LABRADOR – ISLAND TRANSMISSION LINK

Environmental Assessment Registration
Pursuant to the *Newfoundland and Labrador Environmental Protection Act*

Project Description
Pursuant to the *Canadian Environmental Assessment Act*

Submitted by Nalcor Energy
January 29, 2009

PREFACE

This *Environmental Assessment Registration* and *Project Description* is submitted by Nalcor Energy in relation to the proposed **Labrador – Island Transmission Link** (the Project).

The Project involves the construction and operation of an approximately 1,200 km long transmission line and associated infrastructure within and between Labrador and the Island of Newfoundland. A High Voltage Direct Current (HVdc) transmission system will be established from Gull Island in Central Labrador to Soldiers Pond on the Island's Avalon Peninsula, and will include the following key components:

- a converter station at Gull Island;
- an overhead HVdc transmission line from Gull Island to the Strait of Belle Isle;
- cable crossings of the Strait of Belle Isle with associated infrastructure;
- an overhead HVdc transmission line from the Strait of Belle Isle to the Avalon Peninsula;
- a converter station at Soldiers Pond; and
- two electrodes with connecting overhead lines.

This submission will initiate the provincial and federal environmental assessment processes for the Project. It is a Registration under the Newfoundland and Labrador *Environmental Protection Act* (Part X) and a Project Description intended to commence the federal environmental assessment process under the *Canadian Environmental Assessment Act*.

Nalcor Energy conducted extensive engineering and environmental programs in relation to the Project from 2006 – 2008, with additional studies and analysis on-going and planned for 2009 and beyond. This work is building upon previous studies related to the transmission of electricity between Labrador and the Island of Newfoundland that began over 30 years ago.

As a result, there exists an extensive body of knowledge about the Project, the natural and human environments through which it will extend, and the key questions and issues related to the Project and its potential interactions with the environment. This information and understanding has been and will continue to be invaluable in ongoing Project planning and design.

Nalcor Energy is committed to sustainable development, and to maintaining a high standard of environmental responsibility and performance. The corporation, through its subsidiaries and their previous development projects and activities, has an outstanding record of environmental protection and stewardship, which has been achieved through a comprehensive and effective environmental management system and associated plans and procedures. This experience will be applied to the planning and development of this Project, in order to avoid or reduce potential environmental effects during its construction and operations phases.

As proponent, Nalcor Energy is very encouraged by the substantial environmental and socioeconomic benefits that will be realized through this Project, and is confident that environmental questions and issues that may be associated with the proposed development can be addressed through sound Project planning and implementation, supported by public and stakeholder consultation and involvement throughout.

A key purpose and rationale for the proposed *Labrador – Island Transmission Link* is to put in place infrastructure to further interconnect Newfoundland and Labrador with the North American electricity system, and thus, set the stage for further development and growth in the province's energy sector and overall economy.

It will also play an important part in ongoing efforts towards securing an adequate, reliable and sustainable electricity supply for Newfoundland and Labrador, to address the current and future needs of the province's residents and industries.

The Project is in keeping with, and represents a key aspect of, the province's *Energy Plan*, which was released by the Government of Newfoundland and Labrador in September 2007.

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1.0 INTRODUCTION

PROJECT NAME: *Labrador – Island Transmission Link*

Nalcor Energy is proposing to develop a transmission system within and between Labrador and the Island of Newfoundland. The following provides a general overview of the proposed *Labrador – Island Transmission Link* (the Project), outlines the purpose of this Environmental Assessment Registration / Project Description, identifies the proponent, and describes the regulatory context for the Project.

1.1 Nature of the Undertaking

A High Voltage Direct Current (HVdc) transmission line and associated infrastructure will be established between Gull Island in Central Labrador and Soldiers Pond on the Island of Newfoundland's Avalon Peninsula (Figure 1.1). The ± 450 kV HVdc transmission system will include the following key components:

- a converter station at Gull Island;
- an overhead HVdc transmission line from Gull Island to the Strait of Belle Isle;
- cable crossings of the Strait of Belle Isle with associated infrastructure;
- an overhead HVdc transmission line from the Strait of Belle Isle to the Avalon Peninsula;
- a converter station at Soldiers Pond; and
- two electrodes with connecting overhead lines.

A key rationale for the Project is to put in place infrastructure to further interconnect the province with the North American electricity system, in order to facilitate the future import and export of electricity between mainland North America and Newfoundland and Labrador, and thus, help to set the stage for further development and growth in the province's energy sector (see Section 2.1). The proposed transmission link can also take advantage of the opportunity to transmit 800 megawatts (MW) of power from the proposed Lower Churchill Hydroelectric Generation Project to the Island of Newfoundland, in order to help the province meet its present and future energy needs. Additional capacity will also be available should future developments or market decisions require that additional power be transported over the HVdc system for use and/or export.

Commencing in 2009 with detailed engineering and the procurement and manufacture of key long-lead components, the current schedule would see construction begin in 2011 and conclude in late 2014, followed by Project commissioning and operations in 2015. Chapter 2 provides a Project description.

Through its Newfoundland and Labrador Hydro and Churchill Falls subsidiaries, Nalcor Energy has constructed and currently operates hydroelectric facilities and transmission lines throughout Newfoundland and Labrador. This experience will be applied to the planning and development of this Project. There also exists an extensive body of knowledge about the Project, the surrounding biophysical and socioeconomic environments, and potential environmental interactions. This, in combination with the fact that the environmental effects of transmission lines are generally well understood and manageable, means that the Project can and will be planned and implemented to avoid or reduce potential adverse environmental effects and to optimize benefits.

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FIGURE 1.1

Labrador - Island Transmission Link

1.2 Purpose of the Project Registration and Description Document

The Project is subject to Part X of the Newfoundland and Labrador *Environmental Protection Act* (*NL EPA*) and the provisions of the *Canadian Environmental Assessment Act* (*CEAA*). This document is intended to initiate the provincial and federal environmental assessment processes pursuant to the *NL EPA* and *CEAA*, respectively. In doing so it:

- provides an overview of the Project, and its purpose, rationale and need;
- identifies the Proponent and describes its environmental management approaches and procedures;
- describes the key components and activities associated with the Project, and ongoing planning and design work;
- provides an overview of the environmental setting for the Project; and
- describes ongoing and planned Project-related consultation activities and environmental considerations that have been identified to date, as well as Nalcor Energy's current plans and approaches for addressing these potential issues.

1.3 The Proponent

Newfoundland and Labrador has an immense and diverse energy warehouse. In 2007, guided by a long-term *Energy Plan* to manage these energy resources, the Government of Newfoundland and Labrador created a new provincial energy corporation, recently named *Nalcor Energy*.

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President and Chief Executive Officer:	Edmund J. Martin
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Nalcor Energy's foundation is built on its core business - the generation and transmission of electrical power – and the corporation has a strong commitment to providing safe, reliable and dependable electricity to its utility, industrial, residential and retail customers. Beyond that core business, the corporation's focus has expanded into the broader energy sector, including oil and gas, wind energy, and research and development.

Nalcor Energy is leading the development of the province's energy resources, and is focused on environmentally-responsible and sustainable growth. The corporation has five lines of business:

1) *Newfoundland and Labrador Hydro*: A Crown corporation and subsidiary of Nalcor Energy, Hydro generates, transmits and distributes electricity to industrial, utility and rural residential customers throughout Newfoundland and Labrador. With an installed generating capacity of 1,635 MW (of which 58 percent is hydroelectric generation), Hydro's power generating assets consist of nine hydroelectric plants, one oil-fired thermal plant, four gas turbines, 25 diesel plants, and thousands of kilometres of transmission and distribution lines (Figure 1.2). Hydro is dedicated to delivering safe, reliable, least-cost power to residents, businesses and industries of the province, and has been doing so for over 50 years.

2) *Churchill Falls*: The Churchill Falls Generating Station is one of the largest hydroelectric generating stations in the world. The plant has 11 turbines with a rated capacity of 5,428 MW. In 2007, more than 33 terawatt hours (TWh) of electricity was produced, with the majority of that energy sold to Hydro-Québec through a long-term power purchase contract set to expire in 2041. Most of the remaining production is used for mining operations in Labrador West and Hydro's Labrador Interconnected System, with any excess power sold to Hydro-Québec under a short-term recall agreement. The company also operates the town, including a school, grocery store, theatre, library and recreational facilities.

3) *Lower Churchill Project*: The Churchill River in Labrador is a significant source of renewable electrical energy. While the existing Churchill Falls facility harnesses about 65 percent of the river's generating potential, the remaining 35 percent is located at two sites on the lower Churchill River - Gull Island (2,250 MW) and Muskrat Falls (824 MW). The proposed Lower Churchill Project is one of the best undeveloped hydro resources in North America. It is one of the key elements in the province's energy warehouse, and provides an opportunity for Newfoundland and Labrador to meet its own energy needs in an environmentally-sustainable way, with enough power remaining to export to other jurisdictions where the demand for clean energy is growing. Nalcor Energy is actively working towards the development of the Lower Churchill Project.

4) *Oil and Gas*: Nalcor Energy-Oil and Gas holds and manages oil and gas interests on behalf of the Province of Newfoundland and Labrador. The Company is committed to the growth and marketing of oil and gas development opportunities around the world and is currently partner in two developments offshore Newfoundland and Labrador - the Hebron oil fields, the province's fourth offshore oil project, and the White Rose Expansion Project.

