Labrador – Island Transmission Link

Marine Habitats in the Strait of Belle Isle: Interpretation of 2007 Geophysical (Sonar) Survey Information for the Submarine Cable Crossing Corridors

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EXECUTIVE SUMMARY

Nalcor Energy is proposing to develop the *Labrador-Island Transmission Link*, a High Voltage Direct Current (HVdc) transmission system extending from Gull Island in central Labrador to Soldiers Pond on the Island of Newfoundland's Avalon Peninsula. The proposed Project will involve the installation and operation of submarine cables across the Strait of Belle Isle.

This report comprises one component of the Marine Environment baseline study program conducted by Nalcor Energy as part of the Project's environmental assessment (EA). It is intended to provide information on marine habitats within the two submarine cable crossing corridors across the Strait of Belle Isle, for use in the Project's Environmental Impact Statement (EIS).

2007-2008 Marine Surveys in the Strait of Belle Isle

As part of its engineering and environmental programs in the Strait of Belle Isle, Nalcor Energy has collected considerable information on the existing marine environment within and adjacent to the Project area. This includes data on bathymetry and substrate characteristics within the proposed submarine cable crossing corridors, through side-scan sonar, multi-beam and sub-bottom profile surveys in 2007 and an underwater video survey program in 2008. This report presents an interpretation and analysis of the geophysical survey data (sidescan sonar imagery) acquired in 2007 along the two proposed submarine corridors, in order to identify and classify the seafloor marine habitats (substrate types and water depths) within these corridors.

The 2007 geophysical surveys were conducted by Fugro Jacques GeoSurveys Inc. (FJGI) on behalf of Nalcor Energy (then Newfoundland and Labrador Hydro), over a total area of approximately 28 km^2 in the Strait of Belle Isle. Potential submarine cable corridors were identified from the results of a regional multibeam echosounder survey. Two 500 m wide corridors were identified for the cable crossings, which extend between potential cable landing sites at Forteau Point and L'Anse Amour on the Labrador side and Mistaken Cove and Yankee Point on the Newfoundland side. Detailed geophysical surveys of the two corridors were carried out using a sidescan sonar, sub-bottom profiler and multibeam echosounder to further investigate and characterize the bathymetric and seafloor surficial geological conditions.

A ground-truthing video survey of the two Strait of Belle Isle submarine cable corridors was subsequently carried out on behalf of Nalcor Energy by Amec Earth and Environmental in September and October of 2008. This vessel-based survey resulted in the collection of high quality underwater video footage covering approximately 84 percent (52 km) of the total length of the two submarine cable corridors. The results of the survey were used to identify and categorize the types of seafloor substrate along the corridors, as well as the presence, abundance and distribution of marine flora and fauna.

Study Purpose and Approach

In this study, the sonar imagery obtained from the 2007 geophysical (side-scan sonar) survey was reviewed, interpreted and analysed in detail, using the results of the 2008 video survey to guide and inform the interpretation. Specifically, the sonar imagery and video footage were used together in order to identify, categorize and map the seafloor substrate and bathymetry within the two 500 m wide submarine cable corridors. This interpretation was based on the following substrate categories and water depth categories:

SUBSTRATE CLASS	DESCRIPTION
Bedrock	Continuous rock
Coarse-Large	Rubble and Boulder (140 to > 1000 mm)
Coarse-Small	Gravel and Cobble (2 – 140 mm)
Fine	Detritus/silt/sand (>0.06 – 2 mm)
Shells	Calcareous remains of shells fish or invertebrates containing shells
WATER DEPTH CLASS	**DESCRIPTION**
Intertidal Zone	Between high and low tide
Shallow Subtidal	0 – 30 m
Deep Subtidal 1	30 – 60 m
Deep Subtidal 2	60 – 90 m
Deep Subtidal 3	90 – 120 m
Deep Subtidal 4	120 – 150 m

These substrate and water depth classes used were developed through an aggregation of various categories outlined in the *Interim Marine Habitat Information Requirements* (IMHIR) issued by Fisheries and Oceans Canada (and used in the Amec study outlined above), based on the nature and scale of the Transmission Project and the resolution of the sonar imagery and associated interpretation limits.

In addition to mapping substrates based on the above categories, an additional "hybrid" substrate class of Coarse-Small / Shells was added for regions in the corridors comprised of roughly equal proportions of these two substrate classes.

The marine habitat analysis is presented in a set of five 1:10 000 scale maps. These maps are contained on CD Enclosures in Appendix A. However, a set of reduced maps, produced as a series of summary figures, are found in this report.

Summary of Results

Sidescan sonar data collected in the Strait of Belle Isle in 2007 were analyzed, in conjunction with underwater video survey information collected in 2008. Matching characteristic acoustic backscatter intensity with overlapping camera data allowed extrapolation of substrate types into the entire area of the two 500 m wide corridors as surveyed by sidescan. The estimated surveyed area of seafloor imaged by seafloor camera in 2008 was 0.052 km^2 and the actual surveyed area covered by sidescan sonar data in 2007 was 28 km^2 (a ratio of 1 to 539). Any discrepancies between the two datasets are largely a function of this difference in spatial coverage.

Exposed Bedrock occurs over 5.7% of the seafloor within the two survey corridors. The majority of Bedrock occurs on the steep western margin of a deep, bedrock-controlled valley between KP 8 – 13 (Western corridor).

Coarse-Large occurs over 14% of the seafloor. Most of this substrate class occurs in the berms, or side mounds, of relic iceberg scours. Coarse-Small covers 68.4% of the seafloor, and is the dominant substrate class within the two corridors.

Shells cover 3.4% of the seafloor. All of the Shell deposits occur as thin, narrow stringers, usually above Coarse-Small. The only exception to the stringers is the Shell deposit that occupies most of the floor of the bedrock-controlled valley (KP 8 – 13, Western corridor).

Coarse-Small/Shells occupies 6.9% of the seafloor. This hybrid category was added because of the presence of regions where roughly equal proportions of Coarse-Small and of Shells could not be assigned logically to one substrate.

Fine is mapped over 1.6% of the seafloor. This substrate is restricted in distribution to an easily identifiable narrow band close to the shore at L'Anse Amour on the Labrador side.

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1.0 INTRODUCTION

This report presents the results of marine habitat interpretations conducted on data from geophysical survey investigations carried out during August – October 2007 for two proposed subsea transmission corridors across the Strait of Belle Isle between Labrador and insular Newfoundland. The work described comprises part of the marine environment baseline study program conducted by Nalcor Energy in relation to the proposed *Labrador-Island Transmission Link*, and is intended to provide additional information on marine habitats in the Strait of Belle Isle for use in the Project's environmental assessment.

1.1 Project Overview

Nalcor Energy is proposing to establish a High Voltage Direct Current (HVdc) transmission system extending from Gull Island in central Labrador to Soldiers Pond on the Island of Newfoundland's Avalon Peninsula. The Project will include the installation and operation of submarine power cables across the Strait of Belle Isle between Labrador and insular Newfoundland.

The proposed 450 kV transmission system, as currently planned, will include the following key components (Figure 1.1):

- an ac-dc converter station at Gull Island in central Labrador, on the north side of the Churchill River adjacent to the switchyard for the Lower Churchill Hydroelectric Generation Project;
- an HVdc transmission line extending from Gull Island across southeastern Labrador to the Strait of Belle Isle. This overhead transmission line will be approximately 407 km in length with a cleared right-of-way averaging 60 m wide, and consist of single galvanized steel lattice towers;
- cable crossings of the Strait of Belle Isle with associated infrastructure (Figure 1.2), which may involve placing three to five cables within two separate corridors across the Strait and under the seafloor through various means to provide the required cable protection;
- an HVdc transmission line (similar to that described above) extending from the Strait of Belle Isle across the Island of Newfoundland to the Avalon Peninsula, for a distance of approximately 688 km;
- a dc-ac converter station at Soldiers Pond on the Island of Newfoundland's Avalon Peninsula; and
- electrodes in Labrador and on the Island of Newfoundland with overhead lines connecting them to their respective converter stations.

