Legislation	Regulatory Authority	Marine Survey Activity	Required Authorization/ Permit/Approval
Government of Nunavut Departments - Nunavut			
Nunavut Scientists Act	Nunavut Research Institute (NRI)	All aspects of the KBC Marine Survey.	Research License.
Federal Requirements			
Fisheries Act: • Section 34.4(1). • Section 35(1). Marine Mammal Regulations (MMR). Aquatic Invasive Species Regulations (AISR).	Fisheries and Oceans Canada – Fish and Fish Habitat Protection Program (DFO-FFHPP)	All aspects of the KBC Marine Survey for the potential to result in the Harmful Alteration Disruption or Destruction (HADD) to fish or fish habitat, as defined under the *Fisheries Act.*	A Request for Review (RFR) to be submitted to DFO-FFHPP to confirm compliance requirements. A Letter of Advice (LoA) is expected.
Fisheries Act • Section 36 Canadian Environmental Protection Act (CEPA): Part 7, Divisions 2 and 3. Disposal at Sea Regulations	Environmental and Climate Change Canada (ECCC)	Activities with the potential to result in the deposition of deleterious substances into the marine environment.	Direct engagement with ECCC is not required, and their involvement is generally only from the position of an investigation after an occurrence. Measures in this EMP outline preventative measures that will need to be in place to minimize the potential for deposition of deleterious substances into the marine environment.
Territorial Land Use Regulations	Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC)	Sediment collection activities. The CIRNAC is a federal institution but there will be no sediment collection in Nunavik waters, as this activity is specific to the planning for the landing approach. There is a BU in Salluit (Nunavik) and therefore this activity is not required in the NMR.	Class A Land Use Permit (LUP).

2 Kivalliq-Baffin Connector Marine Survey Activities Description

2.1 Intention and Activities Description

The intention of the KBC Marine Survey is to:

- Assess seabed conditions (e.g. bathymetry, substrate, sub-surface geological layers beneath the seafloor to support the detailed design phase of the KBC Project to support the cable route engineering (e.g. confirm or amend the cable route, validate expected cable length estimates, identify seabed exit points, reduce fatal flaw uncertainties), application of cable types (armoring) and burial feasibility assessment.
- Ensure that the cable system is installed on the most benign seabed, avoiding any adverse impacts on sensitive living marine resources and clear of any features which could pose a threat to the design life of the cable system.

The KBC Marine Survey will encompass the full extent of the marine cable route with a survey corridor that will range between 500 m to 900 m depending on the survey type up to a water depth of approximately 440 m. The width of the survey corridor considers the marine cable as its centre. The approximate route within the NSA is 574 km, with an additional 492 km being in NMR. The system's approximate Route Positioning List (RPL) length is 890 km (base), with the approximately 180 km in BUs for the total length of 1,066 km (see Figure 2-1).

The KBC Marine Survey will be categorized by perceived risk, depth and substrate into three distinct surveys, which are summarized in Table 2-1.

- Geophysical Program which will cover 11 specific cable segments across the RPLs.
- Geotechnical Program where sediment coring, cone penetration tests (CPTs), and grab samples will be conducted in areas that may require cable burial.
- Biological Program to support an existing environmental conditions assessment.

The main drivers for the geophysical and geotechnical programs are to support the technical aspects of the KBC Project design, where the biological program is driven by regulatory requirements. The Biological Program driver will largely be to support the existing conditions assessment for DFO-FFHPP.

The marine route will be composed of three main components as below:

- Buried cable: Sections of cable that will be buried to minimize risk to cable from natural (e.g. ice scour) and anthropogenic (e.g. trawling, vessel anchoring) interferences.
- Surface laid cable: Sections of cable that will be laid directly on the seabed.
- HDD: Required at marine landings to allow for minimal impact to marine environment, and minimization of risk to cable (e.g. ice).

The information obtained from the KBC Marine Survey will inform marine installation, the extent of cable armoring and burial, particularly in areas where trenching (burial) may be required. However, the areas for surface laid versus buried cable have been predicted based on desktop study and the experience of the design engineer. The marine route is composed of 11 sections, to allow for BU that

will support future cable installations and allow for the route to each respective community (see Figure 2-1).

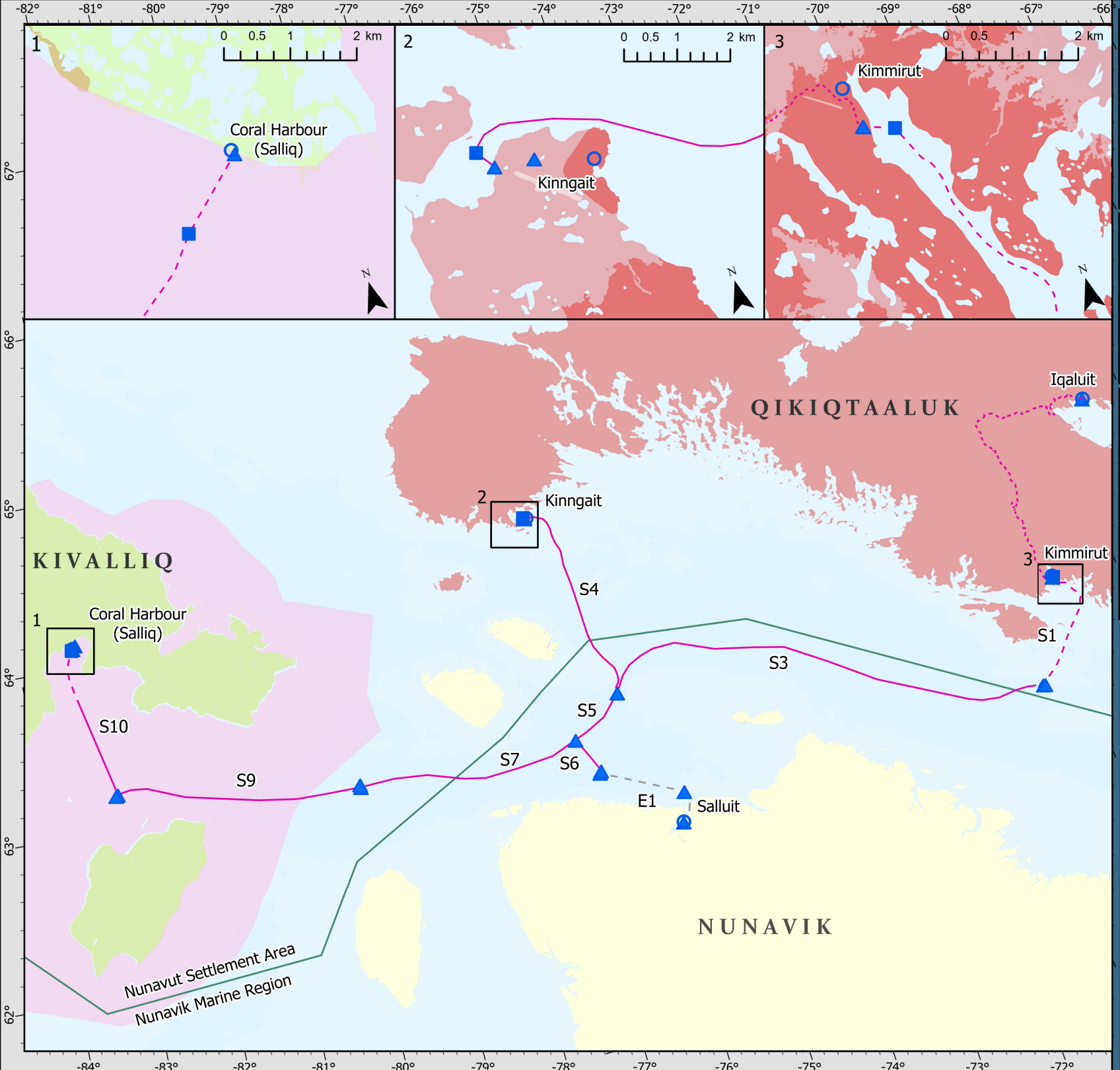
During the KBC Marine Survey, geophysical assessment is required over the entire route, where geotechnical is specific to planned buried cable areas. The primary reason for buried cable is due to the identification of natural (e.g. ice scour) and anthropogenic (e.g. trawling) effects during the operational phase. The geotechnical program is planned to follow the geophysical program to collect the data necessary to assess burial feasibility.

The main adverse effects of the project are the potential for anthropogenic noise contribution to the underwater soundscape (geophysical), potential for sediment disturbance and turbidity (geotechnical), and accidental spills (vessel, general activities). A description of the activities is provided in Table 2-2, with equipment footprint sizes described in Section 1.3 (Table 1-1). As outlined in Sections 5.3 and 5.4, all activities are considered mitigatable and there will be no residual environmental effects due to the KBC Marine Survey.

Table 2-1: Kivalliq-Baffin Connector Marine Survey Activities

Activity Type	Description	Surface Cable Lay Route	Buried Cable Route & HDD
Geophysical	• Swath bathymetry using a Multibeam Echosounder (MBES). • Side Scan Sonar (SSS). • Subbottom profiler (SBP). • Magmetometer. • Sound velocity profiling.	✓	✓
Geotechnical	• Sediment sampler (vibracore, grab sampler). • CPTs.	-	✓
Biological	• Potential for Drop Camera requirements to support regulatory requirements.	TBD[1]	✓

Note: 1. The requirement for visual assessment of the seabed is under discussion with Fisheries and Oceans Canada – Fish and Fish Habitat Protection Program (DFO-FFHPP)



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Nunavut

- Surface Laid Cable
- Buried Cable
- Terrestrial Laid Cable
- KRG Branching Unit
- NSA and NMR Boundary
- Landings
- Branching Unit Stubs
- HDD Punch-Out Point
- Southampton Island Area of Interest

Scale 1:3,400,000

0 35 70 140 km

Spatial Reference
GCS: GCS WGS 1984
Datum: WGS 1984
Projection: Mercator Auxiliary Sphere
Map Units: Meter
Drawn: C. Laidlaw

Figure 2-1

Kivalliq-Baffin Connector Project Cable Segments Showing Burial and Surface Laid Sections

Table 2-2: Description of Activities

Activity No.	Activity	Purpose	Description of Equipment	Description for Project	Interaction with Seabed	Potential for Anthropogenic Noise Contribution (see Table 4-2 for publicly available estimates on source levels)
Survey Vessel						
-	Survey Vessel	A vessel capable of being able to support operation of the required equipment and provide accommodations for the contractor's crew and GN representatives.	**RV Coriolis II** • Seaforth will utilize the vessel RV Coriolis II to support the completion of the KBC Marine Survey. The RV Coriolis II has the following attributes: ○ Station keeping abilities. ○ 30-day endurance. ○ Ability to support enough crew for 24-hour survey operations. ○ Vessel tracking via AIS. ○ Communication facilities. The RV Coriolis II is a 50 m long, 5.5 m draft vessel and will be operated by Reformar. Vessel specifications are provided in Appendix C(Specification C-1). • Up to 28 personnel can be accommodated aboard the RV Coriolis II. **Alternate Vessel** • Seaforth may decide to utilize a second vessel to support the Geotechnical and Biological Programs.		No	Yes
Geophysical Program (Buried Cable, Surface Cable Lay)						
1A	Swath Bathymetry Using MBES	Document depth along the survey route, which will be corrected for the speed of sound in seawater and recorded in metres.	• Measures water depth by emitting rapid pulses of sound toward the seabed and measuring the sound reflected back. • Provide dimensional bathymetric mapping of the cable route corridor using multiple beams elongated in the across track direction to cover a fan-shaped sector (or swath). The across track beam is typically 150° to 160° Crocker and Fratantonio (2016).	• Hull or pole mounted swathe system that will obtain continuous depth recordings along the survey route. • Minimum Survey Corridor. • Surface Laid Route: 500 m when water depth < 250 m; Minimum of two times water depth (maximum water depth is 465 m) when water depth is > 250 m. • Buried Cable Route: 500 m. • Depth resolution and bathymetric accuracy of 1 % (surface layed route) and 0.5 % (buried cable route).	No	Yes
1B	Sound Velocity Profiling	To measure the speed of sound at different water column depths.	• Sound velocity profiling is an important aspect for supporting sonar systems (e.g., MBES). • Sound velocity will be measured via a sound velocity profiler (SVP) at the MBES system transducer head, as well as through a separate SVP tethered to the vessel and	• Sound velocity profiles of the water column will be collected at a minimum four times a day and/or as required based on sonar data quality.		

Activity No.	Activity	Purpose	Description of Equipment	Description for Project	Interaction with Seabed	Potential for Anthropogenic Noise Contribution (see Table 4-2 for publicly available estimates on source levels)
			capable of collecting sound velocity profiles while the vessel is underway without requiring for surveys to halt operations.			
2	SSS	• Required to document all natural and anthropogenic seabed features, and specifically those that may cause design concerns. • Aid in identification of seafloor sediment, surficial bedrock outcrops and geomorphology mapping.	• High resolution and detailed two-dimensional imagery of the seabed. • Use of an acoustic beam to obtain an accurate image over a narrow area of seabed to either side of the instrument. • Generate high frequency acoustic pulses. • The intensity of the acoustic reflections from the seafloor is recorded in a series of cross-track images. When stitched together, these form a view of the seafloor within the swath of the beam. • Typically, an angle range of 50 m to 300 m on either side of the instrument.	• Will be integrated with the MBES data. • The minimum operating frequency shall be 300 kHz (buried cable route).	No	Yes
3	SBP	• Determine the thickness and nature of substrate conditions below the seabed. • Identify subsurface seabed features, inclusive of type, texture, variability. • Identify nature and density of subsurface seabed for up to 4 m below the seabed. • Investigate the upper layers of the seabed sediments for cable burial potential and installations risk from seabed obstructions (e.g. rock formations).	• Most likely to be towed but can be hull mounted. • Can penetrate the seabed to a range of depths to identify changes in sediment or structures within the sediment. • Generate acoustic signal through impulsive physical processes of electrostatic discharge (e.g. sparkers) or electromagnetically via accelerated water mass (e.g. boomers).	• High-resolution sub-bottom profiler is required to determine the thickness and nature of the sediments. Details and resolution of sediments to 1 m greater than the target depth of burial is critical, but the system must be capable of determining the geology and structure of the underlying seabed. • Utilize equipment that maximizes the identification of obstacles to cable burial. • Buried Cable Route: Details and resolution of sediments to 1 m greater than the target depth of burial is critical, but the system must be capable of determining the geology and structure of the underlying seabed.	No	Yes
4	Magnetometer	• Identify anomalies or issues with collection of survey data. • Aid in collecting data to identify existing anthropogenic infrastructure (e.g. existing BU).	• Passive towed sensor used to measure magnetic field strength and to detect variations in the total magnetic field of the underlying seafloor. • Does not transmit any signals to the marine environment.	• Identify any anomalies or issues requiring further investigation that arise during the collection of any survey data along any of the survey lines.	No	No

Activity No.	Activity	Purpose	Description of Equipment	Description for Project	Interaction with Seabed	Potential for Anthropogenic Noise Contribution (see Table 4-2 for publicly available estimates on source levels)
Geotechnical Program (Buried Cable Route)						
5	Sediment Sampler	Interpretations of the below seabed conditions, and to ground truth the SBP data.	• Equipment that will support obtaining sediment samples to further interpret seabed conditions. • Gravity Core: Liner for diameter likely to range from 90 mm to 120 mm and be up to 3 m in depth. • Vibracore: Has a tripod frame for stability. Coring barrel liner likely to range from 90 mm to 120 mm, and up to 3 m in depth. • Grab Sampler: Ponar that can obtain a surface sample (typically up to 10 cm in depth), and up to 20 cm footprint.	• The contractor will determine the frequency of samples required, with a minimum interval of every 10 km (buried cable route only). • A sample will be taken at the HDD exit point, when the depth is greater than 15 m Chart Datum (CD). • Expected to be a gravity corer, piston corer, vibracorer, or grab sampler. • The below seabed penetration will be up to 4 m. • Cores may be repeated for one of the following reasons a) refusal met before 4 m, b) within the core, there is less than 50 % recovery, c) the recovered core is compromised / disturbed. A maximum of three attempts will be made. If a core is considered unsuccessful, a grab sampler for the potential to recover a surface sediment sample (up to six inches) will be attempted, unless SBP data indicates the substrate is hard (e.g. bedrock, boulder) (buried cable route).	Yes	No (Gravity Core) Yes (Vibracore)
6	CPT	To support determination of simultaneous laying and burial of the cable.	• A CPT is an instrument placed on the seabed; however, does not collect sediment, so much as measure the resistance to penetration to assess subsurface properties of substrate below the seabed.	• Will interact with the seabed but does not collect sediment. • Surface laid route: N/A not required. • Buried Cable Route: Require sampling allowance based on interval of approximately every 4 km.	Yes	Yes
Biological Program						
7	Drop Camera	Visual observation of seabed conditions to support regulatory and environmental requirements.	• A drop camera will be a device on a tether with a camera.	• Requirements will be confirmed with DFO-FFHPP; however, expected to only be required in the buried cable route, or within surface laid route sections within the Southampton Area of Interest (AOI). • Expected to require 20 100 m transects, where locations will be agreed to by Seaforth, Dynamic Ocean and GN-TIN. The DFO-FFHPP will be engaged in advance of the KBC Marine Survey to provide advice and input on transect locations.	No	No

2.2 Schedule

The KBC Marine Survey will be undertaken in open-water seasons of 2025 or 2026 and will is expected to require approximately 75 days, however, if Seaforth utilizes a second vessel for the Geotechnical Program, the duration may be shorter. The KBC Marine Survey activities are planned to occur on a 24-hour basis in two 12-hour shifts.

2.3 Equipment

Equipment expected to be required for the KBC Marine Survey is summarized in Table 2-3, which were provided by Seaforth. Specifications for the equipment are provided in Appendix C. Seaforth will be responsible for the calibration of all Geotechnical and Geophysical equipment, where equipment calibrations can be provided upon request.

Table 2-3: Equipment Requirements for the KBC Marine Survey

Equipment	Brand & Model	Specification ID in Appendix C
Geophysical Program		
MBES	Kongsberg EM2040	Specification C-3
SVP	Valeport SWiFT, Oceanscience Underwater CTD	Specification C-2
SSS	Edgetech 4205	Specification C-4
SBP	Knudsen 3260 2x2 array pole-mounted	Specification C-5
Magnetometer	Geometrics G-882	Specification C-6
Ultra-Short Baseline (USBL) System	Kongsberg HiPaP 352P, iXblue GAPS M5 (spare)	Specification C-7
Geotechnical Program		
CPT	Datem Neptune 3000	Specification C-8
Sediment sampler (ponar and or vibracore)[1]	OSIL Vibrocorer	Specification C-9
Biological Program		
Drop camera	STR SeaSpyder 1500	Specification C-10
Passive acoustic hydrophones	icListen Smart Hydrophone	Specification C-11

Note: See Section 2.1 (Table 2-2) for description of survey types

1. Specifications only provided for vibecore

2.4 Mobilization and Planning

The RV Coriolis II will mobilize for the KBC Marine Survey from Dartmouth, Nova Scotia (NS). The majority of the crew, apart from local support and environmental support from Iqaluit, will board in NS. All fuel resupply and crew transitions will occur in Iqaluit.

3 Fish and Fish Habitat Existing Conditions

3.1 Fish and Fish Habitat Existing Conditions

Existing conditions for fish, marine mammals and their habitats were assessed through desktop review.