5) *Bull Arm Fabrication*: The Bull Arm facility was constructed by the Hibernia Management and Development Company (HMDC) in 1990 for the Hibernia project. In 1998, HMDC transferred ownership of the site to the Province and the Bull Arm Site Corporation (BASC) was formed. Since that time, fabrication and other work associated with the Terra Nova FPSO, White Rose project, Voisey's Bay nickel project and the Henry Goodrich drill rig has been completed at the site. The transfer of the site, to be operated as a

subsidiary of Nalcor Energy, ensures this key asset is ready and available to maximize the benefits to the province from the number of large-scale construction and fabrication projects on the horizon.

Additional information can be obtained at Nalcor Energy's website at *www.nalcorenergy.com*

Figure 1.2 Existing Newfoundland and Labrador Generation and Transmission System

1.4 Environmental Assessment Processes and Requirements

In Newfoundland and Labrador, proposed developments may be subject to provincial and/or federal environmental assessment requirements.

The *NL EPA* requires anyone who plans a project that could have a significant effect on the natural, social or economic environment (an "Undertaking") to present it for examination through the provincial environmental assessment process. Under *NL EPA*, this Project is considered an Undertaking subject to Part X, and pursuant to Section 34(2) of the associated *Environmental Assessment Regulations*:

> *34. (2) An undertaking that will be engaged in the construction of new electric power transmission lines or the relocation or realignment of existing lines where a portion of a new line will be located more than 500 metres from an existing right of way shall be registered.*

Following public and governmental review of this Registration, the Minister of Environment and Conservation will determine whether the Project may proceed, subject to any terms and conditions and other applicable legislation, or whether further environmental assessment is required.

The federal environmental assessment process under *CEAA* applies to projects that involve the federal government - as proponent, regulator, and/or source of funding or land. A number of federal departments and agencies may have decision-making responsibilities in relation to this Project or particular portions of it, which may trigger federal environmental assessment requirements. Potentially applicable *Law List Regulations* triggers may include, for example, the issuance of authorizations by:

- Fisheries and Oceans Canada (DFO), for work with the potential for harmful alteration, disruption or destruction of fish habitat pursuant to Section 35(2) of the *Fisheries Act*;
- Transport Canada, for work on, over, under, through, or across a navigable waterway pursuant to Section 5(1) of the *Navigable Waters Protection Act*;
- Environment Canada, for the disposal of dredged material or other matter at sea pursuant to Section 127(1) of the *Canadian Environmental Protection Act*; and/or
- Industry Canada, for sites on which radio apparatus may be located as well as the erection of towers pursuant to Section 5(1) of the *Radiocommunication Act*.

Other potential *CEAA* triggers may also apply to some or all of the Project. For example, Parks Canada Agency may be requested to provide federal lands and/or other approvals for the purpose of enabling the Project to be carried out. Other than this, there are presently no known additional requirements for the acquisition of federal land to enable the Project to proceed. The *CEAA* process may also be triggered as a result of any potential financial assistance which may eventually be provided by a federal department or agency. Federal departments and agencies may also be in possession of specialist or expert information or knowledge that is applicable to an environmental assessment of the Project. The relevant federal Responsible Authorities (RAs) will ensure that an appropriate environmental assessment is conducted under *CEAA* prior to the issuance of applicable federal permits and authorizations and/or the provision of other relevant federal support for the Project.

In addition to approvals under the provincial and federal environmental assessment processes, the Project will also require a number of other provincial, federal and municipal authorizations. These are discussed further later in this document and outlined in Appendix A.

2.0 PROJECT DESCRIPTION

The Project involves the construction and operation of an HVdc transmission system within and between Labrador and the Island of Newfoundland.

2.1 Purpose, Rationale and Need

Nalcor Energy's foundation is built on its core business - the generation and transmission of electrical power – and the corporation has a strong commitment to providing safe, reliable and dependable electricity to its utility, industrial, residential and retail customers. Beyond that core business, the corporation's focus has also expanded into the broader energy industry, and Nalcor Energy is leading the overall development of the province's energy sector.

A key purpose and rationale for the proposed Labrador – Island Transmission Link is to put in place infrastructure to further interconnect the province with the North American electricity system, in order to help set the stage for further development and growth in the province's energy sector (as described below).

The Project also presents an opportunity to transmit power from Labrador to the Island (Section 1.1), and will therefore also play an important part in ongoing efforts towards securing an adequate, reliable and sustainable electricity supply to address the current and future needs of the province's residents and industries. The Project will, in particular, enable the displacement of existing generation from the Holyrood Thermal Generating Station in eastern Newfoundland, in order to address the air quality issues that are currently associated with that facility's emissions.

The proposed Labrador–Island Transmission Link represents a key component of the provincial *Energy Plan* which was released by the Government of Newfoundland and Labrador in September 2007. The *Energy Plan* states that: "*The Government of Newfoundland and Labrador will build a transmission link between Labrador and the Island...*" (p. 41).

The transmission link will further interconnect Newfoundland and Labrador with the North American electricity system, and therefore, help to facilitate additional electricity import and export between Newfoundland and Labrador and mainland North America. The Project will be connected to the North American grid via other transmission infrastructure in Labrador and elsewhere, which will allow power to be transmitted from Labrador and the North American system to Newfoundland, as well as in the opposite direction, permitting possible power exports from Newfoundland to the North American market. The Project will therefore help facilitate the development of other energy resources in the province for local use and export.

The existence of the transmission link would also improve the viability of a future maritime transmission line to eventually transmit power from the province into the Maritimes and beyond. The HVdc system has been designed to meet applicable electrical design requirements, and therefore, inherently has extra power capacity built in (Section 2.4). In the event that future developments and market decisions require that additional power from the province be transported over the HVdc system for use and/or export, the Project's transmission line infrastructure would be adequate to address this requirement. The Project may therefore help facilitate the eventual further export of power from Newfoundland and Labrador to mainland Canada via the Maritimes.

Any additional development projects and/or transmission infrastructure which may be associated with such power use and/or export will be presented for environmental review by the relevant proponent(s) of those project(s), once they are determined and defined.

The Newfoundland and Labrador *Energy Plan* summarizes the purpose, rationale and need for the Project, as well as outlining some of its important environmental and socioeconomic benefits. These include:

- significant direct, indirect and induced employment and business opportunities and economic benefits to the people of Labrador and the Island during Project construction and operation;
- the provision of a sustainable energy supply for Newfoundland and Labrador, which will enable the province to meet almost all of its electricity requirements with clean and renewable electricity;
- the displacement of existing generation from the Holyrood Thermal Station, to address air quality issues that are currently associated with that facility's emissions, as well as reduce the dependence of the province's electricity supply on imported oil;
- helping to achieve long-term electricity rate stability and certainty in the province, both for local consumers as well as to help attract new industry to the province;
- by allowing for a two-way transmission of power, the link will assist in the development of other energy projects in Newfoundland and Labrador for local use and export; and
- the Project would improve the viability of a future maritime transmission line, to eventually transmit power from the province into the Maritimes.

As proponent, Nalcor Energy is very encouraged by the environmental and socioeconomic benefits that will be realized through this Project. The corporation is also confident that any environmental questions and considerations that may be associated with the proposed Project can be addressed through sound Project planning and implementation, supported by public and stakeholder consultation and involvement.

2.2 Project Planning and Alternatives

The consideration of environmental issues from the earliest stages of Project planning and design is an integral part of Nalcor Energy's approach to its development projects and activities. This approach allows potential environmental issues and interactions to be identified early, such that they can be considered and addressed in a proactive manner through appropriate Project planning and design. The objective is to attempt to avoid adverse environmental effects where possible and practical, or at least, to put in place mitigation measures to ensure that they are reduced to acceptable levels.

This approach is especially relevant in the case of transmission line planning and design. As a linear development, there are typically a range of options and alternative routings that can be considered to meet project objectives. These can be identified and evaluated on the basis of technical, economic, environmental and socio-cultural considerations, in order to select and implement a feasible and acceptable option.

As noted previously, studies related to the transmission of electricity between Labrador and the Island of Newfoundland began over 30 years ago. Nalcor Energy conducted extensive engineering and environmental programs in relation to the proposed transmission link from 2006 – 2008, with additional studies and analysis on-going and planned for 2009 and beyond.

Nalcor Energy's ongoing planning and design activities for the Project are generally based on a process of identifying and analyzing potential transmission line study areas, corridors and then specific routings (at progressively narrower spatial scales and greater detail) based on technical, economic, social and environmental considerations and constraints. This general process is illustrated in Figure 2.1 and described briefly below.