Figure 1.1. Labrador – Island Transmission Link: Project Overview

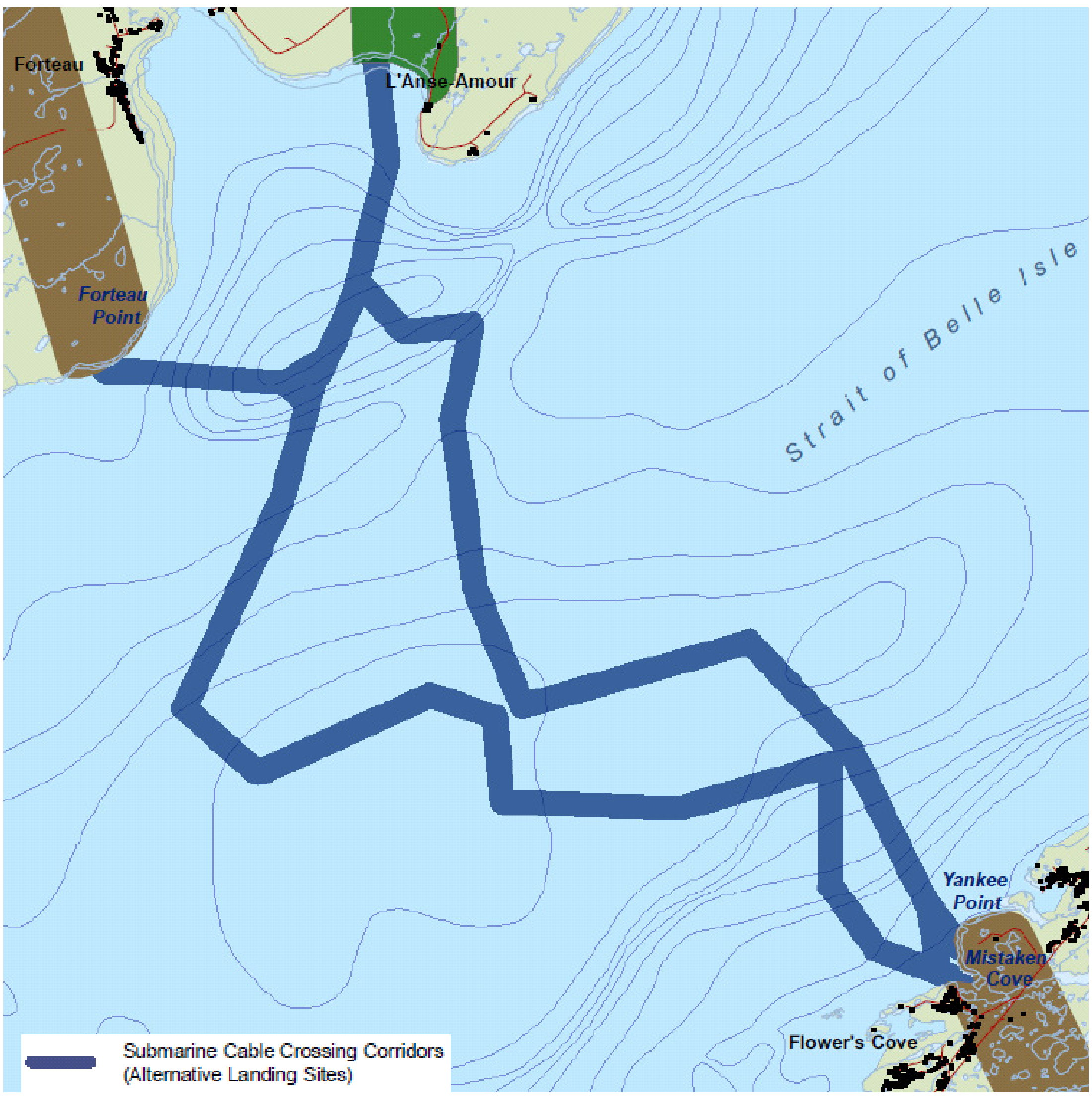
The HVdc transmission line will extend from Central Labrador to a crossing point on the Labrador side of the Strait of Belle Isle. From there, cables will extend under and across the Strait and make landfall on the northwestern side of the Island of Newfoundland's Northern Peninsula (Figures 1.1 and 1.2).

As a result of geophysical investigations in the Strait of Belle Isle in 2007 and other analyses, two alternative cable landing sites have been identified on the Labrador side - Forteau Point and L'Anse Amour. On the Newfoundland side, two options are also being considered - Mistaken Cove and nearby Yankee Point. Two 500 m wide submarine cable corridors have been identified for the cable crossings, which extend from these potential landing sites and across the Strait. The cable corridors are between 25 and 35 km in length, depending upon the specific landing site alternatives involved (Figure 1.2). Construction of the submarine crossings would include the placement of three to five cables within the two separate corridors across the Strait (two to four cables to carry the power and one to be used as a spare). Both cable crossing corridors would therefore be used, minus the inshore segments connecting the unused alternative landing sites.

Within the two corridors, the cables will be placed on essentially independent routes across the Strait, each cable occupying a footprint approximately 1-5 m in width (including the footprint of the associated cable protection), likely with 2-3 cables routed within one corridor and the other 1-2 cables within the second. The separation of the cables in two corridors is required primarily for system reliability reasons. The eventual selection of specific cable routes within the two 500 m wide corridors is the subject of ongoing engineering analysis. Although the cables will be installed along relatively narrow routes, considerable flexibility in the specific location of the cable routes within the corridors will be required up to and during the cable installation process, in order to select and make use of an optimal path for the cable to ensure adequate protection and reliability.

A number of methods will likely be used to protect the cables across the Strait of Belle Isle. Primarily, the currently identified corridors make use of natural sea-bed features to shelter the cables in valleys and trenches to minimize the possibility of iceberg contact or interaction with fishing activity. In order to access these natural deep valleys and seafloor and other seafloor topography and to provide further required protection, various cable protection techniques are under consideration, including tunnelling and rock trenching. Rock placement and the laying of concrete mattresses over the cables are also being evaluated for specific areas. Engineering analyses are ongoing to assess these and other potential approaches and techniques for protection of the subsea cables. The eventual selection of particular approaches and methods for cable protection along the route and specific portions of it is the subject of on-going analysis, and will be based on water depths, terrain and seabed geology, substrate characteristics, risk exposure, and overall technical and economic viability.

Figure 1.2. Strait of Belle Isle Cable Crossings: Potential Landing Sites and Corridors



1.2 Nature, Purpose and Rationale of the Study

The objective of this study is to provide information on the marine habitats that occur within the two 500 m wide submarine cable crossing corridors across the Strait of Belle Isle, for use in the Project's Environmental Impact Statement (EIS). The study further supplements the information gathered on marine habitats and biota within the cable corridors during the 2008 video survey (and reported separately by Amec, 2009) and from other sources. Results from the study contribute to an understanding of the marine habitats, including substrate characteristics and water depths, within the two corridors across the Strait of Belle Isle.

As part of its recent engineering and environmental investigations in the Strait of Belle Isle, Nalcor Energy has collected detailed information on the seafloor environment within and adjacent to the Project area. This includes data on bathymetric and substrate characteristics within the proposed submarine cable crossing corridors gathered through side-scan and multi-beam sonar and sub-bottom profile surveys in 2007, as well as an underwater video survey program in 2008. This report presents an interpretation and analysis of the sidescan sonar imagery acquired in 2007 along the two proposed submarine corridors, using the results of the 2008 video survey within the corridors to guide and inform that interpretation.