Important IQ desktop resources that contributed the understanding of existing conditions are listed below:

- RNLUP (NPC, 2023a).
- RNLUP Interactive Maps (NPC, 2023b).
- Nunavut Coastal Resources Inventory (NCRI) for Coral Harbour, Kimmirut and Kinngait (GN, 2009, 2012a, 2018).
- Nunavut Wildlife Harvest Study (NWHS) (Priest & Usher, 2004).
- Inuit Bowhead Knowledge Study (IBKS) (NWMB, 2000).

3.1.1 Focal Fish

Focal marine fish and mammals were selected based on desktop study with the selection criteria as summarized below and defined in Table 3-1.

- Importance to Inuit for subsistence and food security.
- Geographic ranges, which includes the potential to occur in the KBC Marine Survey footprint.
- Representative role in food chain dynamics.

Focal species for the KBC Marine Survey with their species description are listed in Appendix A (Table A-1).

Table 3-1: Arctic Species Spatial Categories and Descriptions

Category	Marine Fish	Marine Mammals
Resident	Species that occupy in the same general area throughout the year.	Species that reside in the Arctic year-round.
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.	Species that predictably reside within the Arctic region for a portion of the year, most typically the open-water season.
Anadromous	The movement of fish between freshwater and marine environments for the purpose of feeding in one environment and spawning in the other.	N/A

3.1.2 Designated Species

SAR were categorized by international, federal, and territorial designations, and were selected as those having the potential to overlap with the KBC Marine Survey Area for various life history stages (e.g., breeding, nursery, resident, migration, and feeding). See Appendix A (Table A-1) for a full list of species with designations that have the potential to be present during the KBC Marine Survey.

3.1.3 Aquatic Invasive Species

Risk of introducing invasive species in the NSA due to the KBC Marine Survey is not expected. Vessels and equipment performing the KBC Marine Survey will be in compliance with pertinent regulations to prevent importing, releasing, introducing, possessing, or transporting aquatic invasive species.

3.2 Fish Habitat

3.2.1 Designated Habitats

The KBC Marine Survey will travel through or be in proximity to several designated habitats as summarized in Table 3-2. The location of these designated habitats is provided in Appendix B (Figure B-1).

Table 3-2: Designated Areas Within or In Proximity to the Kivalliq-Baffin Connector Marine Survey

Designated Area	Description	Distance and Direction from the KBC Marine Survey
Southampton Island AOI	The Southampton Island AOI, approximately 93,000 km^2, was established in 2019 due to numerous colonies of seabirds, the presence of Atlantic walrus (*Odobenus rosmarus ssp. rosmarus*) haul-out sites, polar bear (*Ursus maritimus*) dens, and as the region is an important migratory pathway for marine mammals (DFO, 2015, 2022). Fisheries and Oceans Canada is working with the Kivalliq Inuit Association (KIA) to designate the South Hampton Island AOI as a Marine Protected Area (MPA) (DFO, 2022). It would be the first MPA within Hudson Bay. Salliq (Coral Harbour) is located on Southampton Island within the AOI.	The Salliq (Coral Harbour) landing and approximately 235 km of the KBC marine cable are within the Southampton Island AOI.
Western Hudson Strait (WHS)	The WHS Ecologically and Biologically Significant Area (EBSA) was established for its uniqueness to a migration corridor for the Western and Eastern Hudson Bay beluga whale (*Delphinapterus leucas*), overwintering for bowhead whales (*Balaena mysticetus*), and Atlantic walrus haul-out sites. Aggregations of seabird colonies (murres: *Uria* spp.), sea duck nesting (eiders: *Somateria* spp.), epibenthic habitat, and sponge (*Porifera* sp) beds are other reasons for its designation (DFO, 2011). A portion of the KBC Marine Survey will take place in the offshore waters of the WHS EBSA.	The Kinngait and Salluit landings, and approximately 712 km of KBC marine cable are within the WHS.
East Bay (Qaqsauqtuuq) Migratory Bird Sanctuaries (MBS)	On South Hampton Island (ECCC, 2019a), species known to breed in the East Bay MBS include lesser snow goose (*Chen caerulescens*), Atlantic brant (*Branta bernicla hrota*), cackling goose (*Branta hutchinsii*), king eider (*Somateria spectabilis*), long-tail duck (*Clangula hyemalis*) and tundra swan (*Cygnus columbianus*), along with over a dozen other species of loon (*Gavia spp.*), gull (*Larus spp.*), plover (*Pluvianus spp.*) and jaeger (*Stercorarius spp.*).	The East Bay MBS is adjacent to the KBC marine cable, approximately 34 km east.
Harry Gibbons (Ikkattuaq) MBS	On South Hampton Island, the Harry Gibbons MBS was designated due to its importance as nesting habitat for the lesser snow goose (ECCC, 2019b). The MBS is also utilized for nesting by over a dozen other migratory bird species	The Harry Gibbons MBS is adjacent to the KBC marine cable, approximately 105 km west.

Note: See Appendix B (Figure B-1) for graphical representation of KBC Marine Survey relative to designated areas

3.2.2 Critical Habitats

For all designated species, the *Species at Risk Act* (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.

There are no SARA defined or critical habitats being considered in proximity to the KBC Marine Survey.

3.2.3 Important Habitats Defined by the Recommended Nunavut Land Use Plan

Several important habitats defined in the Recommended Nunavut Land Use Plan (RNLUP) that may be in close to the KBC Marine Survey are presented in Appendix B (Figure B-2, Marine Mammals | Figure B- 3, Migratory Birds).

Based on the schedule of the KBC Marine Survey (see Section 2.2), seasonal interactions with the following species may be encountered:

- Bowhead whale calving area.
- Atlantic walrus terrestrial haul outs.
- Migratory birds Class 1, 2 and 3.

Important habitats defined in the RNLUP which are spatially in proximity but not at risk due to temporal (schedule) differences are listed below:

- Narwhal (*Monodon monoceros*) and beluga calving area.
- Polar bear denning.
- Polynyas.

Mitigation measures to protect these important habitats have been incorporated into this EMP.

4 Potential Environmental Effects

Potential negative environmental effects due to the KBC Marine Survey are summarized in Table 4-1. There are no residual environmental effects expected after the implementation of environmental management as outlined in Section 5.

Table 4-1: Potential effects due to the Kivalliq-Baffin Connector Marine Survey

Effect	Section
Disturbance, injury, or mortality to fish and marine mammals due to underwater noise	4.1
Marine water quality degradation	4.2
Physical damage to marine fauna (Crushing, burial, or mortality)	4.3
Marine Habitat Modifications	4.4
Sensitive Marine Habitats	4.5
Waste Production	4.6

4.1 Disturbance or Injury to Fish or Marine Mammals due to Underwater Noise

There is the potential for some of the survey equipment required to implement the KBC Marine Survey to contribute to anthropogenic noise in the marine environment. These effects can be managed through implementation of Exclusion Zones (EZ) and hydroacoustic monitoring.

There are currently no federal noise disturbance criteria in Canada; however, marine mammal noise threshold guidance is provided by the National Oceanic and Atmospheric Administration (NOAA) (NOAA, 2024) and by DFO-FFHPP through LoAs and *Fisheries Act* Authorization (FAA) which have consistently been providing underwater acoustic metrics and distance radii for EZs relevant to fish and marine mammals. Anthropogenic noise in water are categorized as impulsive or continuous signals (TC, 2020). Impulsive signals include impact pile driving, air guns, explosions and sonar pings. Continuous signals on the other hand include activities such as vibratory pile driving, drilling rigs, and ship engines. Auditory thresholds for injury and behavioural disturbance from NOAA (NOAA, 2024) are summarized in Table 4-2.

Potential impacts to marine mammal species may occur if SSS, MBES, and SBP systems operate at frequencies that overlap with their hearing ranges of the animal (see Table 4-2) at potentially harmful levels if the animal is at close proximity to the noise source. The KBC Marine Survey is expected to generate impulsive signals via SSS, MBES, and SBP (NMFS, 2024). Details for the expected noise levels from survey equipment can be found in Section 2.3 (Table 4-3).

Effects to marine mammals and fish due to underwater noise are not expected, as measures will be implemented to document anthropogenic noise contributions due to the KBC Marine Survey equipment (see Section 5.4.5), such as implementation of appropriate marine mammal observation programs and monitoring of appropriately sized EZs. Additionally, most systems are expected to operate at high frequencies, which will limit the distance that the sound is expected to travel from its source. Real-time monitoring of underwater noise will not be logistically feasible due to the nature of the KBC Marine

Survey, however, based on an understanding of the source levels of proposed geophysical equipment (described in Section 2.3 (Table 2-2)), the use of appropriate EZs is expected to minimize negative impacts to marine mammals.

Table 4-2: National Oceanic and Atmospheric Administration Acoustic Injury and Behavioural Disturbance Thresholds

Hearing Group	Hearing Range	Applicable Species	Impulsive Source (0-pk, re 1 µPa)			Continuous Source (rms, re 1 µPa)		
			Auditory Injury	Temporary Threshold Shift (TTS)	Behavioural Disturbance	Auditory Injury	Temporary Threshold Shift (TTS)	Behavioural Disturbance
Low Frequency Cetacean (LFC)	7 Hz – 36 kHz	Bowhead Whale	222 decibels (dB)	216 dB	160 dB	197 dB	177 dB	120 dB
High-Frequency Cetacean (HFC)	150 Hz – 160 kHz	Beluga, Narwhal	230 dB	224 dB		201 dB	181 dB	
Phocids-in Water (PW)	40 Hz – 90 kHz	Ringed Seal (*Pusa hispida*), Bearded Seal (*Erignathus barbatus*)	223 dB	217 dB		195 dB	175 dB	
Fish	-	Arctic Cod (*Boreogadus saida*), Arctic Char (*Salvelinus alpinus*)	206 dB	-	150 dB	-	-	-

Source: Hearing range in Table 1 NMFS (2024)

Note: SPLs provided in table are flat weighted. Fish in NOAA (NOAA, 2024) are divided into two groups; <2 g and >2 g with differing Sound Exposure Level (SEL) thresholds, but were simplified into single category for this table since peak injury and behavioural disturbance thresholds were the same between groups

Table 4-3: Specifications of Acoustic Sources for the Kivalliq-Baffin Connector Marine Survey

Equipment Type	Frequency Range		Impulse Duration (ms)	Maximum Source Sound Pressure Level[1] (dB)		Reference	Specification ID in Appendix C
	Minimum	Maximum		Minimum	Maximum		
Geophysical Program							
MBES	200 kHz	700 kHz	0.05 - 10	210	245	BEIS (2020); Crocker and Fratantonio (2016); Danson (2005); DECC (2011); Hopkins (2023); Lurton (2016); Lurton and DeRuiter (2011)	Specification C-3
SSS	300 kHz	900 kHz	0.4 - 1.0	200	240	BEIS (2020); Crocker (2016); Crocker and Fratantonio (2016)	Specification C-4
SBP (Chirper)	2 kHz	16 kHz	5 - 40	185	215	Crocker and Fratantonio (2016); Hartley Anderson (2020)	Specification C-5
Magnetometer	-	-	-	-	-		Specification C-6
Geotechnical Program							
CPT	28 Hz		-	118	145	BOEM (2012); ERGRID PLC (2014)	Specification C-8
Vibracore			30 Hz	187.4		LGL Ltd. and Jasco (2010)	Specification C-9
Grab sampler	-		-	-	-	-	-

Note:

1. Measurement applies for 1 µPa at 1 m
2. Source levels for all equipment and frequency ranges for SBPs derived from Crocker and Fratantonio (2016) and Hartley Anderson (2020). Parametric SBP operates with two differences sources simultaneously and thus has two frequency ranges/ source levels

4.2 Water and Sediment Quality Degradation

Short-term degradation of marine water quality has the potential to occur during the KBC Marine Survey as a result of accidental spills, or due to turbidity from the Geotechnical Program.

Negative effects on water quality are expected to be minimal and will be managed through appropriate mitigations and BMPs (see Sections 5.1, 5.3). The KBC Marine Survey will follow the Spill Planning and Reporting Regulations in Nunavut and Nunavik. A spill prevention and response procedure will be implemented to ensure the appropriate spill response equipment is on site should a spill occur (described in Section 5.3.9).

Seafloor disturbance during sediment sampling is expected to be minimal during the KBC Marine Survey. The approximate footprint of the geotechnical equipment that will interact with the seabed are summarized in Section 2.1 (Table 2-2), however, the actual size will be a contractor led decision. Where in either case, is considered to be relatively small in comparison to the extent of available seabed. Therefore, due to the small size of the equipment and the small scale of the activity, concerns for turbidity are not expected to occur.

Turbidity is not anticipated to exceed the Canadian Council of Ministers of the Environment (CCME) Water Quality Guidelines (WQG) (CCME, 1999b), turbidity monitoring requirements are summarized in Section 5.4.3.

4.3 Physical Damage to Marine Organisms (Crushing, Burial or Desiccation)

Physical damage to marine organisms is not expected to occur during the KBC Marine Survey.

There will be no interaction with the seabed during the Geophysical Program, and as described in Section 4.2, interactions with the seabed during the Geotechnical Program will be small scale.

Direct mortality to fish is expected to be improbable.

4.4 Modification and Destruction of Fish Habitat

There will be no impact to the water column habitat during the KBC Marine Survey, and as summarized in Sections 4.2 and 4.3, impacts to the seabed will be minimal and temporary in nature should it occur. Activities from the KBC Marine Survey will not cause permanent damage to fish habitat.

4.5 Sensitive Marine Habitats

Sensitive marine habitats as described in Section 3.1.2 will be protected through the implementation of management measures for a) maintaining minimum distances from sensitive areas, b) limiting vessel speeds and c) implantation of EZs. These measures are described in Section 5.3.

4.6 Waste Production

The KBC Marine Survey waste generation will be completely contained on the vessel and will be disposed of appropriately. Waste management measures outlined in Section 5.3.8 will be followed.

5 Environmental Management

5.1 Guidelines and Best Management Practices

The following guidelines and BMPs are relevant to the KBC Marine Survey.

- DFO: Fish and Fish Habitat Protection Policy statement (DFO, 2019).
- DFO: Measures to Protect Fish and Fish Habitat (DFO, 2025).
- DFO: Interim code of practice: End-of-pip fish protection screens for small water intakes in freshwater (DFO, 2020b).
- DFO: Pathways of Effects (PoE) (DFO, 2024b).
- NPC: Recommended Nunavut Land Use Plan (NPC, 2023a).
- NOAA: 2024 Revisions to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 3.0) (NOAA, 2024).
- Government of Canada: Guidelines for Spill Contingency Planning (INAC, 2013).
- Government of Canada: National Oil Spill Preparedness and Response Regime (TC, 2019).
- Canadian Construction Association: CCA 81 – 2001: A Best Practices Guide to Solid Waste Reduction (Canadian Construction Association, 2001).
- GN: Non-native and invasive species in Nunavut (GN & ECCC, 2022).
- GN: Contingency Planning and Spill Reporting in Nunavut. A Guide to the New Regulations (GN, 2022).
- GN-Department of Environment (DoE): Environmental Guideline for the General Management of Hazard Waste (GN, 1999).
- Canadian Environmental Quality Guidelines (CEQG) (CCME, 2024).

5.2 Roles and Responsibilities

The requirements to meet regulatory commitments will be undertaken by the GN-TIN, the marine regulatory permitting specialists, and Seaforth's team. The roles and responsibilities for each team with respect to management of environmental performance on the KBC Marine Survey are described below. The responsibility for the application of this EMP encompasses all personnel.

5.2.1 Government of Nunavut

The GN-TIN will undertake the following responsibilities to manage regulatory compliance:

- Communicating with AHJs on matters related to permitting and regulatory compliance.
- Continued consultation with the communities and Hamlets.
- Coordination with the contractor to manage and communicate on compliance issues.
- Transmitting monitoring reports and incident notices to AHJs, community members and groups, as necessary.

5.2.2 Regulatory Permitting Specialists – Dynamic Ocean Consulting Ltd.

Dynamic Ocean will support GN-TIN as the Environmental Inspector (EI) as described below:

- Support to the GN-TIN responsibilities summarized above.
- Acquisition of GN-TIN permits to support the implementation of the KBC Marine Survey.
- Monitor that the contractor's activities comply with contractual requirements and the approved design, including environmental requirements, regulations and relevant permits and approvals.
- Support GN-TIN to confirm the contractor's environmental Qualified Professional (QP) is appropriately qualified and understands the compliance requirements outlined in this EMP and all associated permits issued by AHJs.

5.2.3 Seaforth (Contractor Team)

Seaforth will be responsible for the implementation of the Environmental Monitoring Compliance Program (EnMCP) to confirm that the measures outlined in this EMP and all associated permits are followed. An appropriately qualified Environmental Monitor (EM) / Marine Mammal Observer (MMO) will be on the vessel and will provide the KBC Survey Environmental Report, as detailed in Section 5.8.1. Seaforth are being supported by Edgewise Environmental (Edgewise) to implement the MMO component of the EnMCP.

All incidents, non compliances and stop-works, will be immediately reported to the GN-TIN's EI representative (see Section 5.8.2).

5.3 Mitigation Measures

Mitigation measures to be implemented to minimize negative effects are provided in this section. The categories of considered impacts were developed during the NIRB permitting process, and while assigned to one category, may be applicable to others. These measures, combined with AHJ approvals constitute the regulatory compliance program. Environmental management and implementation of the following mitigation measures will be supported by QPs from Seaforth and Edgewise, collectively referred to as 'the contractor' in the following subsections. Seaforth will manage and oversee the delegation for the KBC Marine Survey, and ensure the GN-TIN and Dynamic Ocean are kept informed on topics pertinent to regulatory compliance.

5.3.1 General

General mitigation measures for the KBC Marine Survey are summarized in Table 5-1.

Table 5-1: General Mitigation

ID	Mitigation Measure
G1	A qualified EM / MMO will be onboard the vessel for the duration of the KBC Marine Survey and will be responsible for the implementation of measures as outlined in this EMP, and as detailed in permit conditions from pertinent AHJs.
G2	Works shall comply with requirements of applicable laws, legislations, and BMPs.
G3	Adherence to BMPs for working in the marine environment (see Section 5.1).

ID	Mitigation Measure
G4	The contractor will suspend survey activities should any dead or injured fish or marine mammals be observed. Stop-work procedures are described in Section 5.6.
G5	Appropriate stop-work and non-compliance reporting will be implemented as applicable. See Sections 5.6, 5.7.
G6	Routine inspections of the survey vessel, equipment, as required to ensure regulatory compliance.
G7	General housekeeping rules will be used to minimize clutter and keep work areas tidy.
G8	The contractor's EM will complete all AHJ communications as summarized in Section 5.9.1.

5.3.2 Project Permit and Approval Compliance

Mitigation measures associated with project permit and approval compliance are described in Table 5-2.

Table 5-2: Project permit and approval compliance

ID	Mitigation Measure
PPAC1	The GN-TIN and their contractor will operate in compliance with applicable Acts, Regulations and Guidelines. This includes permits, approvals and authorizations received after issuance of this EMP.
PPAC2	The contractor will be provided with a copy of this compliance document and all permits in advance of mobilization. The contractor will maintain copies of Project permits, approvals and authorizations issued by AHJs at the site at all times.
PPAC3	The contractor will provide to GN-TIN copies of permit application(s) and contractor held permits.
PPAC4	A copy of each permit, license, or other authorization issued for the Project will be submitted to NPC and the NIRB as per S 137(4) of the NuPPAA. The GN-TIN will be responsible for the submission of permits on behalf of the contractor.
PPAC5	Adherence to appropriate BMPs (see Section 5.1).
PPAC6	The contractor's EM will conduct a 'tailgate' meeting prior to the start of the KBC Marine Survey to confirm that all personnel are aware of regulatory compliance requirements and understand their responsibilities (e.g. during spill response).