1) Transmission Study Area Selection

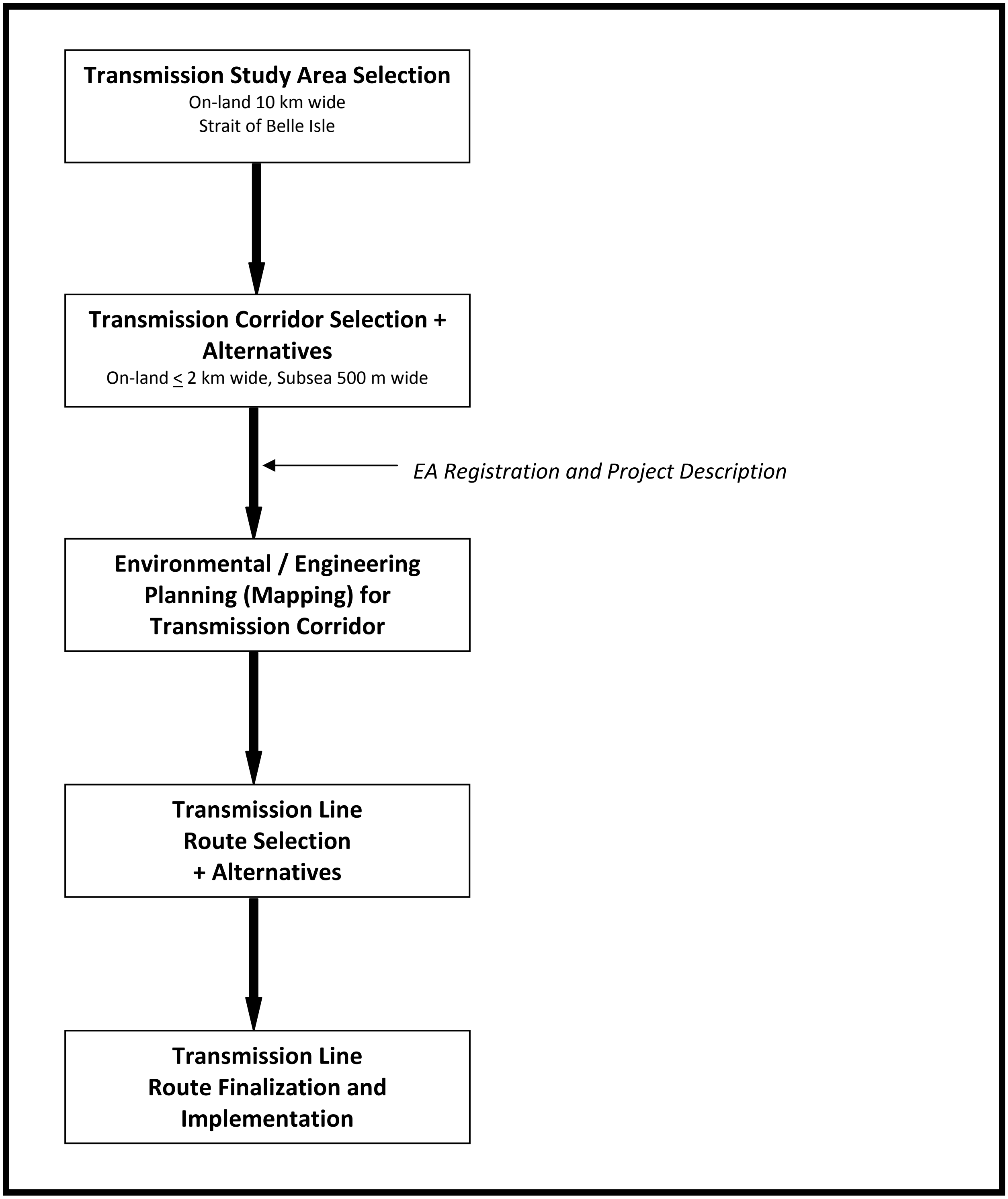
As a first step, Nalcor Energy identified a 10 km wide transmission line study area from Gull Island to Soldiers Pond. This exercise was based initially on a transmission proposal first made in the late 1970s, and involved considerable further analysis considering relevant changes in technology, the natural and human landscapes and any additional information available since that time, including through the extensive engineering and environmental work undertaken by Nalcor Energy since 2006.

Study area selection was completed using 1:50,000 scale mapping and digital topographic data, and was undertaken with a view to reducing the line length to the degree possible, while at the same time identifying and avoiding key known technical and environmental issues and constraints such as difficult topography and meteorological conditions, and known environmentally sensitive areas.

For the Labrador (Gull Island to Strait of Belle Isle) component, study area selection was undertaken to identify a pathway within Labrador that would minimize the overall length of the transmission line, and which would take advantage of the Trans Labrador Highway (TLH, Phase 3) to provide construction and maintenance access, particularly along the central part of the proposed line. The option of following entirely along or adjacent to the TLH (Phases 2 and 3) was also explored, but given the added distance involved (over 200 km) this was not considered to be an economically viable alternative. The study area eventually selected generally represents the shortest distance in Labrador between Gull Island and the Strait, with any deviations being attempts to avoid unfavourable topography such as significant waterbodies, hills and wetlands.

For the Island (Strait of Belle Isle to Soldiers Pond) component, physical environment conditions and constraints were key technical considerations on the Northern Peninsula. HVdc technology is extremely sensitive to salt spray from the maritime environment, so it is necessary to, wherever possible, locate the line further inland from the coast than much of the existing highway and transmission lines along the western side of the peninsula. It was also necessary to attempt to avoid the mountainous terrain at the centre of the peninsula. From the southern end of the Northern Peninsula, an attempt was made to minimize the length of the transmission line across north-central and eastern Newfoundland, while also attempting to take advantage of existing access routes and to avoid unfavourable terrain and existing protected areas. Southeast of Terra Nova National Park, the study area was selected to follow existing transmission lines and roadways to and across the Avalon Peninsula.

Figure 2.1 Labrador – Island Transmission Link Planning Process



In the marine environment, a number of options for the Strait of Belle Isle cable crossings have been considered previously. These include landing sites at L'Anse au Clair, Forteau Bay, Forteau Point, L'Anse Amour and others on the Labrador side, and at Yankee Point, Winter Cove, Mistaken Cove and others on the Island side, as well as various potential cable routings between them.

In 2007 and 2008, Nalcor Energy undertook a significant and comprehensive survey program in the Strait of Belle Isle. The study area generally encompassed the area of the Strait between L'Anse au Clair and Pinware Bay on the Labrador side and from St. Barbe to Green Island on the Island side. The objective of that program was to identify suitable cable crossing corridors and landing points in the Strait. Existing and available information on geology, bathymetry, oceanography, ecology, fisheries, archaeology and other factors were gathered and used as inputs to the 2007-2008 survey program, which involved detailed side scan and multibeam sonar surveys and sub-bottom profiles, as well as an underwater video survey of the seafloor.

2) Transmission Corridor Selection

Following the selection and analysis of the on-land study area described above, including an engineering and environmental reconnaissance helicopter survey undertaken in late 2007, a preferred 2 km wide transmission corridor was selected, as well as various alternative corridor segments for particular areas. Similar to the evaluation and selection of a transmission study area, corridor selection was completed with consideration of a number of factors, but at a finer spatial scale. These included:

- minimizing the length of the transmission line to the degree possible and practical;
- avoiding unfavourable meteorological conditions (such as heavy icing and/or strong winds);
- avoiding difficult terrain where possible;
- minimizing the requirement for new access roads and trails;
- minimizing watercourse and wetland crossings;
- avoiding interactions with communities, protected areas and other known environmentally and socially important areas where possible and practical; and
- avoiding areas of known archaeological and historical significance.

The proposed transmission corridor and alternative segments that were identified through that process are those illustrated in Figure 1.1.

The Long Range Mountains, with their difficult terrain and meteorological conditions (including very heavy ice loading), pose an engineering design challenge for the Project. Operating and maintaining a reliable transmission system which crosses over these mountains would be quite challenging, both from a technical and an economic perspective. This issue is also of particular importance given the significant role that the Project and the electricity it transmits will play for the province and its economy (Section 2.1), which requires that the HVdc system be designed and implemented to a very high level of reliability.

In order to avoid this challenging area and to ensure the required reliability levels are achieved, a number of corridor alternatives are being evaluated for that area. These include an option which would follow along the southwestern portion of the Northern Peninsula and through portions of Gros Morne National Park. This would see approximately 64 km of transmission line constructed within the boundaries of the Park, currently proposed to follow along or adjacent to the existing transmission lines in the area (see Figure 1.2). This option, as well as potential alternative corridors across the Long Range Mountains, are the subject of ongoing engineering and environmental analysis and design, and will be assessed and evaluated as part of any environmental assessment review. Additional information is provided in Section 2.4.4.

With regard to the proposed Strait of Belle Isle cable crossings, the information gathered in 2007 led to the identification of two potential 500 m wide subsea corridors in which to place the cables under the seabed and across the Strait. These were selected primarily because they would provide the greatest natural protection for the cables, giving the quickest access to deep water and making use of natural seabed features to shelter the cables in deep valleys and trenches to minimize the possibility of iceberg contact or interaction with fishing activity. Based on these identified corridors, several alternative landing sites are being considered on the Labrador side, including Forteau Point (the currently preferred option) and L'Anse Amour. On the Newfoundland side, the potential cable landing sites are at Mistaken Cove (preferred) and Yankee Point.

In order to access these natural deep valleys and ocean bed contours and to provide the necessary cable protection, various construction techniques are under consideration, including tunneling, trenching and others. Additional work on the Strait of Belle Isle crossing is ongoing to evaluate these approaches and potential corridors and landing sites, which are also discussed further in the following sections. The eventual selection of a particular method(s) for cable protection will be based on water depths, terrain and seabed geology, substrate characteristics, risk exposure, and overall technical and economic viability.