2.0 APPROACH AND METHODS

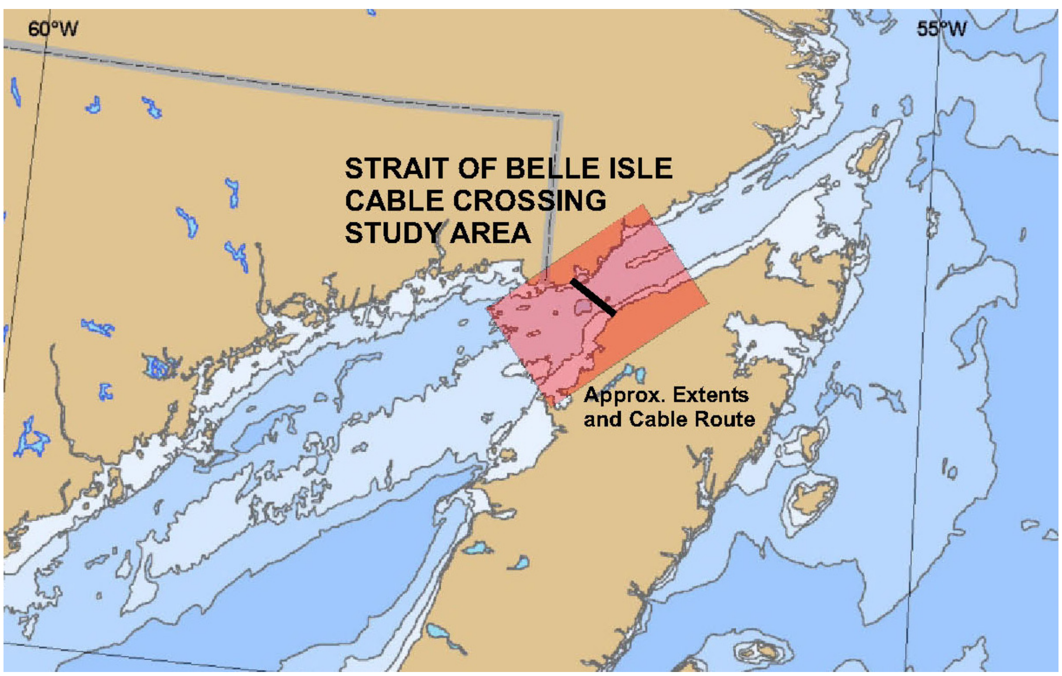
The following sections provide an overview of the various information sources used in this study, as well as the methodology employed for the associated data interpretation and analysis.

2.1 2007 Geophysical Surveys

A geophysical survey program was conducted on behalf of Nalcor Energy (then Newfoundland and Labrador Hydro) by Fugro Jacques GeoSurveys Inc. in the Strait of Belle Isle from August-October 2007. The survey plans were guided by a preceding desk study compilation of existing data on the area's natural and socioeconomic environments, as well as a reconnaissance multibeam bathymetry survey that provided regional seafloor topographic information.

The original, regional study area was approximately 40 km by 50 km in size (Figure 2.1), and extended from approximately L'Anse au Clair to the Pinware River on the Labrador coast, and from St. Barbe Bay (between Anchor Point and Black Duck Cove) to Green Island Brook on the Newfoundland side of the Strait. An initial multibeam echosounder survey was carried out in this region to assess seafloor topography and to assist in the identification of potential submarine cable corridors for the later dedicated geophysical corridor survey. The regional multibeam survey data were acquired by a Reson SeaBat 8101 system operating at a frequency of 240 kHz.

Figure 2.1. Approximate Study Area of the 2007 Geophysical Survey Program



Following an analysis of the results of the 2007 multibeam survey, two potential submarine cable corridors were identified across the Strait, each approximately 500 m in width (see Figure 1.2).

The subsequent 2007 geophysical survey program then involved the collection of detailed sidescan sonar imagery, high resolution multibeam echosounder data and sub-bottom profile data within the two submarine cable corridors, with a total surveyed area of approximately 28 km^2. The purpose of this survey was to characterize the bathymetric and seafloor conditions along the two potential corridors. A total of 890 km of geophysical survey lines were shot, comprising:

- 772 km of deep water offshore survey (including near Forteau Point);
- 92 km of nearshore survey at Mistaken Cove / Yankee Point; and
- 26 km of nearshore survey at L'Anse Amour.

The deep water geophysical data collected as part of the corridor surveys included:

- side scan data, acquired by an Edgetech DF-1000 digital side scan sonar operating at both 100 kHz and 380 kHz at 150 m slant range on both channels;
- multibeam bathymetry, acquired by a Reson SeaBat 8111 system operating at a frequency of 100 kHz; and
- sub-bottom profiler data acquired by a Huntec boomer Deep Tow System (DTS) operating at 240/135 Joules with a frequency range between 0.5 – 6 kHz (centre frequency 2.5 kHz) and 0.5 second firing rate.

The nearshore geophysical data collected included the following:

- side scan data, acquired by a Klein 3000 digital side scan sonar operating at both 100 kHz and 500 kHz at 150 m slant range on both channels;
- multibeam bathymetry, acquired by a Reson SeaBat 8125 system operating at a frequency of 455 kHz; and
- sub-bottom data acquired by a surface-towed IKB Seistec system operating at 200 Joules with a frequency range between 0.5 – 6 kHz and 0.5 second firing rate.

The 2007 geophysical survey was followed by an initial interpretation of seafloor surficial geology within the two corridors.

2.2 2008 Underwater Video Survey

A seafloor video survey of the Strait of Belle Isle submarine cable corridors was subsequently carried out on behalf of Nalcor Energy by Amec Earth and Environmental in September and October of 2008. This survey was carried out using a vessel-based, winch-deployed, downward-looking video camera system. Video footage was acquired along predetermined transects through the controlled drift of the camera survey vessel along the Eastern and Western submarine cable corridors. A total of 52 linear kilometres of video were acquired, representing approximately 84 percent of the total Eastern and Western corridor lengths. Results from the survey were used to identify and categorize the marine habitats (seafloor substrates) along the corridors, as well as the presence, abundance and distribution of associated marine flora and fauna (Amec 2009). The associated video footage was provided to Fugro Jacques GeoSurveys Inc. in early 2009 for use in the current study.

The viewable seafloor footprint from the 2008 video footage ranged from approximately 0.09 m^2 (0.3 x 0.3 m) when the camera was touching the seafloor, to a maximum visibly usable footprint of about 4 m^2 (2.0 x 2.0 m) when the camera was suspended above the seafloor. At viewing altitudes greater than the point where approximately 4 m^2 of seafloor was illuminated, visibility degraded due to limits of illumination power of the two camera lights and to light backscatter from sea "snow" (particulate matter in the water column) which obscured the seafloor.

The combined length of the Eastern corridor (approximately 27 km) and Western corridor (approximately 34 km) surveyed during the 2007 geophysical study totalled approximately 61 km, and the combined survey area within the two 500 m wide corridors was approximately 28 km^2 in area. Assuming the ribbon of seafloor viewed by the 2008 video transect averaged 1 m in width, then the actual amount of observable seafloor for all transects is about 0.052 km^2, or 0.2% of the total area within the two 500 m wide submarine cable corridors.

2.3 Substrate and Water Depth Categories

The study used the 2007 sonar and 2008 underwater video data described above to identify, categorize and map the marine habitat (seafloor substrate and bathymetry) within the two 500 m wide cable corridors across the Strait of Belle Isle. The substrate and water depth classes used for this study were developed based on an aggregation of the categories outlined in the *Interim Marine Habitat Information Requirements* (IMHIR) issued by Fisheries and Oceans Canada (and used in the Amec study outlined above) (Tables 2.1 and 2.2).

Table 2.1. Substrate Categories Used in the Marine Habitat Interpretation

SUBSTRATE CLASS	DESCRIPTION
Bedrock	Continuous rock
Coarse-Large	Rubble and Boulder (140 to > 1000 mm)
Coarse-Small	Gravel and Cobble (2 – 140 mm)
Fine	Detritus/silt/sand (>0.06 – 2 mm)
Shells	Calcareous remains of shellfish or invertebrates containing shells

Table 2.2. Water Depth Classes Used in the Marine Habitat Interpretation

WATRE DEPTH CLASS	DESCRIPTION
Intertidal Zone	Between high and low tide
Shallow Subtidal	0 – 30 m
Deep Subtidal 1	30 – 60 m
Deep Subtidal 2	60 – 90 m
Deep Subtidal 3	90 – 120 m
Deep Subtidal 4	120 – 150 m

These "aggregated" categories were developed based on the nature and scale of the Transmission Project and the resolution of the sonar imagery and associated limits of interpretation. The categories were developed in discussion with Fisheries and Oceans Canada as part of initial planning and design work by Nalcor Energy for the Project's Marine Environmental Baseline study program in 2008.

In addition to the above categories, an additional "hybrid" substrate class of Coarse-Small / Shells was added for regions in the corridors comprised of roughly equal proportions of Coarse-Small and Shells.