5.3.3 Sediment and Water Quality

Mitigation measures for sediment and water quality are described in Table 5-3.

Table 5-3: Sediment and Water Quality

ID	Mitigation Measure
SWQ1	The EM will confirm that no activities performed during the Geotechnical Program will result in exceedances of the CCME Approved WQG outside the work area. Monitoring and compliance thresholds are outlined in Section 5.4.3.

ID	Mitigation Measure
SWQ2	Machinery and equipment will be maintained in good working order to minimize emissions.
SWQ3	Seaforth will not deposit any deleterious substances (e.g., fuel, chemicals, waste) into the marine environment. Should such activities occur, appropriate measures for response and reporting must be adhered to as outlined in Section 5.3.9.

5.3.4 Fish and Fish Habitat (Including Marine Mammals)

Mitigation measures for fish, fish habitat, and marine mammals are described in Table 5-4.

Table 5-4: Fish and Fish Habitat (Including Marine Mammals)

ID	Mitigation Measure
FMM1	Visual monitoring will be undertaken as described in Section 5.4.2. All aquatic works will cease in the event of fish kill/injury or stress to aquatic wildlife is observed until the EM can provide guidance for the continuation of survey activities.
FMM2	The vessel captain will maintain vigilance for marine mammals. Minimum approach distances and best practices as outlined in the MMR must be adhered to, and protected areas as outlined within the most recent Notice to Mariners published by the Canadian Coast Guard (CCG) at the time of the KBC Marine Survey will be followed.
FMM3	An MMO will be on board the vessel for the duration of the KBC Marine Survey to monitor for the presence of marine mammals and document species observations, inclusive of distance from marine vessel and behavioural interferences. The EZ will be set and maintained as described in Section 5.4.4 (Table 5-11).
FMM4	Should monitoring of the EZ occur in low light or dark conditions, the EM/MMO will utilize appropriate techniques to allow for appropriate management of the EZ in low light conditions. Minimum requirements for the management of the EZ are described in Section 5.4.4.
FMM5	Activities shall cease if there is risk of physical harm to a marine mammal from direct contact. Activities shall only resume once there is no longer a risk of injury to marine mammals from direct contact. Monitoring is described in Section 5.4.2.
FMM6	The minimum gear power required to achieve survey objectives will be employed to minimize the impact on marine wildlife. A ramp up procedure will be established at the start of each survey with a gradual increase of power to allow undetected marine wildlife to exit the vicinity before source levels reach thresholds for injury.
FMM7	Water will not be extracted from any fish-bearing waterbody unless undertaken in compliance with Nunavut Water Board (NWB) and DFO-FFHPP legislative requirements. If salt water extraction is required for desalination for fresh water, water intake must be in compliance with DFO-FFHPP's Standards and Codes of Practice [SCOPs] for end of pipe fish protection screens) (DFO, 2024c).
FMM8	No disturbance to the seabed outside of the Project footprint shall occur other than as required to support the Geotechnical Program.

ID	Mitigation Measure
FMM9	KBC Marine Survey activities may occur in proximity to Atlantic walrus terrestrial haul outs. DFO and NIRB will be engaged to manage and avoid impacts to walrus terrestrial haul out habitat prior to survey activities which may be unable to adhere to the setbacks identified within Measure 2.4-2 of the RNLUP
FMM10	Any additional commitments as specified in a DFO-FFHPP LoA will be followed.

5.3.5 Species at Risk

Mitigation measures for Species at Risk (SAR) are described in Table 5-5.

Table 5-5: Species at Risk

ID	Mitigation Measure
SAR1	If SAR are reported or observed, the EM will record, document, and monitor their presence (including time, date, location, activity, and proximity to vessel) and determine potential impacts to SAR, as well as any modification to survey activities that may be required to protect SAR.

5.3.6 Communication

Mitigations outlined in Table 5-6 pertain to communication with AHJs, stakeholders, the respective Hamlets, HTAs, and community members.

Table 5-6: Communication

ID	Mitigation Measure
COM1	Appropriate communication and documentation measures will be in place for reportable incidents (Section 5.8.2), non-compliances (Section 5.7) and adaptive management measures implemented (Section 5.5).
COM2	Communication requirements as required by permit conditions to pertinent AHJs will be completed as required. Parties responsible for AHJ communications is addressed in Section 5.9.1.
COM3	The contractor will include the GN-TIN representative on communications with AHJs, stakeholders or other community groups related to Project activities.
COM4	Communication protocols will be established to notify the community of marine activities, including ongoing consultation with the community and HTA.
COM5	An appropriate communication plan will be provided to the GN-TIN and their EI in advance of mobilization for the KBC Marine Survey confirm that the EM and MMO have clear communication protocols with the contractor's site supervisor/foreman should shut down or other activities be required to be quickly communicated during survey activities.

5.3.7 Fueling and Chemical Storage

Over water re-fuelling may be required, depending on the types of equipment used during the KBC Marine Survey. There are well established practices in place to manage for this activity. Mitigation measures as outlined in Table 5-7 will be in place to minimize negative effects to the marine environment and have been developed using BMPs and industry standard measures to minimize or prevent spills to the marine environment.

Table 5-7: Fuel and Chemical Storage

ID	Mitigation Measure
FCS1	Fuelling of equipment that may occur over and near water; the contractor will verify the use of secondary containment, drip trays, and fuel line check valves during fuelling, and have spill kits readily accessible.
FCS2	All fuel storage containers examined for leaks a minimum of once every day and all leaks repaired immediately. Further they will be covered to keep out rainwater and snow.
FCS3	Procedures and methods will be in place to prevent spillage of deleterious substances or debris falling into the marine environment including measures to minimize the spread to surrounding lands or into water.
FCS4	The contractor will maintain an inspection record for equipment used that requires hydraulic, fuel, and lubrication systems.
FCS5	The contractor will provide a list of all chemicals and expected volumes which are planned to be mobilized to site and stored for use. The plan will also include a description of how chemicals will be stored on site.

5.3.8 Waste Management

Mitigation measures pertinent for the KBC Marine Survey are outlined in Table 5-8.

Table 5-8: Waste Management

ID	Mitigation Measure
WM1	Storage and handling procedures designed to prevent harm to personnel and the environment from hazardous materials, as per the Safety Data Sheets (SDS), shall be implemented. The SDS will be kept on site.
WM2	Procedures and methods in place during the KBC Marine Survey that prevents waste material from entering the environment. This will include plans on how food, food waste, and other attractants will be handled, stored, and disposed of safely to avoid attracting and habituating animals.
WM3	All waste shall be properly sealed and transported to the appropriate disposal facilities at the end of the KBC Marine Survey. Records of disposal shall be maintained and available upon request.
WM4	Engine oils and lubricants will be stored in separate leak-proof containers.

ID	Mitigation Measure
WM5	Routine inspection of worksites, equipment, as required to ensure regulatory compliance and spill prevention.
WM6	Waste will be stored in labelled containers and appropriately segregated based on material.

5.3.9 Spill Prevention and Emergency Response

Steps and measures to be taken in the event of an accidental spill are summarized in Table 5-9 and Section 5.3.9.1. The Schedule B Spill Contingency Planning and Reporting Regulations are provided in Appendix D.

Table 5-9: Emergency Spill Response

ID	Mitigation Measure
SERP1	Emergency response kits and spill kits will be onsite and will be appropriate to the type and quantity of hazardous materials associated with the KBC Marine Survey. Spill kits will contain materials appropriate for the potential products to be spilled, taking into consideration the surrounding environment and seasonal conditions (e.g. iced ocean). The emergency response kits will include appropriate Personal Protection Equipment (PPE) such as gloves and goggles.
SERP2	All personnel will be instructed on their role and responsibility in the event of spill response requirements, in addition to the location of spill response equipment.
SERP3	The contractor's personnel will understand their roles and responsibilities in the event of a spill in advance of the start of the KBC Marine Survey.
SERP4	The contractor will have on hand, emergency response kits and spill kits to manage spills of a predictable size for their operations. All contractor personnel will be aware of the location of the spill response materials, and they will be in a location that is easily accessible in the event of a spill.
SERP5	In the event a spill occurs, spill response will be carried out as outlined in Section 5.3.9.1 and notifications to AHJ and the GN-TIN as indicated in Section 5.9.1 will be undertaken.
SERP6	The contractor will provide a list of accidental discharges and of corrective actions taken to the contractor's field supervisor.

5.3.9.1 Spill Response Protocol

Accidental releases of deleterious substances, such as hydrocarbons, can affect soils, freshwater fish and aquatic life, terrestrial wildlife, birds, marine mammals or fish in the area. Whether the spill is on land, water, or snow/ice, a Spill and Emergency Response Plan (SERP), as outlined below, will be implemented if a spill occurs during the KBC Marine Survey:

- In the event of a spill, activities will be immediately suspended, and emergency response procedures will be initiated.
- Stop the spill or leak, where practical and safe to do so.

- Identify, if possible, the substance involved and review applicable SDS prior to attempting further mitigation. Obtain safety equipment as necessary before proceeding.
- Obtain and use spill control equipment to contain the spill.
- Contain any spill to water bodies by installing berms or aquatic containment (e.g., floating oil booms) appropriate for the type and size of spill.
- Contain the spill on land as required (e.g., sandbags, spill pads).
- Contain any spill on snow or ice and prevent spilled liquids from moving towards waterways using absorbent materials or a snow dike.
- Determine if external support, such as local authorities, should be called to assist.
- Divert potential runoff away from the spill area, if possible.
- Store and/or dispose of contaminated materials resulting from the spill appropriately.
- Determine the extent of the spill, volume, area affected, and equipment required to conduct remediation works.
- Plan and implement remediation works.
- Complete an incident report.

5.4 Monitoring Measures

Monitoring measures, completed by the EM to meet compliance requirements, are described in this section. The EM will be responsible for appropriate documentation of activities and for environmental monitoring to confirm measures are tracked for reporting.

5.4.1 General

Primary responsibilities of the EM will be to:

- Conduct regular monitoring for the duration of the KBC Marine Survey.
- Visual monitoring as outlined in Section 5.4.2.
- Monitor and adaptively manage work procedures as necessary to limit environmental effects.
- Monitor for presence of marine mammals, and document behaviors and distance from marine vessel, as outlined in Section 5.4.2.
- Monitor and document presence of SAR, as outlined in Section 5.3.5.
- Monitor large congregations of seabirds and communicate with marine vessel personnel to avoid those areas while the birds are present.
- Routinely check to verify that equipment in use for the KBC Marine Survey is in good working condition.
- Routinely check to determine that the required emergency response materials, including the spill kits, are on site and appropriately stocked during KBC Marine Survey.

- Confirm site personnel are aware of and trained in emergency procedures outlined in the SERP (Section 5.3.9.1).
- Confirm that mitigations outlined within Section 5.3 are strictly adhered to.
- Report any non-compliance or unplanned events as outlined in Section 5.7.
- Reporting requirements as described in Section 5.8.

5.4.2 Visual Monitoring

Visual monitoring during the KBC Marine Survey will be ongoing and will include:

- Monitoring of stressors on aquatic species, fish kills, any fish spawning/migration activity.
- Incidental SAR occurrences.
- Observe for the presence of marine mammals to avoid physical interaction and maintain an EZ (see Section 5.4.4).

Details of sightings including species, number, and behaviour of wildlife observed will be included in the end of survey report (see Section 5.8.1).

5.4.3 Turbidity

Turbidity plumes are not expected to occur during the Geotechnical Program (activities that interact with the seabed only) due to the relatively small size of the sampling equipment and the probability of dilution in the marine environment. The EM will be vigilant to monitor for the presence of turbidity plumes, and undertake compliance monitoring to confirm compliance with Federal CCME WQG (CCME, 1999a). The compliance monitoring will be performed if a turbidity plume is detected beyond a 30 m Compliance Monitoring Zone (CMZ) as per the thresholds summarized in Table 5-10.

Table 5-10: Project Turbidity Thresholds

Flow State	Turbidity Threshold
Clear flow water	• Maximum increase of 8 Nephelometric Turbidity Units (NTUs) from background levels for short-term exposure (e.g., 24-hour period). • Maximum average increase of 2 NTUs from background levels for a longer-term exposure (e.g., 30-day period).
High flow or turbid water	• Maximum increase of 8 NTUs from background levels at any one time when background levels are between 8 and 80 NTUs. • Should not increase more than 10% of background levels when background is > 80 NTUs.

Source: CCME (1999a)

5.4.4 Exclusion Zones and Marine Mammal Observation

The contractor's QP will be responsible for confirming there is appropriate representation of MMOs to allow for 24-hour monitoring, and to be available whenever there are activities (surveys, vessel transit) that require management of EZs and of proximity to marine mammals.

MMOs will be equipped to detect presence of marine mammals using a combination of strategies, including binoculars for daytime monitoring, night-vision goggles for low light or nighttime monitoring, and through Passive Acoustic Monitoring (PAM) to detect presence of marine mammals through vocalizations.

The MMO will monitor for stress related behaviours to marine mammals within the minimum EZs described in Table 5-11. If observed, adaptive management will be implemented or, if necessary, stop-work procedures will be implemented until effective mitigation measures are in place.

- The DFO-FFHPP is being engaged through the RFR process and is expected to issue a LoA to confirm if additional requirements for EZs are required.
- The MMO will document:
  - Behaviours of marine mammals which will be able to demonstrate whether marine mammals are responding to the survey activities.
  - How the MMO requirements have been managed.
  - Any additional requirements due to adaptive management (if needed).

Table 5-11: Minimum Marine Mammal Exclusion Zones during the Kivalliq-Baffin Connector Marine Survey

KBC Marine Survey Activity Aspect	Minimum EZ
Vessel when in transit	100 m (200 m if they are resting or with a calf)
Vessel during activities that have the potential to result in underwater noise contributions (see Section 4.1 (Table 4-2)).	
Vessel during activities that are not noise producing (therefore just to prevent physical interaction).	100 m (200 m if they are resting or with a calf)

5.4.5 Underwater Noise and Modelling

Due to the nature of the KBC Marine Survey, it is not logistically feasible to undertake real-time hydroacoustic monitoring as the vessel is in motion. To perform real-time monitoring, a smaller vessel would be required, which is not considered practical or safe in the open ocean sections of the KBC Survey.

The ability to perform short-term autonomous hydroacoustic monitoring, where a hydrophone would be attached to the survey equipment is under discussion with the GN-TIN and Dynamic Ocean. However, the EZs described in Section 5.4.4 are considered sufficient for the protection of marine mammals from the effects of the underwater noise contribution due to the KBC Marine Survey.

5.5 Adaptive Management

During the KBC Marine Survey, it may be necessary to modify methodology and address site conditions not foreseen in this EMP. For communication measures, see Section 5.3.6 (Table 5-6) to confirm how

engagement between the EM, the contractor, and the GN-TIN are carried out to accept any changes. The EM will then evaluate any additional potential environmental effects or regulatory requirements. Mitigation measures will be updated, if required, and documented within the contractor's EMP. Adaptive management reporting will be detailed within the monitoring reports in accordance with Section 5.8.1.

5.6 Stop-Work

Stop-work procedures will be implemented, when necessary, based on specific conditions. A clear communication strategy must be described by the contractor prior to mobilization for the KBC Marine Survey. See Section 5.3.6 (Table 5-6) to outline how EM/MMO can notify the KBC Marine Survey supervisor when this is necessary.

5.7 Non-Compliance

In the event of a non-compliance or a potential non-compliance with this EMP and/or applicable environmental permits, the EM/MMO has the authority to suspend survey activities and/or implement adaptive mitigation strategies (see Section 5.5) to re-instate KBC Marine Survey compliance.

The contractor will maintain and retain records associated with, or produced by, actions or activities undertaken to achieve compliance or that indicate non-compliance with the KBC Marine Survey permit conditions. These records must be made available upon request and must be documented in the KBC Survey Monitoring Report (see 5.8.1). Non-compliances must be reported to GN-TIN immediately (before end of the survey). Non-compliance reporting protocol to pertinent AHJs will be determined by GN-TIN and communicated to the contractor prior to the start of KBC Marine Survey.

5.8 Reporting

Reporting requirements including incident reporting and AHJ reporting during the KBC Project are outlined within this section.

5.8.1 Kivalliq-Baffin Connector Marine Survey Monitoring Report

A KBC Survey Monitoring Report will be required to be submitted within 30 days of demobilization.

The KBC Survey Monitoring Report will, at a minimum, contain:

- List of activities that occurred to support the Geotechnical and Geophysical Programs, along with the types of equipment used (when there were simultaneous activities). This information will include:
    - Survey activity duration and coordinates, including vessel tracklines.
    - Environmental parameters at the time of surveys.
    - Equipment used.
    - The number of survey lines performed, or cores collected.
    - Photographs.
- Name(s) of crew and EM/MMO on-site.
- Date.

- Weather conditions, inclusive of visibility and sea state (Beaufort scale).
- Environmental meeting notes (including tailgate) and key issues discussed.
- Compliance and sighting report of marine organisms observed. This will include a detail of species, number, behaviours of the wildlife observed.
- Water sampling data (if conducted).
- Outstanding environmental issues and/or non-compliances, including corrective actions.

5.8.2 Reportable Incidents

The contractor will be responsible for the reporting of incidents to GN-TIN. Prior to the KBC Marine Survey, the GN-TIN will confirm incident reporting protocol to the contractor to confirm that pertinent AHJs are appropriately informed.

Adaptive management measures, stop-work orders issued, and KBC Project non-compliances must be reported as summarized in Sections 5.5, 5.6, and 5.7, respectively.

5.8.2.1 Canadian Environmental Protection Act

In the event of an emergency that is reportable under the CEPA. A reportable incident is defined as an incident resulting in:

- A potential/actual contravention of legislation. According to Section 64 of CEPA, substances are considered harmful if they are entering or could enter the environment in quantities or concentrations or under conditions that:
  - Have or may have an immediate or long-term harmful effect on the environment or its biological diversity.
  - Constitute or may constitute a danger to the environment on which life depends.
  - Constitute or may constitute a danger to human life or health in Canada.
- A potential/actual contravention of a permit/approval condition.
- A significant non-compliance with this EMP resulting in environmental effects.
- Adaptive management measures implemented, and results of additional monitoring triggered by the exceedance can be submitted to DFO-FFHPP, if requested.

5.8.2.2 Government of Nunavut Department of Environment

All spills that occur in excess of the minimum reportable quantities described in Schedule B of the Spill Planning and Reporting Guidelines, must be reported to GN-DoE via email (spills@gov.nt.ca) or via the 24-hour spill reporting line (1-867-920-8130). The GN spill report form will be completed[1].

[1] The GN Spill Report Form is available at: NT NU Spill Report Form.pdf

5.8.2.3 Kativik Regional Government

All spills that occur in the NMR will be reported to the KRG as stipulated in the Hazardous Spills Clean Up Information Sheet via the toll-free emergency response reporting line (1-866-694-5454). The KRG spill report form will be completed[2].

5.8.2.4 Fisheries and Oceans Canada – Fish and Fish Habitat Protection Program

Potential fisheries violations due to the KBC Marine Survey must be reported to DFO-FFHPP through the Nunavut office 24-hour spill reporting hotline (1-867-920-8130) or by email (fisheriesprotection@dfo-mpo.gc.ca). Violations could include HADD and death of fish not authorized in the FAA, or injury/mortality of SARA species.

5.8.2.5 Environment and Climate Change Canada

Environment and Climate Change Canada has authority over the *Migratory Birds Convention Act* (MBCA), terrestrial SARA species, and Section 36(3) of the *Fisheries Act*.