These on-land (2 km wide) and submarine (500 m wide) transmission corridors and their alternatives are the subject of this Environmental Assessment Registration and Project Description. These are described further later in this Chapter. For specific corridor sections, particularly those proposed within Gros Morne, a more focused 200 m wide corridor has been identified (see Section 2.4.4) as the basis for further analysis and environmental review. Appendix B provides a series of topographic maps which show the proposed transmission corridors and various alternative corridor segments in more detail.

Any environmental assessment of the Project would be conducted in relation to these identified transmission corridors and alternatives, subject to further alteration and refinement as planning and design work continue. It would also identify, discuss and assess alternative means of carrying out the Project that are technically and economically feasible, as required by the provincial and federal legislation.

For specific segments of the proposed transmission line, a specific routing may also be identified and presented in any environmental assessment for review and approval.

3) Detailed Environmental Analysis and Planning for Route Selection

An important principle of environmental assessment is that it should occur at a relatively early stage of, and therefore influence and seek to improve, Project planning and design. Therefore, in conjunction and concurrent with the environmental assessment process, Nalcor Energy will be continuing with its technical and environmental analysis of the identified transmission corridors and alternative segments in order to identify and eventually select a specific routing for the transmission line.

This analysis includes a constraints mapping exercise, which involves the compilation of information on the existing natural and human environments within the transmission corridor, in order to identify and evaluate key environmental and socioeconomic factors and issues for consideration in the eventual route selection process. Inputs to this analysis and planning process will include existing and available information on the biophysical and socioeconomic environments, any additional baseline information collected and issues identified as part of the environmental assessment process, as well as the results of the associated public and stakeholder consultations.

4) Transmission Line Route Selection

Based on the results of the above and further engineering analysis and aerial and ground surveys in the final design stage, a preferred transmission line route (for an on-land right of way averaging approximately 60 m wide) will be defined, as well as various alternative routes for particular areas and segments. Again, these will be evaluated and selected with consideration of technical, environmental and socioeconomic factors through the environmental and engineering work described above. The current transmission corridor is intended to form the basis for eventual detailed route selection, subject to further refinement as Project engineering and environmental work continue.

Once identified, and prior to final Project design and construction, Nalcor Energy plans to conduct public consultations to present these transmission line routing(s) to the interested public and stakeholders. This will serve as a final check on its overall environmental acceptability, and allow for any final amendments to address any important remaining environmental issues, as required and possible.

2.3 The Project

The Project, for the purposes of environmental assessment, consists of the construction and operation of a ± 450 kV HVdc transmission system from Central Labrador to the Island of Newfoundland's Avalon Peninsula and associated infrastructure.

The proposed transmission system will include the following key components:

- a converter station at Gull Island;
- an overhead HVdc transmission line from Gull Island to the Strait of Belle Isle;
- cable crossings of the Strait of Belle Isle with associated infrastructure;
- an overhead HVdc transmission line from the Strait of Belle Isle to the Avalon Peninsula;
- a converter station at Soldiers Pond; and
- two electrodes with connecting overhead lines.

These are described in the following sections. A general overview of the Project is presented in Figure 2.2.

FIGURE 2.2

Labrador - Island Transmission Link: Project Overview

As indicated, the Project is being planned and designed as an HVdc system, rather than the more common High Voltage Alternating Current (HVac) system. This is the case for the reasons outlined below.

Modern electric power systems used to supply industrial, commercial and residential consumers are primarily alternating current (ac) power systems, with ac being the form in which everyday household and commercial power is delivered and used. HVac transmission lines are characterized by having three separate electrical current carrying conductors (or wires), each referred to as a “phase”.

A less common form of power transmission from generating station to load center is HVdc transmission. In contrast to an HVac system, HVdc transmission uses one or two electric current carrying conductors and associated equipment, each referred to as a “pole”. Technology allows for the conversion of ac power to dc, transmission over long distances as dc power, and conversion back to ac power at the receiving end for distribution and use.

For a unit length of transmission line to deliver a fixed amount of electric power, an HVdc configuration requires less conductor material (and as a result, less transmission tower material) than a similar ac system. This, in turn, can greatly reduce the construction cost of the line when compared to an equivalent HVac configuration. However, an HVdc system requires the installation of expensive converter stations at each end of the line, to convert the ac electricity into a dc form for transmission, and subsequently, back into ac form. There is, however, a “break-even distance” with respect to transmission distances for a fixed amount of electric power at which dc systems are more economical than ac systems.

The characteristics of the Island power system, the length of the proposed transmission line between Gull Island and Soldiers Pond, and the length of the submarine component of the transmission link are significant impediments to using an ac transmission system. HVdc technology has therefore been selected for this Project, for both technical and economic reasons.

As described above, the Project is the subject of ongoing planning and engineering design. An overview of the current Project design is presented below, but as with any development project, this will be subject to continued refinement and optimization.

Also, as part of any environmental assessment, alternative means of carrying out the Project that are technically and economically feasible will also be evaluated, including its overall design, layout, technology and methods.

2.4 Project Components and Layout

The following provides a general overview of the Project's key components, based on previous and ongoing engineering studies and reflecting the current stage of Project planning and design.

2.4.1 Gull Island Converter Station

In an HVdc transmission system, the combination of an ac-dc converter, dc transmission line, and dc-ac converter is known as a "pole". This Project has been designed as a *bipole* system, comprised of two transmission paths and two converters of opposite polarity at each end of the circuit.

A converter station will be required at Gull Island to convert ac electricity from the Lower Churchill Hydroelectric Generation Project into dc form. The converter station will be located on the north side of the Churchill River, just south of and adjacent to the switchyard at Gull Island (at coordinates 52^{o}58'28.6" N; 61^{o}23'43.1" W). The proposed Gull Island converter station is illustrated in Figure 2.3.

The converter station is currently being designed with a dc voltage rating of ± 450 kV and an ac voltage rating of 230 kV. The HVdc system is currently planned to transmit 800 MW of power from Gull Island to Soldiers Pond during normal operations (and a minimum of 600 MW in the event of certain system fault conditions).

The converter station will occupy an area of approximately 300 m by 250 m, consisting of a leveled gravel surface yard over a grounding grid. It will consist of concrete foundations and galvanized steel structures to support the electrical equipment and switchgear, and a building (valve hall) containing equipment that requires sheltering from the elements, as well as office and maintenance areas. The facility will not require the establishment of new water and sewage systems at the site. It will be surrounded by a fence and locked gate to restrict access to authorized personnel only.

The converter station will be linked to the Gull Island generating facility's switchyard by 230 kV HVac transmission lines which will each be approximately 200 m in length. Power from the switchyard will be converted into dc form and leave the converter station on a single tower overhead transmission line carrying two electrical conductors (Section 2.4.2).

The specific characteristics of the Gull Island converter station will be determined and finalized during detailed Project engineering. The eventual capacity of the converter station is also subject to further review and refinement, depending upon future energy use and/or export decisions, as described previously (Section 2.1).

The overall capacity of the converter station is determined by the maximum current handling capacity of each pole. Typical current ratings for the associated converter elements are 3,000 A, and so the maximum converter rating at Gull Island could be increased up to 2,700 MW if desired without materially changing the nature, overall size, or location of the Gull Island converter station. The eventual rating, as well as the requirement for converter options, such as bi-directional power transmission capability, will be finalized during detailed planning and design.