2.4 Amalgamation of the 2007 Sonar and 2008 Video Survey Data

Amec (2009) found that for each video camera deployment, the survey track could be divided into a series of "reaches" of variable length, where typically one substrate was dominant over others. Substrate types were identified by Amec (2009) within the imaged area of each reach and an estimate recorded of the percentage of surface area occupied by each substrate within the reach. For example:

- *Coarse-Large*: 55%
- *Coarse-Small*: 20%
- *Fine:* 20%
- *Shells:* 5%

The dominant substrate in particular within a reach (in the above case "Coarse-Large") was used as a guide in reinterpreting the sidescan data.

2.5 Reach Averaging Effects

The 2008 video files were reviewed during the analysis for the purposes of both validating the original video interpretation, and also to understand the distribution of substrate types within each reach. For instance, in deeper portions of the Strait of Belle Isle, where linear, relic, iceberg scours occur, Coarse-Large is preferentially concentrated in the scour mark berms. Thus where several berms were traversed and the reported proportion of Coarse-Large in a reach may have been less than 50%, the local concentration of Coarse-Large often reached 100% in the berms and 0% in the regions between. Such substrate variability within the reaches was found to be quite common allowing a considerably more detailed analysis than was possible from the 2007 sidescan sonar data alone. Of the total 52 km (28.5 hours) of video footage compiled and analyzed by Amec in 2008, 40.1 km (22.5 hours) were analyzed in support of the current study.

2.6 Matching the 2008 Video to the 2007 Sidescan Imagery

Direct matching between the noted position of substrate types seen on the 2008 underwater video and the substrate types interpreted from the 2007 sidescan sonar imagery could not be made with complete accuracy. However, the general interpretation of substrate variability over a number of reaches within a video transect could be correlated with reasonable approximation to the sidescan data. The reasons why one-to-one correlations between the data sources could not be made is likely the result of several factors, including:

- The general nature of the reported camera positions for the 2008 video. GPS (Global Positioning System) coordinates were recorded from either the unit on the bridge of the survey vessel (a 55-ft longliner), and/or from a hand-held unit. This approach to positioning was appropriate given the nature, scale and purpose of the 2008 video survey, which was intended to obtain representative video segments from within the 500 m wide corridors. However, neither GPS system was capable of operating at surveystandard precision of the 2007 geophysical survey (for which the accuracy of the Dynamic GPS system ranged from ±1.0 m to ±3.0 m).

- Offsets were not taken into account between the GPS antenna of the vessel, or of the hand-held unit, and the A-frame deployment point of the camera; and
- The surveying speed of the vessel (typically 1 – 1.5 knots) combined with strong tidal currents in the survey area (up to 4.5 knots), likely caused considerable deflection of the nominally vertical wire tether and camera so that horizontal position of the camera with respect to the A-frame could not be known with complete certainty.

As a result of these inherent inaccuracies in exact location of the video camera during the 2008 survey, the video information was therefore used as a general guide in the interpretation and analysis of the 2007 sidescan sonar data.

2.7 Video and Sidescan Data Analysis

During analysis the time-stamped geo-referenced tracks of the 2008 underwater video survey were imported and superimposed on the CAD drawings of the initial interpretation of the 2007 sidescan survey corridor data completed previously for Nalcor Energy by Fugro Jacques GeoSurveys Inc. The CAD drawings contained the geo-referenced, processed sidescan data and the earlier surficial geological interpretation (a series of coloured polygons) within the original 200 m wide corridor limits. In addition, the processed multibeam data and multibeam backscatter data were available as map layers. Alternating between these layers assisted in interpolating the boundaries of substrate categories, derived from the video data track, to the full 500 m width of the corridors.

A three-screen workstation was used for the interpretation effort. As the video data were streamed on one screen, interpretations from the video were simultaneously transposed onto the video track on the CAD drawing opened in a second screen. This was accomplished by drawing simple coloured polygons along the segment of video track for which a particular dominant substrate was interpreted, matching the time stamps on the tracks with the elapsed video time. In this way all of the analyzed video tracks were interpreted in a series of linked along-track polygons, each of which represented a dominant substrate type as seen in the video. The substrate polygons were extended to either side of the video track using backscatter contrast on the sidescan layer to define the substrate boundaries to the margins of the 500 m corridor. A third screen was used to tabulate the viewed videos on a spreadsheet.

2.8 Study Team

Dr. Chris Woodworth-Lynas (Ph.D. Earth Sci., P.Geo.): Project Geologist, sidescan sonar interpretation and report preparation. Chris was involved in planning and executing the 2007 geophysical surveys, and analyzed and interpreted the data. He performed the analysis and interpretation of the combined 2007 geophysical and 2008 video data. Chris has over 25 years experience in research and commercial marine surveys from the Canadian east coast, eastern and western Arctic, Middle East and Far East.

Mr. Ewan Cumming (M.Sc. Earth Sci., P.Geo.): Project Manager, general oversight and QA/QC. Ewan provided editorial and technical review of the report. Ewan is the Business Line Manager for Geoscience and Marine Surveys at Fugro Jacques GeoSurveys Inc. He has 21 years of experience in conducting and managing coastal and regional investigations offshore Eastern Canada and elsewhere, including all of the work conducted to date for Newfoundland and Labrador Hydro and Nalcor Energy in the Strait of Belle Isle.

Dr. Laurie Davis (Ph.D. Earth Sci.): Data and Interpretation Manager. Laurie provided interpretation oversight, and reviewed and edited the report. Laurie has over 20 years experience in marine geology and geophysics, and has worked on many site and route surveys on the Canadian east coast, Arctic and the Gulf of Mexico. He is an expert in sidescan, sub-bottom and 3-D seismic analysis and interpretation.

Mr. Curtis Strickland (B.Sc. Earth Sci., GIT): Geophysicist and sidescan sonar interpretation. Curtis was an Operator of both Sub Bottom Profiler and Sidescan Sonar systems during the 2007 geophysical surveys. During the report writing stage of the 2007 data, Curtis interpreted sub bottom profiler data, as well as side scan sonar data. For the current project, Curtis was the Operator of the deep sea camera system used by Amec for the marine surveys in 2008. In 2009 he was involved in further geophysical surveys in the Strait of Belle Isle for Nalcor Energy as an Operator of the 2D High Resolution Multichannel Seismic system.

Ms. Jennifer Fowler (B.Sc. Earth Sci.): Geoscientist and Geographical Information Systems specialist. Jennifer has advanced knowledge of ArcGIS software gained through courses taken in the GIS Diploma Program, at Memorial University. Her role in the current project was in preparing and manipulating the substrate data within ArcGIS for the calculation of substrate statistics. Jennifer was involved in geophysical surveys in the Strait of Belle Isle for Nalcor Energy in 2009 as the Sidescan Operator.

Ms. Andrea Caines (B.Sc. Geog.): Physical Geographer and Geomatics specialist. Her role in the Strait of Belle Isle substrate analysis was the production and editing of the final AutoCAD map products for the report. Andrea also has an advanced diploma in Marine Geomatics from the Centre of Geographic Sciences.

Mr. Dave Downey (PTech): Geomatics specialist. Dave has a diploma in Geomatics Engineering Technology from Cabot College. His role in the Strait of Belle Isle Substrate analysis was data processing as well as the production and editing of various AutoCAD map products for the report.

Ms. Candida Smith: Geomatics specialist. Candi has a diploma in Geomatics Engineering Technology from Cabot College. Her role in the Strait of Belle Isle Substrate analysis was production and editing of various AutoCAD and ArcGIS map products for the report.

3.0 ANALYSIS AND RESULTS

The following sections describe the key results of the study, including the marine habitats (substrate and water depth characteristics) within the two 500 m wide submarine cable corridors across the Strait of Belle Isle.

The descriptions that follow are referenced to specific Enclosure maps (Appendix A) and are structured with reference to a system of “kilometre points” (KP). KPs show the distance, in kilometres from L’Anse Amour, along an imaginary centre line in each corridor. For both corridors, KP 0 is registered at the high water mark at the western end of L’Anse Amour beach. The corridor segment from Forteau Point begins at KP 0 also at the high water mark. This corridor segment extends seawards for approximately 4.5 km to a forked junction with the western corridor which it joins between KP 6 and 7.