Any harm, destruction, or disturbance to terrestrial SAR species (plants and animals), as well as birds, nests, or eggs are afforded protection under the MBCA will be considered reportable. Such events result in immediate notification to the Canadian Wildlife Services (CWS) branch of ECCC through the toll-free 24-hour reporting hotline at 1-800-668-6767 or through email (ec.enviroinfo.ec@canada.ca).

Deposit of deleterious substances are prohibited under Section 36(3) of the *Fisheries Act*, unless specifically authorized under a *Fisheries Act* regulation or by a regulation under other federal legislation. Any deposit whether made directly into water frequented by fish or indirectly must be immediately reported to ECCC's environmental notification system by calling the 24-hour telephone number for the region in which the event occurred.

5.9 Communications

Communications with the community, stakeholders, and AHJs will be required throughout the KBC Project.

5.9.1 Authorities Having Jurisdiction Communication & Reporting

Development and submission of a summary report may be required by pertinent AHJs at the conclusion of the KBC Marine Survey. The development and submission of reports will be the responsibility of the GN-TIN's EI. However, the contractor is expected to provide sufficient information in the KBC Survey Monitoring Report (described in Section 5.8.1) to allow for the assimilation of information.

5.9.2 Social Media, Website and Community Postings

Notices to support communication of the KBC Marine Survey will be required and will be the responsibility of the GN-TIN and their consultant team. Notices will be developed and translated to be posted publicly on social media, community radio, Very High Frequency (VHF) radio, the Hamlets, the HTA offices, and the Co-op Store.

5.9.3 Hamlet and Hunters and Trappers Association

The GN-TIN and their consultant team will be responsible for communications with the respective HTAs.

[2] The KRG Spill Report Form is available at: KRG_Spill_Report_Procedure_en_iu.pdf

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Appendix A: Supporting Tables

Nunavut

Dynamic Ocean Consulting Ltd.

Table A-1: Description of Focal Fish and Marine Mammals for the KBC Marine Survey

Species (Common Name)	Species (Latin Name)	Inuktitut Name	Species Spatial Category	Type	Seasonal Occurrence	Species Description
Fish						
Arctic char	*Salvelinus alpinus*	Ikaliviit, Ivitaruk	Anadromous	Pelagic fish	Open-water season	Arctic char are ecologically and socio-economically important. Runs of arctic char are either anadromous or strictly freshwater (landlocked). Anadromous populations are found commonly throughout Nunavut, including the KBC Marine Survey location (GN, 2012a, Figure 10). In the marine environment arctic char have better foraging opportunities but will migrate along coastlines to return to their natal spawning grounds in freshwater habitats (Moore et al., 2016; Moore, 1975; Reist et al., 2018). Arctic char are fished for Inuit subsistence and commercial fisheries across the Arctic (DFO, 2018a; NWMB & DFO, 2020) (Galappaththi et al., 2022; Roux et al., 2011).
Arctic cod	*Boreogadus saida*	Ugak	Migratory	Pelagic fish	Open-water season	Arctic cod are an ecologically important prey species occurring throughout the Arctic (Froese & Pauly, 2000). Arctic cod are fast growing and short lived with high fecundity (DFO, 2016; Lawson et al., 1998). Arctic cod are harvested for subsistence in Nunavut but are not considered of high value (Hurtubise, 2016; p43, pers comm July 13 2015). There are no commercial fisheries for arctic cod in the Arctic; however, there is interest in exploring future opportunities (CBC, 2015; Nunatsiaq News, 2016).
Sculpin	*Myoxocephalus Scorpius (shorthorn)* *Gymnocanthus tricuspis* *(Arctic staghorn)*	Kanayuk, Kanajuq	Resident	Bottom dwelling fish	Year-round	Sculpin include fourteen marine species found across Nunavut (Coad & Reist, 2017). The most common species in the KBC Marine Survey region are the Shorthorn sculpin, Arctic staghorn sculpin and Arctic sculpin (GN, 2009, 2012b). All sculpin in the region are generalist feeders (Landry et al., 2018), and documented predators of the focal sculpin species include harp seals, bearded seals, black guillemots, Brunnich's murres, thick-billed murres, Arctic cod, and Arctic char (Coad & Reist, 2017). There are no commercial fisheries for Arctic sculpin in Nunavut; however, it is considered a subsistence fishery species (GN, 2009, 2012b; QIA, 2018b).
Marine Mammals						
Atlantic walrus	*Odobenus rosmarus ssp. rosmarus*	Akvik	Resident	Pinniped	Summer, Fall	The Atlantic walrus are the largest pinnipeds in the Northern Hemisphere. They spend up to two-thirds of their time at sea, with the other third spent hauled-out on sea ice and land to moult, rest, and rear pups (Godwin, 1990). While at sea, walrus forage primarily on the seafloor for invertebrates, but have also been known to prey on squid, birds, and seals (Bluhm & Gradinger, 2008). They are a gregarious species, that are often found in large groups while hauled-out (Lowry, 2016). Walrus are present in the Hudson Strait and Hudson Bay region year-round, and are an important harvested species for local Inuit communities (Lowry, 2016).
Bearded seal	*Erignathus barbatus ssp. barbatus*	Ukalik, Qilalugaq	Resident	Pinniped	Summer, Fall, Other seasons indicated by harvest data	Bearded seals are usually solitary and occasionally appear in small groups. Bearded seals are generally found in areas with moving pack-ice and open-water such as polynyas (Kovacs, 2018). They are primarily benthic foragers that feed on invertebrates, however they have also been known to prey on forage fish (Bluhm & Gradinger, 2008). Bearded seals are an important harvested species for local Inuit communities throughout Nunavut, including in the Hudson Bay and Hudson Strait where they are harvested year-round.
Beluga whale	*Delphinapterus leucas*	Kilalugak	Resident	Cetacean	Spring, Summer, Fall	Beluga whales are migratory and usually move in large social groups between their wintering and summering grounds. Their distribution is strongly influenced by ice cover and prey availability (Ellis, 1980). Their diet covers a diverse array of pelagic and benthic fish and invertebrates (Bluhm & Gradinger, 2008). In the Hudson Strait and Hudson Bay region, there are three distinct populations of beluga whale; the West Hudson Bay population, the East Hudson Bay population, and the James Bay population (Committee on the Status of Endangered Wildlife in Canada [COSEWIC], 2016). The East and West Hudson Bay populations migrate through the Hudson Strait in the late-spring to their respective summering grounds and return as ice freezes up in the fall, with many overwintering in the Hudson Strait (COSEWIC, 2020a). The beluga whale is a highly important harvested species for Inuit communities who hunt them

Species (Common Name)	Species (Latin Name)	Inuktitut Name	Species Spatial Category	Type	Seasonal Occurrence	Species Description
						when open-water conditions allow beluga whales to come close to communities during seasonal migrations (Oceans North Conservation Society et al., 2018).
Bowhead whale	*Balaena mysticetus*	Arviq	Resident	Cetacean	Summer	Bowhead whales are the only baleen whale endemic to the Arctic. Bowhead whales in the Hudson Bay and Hudson Strait region are part of the Eastern Canada-West Greenland population, one of four global subpopulations. Their seasonal migrations follow the break-up of sea ice in the spring into productive Arctic waters and move to overwintering habitats as the ice freezes in the fall (COSEWIC, 2009). The Hudson Strait is one such overwintering area, while Western Hudson Bay and Foxe Basin are known to be summering areas for bowhead whales. (COSEWIC, 2009). Bowhead whales are filter feeders and prey on copepods and other aggregations of small zooplankton (Bluhm & Gradinger, 2008). Bowhead whales have traditionally been an important harvested species for Inuit; however, the population was decimated by commercial whaling, resulting in restricted catches (COSEWIC, 2009). Subsistence hunts have been allowed since 1991 but are strictly controlled, monitored, and managed hunt by DFO (NWMB, 2000).
Harp seal	*Pagophilus groenlandicus*	Qairulik	Visitor	Pinniped	Summer, Fall, Other seasons indicated by harvest data	Harp seals are the most abundant marine mammal in the Northern Hemisphere, with a stable population of 7.5 million (Stenson, 2015). Harp seals visit the Arctic during the open-water season from their winter breeding areas off Newfoundland and Labrador. They breed on sea-ice and are almost never seen on land. Harp seals are mainly piscivorous, feeding on capelin, Arctic and Atlantic cod, herring, as well as many other fishes (Bluhm & Gradinger, 2008). Harp seals are highly social and can be found in large groups throughout their range (Godwin, 1990). They can be found in the Hudson Strait near Kinngait and Kimmirut during the open-water season. The primary migratory pathway of harp seals is on the East Coast of Baffin Island (DFO, 2005). Harp seals are harvested by Inuit in this area with most being harvested between June and November (Advisian, 2020).
Killer whale	*Orcinus orca*	Aarluk	Visitor	Cetacean	Spring, Summer, Fall	Killer whales are one of the oceans top predators and are a seasonal visitor to the Arctic. The species is experiencing a range expansion as their presence in the Arctic has been increasing substantially over the last few decades (Higdon et al., 2012; Lefort et al., 2020). Killer whales are present in the Arctic during the open-water season with most sightings occurring in August and September, while they hunt a wide variety of marine mammals including ringed and bearded seals, beluga whales, narwhals, and bowhead whales (COSEWIC, 2023). Killer whales do spend time in the Hudson Strait and Northern Hudson Bay; however, sightings in this region are less common than in other areas of the Arctic (Lefort et al., 2020). Inuit generally do not harvest killer whales but they sometimes co-hunt with the whales as they drive narwhals and beluga whales toward shore. Calls to manage the population have increased because of concerns that killer whales are a threat to the populations of more locally important harvested marine mammal species (Lefort et al., 2020).
Narwhal	*Monodon monoceros*	Allanguaq, Tuugaalik	Resident	Cetacean	Summer	Narwhals are the most northerly of all cetaceans, and show a strong affinity for dense pack-ice for most of the year (Ellis, 1980). There are five subpopulations of narwhal in the East Canadian Arctic; narwhal that occur around the Hudson Bay and Hudson Strait are from the Northern Hudson Bay subpopulation. This population is relatively small at approximately 3,500 individuals (COSEWIC, 2024). Narwhals are capable of diving down to 1,200 metres to hunt for prey, and their diet consists of benthic and pelagic fish, squid, and crustaceans (Bluhm & Gradinger, 2008). Narwhals are a very important harvested species for Inuit across Nunavut, as they are prized for their tusks and maktaaq (skin); however, they are not commonly harvested in Kinngait or Kimmurut (Priest & Usher, 2004).
Polar bear	*Ursus maritimus*	Nanuit, Nanuk	Resident	Ursid/Fissiped	Spring, Summer, Fall	Polar bears are found throughout the Arctic, preferring coastal areas with shallow, ice-covered seas (Wiig et al., 2015). Polar bears primarily prey on bearded, harp, and ringed seals in these regions. Like most bears, polar bears show a high degree of opportunistic dietary flexibility, and have been seen preying on beluga whales, walrus, narwhals, marine birds, and caribou (Bluhm & Gradinger, 2008). Polar bears are harvested under the Nunavut Polar

Species (Common Name)	Species (Latin Name)	Inuktitut Name	Species Spatial Category	Type	Seasonal Occurrence	Species Description
						Bear Co-Management Plan, allowing only Inuit to hunt them. In Kinngait and Kimmirut, polar bear harvests usually occur between October and April (Advisian, 2020).
Ringed seal	*Pusa hispida ssp. hispida*	Natinat, Natsiq	Resident	Pinniped	Year-round	The ringed seal is the most common marine mammal in Arctic waters and is found throughout the Canadian Arctic with an estimated population of 2.3 million (COSEWIC, 2019). Migration patterns are not well understood for ringed seals. The species has been documented as travelling as far as 2,500 km; although, ringed seals are thought to have a limited range (Canadian Geographic, 2014). Ringed seals feed upon a variety of planktonic, nektonic, and benthic prey with considerable regional and seasonal variability (Bluhm & Gradinger, 2008). Ringed seals are a very important harvested species for local Inuit communities across Nunavut, including in the Hudson Bay and Hudson Strait where they are harvested year-round.

Note: Inuktitut translations were sourced from Priest and Usher (2004), Coad and Reist (2017), Rapinski *et al.* (2018), and QIA (2018a)

Table A- 2: Species at Risk with the Potential to be Present during the Kivalliq-Baffin Connector Marine Survey

Species	Latin Name	Inuktitut		IUCN Status	COSEWIC Status	SARA Status	Nunavut Rank	Likelihood of Occurrence	Species Summary
		Syllabics	Transliteration						
Fish									
Lumpfish	*Cyclopterus lumpus*	ᓂᐱᓴ	Nipisa[3]	Near Threatened	Threatened	Not Listed	NR	Possible	Are distributed throughout the North Atlantic Ocean, with occasional incidental catch up to 65° N in Davis Strait, but more common to the south with highest abundance around Newfoundland (COSEWIC, 2017a). They are semi-pelagic, spending winter months in closer association with the seabed but do migrate to shallow coastal waters in the early summer to spawn.
Spotted Wolffish	*Anarhichas minor*	Not available	Tarsalik Kanajuq	Not Listed	Threatened	Threatened	NR	Unlikely	The northwest Atlantic range of this species includes the Davis Strait (south of 68° 17.682'N, 66° 35.026'W, on the Baffin Island coast), the Labrador Sea, the Gulf of St Lawrence, the east coast of Newfoundland, on the Grand Banks and on the Scotian Shelf (COSEWIC, 2012a). This species is found in highest density between 200 m and 750 m (COSEWIC, 2012a).
Thorny Skate	*Amblyraja radiata*	Not available	Isaruliit Iqarmiutaq	Vulnerable	Special Concern	Not Listed	NR	Possible	In the western Atlantic it ranges from western Greenland, Davis Strait, Hudson Strait and Hudson Bay. This species occurs over a wide range of depths (18 m to 1200 m), but is most abundant below 110 m in temperatures between 2 to 10 C (DFO, 2018b). Nunavut range not north of Baffin Island, depth range > 18 m. A distribution map is available in Figure 3a[3] of (COSEWIC, 2012c).
Marine Mammals									
Atlantic Walrus (central/low Arctic population)	*Odobenus rosmarus*	ᐊᐃᓐᑦ	Akvik[1]	Near Threatened	Special Concern	Not Listed	S3	Possible	See Table A-1
Beluga whale (Eastern Hudson Bay)	*Delphinapterus leucas*	ᖃᓚᒋᑦ ᖁᓪᓗᒡᓗᑦ	Kilalugak[1], Qilalugak[2]	Least concern	Threatened	Not Listed	NR	Unlikely	See Table A-1

[3] COSEWIC Assessment and Status Report (Thorny Skate) (sr_raie_epineuse_thorny_skate_1012_e.pdf (SECURED))

Species	Latin Name	Inuktitut		IUCN Status	COSEWIC Status	SARA Status	Nunavut Rank	Likelihood of Occurrence	Species Summary
		Syllabics	Transliteration						
Bowhead whale (Eastern Canada-Western Greenland population)	*Balaena mysticetus*	ᐊᖏᕆᑲ	Arviq[3]	Least Concern	Special Concern	Not Listed	NR	Possible	See Table A-1
Killer whale (Northwest Atlantic/Eastern Arctic population)	*Orcinus orca*	Not available	Aarluk[2]	Data Deficient	Special Concern	Not Listed	NR	Unlikely	See Table A-1
Polar bear	*Ursus maritimus*	ᓇᓄᐃᑦ	Nanuit[1], Nanuk[2]	Vulnerable	Special Concern	Special Concern	S3	Possible	See Table A-1
Ringed seal	*Pusa hispida*	ᓇᕗᑦ	Natinat[1], Natsiq[2]	Least Concern	Special Concern	Not Listed	NR	Likely	See Table A-1
Migratory Birds									
Buff-breasted sandpiper	*Calidris subruficollis*	Not available	Satqarillak[1], Sitjariaq[2]	Near Threatened	Special Concern	Special Concern	S3	Unlikely	As shown in Figure 2[4] of (COSEWIC, 2012b), the KBC Marine Survey will occur outside of the breeding range of buff-breasted sandpiper. However, there is the potential for occurrence during migration. Migrations occur in the spring and fall, and 'migratory habitats' while unknown are thought to be open terrestrial habitats.
Ivory gull	*Pagophila eburnea*	ᖃᐅᔨᓪᓗᒃ	Naujat[3]	Near Threatened	Endangered	Endangered	S1	Unlikely	The breeding distribution of this species is in the high Arctic between southern Ellesmere Island and Northern Baffin Island (COSEWIC, 2006), therefore there will not be an interaction during this life history stage with the KBC Marine Survey. The wintering location for this species is also around Davis Strait and the Labrador Sea, so there is not likely to be a migration interaction (Spencer *et al.*, 2014).
Peregrine falcon	*Falco peregrinus*	ᑭᒡᓘᕐᕕᐊᖅᓯᒃ	Kiggarviarjuk[1]	Least Concern	Not at Risk	Special Concern	S4	Likely	Peck *et al.* (2018) conducted a modelling study to predict breeding distribution and habitat selection of this species, which identified some previously known potential habitats of occurrence. Based on Figures 1 and 2[5] of this article, there is a potential for interaction with this species.There is the potential for interaction with breeding and migratory habitats with this species ((COSEWIC, 2017b)
Red knot	*Calidris canutus*	ᓯᓚᑎᐊᖅ	Sijjariaq[3]	Near Threatened	Endangered	Endangered	S2	Likely	Particularly on the approach to Southampton Island (Coral Harbour) there is a high potential for interaction with this species. See Figure 3[6] in (COSEWIC, 2020b).
Red-necked phalarope	*Phalaropus lobatus*	ᓴᐅᖅᑭᖅ	Saurraaq[1]	Least Concern	Special Concern	Special Concern	S3	Likely	Species is likely to occur and breed within the KBC Marine Survey Study Area (COSEWIC, 2014). However the peak breeding season (Jun/July), is likely to be before the survey would occur, with migration (Aug to Oct) a more likely temporary interaction. See Figure 2[7] in ()

[4] COSEWIC Assessment and Status Report on the Buff-breasted Sandpiper (sr_becasseau_roussatre_buffbreasted_sandpiper_1012_e.pdf (SECURED))

[5]Nesting habitat selection and distribution of an avian top predator in the Canadian Arctic (Nesting habitat selection and distribution of an avian top predator in the Canadian Arctic)