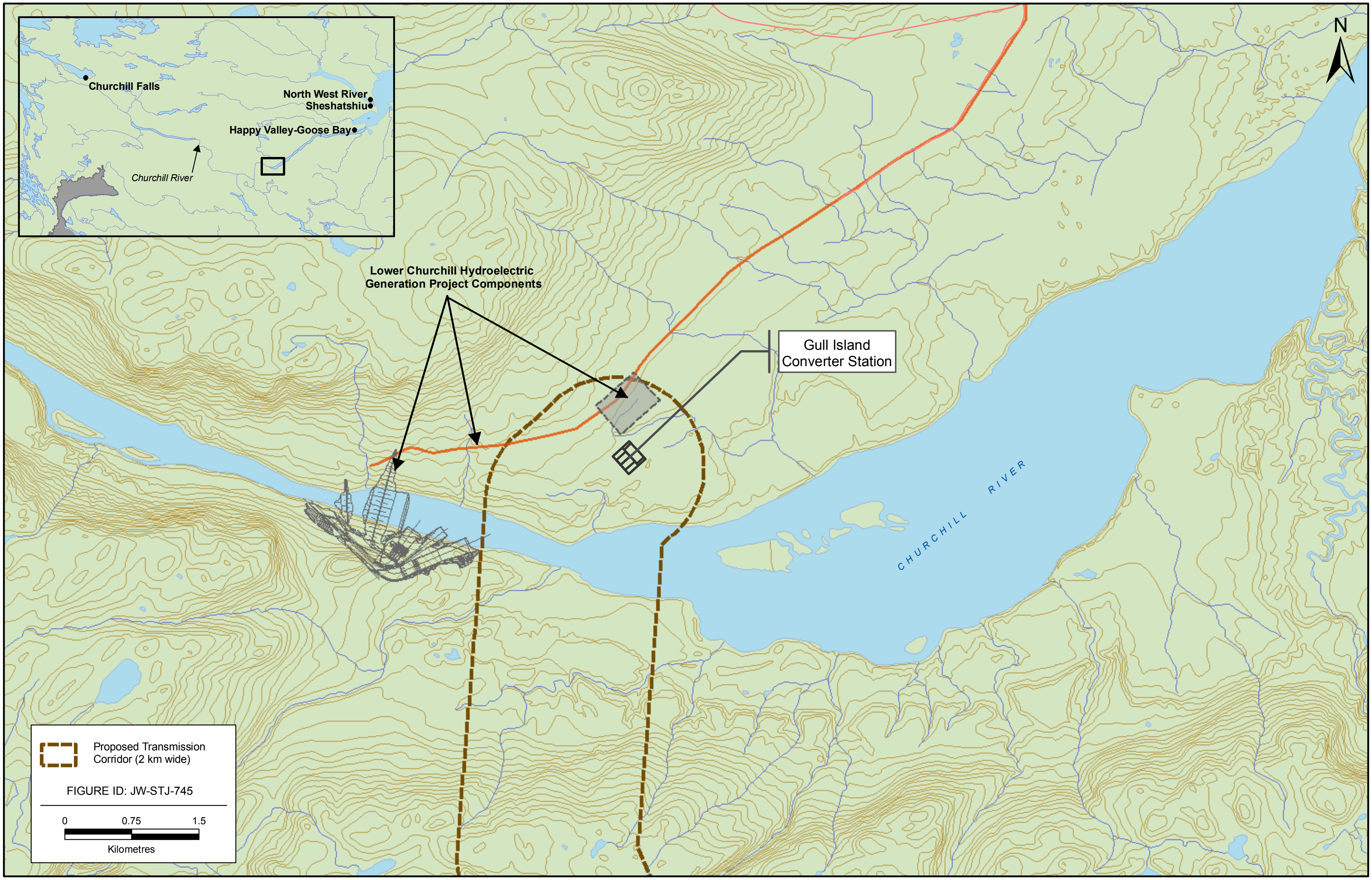


FIGURE 2.3

Gull Island Converter Station

2.4.2 Transmission Line: Gull Island to Strait of Belle Isle

The HVdc transmission line will leave the converter station at Gull Island, cross the Churchill River just upstream of Gull Lake, and travel southeast towards the Strait of Belle Isle for a distance of approximately 407 km (Figure 2.4 and Appendix B).

Under the current development concept, the transmission towers will carry three wires. Two conductors (each approximately 58 mm in diameter) will carry the power, with a third steel overhead ground wire to provide shielding from lightning strikes. The overhead ground wire may also include a fibre optic cable for communication between the converter stations. With this three wire arrangement, the HVdc towers will consist of a single galvanized steel lattice tower, comprised of a frame with two lattice steel crossarms to carry the two power conductors and the overhead shield wire connected to the top of the tower. Tower heights for the line will be governed by clearance issues depending on the terrain at particular sites along the route, but will generally range from 38 m to 49 m and average approximately 43 m in height.

Specific tower span distances will vary and be determined by topographic, meteorological and other environmental conditions and associated technical requirements. Based on an assumed ruling span of 375 m in normal loading zones and 285 m in higher loading zones, there will be approximately 1,100 towers included in the transmission line between Gull Island and the Strait of Belle Isle. A typical HVdc transmission tower is shown in Figure 2.5. Structurally, the HVdc transmission line will be very similar to other existing transmission lines in Newfoundland and Labrador and elsewhere, and will be designed and constructed to meet applicable Canadian Standards. It will comply with *Standard C22.3 No. 1 - Overhead Systems* and *Standard C22.3 No. 60826 – Design Criteria of Overhead Transmission Lines*, set by the Canadian Standards Association (CSA) and issued under the Canadian Electrical Code, Part III.

The transmission line will require a cleared right of way, the width of which will average approximately 60 m. However, this will vary based on design and site-specific conditions (from less than 60 m in some areas, to up to approximately 80 m wide in others). This width is governed primarily by electrical voltage and conductor clearances, and is subject to further definition and refinement as Project engineering and design progress.

Foundations for the transmission towers will consist of steel grillage structures. Locations with weaker soils will require larger and deeper foundations. Tangents and low angle structures will have a single tower foundation and include guy wire supports connected to anchors into the ground. Larger angle and dead-end towers will require four foundations and will be self-supporting structures. Tower foundations will be contained entirely within the transmission line right of way.

The Project’s conductors and transmission towers have been sized to meet applicable electrical design requirements. Conductor design and arrangement for the HVdc system is somewhat different than that of many other transmission lines. Transmission lines operating at 450 kV are generally designed with a "bundle" of two or more relatively small conductors. Given the significant icing issues along sections of the HVdc corridor, however, a bundle would expose the line to much greater ice loading than a single conductor, and as a result, a single (and relatively large diameter) conductor has been selected for the Project. This larger conductor inherently has greater current carrying capacity than is currently required. As a result, in the event that future developments and/or energy market decisions require that additional power be transmitted over the HVdc system, the power transmission levels on the line could be more than doubled without changing the transmission line infrastructure.

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FIGURE 2.4

Transmission Line Corridor: Gull Island to the Strait of Belle Isle

Figure 2.5 Typical HVdc Transmission Tower

As indicated previously, Project planning is currently at a stage of having identified and selected a 2 km wide transmission corridor (Figure 2.4). Any environmental assessment of the Project would be conducted in relation to this corridor and identified alternatives, subject to further alteration and refinement as design work continues.

As also illustrated in Figure 2.4, two corridor options have been identified for a portion of the transmission line near the end at the Strait of Belle Isle, one of which terminates at Forteau Point and the other at L'Anse Amour. The choice of sub-sea cable landing point will in part determine the eventual selection of this section of the corridor (Section 2.4.3).

Detailed routing within the 2 km wide corridor will be determined through an eventual route selection process, on the basis of technical, environmental and socioeconomic considerations (Section 2.2).

2.4.3 Strait of Belle Isle Cable Crossings

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. The proposed Strait of Belle Isle cable crossings, as currently defined and planned, are outlined below.

Various potential submarine cable crossing routes and landing points have been identified and evaluated as part of the current and previous development attempts. Nalcor Energy has and is continuing to evaluate potential cable crossing techniques, corridors, specific routings and landing sites as part of its engineering program for the Project. To date, this work has included detailed subsea surveys of the crossing area using side-scan and multi-beam sonar, sub-bottom profile surveys and underwater video. It has also involved the compilation and analysis of existing and available information on the environmental conditions of the area, including geology, bathymetry, oceanography, environmental sensitivities, fishing activity, known historic sites and other factors.

As a result of this process, two potential cable landing sites have been identified and are currently being considered on the Labrador side - Forteau Point (the currently preferred option) and L'Anse Amour. On the Newfoundland side, two options are also being considered - Mistaken Cove (preferred) and nearby Yankee Point (Figure 2.6). Two proposed submarine cable corridors have also been identified for these cable crossings, which extend from these potential landing sites and across the Strait (Figure 2.6). These were selected based on the 2007 subsea surveys, and with consideration of the natural and anthropogenic characteristics of the crossing area and associated technical and environmental considerations (such as protection from icebergs and fishing gear). These 500 m wide cable corridors are approximately 27 – 36 km in length, depending upon the specific landing site alternatives involved (Figure 2.6 and Appendix B).

Construction of the submarine crossings will include the placement of three to five cables within 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 will therefore be used, minus the inshore segments connecting the alternative landing site options that are not eventually selected for development (Figure 2.6).

Up to 900 MW can be readily transmitted over two working cables, whereas four cables would increase the transmission capability to approximately 1,800 MW. The proactive installation of this additional capacity is being contemplated as part of Project design, in order to address the potential future requirement for additional power to be transported over the HVdc system for use and/or export. In either case, a spare cable will be provided to improve the overall reliability of the Strait of Belle Isle crossing.

Within the two corridors, the cables will travel in essentially independent routes across the Strait, each 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 this manner 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. While the cables themselves will, as indicated above, be installed in relatively narrow routes, considerable flexibility in the specific location of the cable routes within the 500 m corridors will be required up to and during the cable installation process, in order to select and utilize an optimal path for the cable to ensure adequate protection and reliability.

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FIGURE 2.6

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

The specific characteristics and dimensions of the cables will depend on the specific number of cables and crossing routes used, but each cable will be within the range of 140 – 160 mm in diameter and 70 – 90 kg/m in weight. Mass Impregnated (MI) cables are the current choice for the crossings. The MI cable is a conductor insulated with oil impregnated paper with two wound helical armour layers of round wires for protection.

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 ocean bed contours and to provide further required protection, various cable protection techniques are under consideration, including tunneling 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. This also includes the alternative of tunneling to a further distance from various potential points on either side of the Strait to establish a cable conduit to afford maximum protection to the cables. These cable protection approaches and options are described in Section 2.5.2.

The onshore landing stations at either end of the Strait of Belle Isle cable crossings will consist of a concrete or masonry block building located approximately 400 m or more from the water’s edge. These structures will be approximately 50 m long by 50 m wide by up to 16 m high, and will house the switch-works and associated equipment and infrastructure.

On the Labrador side, the overhead HVdc transmission line will terminate at this on-land structure, from within which a cable will extend underground and out under the Strait of Belle Isle. Similarly, on the Island side the cable crossing will continue underground to a point on-land and underneath the building structure, from which the overhead HVdc transmission line to Soldiers Pond will commence.