The 2008 video tracks are shown as magenta-coloured lines superimposed on the 2007 sidescan imagery in the first and third panels of each map. During the 2007 surveys seafloor images were acquired at a number of camera stations, and representative images from these stations are given at the bottom of each Enclosure map (Appendix A). Camera station locations are shown, in green, superimposed on the 2007 sidescan imagery.

3.1 Substrate and Depth Characteristics of the Submarine Cable Corridors

The key results of the geophysical data interpretation are described below. Please refer to the summary Figures provided at the end of the Main Report, as well as to the Enclosure maps (Appendix A) for detailed mapping and imagery.

As described previously, the proposed Strait of Belle Isle submarine cable crossings include two identified corridors across the Strait. Both corridors would be used for the Project, but with optional alternative landing points available, a combination of several possible corridor segments would be used. The text and maps that follow use the terminology *Eastern Corridor* and *Western Corridor* to refer to the main offshore corridors (Figure 3.1).

The “Eastern Corridor” commences at L’Anse Amour on the Labrador side and extends to Mistaken Cove / Yankee Point on the Newfoundland side. The “Western Corridor” also commences at L’Anse Amour on the Labrador side and extends to Mistaken Cove / Yankee Point, though by a more westerly route. The potential corridor segment that extends from the optional Forteau Point landing point on the Labrador side to join the main stem of the Western Corridor is shown on relevant maps and figures and is included in the descriptions below (Figure 3.1).

Figure 3.1. Submarine Cable Crossing Corridors: Strait of Belle Isle

3.1.1 Eastern Corridor: KP 0 to 14.6

See Figure 1 East and Enclosure 1 East

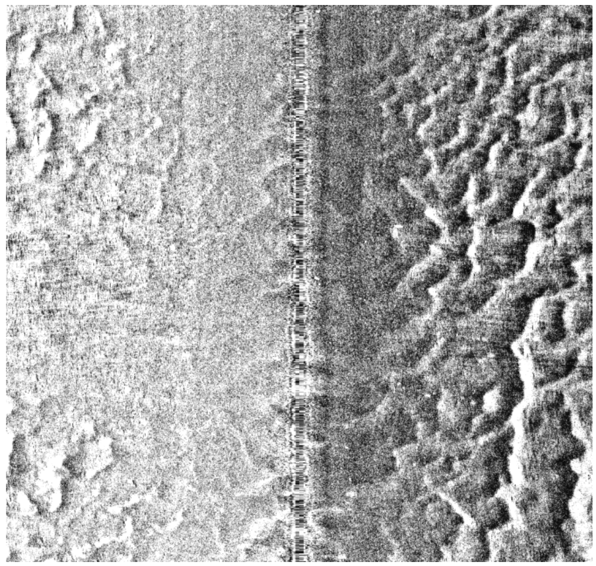
From L'Anse Amour beach at KP 0, the corridor passes south across 200 m of unsurveyed seafloor in the Intertidal and Shallow Subtidal Zones. This short segment was not surveyed in 2007 because water depths were too shallow for safe operation of the sidescan sonar. In this region, the corridor passes from a substrate of Fine (well-sorted, medium- to coarse-grained sand) on the beach face to a submerged rough Bedrock surface (< 1 m relief) beginning at 4 m water depth. The bedrock likely consists of Bradore Formation sandstone (see 2007 imagery from Forteau Camera 1 station on Enclosure 1 East, Appendix A).

At the 10 m isobath, the edge of a seaward-thickening substrate of Fine (sand) is crossed at KP 0.4. The sand surface is generally smooth and featureless, with small-scale bedforms (see 2007 imagery from Forteau Camera stations 2 and 3 on Enclosure 1 East). The Fine/Bedrock contact diverges from the shoreline at a heading of about 220°, such that on the western side of the survey corridor the contact is nearly 700 m from the shore, decreasing to 150 m on the eastern side.

From KP 1.0 to 1.6, the corridor continues over the Fine substrate (smooth sand) passing into the Deep Subtidal 1 zone (30 – 60 m water depth). At the 50 m isobath the 2008 video and 2007 sidescan sonar mosaic shows a transition from Fine (sand; light grey tone on sidescan) to Coarse-Small seafloor (dark tone) of gravelly sand with increasing water depth.

Between KP 2.1 and 2.6, the corridor turns slightly to the south-southwest, and at about KP 1.8 Coarse-Small passes gradually into a Coarse-Small / Shells substrate. Between KP 2.0 to 2.5 the Coarse-Small / Shells substrate is roughened by possible megaripple current bedforms with < 0.75 m relief and wavelengths of 10-20 m. The ripple crests are sinuous but have a general northeast-southwest orientation (Figure 3.2).

Figure 3.2. Megaripples in Coarse-Small / Shells substrate, Forteau Bay. The largest ripples (lower right) have relief of about 0.75 m and crest-to-crest wavelengths of up to 20 m. Image width is 200 m on this 100 kHz side scan sonograph.



In the Deep Subtidal 2 zone (60 – 90 m water depth) between KP 2.5 and the junction between the Eastern and Western Corridors at KP 4.6, the Eastern Corridor descends from 64 m to 112 m water depth, entering and following the axis of a low-relief channel that is 200-300 m wide and 2-4 m deep. At KP 3.1 Coarse-Small / Shells give way to a substrate of Coarse-Small and irregular patches of Coarse-Large form a thin mantle over bedrock on the eastern and western channel margins.

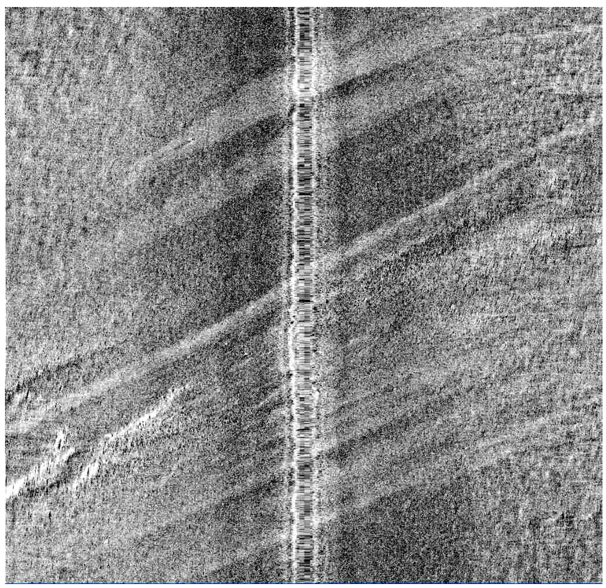
In the Deep Subtidal 3 zone (90 – 120 m) between KP 3.9 and 4.65, the seafloor flattens out at a water depth of 110 m. At KP 4.65 the Western Corridor diverges to the southwest and the Eastern Corridor passes into a region where the seafloor is characterized by a number of relic iceberg scours developed in a relatively thin mantle (generally 1-2 m thick) of Coarse-Small over interpreted bedrock. The scours have vertical relief of up to 2 m and the berms are readily apparent on the Seafloor Substrate Interpretation Panels of Enclosure 1 East as linear concentrations of Coarse-Large substrate. The most distinct scours have an average orientation of approximately east-northeast to west-southwest, with lengths between 0.5 km and at least 2 km, and widths between 50 m and 100 m. The scour mark troughs are characterized by Coarse-Small. Sediment thickness (over interpreted bedrock) within the troughs is estimated to be < 2 m.

From the East and West Corridor junction at KP 4.65, the corridor crosses the deepest portion of the Deep Subtidal 3 zone at 115 m depth, passing through the relic iceberg scour mark terrain. The Eastern corridor turns to the east-southeast at KP 5.55, and within predominantly Coarse-Small substrate at KP 6.25, rises up a steep northwest-facing slope between 100 m and 90 m water depth, crossing over a number of Coarse-Large substrate ridges to KP 6.9.