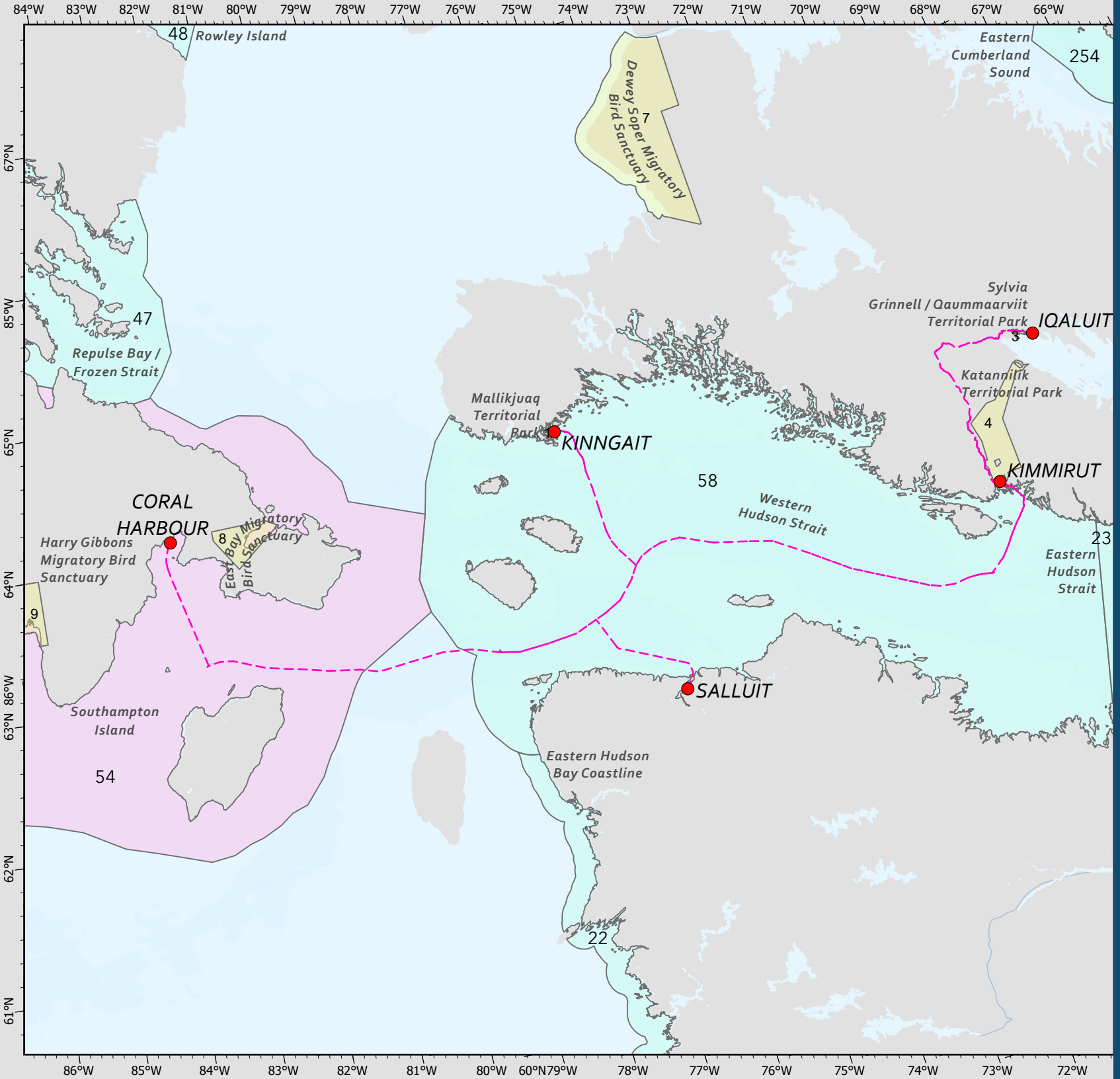
[6] Red Knot: COSEWIC Assessment and Status Report 0220 (Red Knot (Calidris canutus): COSEWIC assessment and status report 2020 - Canada.ca)

[7] Red-necked phalarope: COSEWIC assessment and status report 2014 (Red-necked phalarope (Phalaropus lobatus): COSEWIC assessment and status report 2014 - Canada.ca)

Species	Latin Name	Inuktitut		IUCN Status	COSEWIC Status	SARA Status	Nunavut Rank	Likelihood of Occurrence	Species Summary
		Syllabics	Transliteration						
Ross's gull	*Rhodostethia rosea*	ᓇᐅᔭᖅᑕ	Naujat[3]	Least Concern	Endangered	Threatened	S1	Possible	This species is most commonly found around the High Arctic islands in the Queens Channel, Nunavut, on small sparsely vegetated gravel islands adjacent to marine open-water polynyas. Historically, there were nests in marshy Low Arctic floodplain habitat near Churchill, Manitoba, which has not been observed since 2005 (COSEWIC, 2021).

Source: For status; IUCN in IUCN (2025), COSEWIC and SARA in Government of Canada (2024), Nunavut Rank in Canadian Endangered Species Conservation Council [CESCC (2022, 2025)
Source: For Inuktitut names: 1. Priest and Usher (2004); 2. Rapinski et al. (2018); 3. QIA (2018a). Inuktitut transliterations provided by various online resources.

Appendix B: Supporting Figures



Dynamic Ocean Consulting

Nunavut

- Southampton Island Area Of Interest
- Ecologically and Biologically Significant Areas
- Nunavut Territorial Parks
- Landings
- Route

N

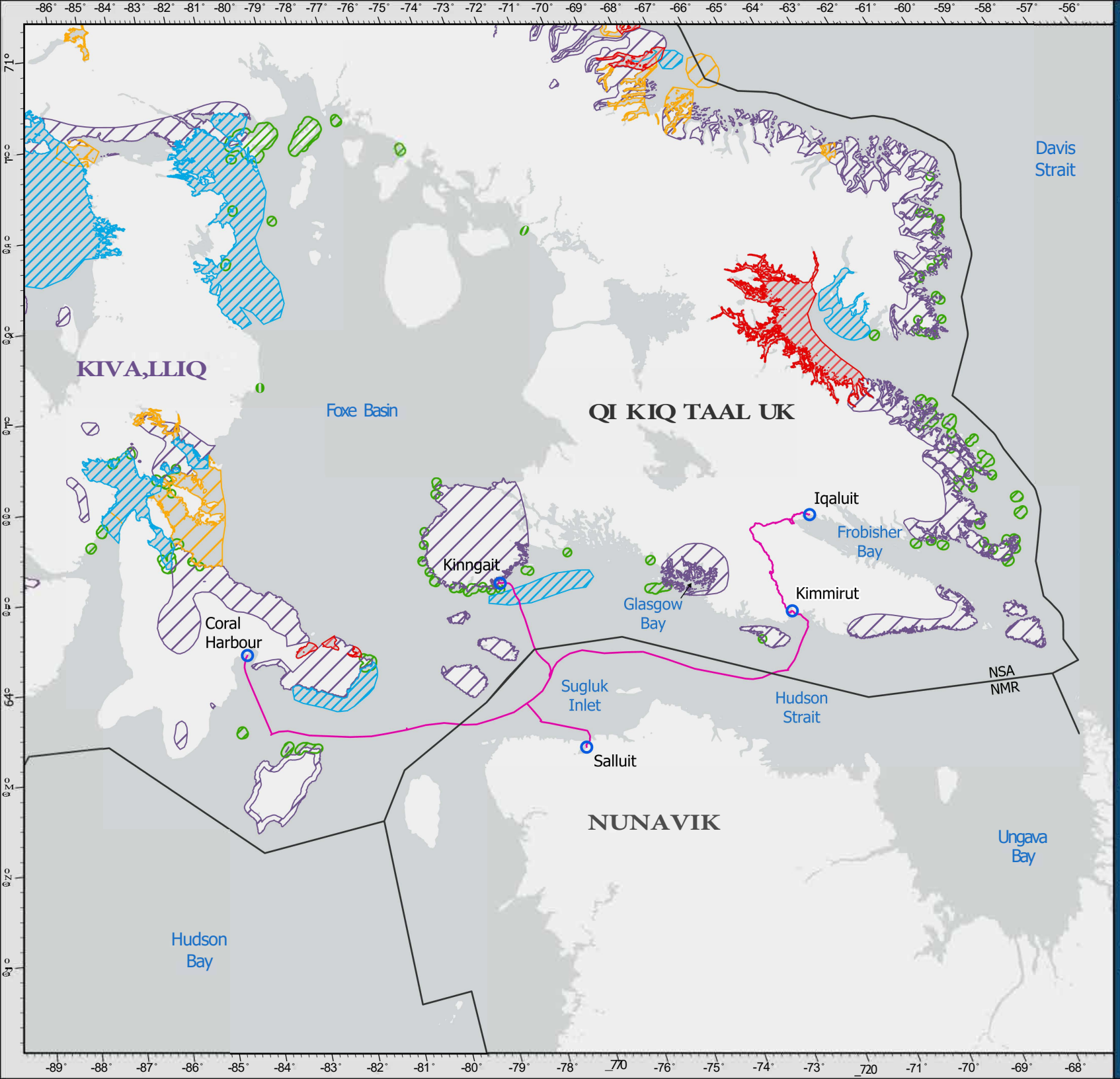
0 40 80 160 Km

Spatial Reference
GCS: GCS North American 1983
Datum: North American 1983
Projection: Albers
Map Units: Meter

Drawn: C. Knight

Figure B-1

Designated Areas Within or In Proximity to the Kivalliq-Baffin Connector Marine Survey



Dynamic Ocean Consulting

Nunavut

Legend

KBC Project footprint

Landings

NSA/NMR Boundary

Potential for seasonal interaction

Atlantic walrus terrestrial haul-outs

[Z] Bowhead calving

No potential for seasonal interaction

[Z] Polar bear denning

No potential for spatial interaction

[Z] Narwhal calving

Beluga calving

0 35 70 140 km

1:6,015,000

N

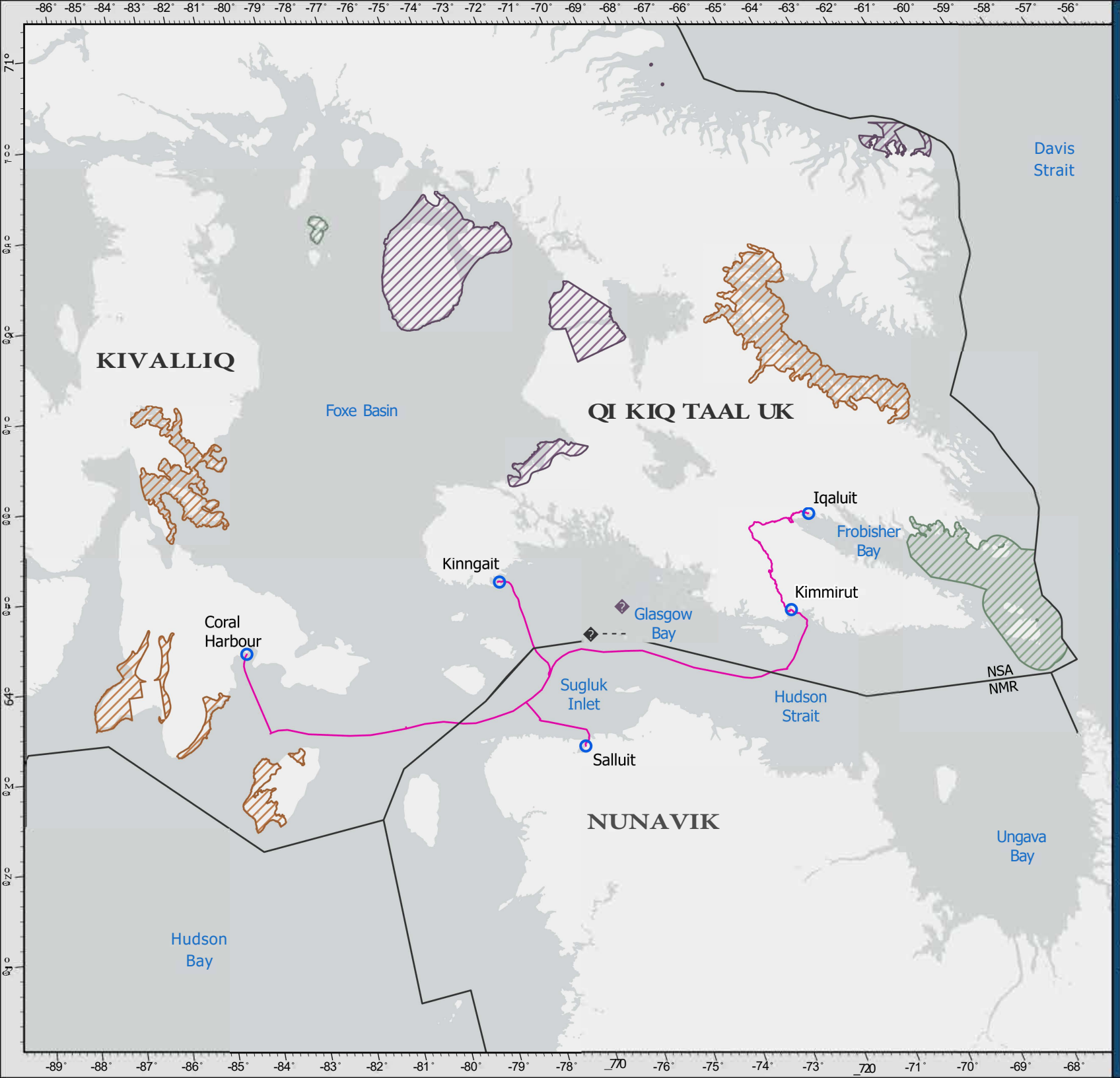
Spatial Reference
GCS: GCS WGS 1984
Datum: WGS 1984
Projection: Mercator Auxiliary Sphere
Map Units: Metre

Drawn: BB
Edited: BB, CL
Approved: VBC

Kivalliq-Baffin Connector Project

Figure B-2

Important Habitats Defined by the Recommended Nunavut Land Use Plan in Proximity to the KBC Marine Survey (Marine Mammals)



Dynamic Ocean Consulting

Nunavut

Legend

- KBC Project footprint
- NSA/NMR Boundary
- Landings

Key Migratory Bird Habitat Sites

- Class1
- Class2
- Class3

0 35 70 140 km

1:6,015,000

Spatial Reference
GCS: GCS WGS 1984
Datum: WGS 1984
Projection: Mercator Auxiliary Sphere
Map Units: Metre

Drawn: CL
Edited: CL
Approved: VBC

Kivalliq-Baffin Connector Project

Figure B-3

Important Habitats Defined by the Recommended Nunavut Land Use Plan in Proximity to the KBC Marine Survey (Migratory Birds)

Appendix C: Kivalliq-Baffin Connector Marine Survey Equipment Specifications

Nunavut

Dynamic Ocean Consulting Ltd.

Oceanic Research Vessel : Coriolis II

REFORMAR

General		Machinery	
Name / Flag :	Coriolis II / Canada	Main Engines :	4 x Deutz SBV6M 628
Official Number :	813736	Power :	3,530 kW / 4,730 BHP
Port of Registry :	Québec (Canada)	Auxiliary :	3 x Caterpillar 3406C
Operator :	Reformar Inc	Kilowatt :	3 x 250 kW
Classification Society IMO Number :	Bureau Veritas 8818570	Emergency Generator :	1 x Mitsubishi 6D14T 80 kW 600V Self Starting unit
Solas / ISM / ISPS Compliant :	Yes	Bow Thruster :	Ulstein Marine 500 TT — 298 kW
Certification :	Unlimited Voyage	Propulsion :	2 x Kamewa CPP 2.5 m in diam.
Call sign :	CGDN	Rudders :	Twin
Gross Tonnage :	836 Tonnes	Fuel Capacity :	145 m^3 @ 95% capacity
Net/Register Tonnage :	250 Tonnes	Potable Water Tank:	18.2 m^3
Dead Weight :	290	Non-Potable Water Tank :	1.5 m^3
Type :	Oceanographic Research Vessel	Water Maker :	1 x Reverse Osmosis
Builder :	Versatile Pacific Shipyard (Canada)	Daily Production :	10,000 litres/day
Year :	1990	Hydraulic Units :	3 power packs, 15 GPM, 3000 psi
LOA :	49.95m		2 power packs Flow 60 GPM, 2000 psi
Beam :	11.00m		

Draft :	5.50m

Navigation Equipment.		Accommodation	
Radio :	Full GMDSS	Capacity :	28 people
Radar :	2 x Furuno X & S band (ARPA)	Crew :	Between 10 to 14
Electronic Charts :	Navi-Sailor 4000	Guests :	Between 10 to 14
Echo Sounder :	1 x Skipper GDS 101 (50 Khz) 1 x Datamarine Int'l Offshore System 3000	Laboratories :	1 x Dry Lab, 19.5 m^2 1 x Wet Lab, 23.3 m^2
Gyrocompass:	1 x Yokogawa CMZ900 Type S		1 x Deck operation control Centre, 4 m^2
Automatic Pilot:	1 x EMRI	Cargo Hold:	1 x 26.25 m^3
Doppler Log :	1 x Sperry SRD-331	TV Lounge :	1
GPS :	2 x Furuno GP-170	Cafeteria :	1
		Air Conditioning :	Yes
Navtex :	JRC	Satellite TV :	Yes
CCTV Camera :	Yes, with full coverage of back deck area	E-mail, voice, internet :	Yes, Starlink Maritime and KVH V7-HTS with CommBox network services
DP System :	Kongsberg C-Pos		

Winches
1 x Hawboldt Oceanographic Research Winch, 5 t capacity, 3,000 m of galvanized cable (3/4''), possibility of various types of cables.
1 x Hawboldt winch with Capstan, 2 t capacity (currently no cable or rope on winch).
1 x J.P. Oceanographic Winch, 499 kg capacity, 1,300 m of Dyneema rope (3/16'').
1 x J.P. Oceanographic Winch, 3 t capacity, 1,500 m of Dyneema rope (1/2'').
2 x DT 210 Marine Winch, 545 kg bare drum capacity, possibility of various types of cables.
1 x DT 3020 Marine Winch, 1,450 kg bare drum capacity, possibility of various types of cables.
1 x DT 3025 Marine Winch, 1,800 kg bare drum capacity, possibility of various types of cables.

Lifting Appliances

1 x Palfinger PK50002M crane—SWL: 2 t at 11.9 m extension, located on aft deck portside.
2 x DMW M40 cranes—SWL: 480 kg at 6 m extension, located on the main deck, port and starboard sides aft.
Aft A-Frame, 9 t capacity, clearance from transom stern 2.5 m, inside breadth 5.18 m and headroom 6.4m
Port Side A-Frame, 2 t capacity, inside breadth 2.5 m and headroom 6 m

Others

- Kongsberg Hugin AUV with dedicated LARS.
- Kongsberg Multibeam Echo Sounders EM2040 MKII
- Kongsberg Multibeam Echo Sounders EM304 MKII
- 3 x Split beam Transducers, Simrad EK80 38 kHz, 120 kHz and 200 kHz
- 2 x fixed ADCP Transducers (Acoustic Doppler Current Profiler), make RDI model OS75VM and model OS150VM
- Hull-mounted Edgetech transducer. X-Star Sub-Bottom Profiler System, KT-216 H
- Acoustic wells 12”, 16” and 20” in diameter with Traveocean fitting arrangement
- 2 x Sea-Bird Scientific Carousel Water Sampler SBE 31, 12 x Ocean Test 12 litres PVC bottles CTD model SBE 9+
- 9 m gravity piston coring system
- 2 x Scientific Freezers of 0.4 m^3 (–40 up to –80 °C)
- 1 x cargo hold: 26.25 m^3, headroom 2 m, hatch 1.82 m x 2.44 m
- Over the side pole for multi-beam or USBL deployment.
- Permanently installed POSMV inertial station
- Scientific container module (14.8 m^2)
Note: Other survey equipment available upon request: www.reformar.ca

SWiFT SVP

DATA SHEET

Product Details

SOUND SPEED

MULTI-PARAMETER CTD

OCEAN & CONNECT PATHWAY EDITION SOFTWARE

Sound Velocity Profiler

Designed from the outset with the intention of a seamless workflow, the SWiFT SVP profiler provides survey-grade sensor technology coupled with the convenience of Bluetooth connectivity and rechargeable batteries. An integral GPS module, to geo-locate each profile, completes the package. Data can be easily and quickly downloaded and reviewed wirelessly, via Bluetooth, using Valeport's new Ocean software for Windows and Connect Pathway Edition for iOS and Android and instantly shared, in industry standard data formats through email and cloud services. A USB Cable and Bluetooth adapter are provided.