In order to provide the required telecommunications services for Project operations, a microwave radio system may also be established, consisting of a tower and associated infrastructure adjacent to the cable landing sites on each side of the Strait of Belle Isle. This would provide a connection between the fibre optic cable systems installed over the on-land transmission structures in Labrador and on the Island of Newfoundland. The resulting interconnected telecommunications system would be used for the transmission of control signals for the HVdc system, as well as other operational data and voice traffic.

The microwave radio system would consist of a fenced microwave site (approximately 15 m by 30 m) established on each side of the Strait of Belle Isle. These would be located at or near the proposed cable station structures (as described above), within the identified 2 km wide transmission corridors (Figure 2.6). Each microwave site would include: a telecommunications building to house the various systems required for the operation of the microwave radios, including the communications electronics and battery bank power supply; a structure to house a backup generator with fuel tank; and a microwave tower structure approximately 35 - 50 m in height with three guy wire supports.

All aspects of the proposed microwave radio system, including transmission power and frequencies, will be registered with Industry Canada in accordance with applicable legislation.

2.4.4 Transmission Line: Strait of Belle Isle to Soldiers Pond

The HVdc transmission line will leave the landing site on the Island side of the Strait of Belle Isle, and travel south along the western portion of the Northern Peninsula and then southeast across the Island. It will then cross the Isthmus of Avalon and extend to Soldiers Pond on the northeast Avalon Peninsula (Figures 2.7 and 2.8), for a distance of up to approximately 760 km (depending upon the specific corridor options eventually selected and implemented).

The characteristics of this on-land transmission infrastructure will be very similar to those of the Gull Island to Strait of Belle Isle portion of the line (Section 2.4.2, Figure 2.5), with single towers supporting two conductors (each approximately 58 mm in diameter) and a third steel overhead ground wire to provide overhead shielding, which may also include a fibre optic cable to provide communication requirements.

With such an arrangement, the HVdc towers will be comprised of a galvanized steel lattice frame with two lattice steel crossarms. Tower heights will again range from 38 m to 49 m and average approximately 43 m, as dictated by clearance requirements.

Specific tower span distances will likewise be determined by technical and environmental requirements and considerations. Based on an assumed ruling span of 300 m in normal loading zones and 175-200 m in higher loading zones, there will be approximately 2,500 towers included in the transmission line between the Strait of Belle Isle and Soldiers Pond.

Tower foundation and anchor requirements will be as described previously, with a cleared right of way averaging approximately 60 m (but up to 80 m) wide, within which the tower infrastructure will be located. The transmission line will be designed to meet applicable Canadian Standards, as outlined in Section 2.4.2.

As discussed previously, Project planning and design are currently at a stage of having identified a 2 km wide corridor for most of the on-land portions of the proposed HVdc transmission line, including a proposed corridor and a number of alternative segments in particular areas (Figures 2.7 and 2.8). Appendix B illustrates these proposed and alternative transmission corridors in greater detail.

The Long Range Mountains, with their difficult terrain and meteorological conditions (including very heavy ice loading), pose an engineering design challenge for the Project – including from a technical, cost and overall system reliability perspective (Section 2.2). This issue is also of particular importance given the significant role that the Project and the electricity it transmits will play for the province and its economy (Section 2.1), which requires that the HVdc system be designed and implemented to a very high level of reliability.

In order to avoid this challenging area and to ensure the required reliability levels are achieved, a number of corridor alternatives are being evaluated for that area. These include an option which would follow along the southwestern portion of the Northern Peninsula and through portions of Gros Morne National Park. This would see approximately 64 km of transmission line constructed within the boundaries of the Park, currently proposed to follow along or adjacent to the existing transmission lines in the area (see Figure 1.2).

For those proposed line segments located within the Park, a more focused potential transmission corridor (200 m wide) has been identified, as the basis for further environmental and engineering review (Figure 2.7 and Appendix B), and for detailed route selection and design of the tower infrastructure as Project planning and assessment continue.