Between KP 6.9 and KP 7.5, the corridor passes back into the Deep Subtidal 2 zone (60 – 90 m water depth), making a gentle turn to the south and rising steeply from 88 m to 68 m water depth at KP 8.0. At KP 7.1 the linear ridges of Coarse-Large give way to a seafloor dominated by Coarse-Small, characterized by irregular outcrops of bedrock that in places rise as bedrock knolls to about 62 m water depth. The seafloor between KP 7.5 and 8.2 is undulatory, reflecting the presence of bedrock beneath a thin mantle of Coarse-Small.

From KP 8.2, the corridor descends south over a relatively smooth seafloor of Coarse-Small from 68 m water depth to nearly 88 m at KP 11.5. A number of northeast-southwest – trending ribbons of Shells substrate are identified from sidescan only in this region, suggesting the activity of strong bottom currents (Figure 3.3).

Figure 3.3. Shell Ribbons. Ribbons (pale streaks) are developed on a Coarse-Small substrate, and are 10-20 m wide, often more than 200 m long and probably less than 50 cm thick (KP 9.0, Eastern Corridor). Image width is 200 m on this 100 kHz side scan sonograph.



At the 90 m isobath the corridor passes down into the Deep Subtidal 3 zone (90 – 120 m water depth) at KP 11.5, and Coarse-Small is interrupted by a zone of northeast-southwest - oriented ridges of Coarse-Large substrate that represent the berms of relic iceberg scours. Alternating ridges of Coarse-Large and regions of Coarse-Small continue, with a minor ribbon of Shells at KP 13.5. At KP 13 the corridor crosses the 106 m isobath, and between here and KP 14.5 curves to the east-southeast.

3.1.2 Eastern Corridor: KP 14.6 to 28.0

See Figure 2 East and Enclosure 2 East

Between KP 14.2 and KP 19.0, the Eastern Corridor is at its deepest point, equating with Deep Subtidal 3, and curves gently from an east-southeasterly to an east-northeasterly orientation in depths ranging from a maximum of 110 m (KP 14.5 to KP 14.9) to 97 m (KP 16.2 - 16.3).

Seafloor substrate in this region is predominantly Coarse-Small but is characterized by numerous intersecting ice scour mark berms of Coarse-Large. The ice scours in this region are between 20-50 m wide and berm heights range between 1-3 m in elevation above the seafloor. Similarly, individual berm widths vary between 5-10 m, and composite berm piles of Coarse-Large, made where two or more scours intersect, may exceptionally reach widths of 30-40 m. Scours and berms are oriented northeast-southwest, so the corridor crosses them at low angles. One or two ribbons and patches of Shells substrate occur between KP 15.5 and KP 16.2, and are seen on sidescan and in the 2008 video. The ribbons are oriented sub-parallel to the scours.

Between KP 18.3 and KP 19.3 the corridor makes a gentle turn to the southeast where irregular outcrops of Bedrock are exposed at the seafloor. In the vicinity of KP 19 a number of northeast-southwest oriented Shell ribbons are interpreted from sidescan only. Beyond KP 19.3 the corridor is oriented to the southeast, and has perpendicular to numerous scour mark berms up to 2 m in elevation and 10-20 m wide comprising Coarse-Large substrate. Irregular outcrops of Bedrock (likely Hawke Bay Formation) begin to appear on the seafloor at KP 20.75. In this area, sediment thickness above bedrock reduces to < 1 m and, with minor local 2 m thick pockets, bedrock remains at this subsurface depth (or less) to the limit of survey coverage at KP 27. A particularly significant ledge, with 18 m of relief (between 92 m and 74 m water depth), outcrops on the southwest margin of the corridor between KP 20.75 and KP 21, locally disrupting the linear pattern of Coarse-Large scour mark berms. Coarse-Large scour mark berms are visible to KP 21.75 where they die out in the vicinity of narrow, 10 – 30 m wide northeast-southwest oriented step-like Bedrock scarps.

The Bedrock step between KP 21.85 and KP 21.9 is between 3 m and 7 m in elevation (between about 88 and 82 m water depth) and can be traced as a linear Bedrock outcrop on the side scan mosaic (third panel of Enclosure 2 East) for nearly 2 km across the eastern and western corridors. Other Bedrock scarps to KP 23 have relief of 1-2 m.

Seafloor in the region beyond KP 21.85 is predominantly Coarse-Small, although in places uniformly mixed with Coarse-Large. Linear substrate patterns associated with scour mark berms are absent. The Bedrock steps are strongly asymmetric, with steep northwest-facing scarp slopes, and gentle southeast-facing dip slopes of about 1° reflecting the gentle regional bedrock dip.

Between KP 23 and KP 24 the seafloor shoals through the 60 m to 30 m isobath (Deep Subtidal 1 zone), and between KP 24 and the end of sidescan survey coverage at KP 26.75 a series of subdued outcrops of Bedrock steps and plateaus cross the corridor in between regions of Coarse-Small. The seafloor Between KP 26.75 and the end of the corridor at the shoreline in Mistaken Cove KP 27.9 was not surveyed in 2007 because water depths were too shallow for safe operation of the sidescan sonar.

3.1.3 Western Corridor: KP 0 to 15.3

See Figure 1 West and Enclosure 1 West

The Eastern and Western Corridors are identical between KP 0 and KP 4.65 where they divide. The description of seafloor substrates is the same for this interval and is reproduced below.

From L'Anse Amour beach at KP 0, the corridor passes south across 200 m of unsurveyed seafloor in the Intertidal and Shallow Subtidal Zones. This short segment was not surveyed in 2007 because water depths are too shallow for the safe operation of sidescan sonar. In this region, the corridor passes from a substrate of Fine (well-sorted, medium- to coarse-grained sand) on the beach face to a submerged rough Bedrock surface (< 1 m relief) beginning at 4 m water depth. The bedrock likely consists of Bradore Formation sandstone (see 2007 imagery from Forteau Camera 1 station on Enclosure 1 East, Appendix A).

At the 10 m isobath, the edge of a seaward-thickening substrate of Fine (sand) is crossed at KP 0.4. The sand surface is generally smooth and featureless, with small-scale bedforms (see 2007 imagery from Forteau Camera stations 2 and 3 on Enclosure 1 East). The Fine/Bedrock contact diverges from the shoreline at a heading of about 220°, such that on the western side of the survey corridor the contact is nearly 700 m from the shore, decreasing to 150 m on the eastern side.

From KP 1.0 to 1.6, the corridor continues over the Fine substrate (smooth sand) passing into the Deep Subtidal 1 zone (30 – 60 m water depth). At the 50 m isobath the 2008 video and 2007 sidescan sonar mosaic shows a transition from Fine (sand; light grey tone on sidescan) to Coarse-Small seafloor (dark tone) of gravelly sand with increasing water depth.

Between KP 2.1 and 2.6, the corridor turns slightly to the south-southwest, and at about KP 1.8 Coarse-Small passes gradually into a Coarse-Small / Shells substrate. Between KP 2.0 to 2.5 the Coarse-Small / Shells substrate is roughened by possible megaripple current bedforms with < 0.75 m relief and wavelengths of 10-20 m. The ripple crests are sinuous but have a general northeast-southwest orientation (Figure 3.2).

In the Deep Subtidal 2 zone (60 – 90 m water depth) between KP 2.5 and the junction between the Eastern and Western Corridors at KP 4.6, the Eastern Corridor descends from 64 m to 112 m water depth, entering and following the axis of a low-relief channel that is 200-300 m wide and 2-4 m deep. At KP 3.1 Coarse-Small / Shells give way to a substrate of Coarse-Small and irregular patches of Coarse-Large form a thin mantle over bedrock on the eastern and western channel margins.

In the Deep Subtidal 3 zone (90 – 120 m) between KP 3.9 and 4.65, the seafloor flattens out at a water depth of 110 m. At KP 4.65 the Western and Eastern Corridors diverge, and the Western Corridor turns slightly towards the southwest in the deepest part of the Deep Subtidal 3 zone. Here the corridor traverses a region of seafloor characterized by a number of relict iceberg scours characterized by berms developed in a relatively thin mantle (generally 1-2 m thick) of Coarse-Small over interpreted bedrock. The scours have vertical relief of up to 2 m, and the berms are readily apparent on the Seafloor Substrate Interpretation Panels of Enclosure 1 West as linear concentrations of Coarse-Large substrate. The most distinct scours have an average orientation of approximately east-northeast to west-southwest, with lengths between 0.5 km and at least 2 km, and widths between 50 m and 100 m. The scour mark troughs are characterized by Coarse-Small estimated to be < 2.0 m thick above interpreted bedrock.