In addition to the directly measured sound speed, temperature and pressure observations, Conductivity, Salinity and Density are calculated using Valeport's proprietary algorithm developed from extensive laboratory and field work.

With an operational battery life of up to 5 days and the convenience of charging via USB, SWiFT SVP is intended for coastal, harbour and inland hydrographic survey use and offers the highest quality sound velocity profiles in a compact, robust and portable package. Optionally, the supplied deployment weight is available to bolt onto the sensor protection cage to help get the SWiFT SVP to depth in fast-flowing currents.

Bluetooth USB Rechargeable Battery GPS

Valeport Limited
St. Peters Quay, Totnes,
Devon TQ9 5EW United Kingdom

Telephone: +44 (0) 1803 869292
Email: sales@valeport.co.uk
www.valeport.co.uk

VALEPORT

Sensor Specifications

The SWiFT SVP is fitted with Valeport's digital time of flight sound velocity sensor, temperature compensated piezo-resistive pressure transducer and a PRT temperature sensor.

Sound Velocity

Range	1,375-1,900 m/s
Resolution	0.001 m/s
Accuracy	±0.02 m/s

Pressure

Range	50 Bar
Resolution	0.001% FS
Accuracy	±0.01% FS

Temperature

Range	-5°C – +35°C
Resolution	0.001°C
Accuracy	±0.01°C

Calculated Parameters and Accuracy

Calculations based on Valeport's proprietary DASH formula

Conductivity	±0.05 mS/cm
Salinity	±0.05 PSU
Density	±0.05 kg/m³

Physical

Materials	Titanium | Stainless Steel deployment weight
Depth Rating	500m
Dimensions	ø78mm x Length 264mm
Weight	2.0kg (in air) / 0.9kg (in water) | 3.0kg (in air) / 1.8kg (in water) with deployment weight

Communications (set up and data offload)

USB Serial

Bluetooth v4 - low energy

Electrical

Battery	Internal rechargeable Li-ion battery pack
Battery life	Up to 5 days operations
Charging	USB Typically, 1 hour fast charge will give 12 hours operation

Software

iOS and Android Valeport Connect Pathway Edition for Bluetooth compatible mobile devices – instrument set up, data offload, display and translation to common data formats. Valeport's Ocean PC software, with both USB cable and Bluetooth connectivity, for instrument setup, data extraction, display and translation to common data formats.

Instrument and data time is synchronised to GPS, UTC.

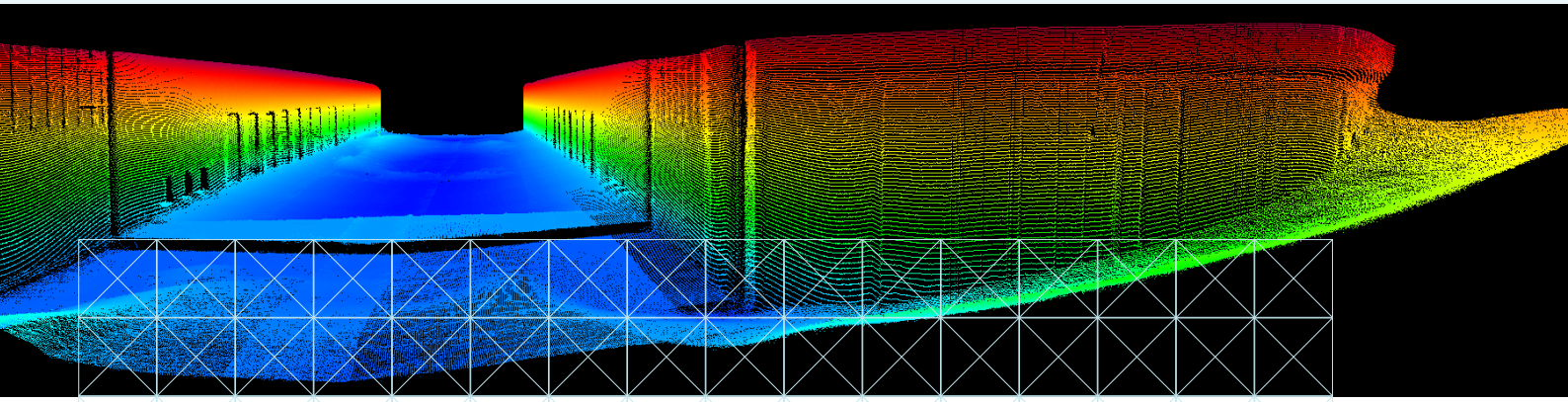
Ordering

0660047-50	SWiFT SVP Profiler Titanium housing rated to 500m
Supplied with	Deployment weight PC Bluetooth adapter USB interface and charging cable 1.5 A charger Valeport Connect software Operating manual System transit case

Datasheet Reference: SWiFT SVP | May 2021

EM® 2040 MKII

KONGSBERG



MULTIBEAM ECHO SOUNDER

The EM 2040 MKII is a true wide band high resolution shallow water multibeam echo sounder, an ideal tool for any high resolution mapping and inspection application. With this release, Kongsberg Maritime has upgraded the hardware and software to increase the swath and improve the data quality of our EM 2040 series.

Key facts

The system fulfils, and even surpasses, IHO-S44 Exclusive Order and the more stringent LINZ specification.

The EM 2040 was the first 3-sector broadband multibeam echo sounder in the market, now available as a 200 - 700 kHz system. The operator can on the fly choose the best operating frequency for the application: 300 kHz for near bottom, 200 kHz for deeper waters and 400 - 700 kHz for very high resolution inspection. 600 kHz wide area high frequency mapping mode offers an unprecedented 100 - 120° swath width. 700 kHz inspection mode provides the highest resolution available contained within a narrow 30° swath.

By alternating between the frequency modes per ping, the system is capable of providing the operator with Multi Frequency Backscatter of up to 5 frequencies in a single pass. The same functionality allows the system to alternate between a full swath mode and a high resolution mode providing full coverage while maintaining ultra high resolution over a target.

Due to the large operating bandwidth, the system has an output sample rate up to 60 kHz. The system can effectively operate with very short pulse lengths, the shortest pulse being 14 microseconds giving a raw range resolution (CT/2) of 10.5 mm.

The angular coverage for the 200 and 300 kHz is up to 170° on slopes and piersides, with coverage up to 8 times water depth on a flat bottom. For a dual transducer system, 220° angular coverage or 10 times the water depth is achieved on a flat bottom.

Components

The EM 2040 MKII is a modular system, fully prepared for upgrading to cater for more demanding applications. The basic system has four units: a transmit transducer, a receive transducer, a processing unit and a hydrographic workstation.

The EM 2040 MKII receiver is 0.5° and is delivered with a 0.25° or 0.5° transmitter(s). The transmit fan is divided into three sectors pinging simultaneously at separate frequencies ensuring a strong and beneficial dampening of multibounce interference.

As an option the EM 2040 MKII can be delivered with dual swath capability, allowing a sufficient sounding density to meet survey coverage standards along track while maintaining a high vessel speed. A single transmitter with dual receiver setup fully exploits the unique angular coverage of our three-sector transmitter for full 220° angular coverage per ping.

The specialised dual transmitter and receiver setup is ideal where mounting requires a large separation of receivers, where mounting the transmitter at the keel is not an option or for ROV pipeline surveying and free span detection. This configuration transmits on a single sector per transmitter with selectable frequency in steps of 10 kHz from 200 to 400 kHz.

The standard depth rating of the EM 2040 MKII transducers is 6000 m, making it ideal for operation on subsea vehicles such as ROVs or AUVs.

443810 /H December 2021

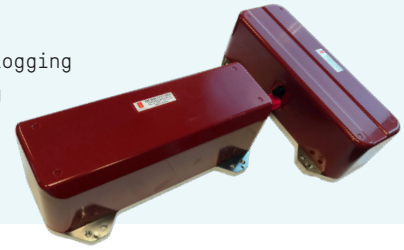
FEATURES

Included Features

- 200-400 kHz wide frequency range
- Seabed image
- Water column display and logging for SIS users
- FM chirp
- Roll, pitch and yaw stabilisation
- Short pulse lengths, large bandwidth
- Transmit and receive nearfield focusing
- Depth rated to 6000 m

Optional features

- Dual swath
- 600 kHz and 700 kHz modes
- EM® MultiFrequency Mode
- Water column display and logging
- Water column phase logging
- Extra detections
- Dual RX
- Dual TX



TECHNICAL SPECIFICATIONS

Frequency range	200 to 700 kHz
Max ping rate	50 Hz
Swath coverage sector	Up to 170° (single receiver) / 220° (dual receiver)
Depth Rating	6000 metres and 50 metres versions available
Beam patterns	Equiangular, equidistant high density and ultra high density
No. of beams per ping	512 (Single RX)/1024 (Single RX, Dual Swath)/2048 (Dual RX, Dual Swath)
Roll stabilised beams	± 15°
Pitch stabilised beams	± 10°
Yaw stabilised beams	± 10°

Coverage example for EM 2040 with bottom type rock (BS = - 10 dB), NL = 45 dB, FM enabled

Operating mode	Cold ocean water			Cold fresh water		
EM 2040-04:	**Max depth**	**Max coverage single RX**	**Max coverage dual RX**	**Max depth**	**Max coverage single RX**	**Max coverage dual RX**
200 kHz	635 m	920 m	980 m	1360 m	1990 m	2110 m
300 kHz	480 m	670 m	760 m	740 m	1100 m	1270 m
400 kHz	315 m	410 m	430 m	430 m	570 m	610 m
600 kHz	95 m	130 m	-	115 m	150 m	-
700 kHz	55 m	27 m	-	60 m	30 m	-
EM 2040-07:						
200 kHz	600 m	880 m	930 m	1300 m	1870 m	2000 m
300 kHz	465 m	640 m	725 m	700 m	1050 m	1200 m
400 kHz	300 m	385 m	410 m	375 m	540 m	570 m
600 kHz	85 m	120 m	-	105 m	140 m	-
700 kHz	50 m	25 m	-	55 m	28 m	-

Pulse lenghts

200 kHz		300 kHz		400 kHz	600 kHz	700 kHz
CW	**FM**	**CW**	**FM**	**CW**	**CW**	**CW**
19 to 324 µs	1.5 to 12 ms	19 to 324 µs	1.5 to 6 ms	14 to 108 µs	100 to 410 µs	70 µs

	Beamwidth					**Physical dimensions (excluding connectors and mounting arrangements)**	
	200 kHz	**300 kHz**	**400 kHz**	**600 kHz**	**700 kHz**	**Dimensions**	**Weight**
TX EM 2040-04	0.7°	0.5°	0.4°	0.25°	0.225°	727 x 142 x 150 mm (LxWxH)	45 kg
TX EM 2040-07	1.5°	1°	0.7°	0.5°	0.45°	407 x 142 x 150 mm (LxWxH)	23 kg
RX	1.5°	1°	0.7°	0.5°	0.45°	407 x 142 x 136 mm (LxWxH)	22 kg
Processing Unit (2U for 19" rack)						482.5 x 424 x 88.6 mm (WxDxH)	10.5 kg
Portable Processing Unit (IP67)						370 x 390 x 101 mm (WxDxH)	10.5 kg

Laptop, Hydrographic Work Station (HWS) and monitor can be delivered on request.

Specifications subject to change without any further notice.

Front page: Curtesy of Port of London.

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KONGSBERG

4205

TRI-FREQUENCY / MOTION TOLERANT SIDE SCAN SONAR SYSTEM

FEATURES

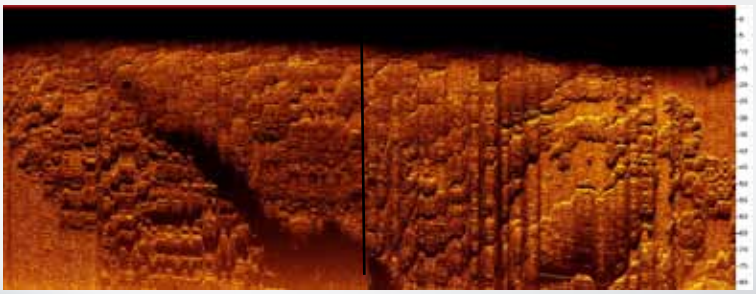
- Tri frequency side scan sonar
- Motion tolerant mode
- Improved target positioning
- Crisp, high resolution CHIRP images
- Increased towfish power to support a wider range of additional 3rd party sensors
- Single pulse high resolution mode

APPLICATIONS

- Cable & pipeline surveys
- Geological/geophysical surveys
- Mine countermeasures (MCM)
- Geohazard surveys
- Channel clearance
- Search and recovery
- Archeological surveys

The next generation 4205 is a versatile side scan sonar system that can be configured for almost any survey application from shallow to deep water operations. The 4205 utilizes EdgeTech's Full Spectrum® CHIRP technology to provide crisp, high resolution imagery at ranges up to 50% greater than non-CHIRP systems; thus allowing customers to cover larger areas and save money spent on costly surveys. In addition to the high-resolution imagery that EdgeTech is known for, the 4205 comes with a number of new features which makes the system even more flexible and powerful in offshore operations. The 4205 is available in either a tri-frequency side scan sonar configuration or motion tolerant and multi-pulse configuration. The tri-frequency version allows surveyors the option to operate any two frequencies simultaneously from the tri-frequency system. Long range operations for example can be achieved with a selection of 230/540kHz combination. Then, on-demand the system can be changed to a 540/850kHz system for an even higher resolution survey. The 4205 motion tolerant configuration with multi-pulse provides surveyors the ability to operate either at faster survey speeds or in more adverse weather conditions while still obtaining high quality underwater imagery. Additionally, this configuration can be operated in a single pulse high-resolution mode for those operations that require an even more finite view of the seafloor.

In both the tri-frequency and motion tolerant/ multi-pulse configurations, towfish and target positioning has been improved with the integration of a more accurate heading sensor that can be coupled with an optional USBL beacon. Additionally, all systems now come with Increased towfish power to support a wider range of additional 3rd party sensors. All EdgeTech 4205 systems are comprised of a topside system and a reliable stainless steel towfish. Topside processors are rack mountable and come with easy-to-use GUI software that can be installed on the optional industrial workstation, laptop, or customer provided PC.



Motion Tolerant Mode Sonar example: During turbulant condtions, the data on the left of side of this image was recorded using the EdgeTech 4205 Motion Tolerant mode. The right side of the image, depicting motion induced striping was captured without the Motion Tolerant mode for comparison.

For more information please visit EdgeTech.com

info@EdgeTech.com | USA 1.508.291.0057

4205

TRI-FREQUENCY / MOTION TOLERANT SIDE SCAN SONAR SYSTEM

KEY SPECIFICATIONS

SONAR SPECIFICATIONS	4205 TRI-FREQUENCY	4205 MULTI-PULSE/MOTION TOLERANT (MP/MT) AND HIGH DEFINITION MODE	
Frequency	Choice of either 120/410/850 kHz or 230/540/850 kHz	Choice of either 120/410 kHz, 230/540 kHz,or 230/850 kHz	
Operating Range (meters/side)	120 kHz: 600m, 230 kHz: 350m, 410 kHz: 200m, 540 kHz: 150m, 850 kHz: 90m		
		MP/MT	HDM
Horizontal Beam Width	120 kHz: 0.7° 230 kHz: 0.44° 410 kHz: 0.28° 540 kHz: 0.26° 850 kHz: 0.23°	120kHz: 0.95° 230kHz: 0.62° 410kHz: 0.40° 540kHz: 0.36° 850kHz: 0.33°	0.7° 0.44° 0.28° 0.26° 0.23°
		MP/MT	HDM
Resolution Along Track	120 kHz: 2.4m @ 200m 230 kHz: 1.2m @ 150m 410 kHz: 0.5m @ 100m 540 kHz: 0.45m @ 100m 850 kHz: 0.20m @ 50m	120kHz: 3.3m @ 200m 230kHz: 1.7m @ 150m 410kHz: 0.7m @ 100m 540kHz: 0.6m @ 100m 850kHz: 0.26m @ 50m	2.4m @ 200m 1.2m @ 150m 0.5m @ 100m 0.45m @ 100m 0.20m @ 50m
Resolution Across Track	120kHz 8cm; 230KHz 3cm; 410kHz 2 cm; 540kHz 1.5cm; 850kHz 1cm		
Vertical Beam Width	50°		
Depression Angle	Tilted down 25°		
TOWFISH	STAINLESS STEEL		
Diameter	12 cm (4.75 inches)		
Length	140 cm (55 inches)		
Weight in Air	52 kg (115 pounds)		
Depth Rating (Max)	2,000m		
Standard Sensors	Heading, pitch & roll		
Optional Sensor Port	(1) Serial – RS 232C, Bi-directional & 28 VDC +/- 4%		
Options	Pressure Sensor, Magnetometer, Integrated USBL Acoustic Tracking System, Built-in Responder Nose, Depressor, Power Loss Pinger and Custom Sensors		
TOPSIDE PROCESSOR	4205 INTERFACE		
Hardware	19" rack mount interface (150 watt or 400 watt)		
Display & Interface	Optional industrial workstation, laptop, or customer provided PC		
Power Input	115/230 VAC		
File Format	Native JSF or XTF		
Sensor Interfaces	Ethernet, RS 232		
TOW CABLE			
	Coaxial Kevlar or double-armored up to 6,000m, winches available		

KNUDSEN

SERIOUS DEPTHS WITHIN REACH...

CHIRP 3260

Proudly Made In CANADA

KNUDSEN

ISO9001 :2008
REGISTERED

Proudly Made
In CANADA

CHIRP 3260

Knudsen CHIRP Systems are the next benchmark in scientific sub-bottom profiling echosounders. The CHIRP 3260, is a high power deep water system capable of reaching serious depths up to 10,000m plus. This next generation system replaces the earlier, well respected Knudsen 320BR echosounder. The Chirp 3260, a blackbox system housed in a SU rackmount case for shipboard installation on a rack, interfaces to your computer via a USB connection, and is supplied with SounderSuite Windows application software. The Chirp 3260 incorporates the latest in digital signal processing technology and specialized chirp and correlation processing algorithms to enhance sub-bottom depth capability.

Available in a 2 or 4 channel configuration, the versatile system is particularly well suited to multiple survey roles and includes a wide range of bathymetric frequencies. Most commonly configured for the low frequency combination of 3.5/12 kHz., the CHIRP 3260 is designed for full ocean depth requirements where high power output is required.