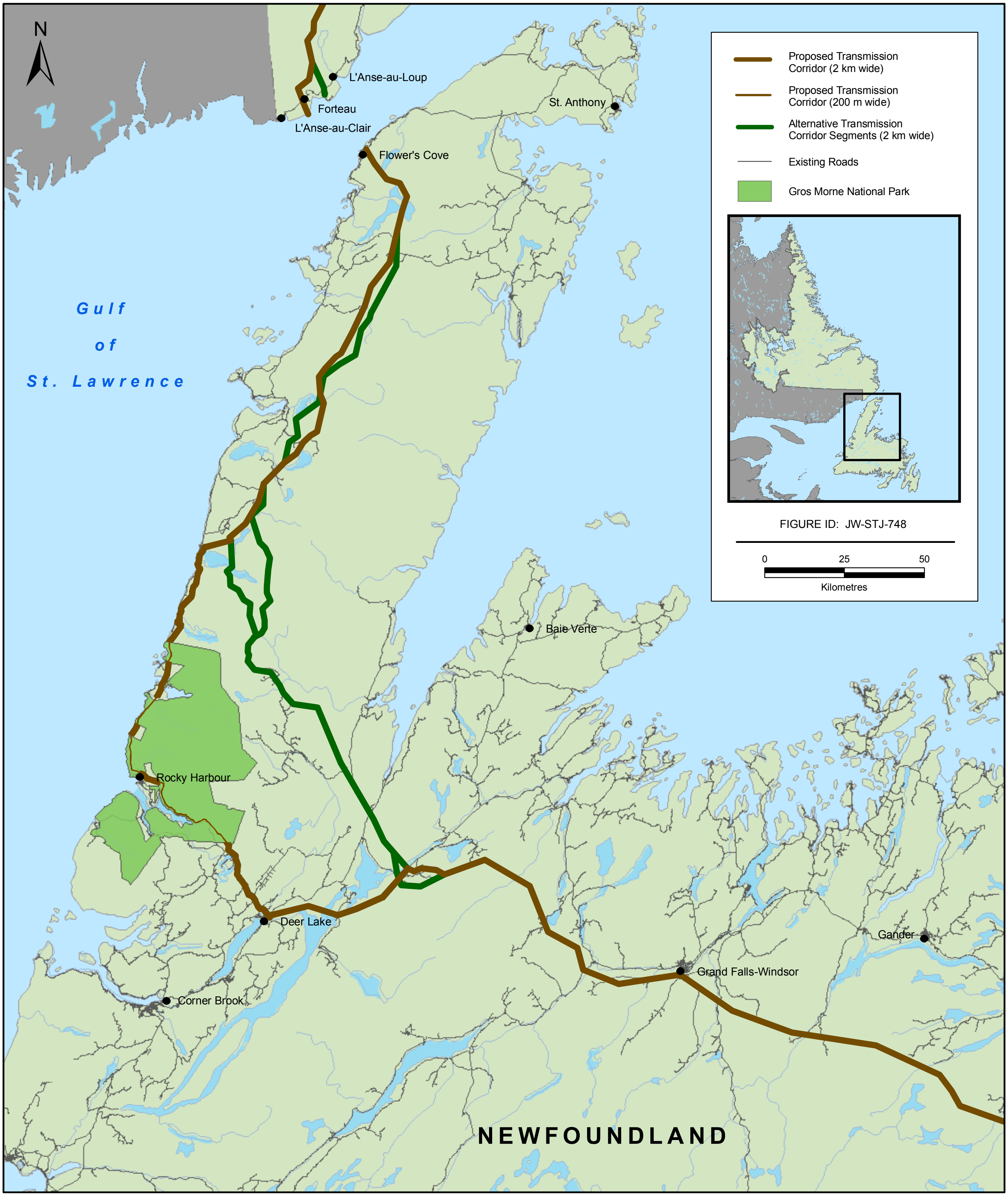

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FIGURE 2.7

Transmission Line Corridor: Strait of Belle Isle to Central Newfoundland

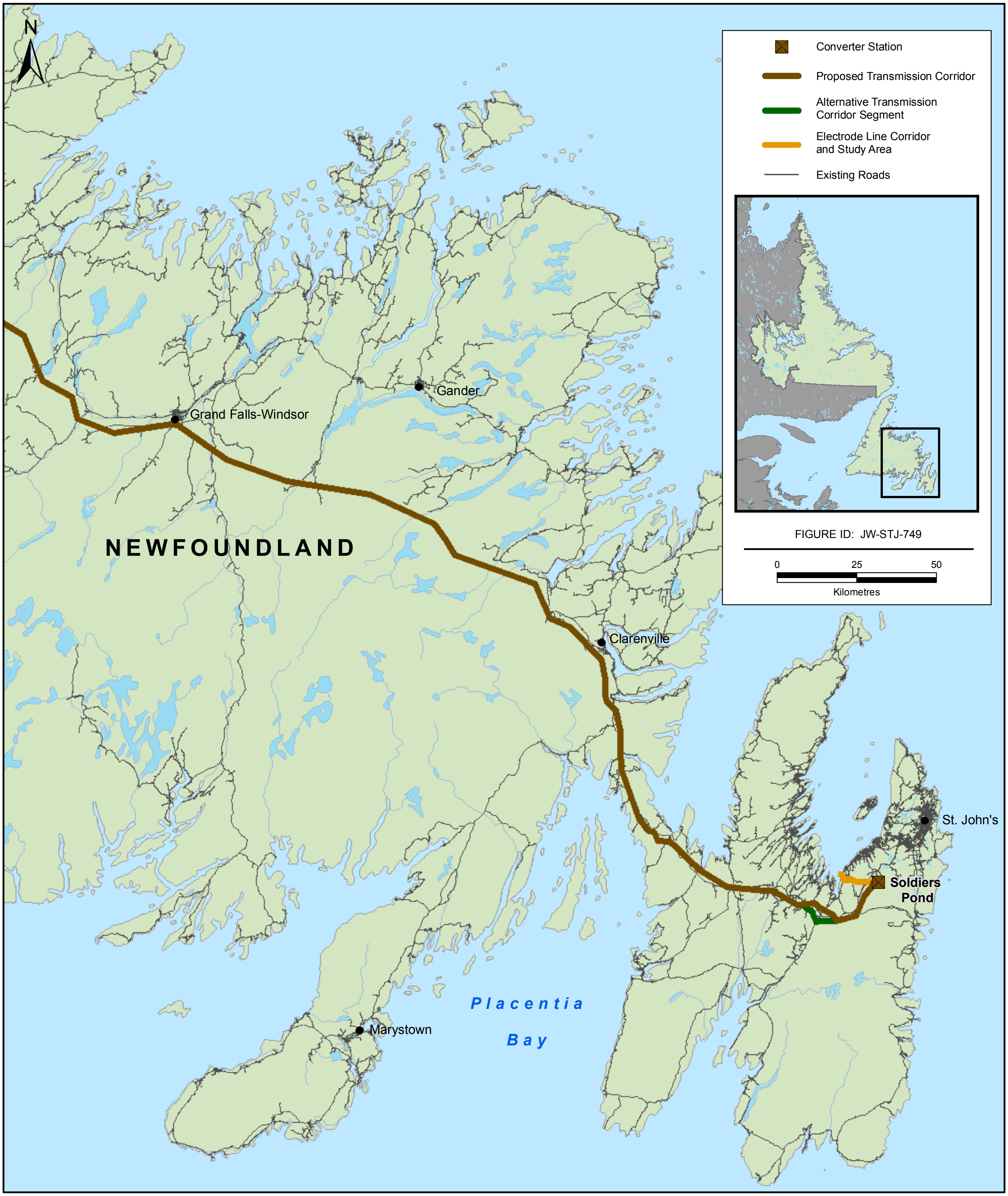

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FIGURE 2.8

Transmission Line Corridor: Central Newfoundland to Soldiers Pond

Nalcor Energy is committed to working with Parks Canada and other stakeholders to explore Project design options that would avoid or reduce potential environmental issues for those proposed sections of the transmission line located within the Park, in order to arrive at a Project concept that is both technically and environmentally acceptable. This may include, for example, the design of towers and other infrastructure, possible transmission line routing options, right of way clearing approaches and widths, the timing of construction and maintenance activities, and other approaches to minimizing any effects on the Park. For these line segments, a specific transmission line routing will likely be defined through, and presented in, any environmental assessment, to seek regulatory approval for a particular route and infrastructure design.

Several alternative 2 km wide corridor segments are also being considered for other portions of the line on the Northern Peninsula (Figure 2.7). These include corridor options based on the various alternative submarine cable landing sites currently being considered, as well as alternative corridors over the Highlands of St. John and the Long Range Mountains due to issues associated with high levels of icing in these areas. In addition, corridor alternatives have been identified in the Birchy Lake area of Central Newfoundland and on the Avalon Peninsula, due to possible land use and other considerations (Figures 2.7 and 2.8). These alternatives are the subject of ongoing engineering and environmental analysis.

Detailed transmission line routing within these 2 km wide corridors will be determined through a comprehensive route selection process on the basis of technical, environmental and socioeconomic considerations (as described in Section 2.2).

For a portion of the proposed transmission line located on the Avalon Peninsula, a specific potential routing has been identified within the 2 km wide corridor, given the relatively intensive existing land use in that region, and because the proposed corridor generally follows along existing transmission lines in the area. This preliminary routing is presented in Appendix B, as the basis for further analysis and review

2.4.5 Soldiers Pond Converter Station and Associated System Upgrades

A converter station is required at Soldiers Pond in order to convert the dc electricity transmitted across the HVdc line back into ac form. That facility will have a dc voltage rating of ± 450 kV and an ac voltage rating of 230 kV.

The Soldiers Pond converter station will be located near the existing system infrastructure at that site, just to the northeast of the pond itself, off the Trans Canada Highway (approximately at coordinates 47^{o} 25'01.2" N; 52 ^{o} 58'38.8" W). The general location of the facility is illustrated in Figure 2.9.

The converter station will be very similar to that proposed at Gull Island (as described in Section 2.4.1), with an area of approximately 300 m by 250 m, consisting of a leveled gravel surface yard over a below surface grounding grid. It will consist of concrete foundations and galvanized steel structures to support the electrical equipment and switchgear, and a building (valve hall) containing infrastructure that requires sheltering from the elements, as well as associated office and maintenance areas. The station will be surrounded by a fence and locked gate to restrict access to authorized personnel only. A new 1.5 km long access road extending from the Trans-Canada Highway to the site will allow for transportation of the required materials and equipment (Figure 2.9).

A total of eight existing transmission lines will be connected to the converter station, through which electricity from the Project will be transmitted to and through the Island grid.

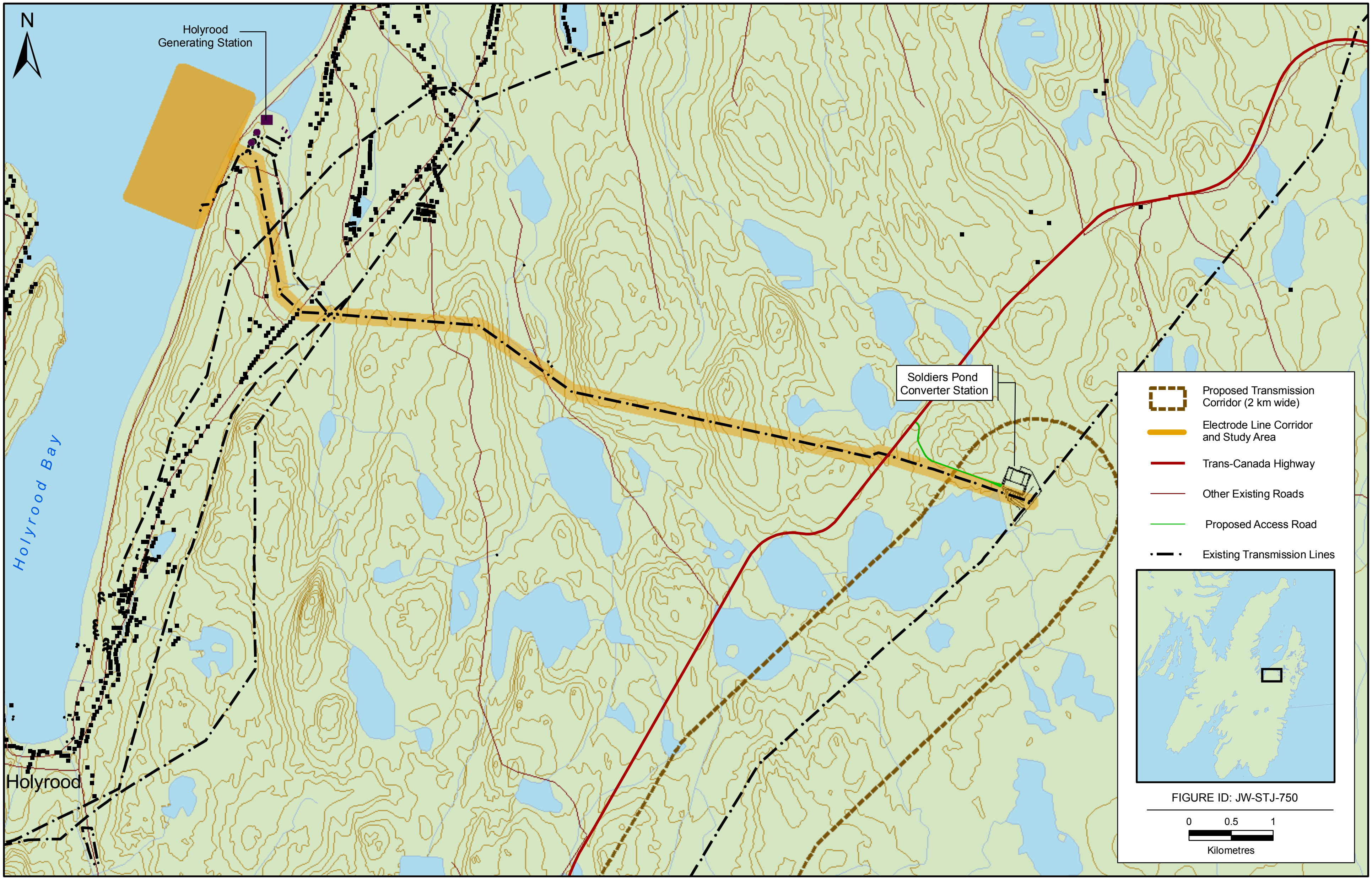

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FIGURE 2.9

Soldiers Pond Converter Station

Some modifications and additions to Newfoundland and Labrador Hydro's existing Island transmission system may be required to successfully integrate the HVdc system, and to accept the power it transmits into the Island grid. Potential additions and modifications to existing infrastructure that may be required include the installation of transmission line compensation equipment, synchronous condensers, static var compensators, circuit breakers, disconnect switches and instrumentation, as well as conductor replacement and mid-span structure installations on some existing transmission lines. Potentially, a new terminal station may also be required in the Come by Chance area, west of the existing terminal station at Sunnyside, as well the possible addition of third line to Newfoundland and Labrador Hydro's existing 230 kV transmission infrastructure from Bay D'Espoir to the Western Avalon terminal station (Refer to system map in Figure 1.2).