Between KP 5.5 and KP 6.5 the linear Coarse-Large scour mark berms give way to large irregular areas of Coarse-Large and also of Coarse-Small / Shells. Between KP 6.5 and 7.0, the seafloor is predominantly Coarse-Small with irregular patches of Coarse-Large. Near KP 7.0 a number of linear ridges (< 1 m relief) of Coarse-Large, oriented east northeast-west southwest, are prominent on the seafloor on the west side of the corridor. The seafloor comprises featureless Coarse-Small between KP 7.0 and KP 7.5, but this rapidly gives way by KP 8.0 into a prominent region of Shells as water depth shoals from 90 m at KP 7.5 to 80 m (Deep Subtidal 2 zone). The region of Shell substrate occupies a band, from 90 m to 220 m wide, in the floor of a prominent north-northeast - south-southwest oriented Bedrock channel. The Shells band is resolved as a series of narrow northeast-southwest oriented ribbons at the mouth of the Bedrock channel that coalesce and curve into alignment with the channel axis, its western margin abutting against the base of the Bedrock channel (Figure 3.4).

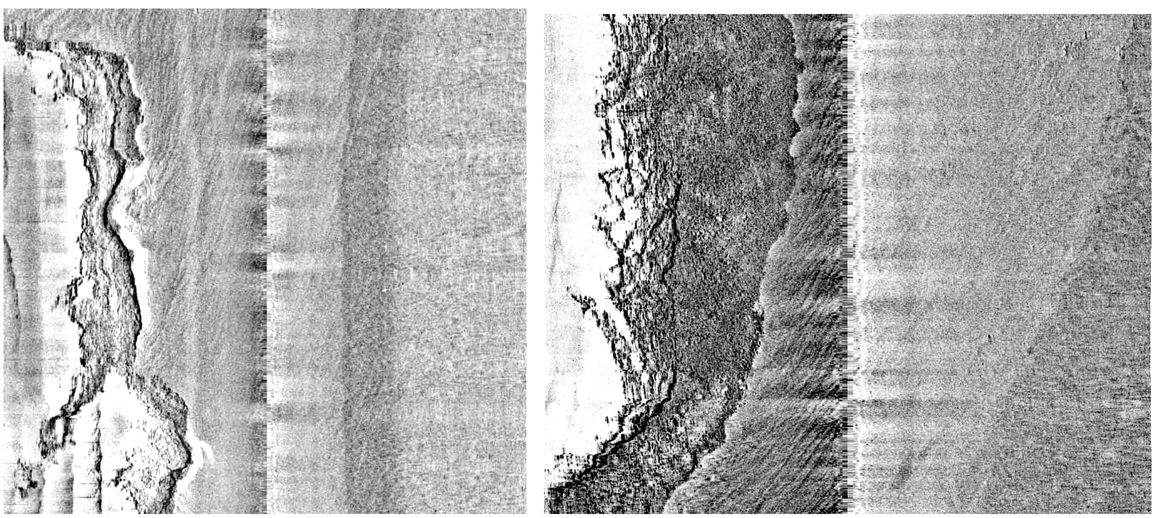
The channel is strongly asymmetric in cross-section with Bedrock cliffs between 20 m and 30 m high rising abruptly above the channel floor on the northwestern side. Average slopes of the cliff from the crest to the base are between 14° and 22°, but the sidescan imagery suggests a strongly step-like, bedding-plane - controlled cliff that may have vertical slopes between bedrock steps. The cliff top elevation descends from 60 m water depth in the north to 80 m at KP 13. The smooth Shells substrate within the channel floor slopes gently upwards towards the southeast. The southeastern margin, comprising mostly Coarse-Small between KP 8.0 and KP 9.5, gradually rises to water depths equivalent to the top of the cliff, but with seafloor slopes of between 2.5° and 5°. Between KP 9 and KP 13 at its southern end, the southeastern margin of the channel comprises irregular linear, northeast-southwest oriented outcrops of Bedrock surrounded by Coarse-Large, giving way to Coarse-Small at the southern entrance of the channel.

Figure 3.4. Shells substrate in the Bedrock channel. Shell accumulation near the base of the cliff on the western margin of the Bedrock channel. Video frame grab from the 2008 survey by Amec (image is 30 cm wide).

The contact between the base of the Bedrock cliff and surrounding seafloor is well defined, characterized either as a sharp Bedrock / Shell contact or as a discontinuous talus apron of Coarse-Large (Figure 3.5). Large numbers of narrow Shell ribbons trend obliquely northeast-southwest across the channel floor. These generally terminate against the base of the cliff. Between KP 13 and the western margin of the corridor, the Shell ribbons give way to narrow bands of Shell waves, 20-30 m wide, at the cliff foot. Shell waves are mapped on Enclosure 1 West as a washboard pattern against adjacent Coarse-Small. The Shell wave crests are oriented north northwest - south southeast and have amplitudes of between 20 cm and 50 cm (exceptionally up to 1 m) and crest-to-crest wavelengths of between 4 m and 15 m.

Between KP 11.0 and KP 12.0 Shells give way to predominantly Coarse-Small, but numerous Shell ribbons are developed on the Coarse-Small substrate from this region to KP 14.5. Between KP 13.35 and 13.7, the corridor exits the channel turning southeast. Between KP 13.8 and KP 15.3 a number of irregular Bedrock outcrops occur in two prominent northwest-southeast oriented bands 20 - 30 m wide on either side of the corridor. The Bedrock outcrops occur in conjunction with northeast-southwest oriented ridges of Coarse-Large that represent the berms of relic iceberg scours developed in the very thin sediment above the bedrock. Coarse-Large berms are 1-2 m high, 10-30 m wide and may be traced as linear features for 100-200 m.

Figure 3.5. Seafloor morphology in the Bedrock channel. LEFT: abrupt contact between Bedrock cliff (left) and smooth seafloor of Shells substrate along the northwest margin of the channel. Bedrock steps (lines of dark reflection with white shadow behind) are probably vertical in places. Faint ribbons of Shells substrate (pale lines) can be seen terminating obliquely against the cliff. RIGHT: Example of a talus apron of Coarse-Large at the bottom of the cliff between Bedrock steps of the cliff (left) and Shell ribbons (right). (100 kHz side scan sonographs. Both images are 200 m wide).



3.1.4 Western Corridor: KP 13.8 to 29.3

See Figure 2 West and Enclosure 2 West

Just beyond the region of irregular bedrock outcrops between KP 13.8 and 15.3 the Western Corridor turns to the northeast, and for the next 3 km (to KP 19.0) is oriented parallel to the Coarse-Large berms of relic scours, upon a seafloor that is generally dominated by Coarse-Small. Minor, small and irregular outcrops of Bedrock occur in this region. The corridor turns to the south between KP 19.0 and KP 21.0, curving back again towards the east between KP 21.0 and KP 23.0. In this region the seabed is largely comprised of featureless Coarse-Small substrate with minor areas of Coarse-Large occurring in irregular patches. At KP 24 relic, linear scour mark berms of Coarse-Large again become numerous within the Coarse-Small substrate. Berms are 1-2 m in height (exceptionally 3 m) and 10-15 m wide, often coalescing into wider zones 50 – 70 m wide.

At KP 24.5 a bedrock exposure interrupts the Coarse-Large scour mark berms on the south side of the corridor. The outcrop has vertical relief of 10 m above the surrounding seafloor (90 – 100 m water depth). Coarse-Large relic scour mark berms, surrounded by Coarse-Small substrate, continue to where the route turns south between KP 28 and KP 29. However, between KP 26.5 and KP 29 Coarse-Large berms are absent on a terrace on the southern side of the corridor. The terrace has vertical relief of between 10 m and 18 m and is characterized by Coarse-Small. The terrace represents a region of thinly-mantled bedrock that trends northeast-southwest to where the corridor turns. At the turn linear bands of Bedrock outcrop at the seafloor (Figure 3.6), trending in the same general orientation as the adjacent Coarse-Large scour mark berms. At KP 29 a small rounded Bedrock bluff represents the northeast end of the thinly-mantled terrace, and here has vertical relief of 10 m (70 – 80 m water depth).