Technical Specifications: *(subject to change without notice):*

Avcilable Channels
- Up to 4 crannels

Frequency
- All chainels: 3.5kHz - 210kHz

Output Po.ver
- Up to 10kW on aiainel 1 (6kW in frur crannel configura:ion)
- Up to 2kW on aiamels 2, 3 and 4

Input Power
- 85-265 VAC

Pulse Length
- Upto 64ms

Gain
- Manual, automatic (AGC), and time varied (TVG)
- 96db range of prq;irammable analog gain

Ranges
- 5, 10,20,50, 100,200,500, 1000,2000,5000

Phasing
- Manual aid automatic (upto 00% over1aps)

Units
- Meters, Feet, or Fathoms

Resolution
- 1cm (0-99.99), 1dm (100-999.9), 1m (>1000)
- 11100ft (0-99.99), 1110ft (100-999.9), 1ft (>1000)
- 1/100fm(0-99.99), 1/10fm(100-999.9), 1fm(>1000)

Sound Velocity
- 1300 - 1800 m/s Resolution 1m/s
- 4265 - 5900 ft/s Resolution 1ft/s
- 710 - 984 fm's Resolution 1fm's

Draft
- 0-100m Resolution 1cm
- 0-328ft Resolution 0.01ft
- 0-54fm Resolution 0.01fm

Interface
- USB 2.0 Full Speed (12rvtJps)

Output Data
- Full resolution envelope data in KEB binary forrrat and XTF (for sidescan only)
- Industry standard SEG-Y in 16-bit fixed point in usa-selected *rem;* filtered, or envelope detected form
- User cortigurable ASCII digital depth strings

Dimensions
- 533mm (21")x483mm(19") x222mm (8.7')

Weight
- 25kg (55lbs)

Installation
- 5U Rackmount case

Operating Temperature
- 0-50°C

Additional Features
- Fre◆ency agility on all crannels
- Full sp◆trum chirp and correlation processing
- Selectablefrequericy s.veep aid windo.vs functions
- Pinger lvbde
- M.lltiple pings in thewater colurm
- Built-in drivers for all popular GPS
- Built-in test signal generator
- Compatible with industry standard da1aloggers aid processing software (Hypack, QINSy, SonarWiz)
- Heave compensated ◆ogram

Options
- Sidescan option
- Network option for multiple PC opera:ion
- Remote Display Indica:ors
- EchoSim Sonar Signal Simulator

SounderSuite Software (included)
- Compatible with Windo.vs Vista or higher
- Easy to use Graphical User Interface (GUI)
- Postsurvey Display aid Printing Software
- Large Digitized Dej:th Display
- Print to standard Windo.vs r:rinters and select thermal r:rinters

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10 Industrial Rd. Perth Ontario Canada K7H 3P2 Phone - Canada: (613) 267-1165 US: (315) 393-8861
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G-882
Cesium Marine Magnetometer

GEOMETRICS
Simplify your search

Geometrics' G-882 Marine Magnetometer is the leading marine system in the industry with over 1,000 systems sold! The G-882 is the only system that meets the standards for UXO clearance in the North Sea.

This very high-resolution Cesium vapor marine magnetometer is low in cost, small in size, and offers flexibility for professional surveys in shallow or deep water. Use your personal computer with our MagLog™ software to log, display and print GPS position and magnetic field data.

The system directly interfaces to all major side-scan manufacturers for tandem tow configurations. Being small and lightweight, it is easily deployed and operated by one person. But add several streamlined weight collars and the system can quickly weigh more than 100 lbs for deep-tow applications.

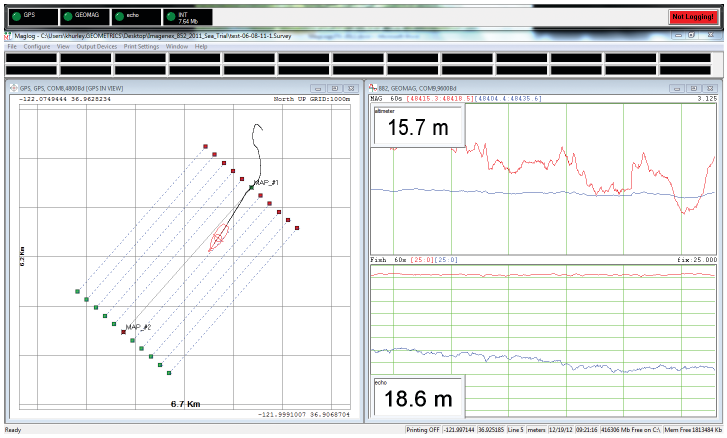
This marine magnetometer system is particularly well-suited for the detection and mapping of all sizes of ferrous objects. This includes anchors, chains, cables, pipelines, ballast stones and other scattered shipwreck debris, munitions of all sizes (UXO), aircraft, engines and any other object with a magnetic expression. The G-882 is also perfect for geological studies. Its high sensitivity and high sample rates are maintained for all applications.

Objects as small as a 5-inch screwdriver are readily detected provided that the sensor is close to the seafloor and within practical detection range (refer to table on back).

FEATURES & BENEFITS

- **Cesium Vapor High Performance** – Highest detection range and high probability of detecting all sized ferrous targets.
- **Streamlined Design for Tow Safety** – Low probability of fouling in fishing lines or rocks. Rugged fiber-wound fiberglass housing.
- **Sample at up to 20Hz** – Unparalleled data density while also covering larger areas per day.
- **Sensor can be Rotated for Optimal Signal** – Can be used worldwide.
- **Easy Portability and Handling** – No winch required. Built-in easy-carry handle. Operable by a single man; only 44 lb with 200 ft cable.
- **Combine Multiple Systems for Increased Coverage** – Internal CM-221 Mini-counter provides multi-sensor sync and data concatenation, allowing side-by-side coverage which maximizes detection of small targets and reduces noise.
- **Export Version Available** – Use anywhere in the world without need for an export license (except embargoed countries). See specifications.

SPECIFICATIONS | G-882 Cesium Marine Magnetometer



MagLogLite™ Data Logging software is included with each magnetometer and allows recording and display of data and position with automatic anomaly detection. Additional software options include: MagLog Pro™, advanced logging software; MagMap™, a plotting and contouring package; and MagPick™ post-acquisition processing software.

MAGNETOMETER / ELECTRONICS

Operating Principle: Self-oscillating split-beam Cesium vapor (non-radioactive).

Operating Range: 20,000 to 100,000 nT.

Operating Zones: The earth's field vector should be at an angle greater than 10° from the sensor's equator and greater than 6° away from the sensor's long axis. Automatic hemisphere switching.

Noise: <0.004 nT/$\sqrt{Hz}_{rms}$. (SX (export) version: <0.02 nT/$\sqrt{Hz}_{rms}$).

Max Sample Rate: 20 Hz.

Heading Error: < 1 nT (over entire 360° spin).

Output: RS-232 at 1,200 to 19,200 Baud.

Power: 24 to 32 VDC, 0.75 A at power-on and 0.5 A thereafter.

MECHANICAL

Sensor Fish

DIA: 7 cm; L: 137 cm (2.75x54 in) (with fin assembly).
Weight: 18 kg (40 lb).

Includes sensor and electronics and 1 main weight. Additional collar weights are 6.4 kg (14 lb) each; total of 5 capable.

Tow Cable

DIA: 12 mm; L: 800 m (0.47 in x 2,625 ft).
Weight: 7.7 kg (17 lb) with terminations.
Break strength: 1,630 kg (3,600 lb)
Bend diameter: 30 cm (12 in).

Typical Detection Range for Common Objects

1.	Ship: 1000 tons	0.5 to 1 nT at 800 ft (244 m)
2.	Anchor: 20 tons	0.8 to 1.25 nT at 400 ft (120 m)
3.	Automobile	1 to 2 nT at 100 ft (30 m)
4.	Light Aircraft	0.5 to 2 nT at 40 ft (12 m)
5.	Pipeline (12 inch)	1 to 2 nT at 200 ft (60 m)
6.	Pipeline (6 inch)	1 to 2 nT at 100 ft (30 m)
7.	Iron: 100 kg	1 to 2 nT at 50 ft (15 m)
8.	Iron: 100 lb	0.5 to 1 nT at 30 ft (9 m)
9.	Iron: 10 lb	0.5 to 1 nT at 20 ft (6 m)
10.	Iron: 1 lb	0.5 to 1 nT at 10 ft (3 m)
11.	Screwdriver: 5-inch	0.5 to 2 nT at 12 ft (4 m)
12.	Bomb: 1000 lb	1 to 5 nT at 100 ft (30 m)
13.	Bomb: 500 lb	0.5 to 5 nT at 50 ft (16 m)
14.	Grenade	0.5 to 2 nT at 10 ft (3 m)
15.	Shell: 20 mm	0.5 to 2 nT at 5 ft (1.8 m)

ENVIRONMENTAL

Operating Temperature: -35°C to +50°C (-30°F to +122°F).

Storage Temperature: -45°C to +70°C (-48°F to +158°F).

Altitude: 9,000 m (30,000 ft).

Depth: 4,000 psi (2,730 m; 8956 ft).

Water Tight: O-Ring sealed for up to 4,000 psi depth operation.

ACCESSORIES

Standard: Operation manual, shipping/storage container, ship kit with tools and hardware, power supply, MagLogLite™, MagMap™ and MagPick™ processing software, depth transducer, altimeter.

Optional: Steel tow cable to 6,000 m (19,600 ft) with telemetry, longitudinal or transverse gradiometer, plastic Pelican® case, MagLogPro™, collar weights.

GEOMETRICS
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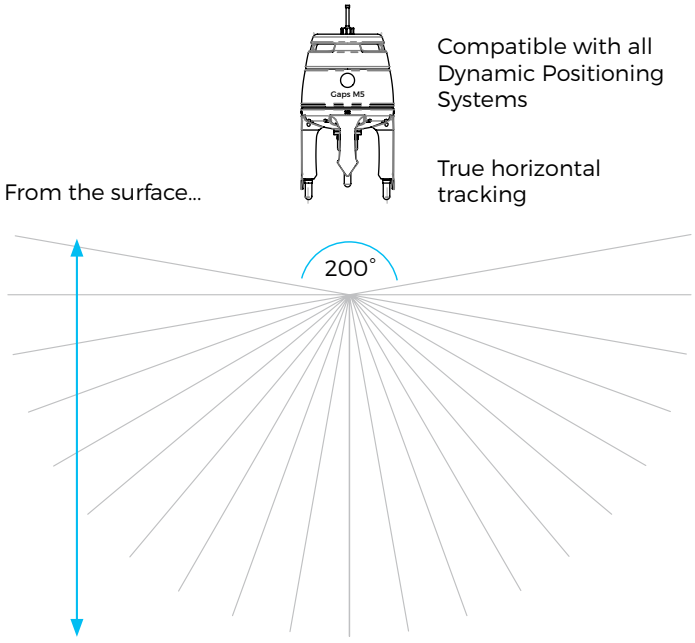
Tel: 44-1525-383438 • Website: www.geomatrix.co.uk • Email: sales@geomatrix.co.uk

GEOMETRICS CHINA Greenview Geophysical Instruments Ltd
Tel: +86-10-85850099 • Fax: +86-10-85850991 • Email: greenviewgeo@greenviewgeo.com.cn

Gaps M5

Calibration-free and export-free USBL system

Gaps M5 is a Medium frequency Ultra-Short Baseline (USBL) positioning system for accurate location, positioning and tracking of subsea assets, from ultra-shallow water to medium water depths.
It combines an USBL integrated with a heading and attitude sensor based on iXblue FOG technology. Free of export* restrictions, Gaps M5 is a lighter and more compact version of Gaps, the lightest high-performance USBL system on the market.



FEATURES

- 200° aperture: above horizontal tracking.
- Not subject to export restrictions*.
- Robust True North finding sensor.
- DP compatible LBL/USBL.
- Third-party transponder compatible.
- Acoustic communication (telemetry).
- 3D display software included (Delph Roadmap).

*According to the European export control regulation

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2019-12-DS-GapsM5

iXblue

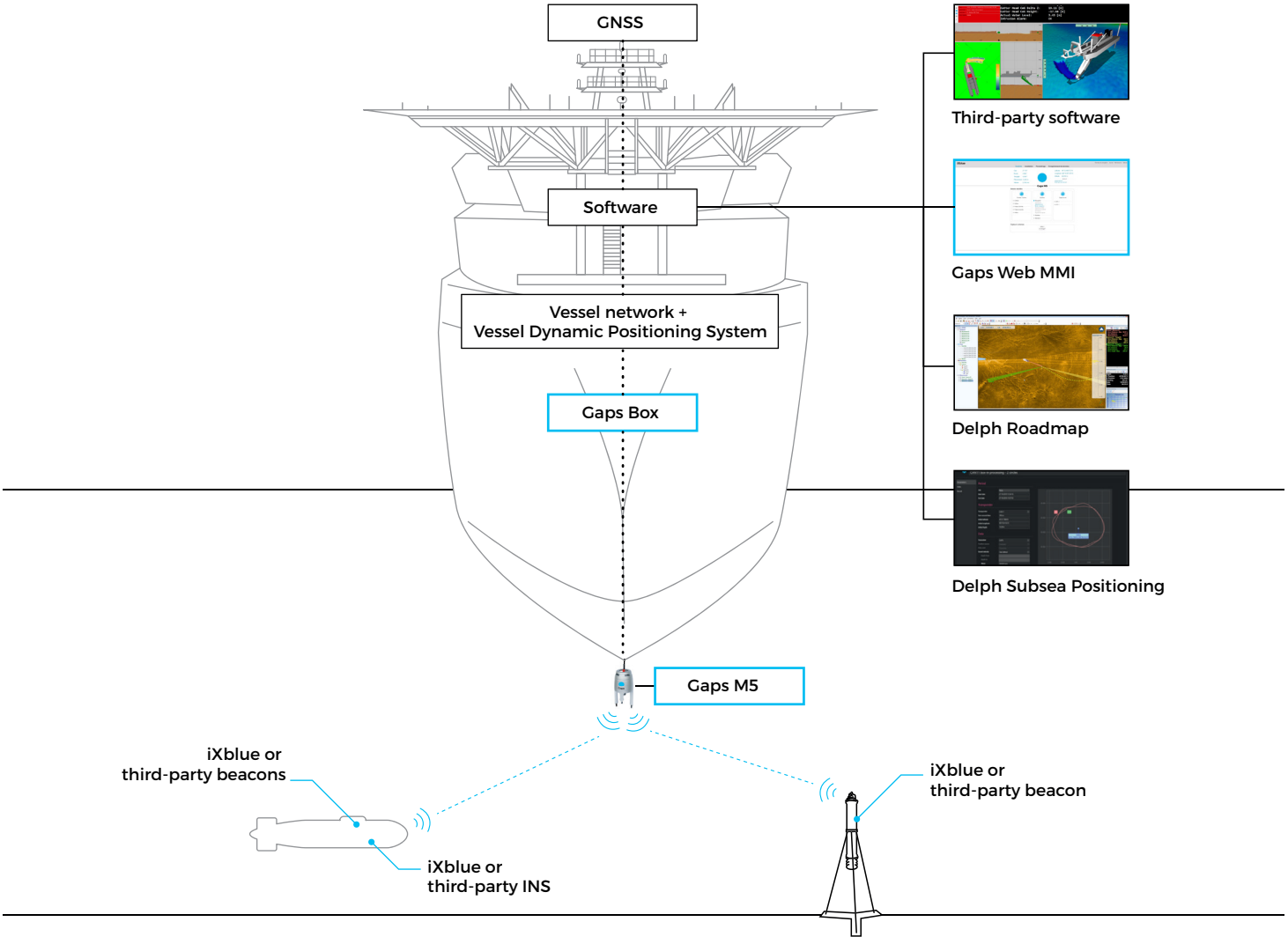
BENEFITS

- Calibration free.
- Shallow water and horizontal tracking.
- Highly accurate positioning (0.5% of the slant range).
- Easy to install, operate and repair for cost-efficiency.

APPLICATIONS

- AUV tracking
- ROV tracking
- Tow fish tracking
- Diver tracking
- Dynamic positioning
- LBL Box-in
- Offshore construction

GAPS ECOSYSTEM



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iXblue

GAPS M5 TECHNICAL DESCRIPTION

Transceiver performance

Operating range*	995 m
Acoustic coverage	200°
Positioning accuracy**	Better than 0.5 % of the slant range
Range accuracy	20 mm
Operational frequency	MF (20-30 kHz)

Embedded MRU

Type	Fiber-optic Gyrocompass
Heading	0.5° secant latitude
Pitch & roll	0.1°
Settling time	5 minutes

Electrical

Power supply	230 VAC (50/60Hz) / 24-36 VDC
Consumption	22 W
Synchro IN	1 PPS ; 1 Trigger
Synchro OUT	2 TTL Pulses
Communication	4 Serial (RS232/422/485) 1 Ethernet (RJ45)

Environmental

Storage temperature	-40 to +70°C
Operating temperature	-5 to +35°C
Max. antenna deployment depth	25 m

Physical characteristics

Dimensions (Length x Diameter)	520.8 x 296 mm
Material	Carbon fiber painted
Weight in air /water	14 kg / -5 kg
Gaps cable length	20m (50m and 95m optional)

Interface unit (Gaps box)

Dimensions	233x330x94
Weight	4.6 kg
EMC	89/336/EEC - EN 60945

*: operating range depends on the conditions of measurement (NIS, SNR)
**: In vertical conditions. Including GPS error of 0.1m. Sound velocity profile compensated. Transponder transmit level = 191 ref µPa@1m. Slant range of 900m. SNR>10dB

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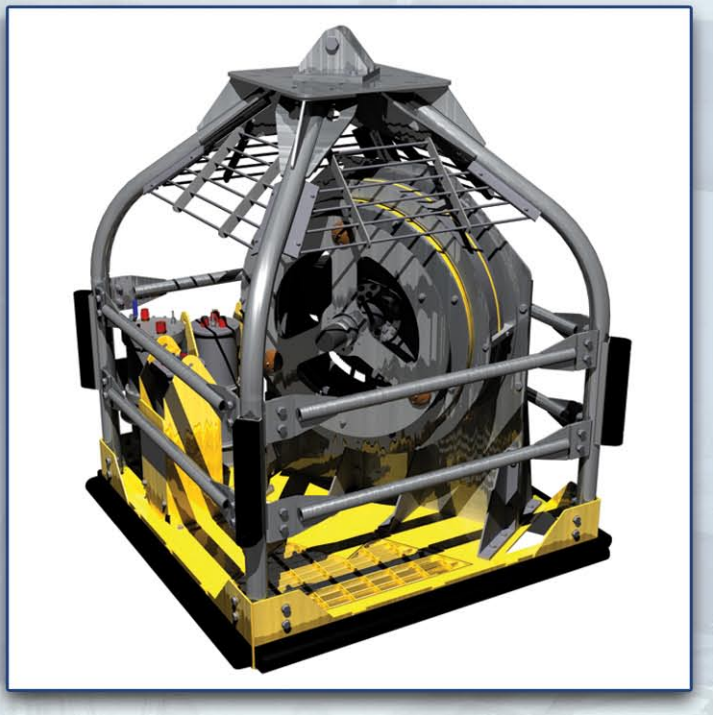
iXblue

Neptune 3000

Miniature Coiled Rod CPT System

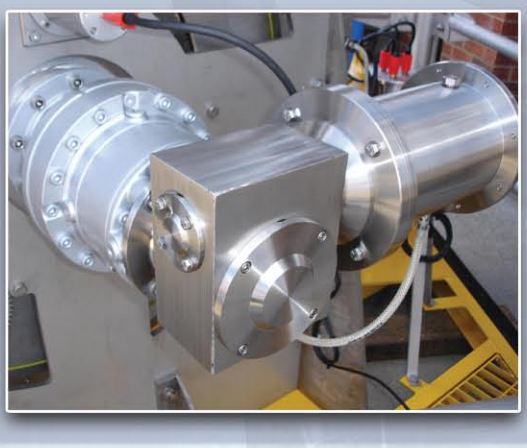
- 2cm² Detachable Cone, 5cm² Detachable Cone, T-Bar Detachable Cone
- 10kN Push Capability
- Up to 10m Penetration from Coiled Rod
- Compact & Easily Deployed Sub-Sea Frame
- Real Time Control and Display
- Single Coax Connection for Power and Data
- Automatic Safety Cut-Outs
- Low Maintenance, Low Consumable Use
- Data Comparable to 10cm² Systems
- Easy to Operate Windows™ based PC Control



Technical Specification

Dimensions	1602mm(L) x 1602mm(W) x 1963mm(H), all ± 15mm
Weight in Air	1500kg approx.
Weight in Sea Water	1200kg approx.
Thrust Capacity	1000kg (approx. 10kN, 2cm² 50MPa, 5cm² 20MPa)
Max Penetration	10m
Depth Rating	3000m
Penetration Speed	2cm/sec ±10%
Retract Speed	5cm/sec approx.
Power Requirement	240 Vac 1ph 50/60 Hz, 2 kw
Umbilical Voltage	650v
Telemetry Link	FSK
Frame Sensors	Altimeters & Tilt
Frame Sensor Data Rate	1 Hz

Tip Accuracy	Better than 100kPa
Sleeve Accuracy	Better than 10kPa
Inclination Accuracy	Better than 1°
Cone Data Rate	20 Hz
Cone Type	Detachable, Digital Subtraction
Cone Sensors	Tip, Sleeve Friction & Inclination
Optional Sensors	Piezo - Ranges to Suit
Cone Tip Area	2cm²
Cone Sleeve Area	30cm²
Operating System	Microsoft Windows™ XP, Vista and 7



www.datem.co.uk email: sales@datem.co.uk

Woodbridge Road Industrial Estate, Sleaford, Lincolnshire, NG34 7EW

Tel: 01529 419970 Fax: 01529 419989

OSIL Vibrocorer

Description

A large vibrocorer that extracts 96-millimetre diameter sediment samples from the seabed, at lengths ranging from two to six metres. This modular unit is easy to assemble and can be deployed with a crane or A-frame.

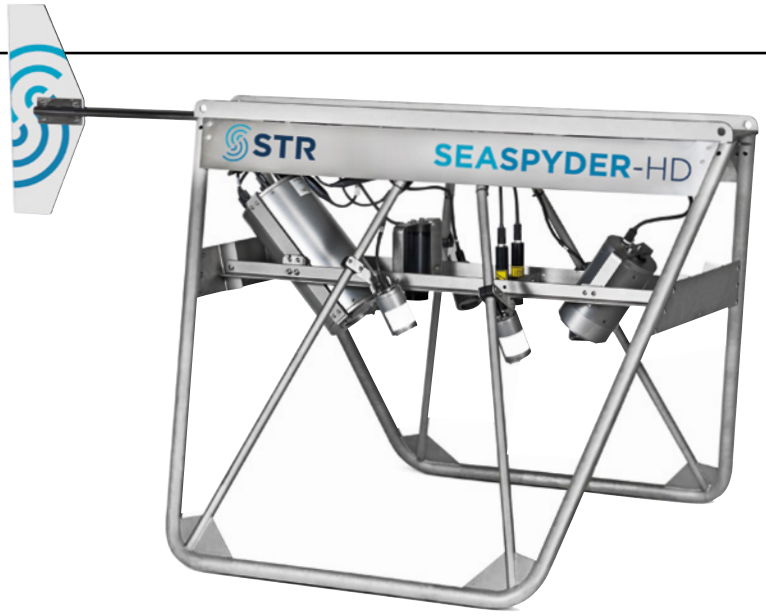
OSIL Vibrocorer

Key data	
Electrical supply	415V or 440V
Input frequency	50Hz or 60Hz
Start-up current	32A
Running current	8A
Max. water depth	250 metres
Vibration force	40 kN
Sample diameter	96 mm
Sample length	2–6 metres

STR

SUBSEA TECHNOLOGY & RENTALS

STR SeaSpyder HD DROP CAMERA SYSTEM



The SeaSpyder Underwater Drop Camera System is part of a family of field proven camera systems manufactured by STR for the marine survey and environmental communities. This technology has been developed continually by STR for several years in order to satisfy the ever increasing demand for quality and performance.

The SeaSpyderHD is designed for operation in water depths up to 3000m utilising coaxial or fibre-optic umbilicals.

The system as standard offers simultaneous uninterupted recording of low latency live video footage along with high resolution stills photography, along with interfacing to a wide range of sensors and dataloggers

The stills camera is fitted with a high quality 18 mega pixel digital SLR Camera offering full control of all photograpic parameters including manual focus, shutter speed and aperture. The stills camera is housed within a robust 3000m rated aluminium enclosure along with a water corrected lens and also forms the mounting point for HD video camera and quad scaling lasers.

Video footage is provided by the STR SeaSpectrumHD camera offering high a quality 1080P video feed via HD-SDI over dedicated high speed fibre optic link.

All data is transferred directly to the surface unit for live interpretation, this includes HD video, stills photos, serial sensor data and Ethernet data such as an imaging sonar.

A 19" rack mount Surface Control Unit and powerful topside processor give full remote control of the camera via the easy to use GUI software.

As standard, the purpose designed camera deployment frame is fitted with a subsea electronics and camera housing, high power underwater flash, an array of four high intensity LED lamps, quad scaling lasers, altimeter, depth sensor and a heading sensor. Many other sensors are easily integrated via numerous serial & Ethernet data channels.

The system is capable of operating over a wide variety of fibre optic umbilicals allowing very high speed data transfer with extremely low latency. Operation over standard armoured coax cable up to 3000m is also supported utilising the STR SeaSpectrumIP video camera with minimal extra latency.

For ease of transportation, fast mobilisation and maximum robustness the Surface Control Unit and topside processor are housed within a shock mounted, waterproof Peli-Hardigg transportation case with internal 19" rack mounted flip out monitors.

KEY FEATURES

- Operation in water depths up to 3000m
- Simultaneous uninterrupted recording
- Interfacing to wide range of sensors and dataloggers
- High resolution stills photography
- Direct data transfer for live interpretation
- Fully remote controllable stills camera settings

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STR SeaSpyder HD DROP CAMERA SYSTEM

SEASPYDER HD-SDI RACK MOUNT PROCESSOR – SP-PRO3

Hardware: Standard 19" Rack Mountable
Processor: Intel i7 3770 3.4GHz Quad-Core
Memory: 8GB DDR3 RAM
Storage: 1TB internal hard drive & 4TB removable drive in caddy
Interface: DVD-RW, 2 x 1 GigE, 6 x USB, 8 x RS232, 1x BNC HD-SDI.
Display: 2 x 19" Rack-mount Full HD LED HDMI Monitor
Power: 110/240 VAC, 50 Hz (900W)

SEASPYDER FIBRE-OPTIC & TELEMETRY SURFACE CONTROL UNIT – ST-FTSU

Power Input: 100 – 264 VAC (47 – 63 Hz) ffi 500 W max
Dimensions: 19" 4U rack mountable
Interface: 2x 100Mbps Ethernet, 1x HD-SDI Video (2x sockets), 8x RS232/485 serial ports, 6x Relay control switches for subsea RS232/485 user ports, TTL Trigger Input (option)
Cable Diagnostics: Low & High Voltage closed loop cable diagnostics, cable polarity test, cable leakage, open and short circuit protection, built in current limit. Voltage and Current LED readout. Fault Indicator LEDs and audible alarm.

SEASPYDER DROP CAMERA FRAME

Length: 2.21m (with tail fin), 1.55m (no tail fin)
Width: 1.43m
Height: 1.40m (with tail fin), 1.18m (no tail fin)
Weight in Air: 91kg (empty frame), 160kg (fully loaded), 200kg (with extra lead weight in leg tubes)

SEASPYDER TELEMETRY 18MP DIGITAL STILLS CAMERA (3000M WIDE ANGLE) - SP-TC-3000AWT

Power Output: 24VDC on User Ports (12VDC option on Port 3); 200W Max.
Interface: 1 x Underwater Flash
4 x 24VDC LED Lamps
2 x RS232 Ports with 24VDC
1 x RS232 Port with 12 VDC/ 24VDC
1 x Dual Scaling Lasers
1 x 12V LAN Port
Depth / Housing: 3000m Hard anodised aluminium
Image Size: JPEG (720 x 480) to (5184 x 3456) RAW (5184 x 3456)
ISO Sensitivity: Auto (100 – 6400), 100 – 12800
Sensor Type: 22.3 x 14.9mm CMOS 3:2
Shutter Speed: 30 – 1/4000 Sec
Aperture Range: F3.5 – F22
Focal Length: 18mm
Focus: Manual & Automatic mode
Angle of View: ≈70° in water
Lens: Fused Quartz Corrected Dome

SEASPYDER SUBSEA FIBRE-OPTIC & TELEMETRY MULTIPLEXER – SP-FTM-3000AT

Power Output: External:24VDC 300W Internal: 5,12,-12V
Interface: 2x SM Fibre, ADSL2+, 100Mbps, Ethernet, 3x RS232/485, Optional TTL trigger output
User Ports: 3x remotely configurable RS232/485 ports, 1x permanent 24V@1.6A supply, 3x relay switched 24V@1.6A Supplies with independent EMI filters.
Depth/Housing: 3000m Hard anodised aluminium
Connectors: OPTG4-2SM,2E-FCR, MINL-5515-75ohm(1c,6#22)BCRL(GS), MCBH8F, MCBH3M, MCBH16F

SEASPYDER HIGH POWER FLASH – MP-FT

Control: TTL control via digital stills camera
Power Input: Power supply via stills camera
Depth / Housing: 3000m Hard anodised aluminium

SEALIGHT LED-1-DC

Input Supply Power: 9W Typical @ 100% Illumination
Colour Temperature: 5000K
Lumen Output: 1200lm Typical
Beam Angle: 120° to 50%
Luminous Efficacy: 130lm/W typical
Depth / Housing: 3000m Stainless-steel Housing / Sapphire Lens

SEASPECTRUM - SP-HDC-3000AWT

Viewport: Quartz Dome with Underwater Correction
Field of View: SP-HDC-3000AW = 85° air/water
Sensor: 1/2.8" Panasonic 2 Mega Pixel CMOS
Min Illumination: (DSS) 0.017Lux Colour, 0.0008Lux BW (STD) 1.0Lux Colour, 0.5lux BW
Zoom: 2.8-12mm Dual-motor optical zoom / 16x Digital Zoom
Focus: Remote controlled manual/ auto-focus
Image Enhancement: Wide Dynamic Range (WDR), Digital Noise Reduction (DNR), colour configuration, defog
Digital Interface HDSDI 1080P 25/30 fps, 720p 60/50/30/25 fps
Depth / Housing: 3000m Hard anodised aluminium

SEASPECTRUM – SP-IPC-3000A

Viewport: Acrylic Viewport
Field of View: 1080p 70° air/ 52°water 720p 85° air/ 64°water"
Sensor: 1/2.5" Aptina 5 Mega Pixel CMOS
Min Illumination: 0.1Lux Colour
Focus: Fixed Focus
Image Enhancement: Brightness, Saturation, Sharpness, Contrast
Digital Interface: Real Time Streaming Protocol RTSP
RTSP:
1080P 25/30 fps, 720p 25/30 fps (up to 2592x1920 10 fps to 1024x768 30fps available)
Digital Latency: 100-200mS Typical
Data Bitrate:
Configurable 500-8000 kbps
Depth / Housing:
3000m hard anodised aluminium

UMBILICAL OPTIONS

Rochester A301241 (0.68") (17mm) - 3000m Max

Rochester A306891 (0.498") (12.65mm) - 3000m Max

Rochester A305382 (0.39") (9.98mm) - 3500m Max

Rochester A302799 (0.45") (11.43mm) - 1500m Max

Rochester A304874 (0.25") (6.53mm) - 700m Max

Fibre = 1080P HD-SDI Video operation & 100Mbps data link

Coax = 720P HD-IP Video operation & 15Mbps data link

Operation over alternate fibre umbilicals supported, cable length limited by cable resistance Vs delivered power

Other umbilical types supported - please consult STR for further info.

E: sales@str-subsea.com W: www.str-subsea.com T: +44 (0)845 388 6383

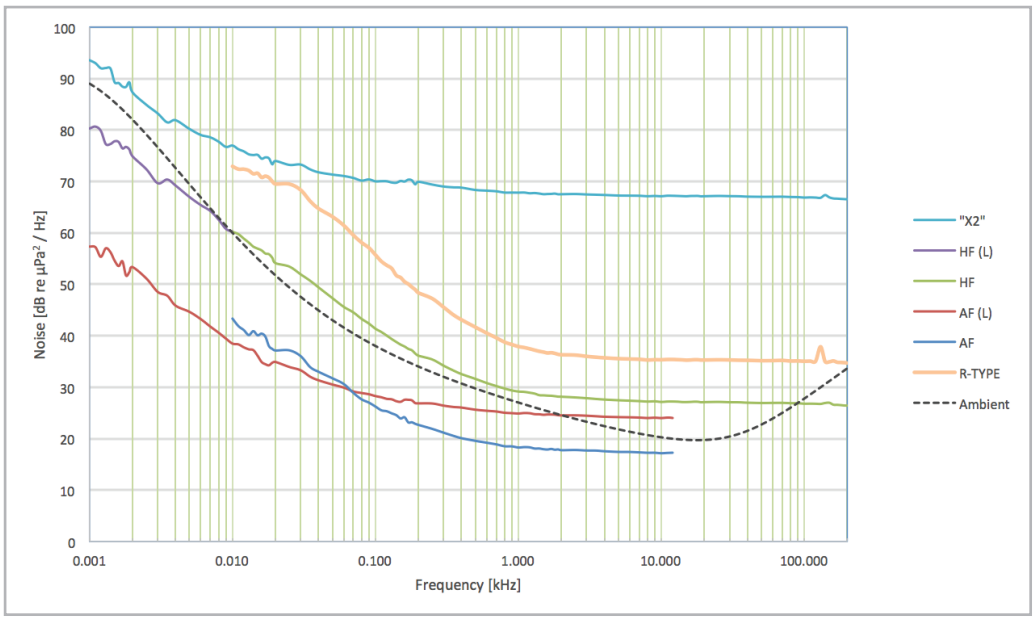
icListen Specification

The new standard in broadband digital marine acoustics

The icListen Smart Hydrophone is a compact, all-in-one instrument that logs calibrated waveforms, spectral or event data in standard formats and can be use to stream real-time data. Use the icListen as a digital hydrophone, acoustic data logger, or both at once.

This compact instrument includes rechargeable batteries, large memory and 24 bit data acquisition system. The icListen detects real-time events and can log or transmit just the event data in real-time.

icListen Self-Noise



Instrument access methods

- **Stream/Collect** waveform and spectrum (FFT) data.
- Use **Lucy PC software** to view and process data or enquire and set up instrument.

HF and AF

- Use the **Web Browser** to view, real-time acoustic data, instrument status, download logged data, configure instrument settings and put to sleep.
- Use **FTP** to manage files on the instrument copy and delete stored data files, and install firmware upgrades.
- Ethernet or Serial Interface

Ocean Sonics
The Smart Hydrophone Company

icListen Models
HF, AF

200m icListen HF

Engineered Plastic

3500m icListen HF

Titanium

Hill House
11 Lornevale Rd., Great Village
Nova Scotia, Canada B0M 1L0
+ 1 902 655 3000

OceanSonics.com

	AF(L)	AF	HF(L)	HF	X2	R-TYPE	UNITS
SIGNAL PERFORMANCE							
Low Frequency Cutoff	1	10	1	10	1	10	Hz
+/- 3 dB bandwidth	4	4	100		100	200	kHz
+/- 6 dB bandwidth	12.8		200		200	N/A	kHz
Sigma Delta Modulator Rate	16.384		16.384		16.384	16.384	MHz
Maximum Data Rate	32		512		512	512	ksps
Minimum Data Rate	1		1		1	1	ksps
Resolution	16 or 24		16 or 24		16 or 24	16 or 24	bits
Minimum Self Noise	19	18	27		67	39	dB re $\mu Pa^2/Hz$
Peak Input Level (µPa)	166	165	175		215	182	dB re µPa
Peak Input Level (Volts)	6		6		6	6	dBV
Voltage Sensitivity	-160	-159	-169		-209	-176	dBV re µPa
Digital Sensitivity, 24-bit, $count^2$ / μPa^2	-31	-30	-40		-77	-47	dB
Digital Sensitivity, 16-bit, $count^2$ / μPa^2	-79	-78	-88		-128	-95	dB
Dynamic range, 1.0 Hz BW	147	147	148		148	146	dB
Dynamic range, Spectrogram, Full BW	132	132	121		121	119	dB
Full Bandwidth Dynamic Range	106	1t06	95		95	90	dB
SOFTWARE / INTERFACE							
Communications Interface	Ethernet RS-422		Ethernet RS-422		Ethernet RS-422	Ethernet RS-422	
Lucy Software Support	Yes		Yes		Yes	Yes	
Collect Data Protocol	Serial / TCP		Serial / TCP		Serial / TCP	Serial / TCP	
Streaming Data Protocol	TCP / UDP		TCP / UDP		TCP / UDP	TCP / UDP	
Web Server (HTTP)	TCP		TCP		TCP	TCP	
FTP, SFTP and SSH Console	TCP		TCP		TCP	TCP	
Maximum Internal Data Storage	128		128		128	128	GB
POWER							
Internal Battery Life[C]	10		10		10	10	Hours
Metalic Lithium Equivalent Content	780		780		780	780	mg
Recommended Supply Voltage	18 - 36		18 - 36		18 - 36	18 - 36	V
Supply Voltage Limits	15 - 48		15 - 48		15 - 48	15 - 48	V
External Power (min, no networking)	1.8		1.8		1.8	1.8	W
External Power (typical)	2.1		2.1		2.1	2.1	W
External Power (charging)	3.8		3.8		3.8	3.8	W
MECHANICAL							
Mass (Titanium Case)	1056		911		911	-	gm
Mass (Plastic Case)	540		445		445	478	gm
Volume (Displacement)	354		317		317	332	cm^3
Overal Length, including connector	256		258		258	318	mm
Sensor Element Length	59		61		61	117	mm
Body (Can) Length	165		165		165	165	mm
Element Diameter	38		22		22	16	mm
Body Diameter	48		48		48	48	mm

Notes:

A. No internal logging above 4 ksps.
B. dBSR is the ratio of Sensitivity in dB to a reference sensitivity. (see our white paper on Digital Hydrophone Sensitivity.)
C. Initial battery life. Battery life will decrease by about 20% per year.

Appendix D: Spill Contingency Planning and Reporting Regulations – Schedule B

Nunavut

Dynamic Ocean Consulting Ltd.

SCHEDULE B

(Section 9)

Item No.	*TDGA Class*	*Description of Contaminant*	*Amount Spoiled*
1.	1	Explosives	Any amount
2.	2.1	Compressed gas (flammable)	Any amount of gas from containers with a capacity greater than 100 l.
3.	2.2	Compressed gas (non-corrosive, non flammable)	Any amount of gas from containers with a capacity greater than 100 l.
4.	2.3	Compressed gas (toxic)	Any amount
5.	2.4	Compressed gas (corrosive)	Any amount
6.	3.1, 3.2, 3.3	Flammable liquid	100 l
7.	4.1	Flammable solid	25 kg
8.	4.2	Spontaneously combustible solids	25 kg
9.	4.3	Water reactant solids	25 kg
10.	5.1	Oxidizing substances	50 l or 50 kg
11.	5.2	Organic Peroxides	1 l or 1 kg
12.	6.1	Poisonous substances	5 l or 5 kg
13.	6.2	Infectious substances	Any amount
14.	7	Radioactive	Any amount
15.	8	Corrosive substances	5 l or 5 kg
16.	9.1 (in part)	Miscellaneous products or substances, excluding PCB mixtures	50 l or 50 kg
17.	9.2	Environmentally hazardous	1 l or 1 kg
18.	9.3	Dangerous wastes	5 l or 5 kg
19.	9.1 (in part)	PCB mixtures of 5 or more parts per million	0.5 l or 0.5 kg
20.	None	Other contaminants	100 l or 100 kg