Figure 3.6. Bedrock substrate at KP 28.5. Video frame grab from the 2008 survey by Amec (image frame is 30 cm wide, but the video camera is above seafloor so field of view in middle and upper frame is estimated to from approximatley 1 m to 2 m wide).

Beyond KP 29 bedrock exposures disappear, Coarse-Large scour mark berms are absent, and the seafloor is characterized by more or less uniform Coarse-Small.

3.1.5 Western Corridor: KP 29.3 to 35.1

See Figure 3 West and Enclosure 3 West

Smooth, featureless seafloor comprising Coarse-Small characterizes the region between KP 29.3 and KP 31. Minor Bedrock outcrops occur from KP 30.5 and large exposures become common from here to the end of the sidescan survey coverage at KP 33.8. The 1.2 km-long nearshore region to the high water mark landing point at KP 35.1 was not surveyed in 2007 because water depths were too shallow for safe operation of the sidescan sonar.

3.1.6 Western Corridor: Forteau Point Segment KP 0 to 4.3

See Figure 3 West and Enclosure 3 West

Southeast from Forteau Point, the corridor emerges from the coast (at KP 0) across 475 m of unsurveyed seafloor to the 46 m isobath (Deep Subtidal 1 zone). From KP 0.475 the seafloor substrate comprises Coarse-Small with a transition to a mixed substrate of Coarse-Small / Shells in the vicinity of KP 1.0 (Figure 3.7). Northeast-southwest - oriented bands of Shells and Coarse-Large begin to appear at the 90 m isobath near KP 2.0. In the Deep Subtidal 2 zone the bands of Shells taper out at around KP 3.0, as Coarse-Large becomes more dominant in large, irregular bands associated with localized Bedrock at the junction of this Corridor segment with the Western Corridor at KP 4. The Coarse-Small / Shells substrate in this region is characterized by larger lithic fragments (Figure 3.8).

Figure 3.7. Mixed Coarse-Small / Shells substrate at approximately KP 1.5. Video frame grab from the 2008 survey by Amec (image is 30 cm wide).

Figure 3.8. Mixed Coarse-Small / Shells substrate at approximately KP 4.8. Lithic fragments are larger in this region. Video frame grab from the 2008 survey by Amec (image is 30 cm wide).

3.2 Substrate Characteristics by Area and Depth Category

The following tables provide an overview of the marine habitats within the two Strait of Belle Isle cable corridors, as derived from the analysis of the 2007 sidescan and 2008 seafloor camera data (Tables 3.1 – 3.5). The tables summarize the various habitat (substrate) types by area and water depth. The combined data for both corridors are summarized in Table 3.6. Results from the combined 2008 camera data analysis are summarized in Table 3.7. Figure 3.9 is a synoptic map of both corridors showing water depth and all substrate classes.

Table 3.1. Shallow Subtidal (0-30 m depth): Substrate Class Distribution from Sidescan

Substrate Class	Area (km^2)	Area (%)
Bedrock	0.517	21.7
Coarse-Large	0.000	0.00
Coarse-Small	1.495	62.76
Coarse-Small/Shells	0.000	0.00
Shells	0.000	0.00
Fine	0.370	15.53
Total	**2.382**	**100**

Table 3.2. Deep Subtidal 1 (30 – 60 m depth): Substrate Class Distribution from Sidescan

Substrate Class	Area (km^2)	Area (%)
Bedrock	0.178	11.36
Coarse-Large	0.000	0.00
Coarse-Small	1.031	65.79
Coarse-Small/Shells	0.252	16.08
Shells	0.001	0.06
Fine	0.105	6.7
Total	**1.567**	**100**

Table 3.3. Deep Subtidal 2 (60 - 90 m depth): Substrate Class Distribution from Sidescan

Substrate Class	Area (km^2)	Area (%)
Bedrock	0.72	8.72
Coarse-Large	0.59	7.14
Coarse-Small	5.89	71.31
Coarse-Small/Shells	0.66	7.99

Shells	0.40	4.84
Fine	0.00	0.00
Total	**8.26**	**100**

Table 3.4. Deep Subtidal 3 (90 - 120 m depth): Substrate Class Distribution from Sidescan

Substrate Class	Area (km^2)	Area (%)
Bedrock	0.366	2.35
Coarse-Large	3.325	21.37
Coarse-Small	10.290	66.13
Coarse-Small/Shells	1.021	6.56
Shells	0.559	3.59
Fine	0.000	0.00
Total	**15.561**	**100**

Table 3.5. Deep Subtidal 4 (120 - 150 m depth): Substrate Class Distribution from Sidescan

Substrate Class	Area (km^2)	Area (%)
Bedrock	0.000	0.00
Coarse-Large	0.020	4.11
Coarse-Small	0.467	95.89
Coarse-Small/Shells	0.000	0.00
Shells	0.000	0.00
Fine	0.000	0.00
Total	**0.487**	**100**

Table 3.6. Substrate Class Distribution from Sidescan: Entire Surveyed Region of Both Corridors

Substrate Class	Area (km^2)	Area (%)	No. of polygons in each Substrate Class
Bedrock	1.604	5.72	386
Coarse-Large	3.934	14.02	804
Coarse-Small	19.174	68.35	105
Coarse-Small/Shells	1.932	6.89	6
Shells	0.960	3.42	131
Fine	0.448	1.6	1
Total	**28.052**	**100**	**1433**

Table 3.7. Substrate Class Distribution from 2008 Seafloor Camera: Entire Surveyed Region of Both Corridors

Substrate Class	Distance (km)	Area (%)
Bedrock	2.066	4.0
Coarse-Large	15.926	30.6
Coarse-Small	27.648	53.1
Coarse-Small/Shells *	N/A	N/A
Shells	5.39	10.4
Fine	1.006	1.9
Total	**52.036**	**100**

* Coarse-Small/Shells is a hybrid substrate class created for the sidescan analysis. This class was not identified for the 2008 camera survey performed by Amec Earth and Environmental (Amec 2009).

4.0 SUMMARY AND DISCUSSION

Sidescan data collected in 2007 were interpreted with the benefit of ground-truthing from camera data collected in 2008. Matching characteristic sidescan acoustic backscatter intensity with overlapping camera data allowed extrapolation of substrate types across the entire width of the two 500 m wide seafloor cable corridors. The estimated surveyed area of seafloor imaged by seafloor camera in 2008 was 0.052 km^2 and the actual surveyed area covered by sidescan sonar data in 2007 was 28 km^2 (a ratio of 1 to 539). In essence, the camera transects are a one-dimensional view of the seafloor. Sidescan imagery represents a two-dimensional view enabling substrate boundaries to be recognized and traced with some precision within the cable corridors.

Exposed Bedrock occurs over 5.7% of the seafloor within the two survey corridors. The majority of Bedrock occurs on the steep western margin of a deep, bedrock-controlled valley between KP 8 – 13 (Western corridor).

Coarse-Large occurs over 14% of the seafloor. Most of this substrate class occurs in the berms, or side mounds, of relic iceberg scours. Coarse-Small covers 68.3% of the seafloor, and is the dominant substrate class within the two corridors.

Shells cover 3.4% of the seafloor. All of the Shell deposits occur as thin, narrow stringers, usually above Coarse-Small. The only exception to the stringers is the Shells deposit that occupies most of the floor of the bedrock-controlled valley (KP 8 – 13, Western corridor).

Coarse-Small/Shells comprise 6.9% of the seafloor. This hybrid category was added because of the presence of regions where roughly equal proportions of Coarse-Small and of Shells could not be assigned logically to one substrate. Sidescan occurrences of the Coarse-Small/Shells substrate are noted where the two routes converge in Forteau Bay and along the Forteau Point branch. The Coarse-Small/Shells substrate is not expressed in the form of stringers, unlike Shell deposits, and occur instead as more regional units.

Fine is mapped over 1.6% of the seafloor. This substrate is restricted in distribution to an easily identifiable narrow band close to the shore at L'Anse Amour.

5.0 REFERENCES

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APPENDIX A

Map Enclosures