The need for, and nature of, any such modifications will be determined through the completion of power system studies carried out during detailed Project engineering. These will primarily involve standard and routine repairs and upgrades to existing infrastructure, occur within and adjacent to existing facilities, and will likely be addressed through Newfoundland and Labrador Hydro's standard and ongoing system maintenance programs. Any additional required components and activities which are specific to the integration of the HVdc system, and which are not part of Newfoundland and Labrador Hydro's ongoing or planned system maintenance program and existing capital plans, will be defined during the next phase of engineering for the Project.

2.4.6 Sea Electrodes

As described previously, in an HVdc transmission system, the combination of an ac-dc converter, dc transmission line, and dc-ac converter is known as a "pole". This Project has been designed as a *bipole* system, comprised of two transmission paths and two converters of opposite polarity at each end of the circuit.

In order for the HVdc system to operate, a return path permitting the flow of current is required at all times. During normal operation, the two conductors between the two converters provide these paths, and if both poles are in service, the system can operate at its full rated capacity. Should one of the converter stations be out of service, such as during maintenance, the operation of the HVdc system can be temporarily reconfigured to use components of each converter and the two conductors to operate in a reduced capacity.

A transmission conductor failure, however, is not desirable as the system requires two current paths to operate. The first line of defense is to minimize the potential for such an occurrence, through corridor and route selection, cable protection planning and the use of a spare cable across the Strait of Belle Isle, and in careful design of the transmission towers and conductors. Should a transmission conductor failure occur, however, a second line of defense is to install an electrode to temporarily provide a return path for the current.

An electrode system involves the installation of a high-capacity grounding system at each end of the HVdc line. Although there is no direct physical connection between them, the electrodes utilize the earth (or ocean) as a return path in the event that one of the conductors becomes temporarily unavailable. The HVdc system can therefore continue to function during such an event in a reduced capacity by using the electrode return to complete the dc circuit.

To provide an acceptable return path, an important design consideration for the installation of such electrodes is ensuring that they are adequately grounded. The electrodes must be established such that conductivity is not obstructed by insulating material, and in general, rock and soil are relatively poor conductors of electricity. Obtaining effective connections therefore often requires that electrodes be installed in water with suitable salinity. Given the geology of the proposed installation sites at Gull Island and Soldiers Pond, the current Project design includes the installation and use of sea electrodes. Sea electrodes are commonly used in European HVdc installations, and comprise approximately 40 percent of the electrodes in use in HVdc systems today.

The Labrador (Gull Island) and Island (Soldiers Pond) sea electrodes will be connected to their respective HVdc converter stations by an overhead wood pole line carrying two low voltage (43 mm) metallic conductors, with the wood poles approximately 10-12 m high and spaced at approximately 60 m intervals. The lines will extend to a small onshore junction house, from which a series of bundled individual cables will extend to the seafloor for a distance of approximately 500 - 1,000 m.

The electrode elements are installed at the end of each cable, and are comprised of graphite rods encased in a coke (carbon) mixture, which are encased in concrete to provide protection and ballast. Each electrode element will be approximately 3 m by 6 m in size, and weigh approximately 20 tonnes.

To reduce the current density to a low level, the Gull Island and Soldiers Pond electrodes will be comprised of approximately 35 and 20 such elements, respectively. These will be arranged in a semi-circular area on the surface of the seafloor, with the Labrador electrode covering an area of approximately 200 m by 30 m and that on the Island approximately 120 m by 30 m. The elements are distributed over this relatively large area on the seafloor in order to ensure that, when they are operational, the total current will be dissipated over a very wide area in order to reduce any environmental risk. A conceptual sea electrode layout is illustrated in Figure 2.10.

During normal Project operations, the electrode lines will carry small unbalance currents between the poles more or less continuously. Otherwise, their level of use is expected to be very low, and they would only be used to provide a return path for the full current in very limited circumstances. Normally, it is anticipated that electrode use would amount to a few tens of hours per year, or at most a few days per year if major equipment replacement is required. The longest potential period of use would be in the event of an extended cable repair period, such as in the event of significant damage to the cable crossings of the Strait of Belle Isle. The Project will be designed and operated in order to minimize the potential for such an occurrence.

In Labrador, several options for the location of the electrode have been identified and are being evaluated, including potential areas on both the north and south sides of Lake Melville. On the Island, the sea electrode will likely be installed in Conception Bay, near the Holyrood Generating Station, given its proximity to the Soldiers Pond converter station site.

Marine study areas for the sea electrodes have been identified in each of these areas (Figures 2.4 and 2.9, Appendix B), which will be subject to further analysis as part of on-going engineering studies for detailed siting and design. Depending on the outcome of these on-going analyses, it may also be necessary to evaluate other possible locations for the proposed sea electrodes.

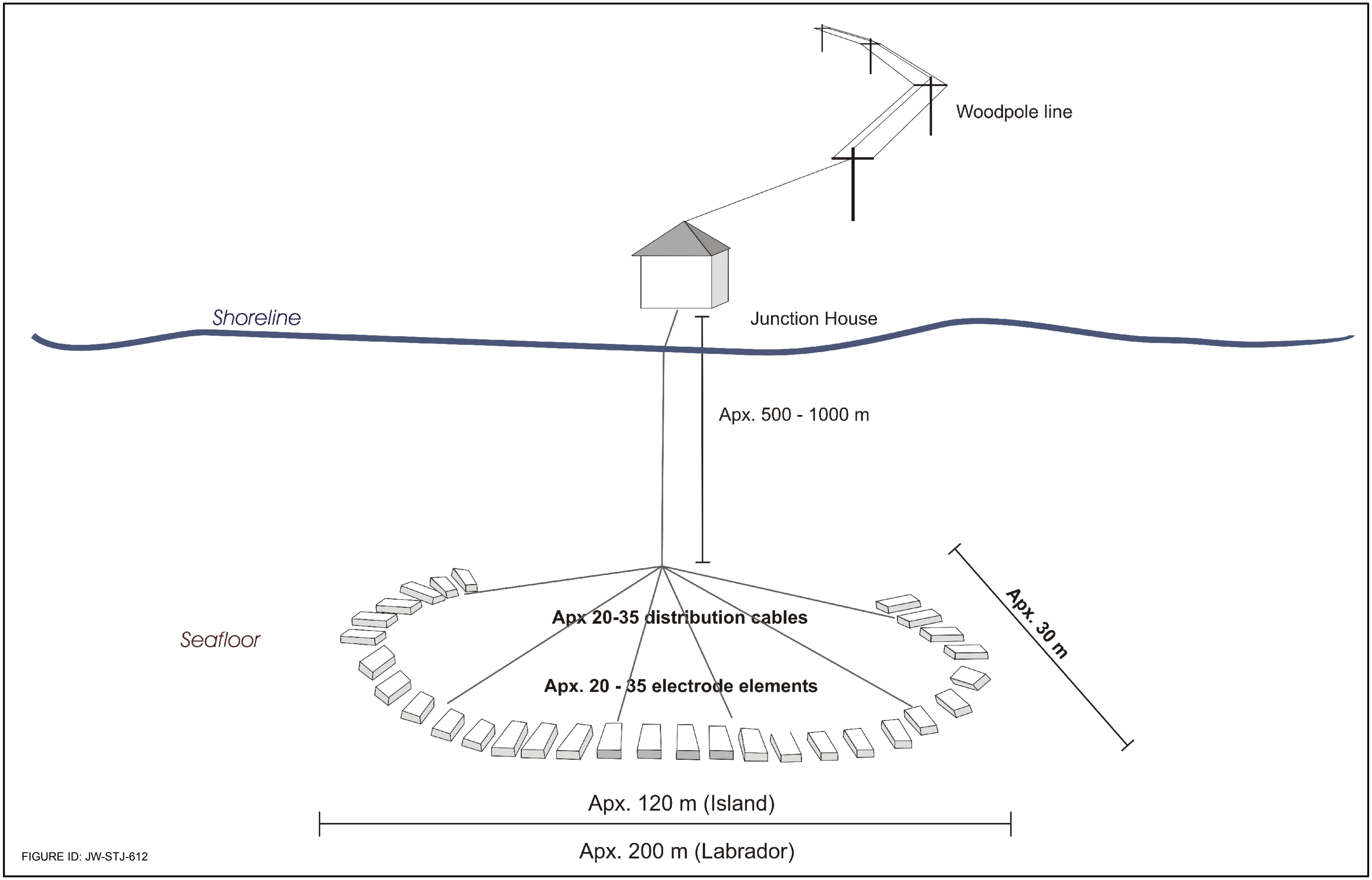

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FIGURE 2.10

Conceptual Layout of a Typical Sea Electrode

Corridors have also been identified for the potential on-land electrode lines, which extend from the proposed converter stations to sea electrode marine study areas in Lake Melville and Conception Bay (Figures 2.4 and 2.9, Appendix B).

In Central Labrador, corridor alternatives (2 km wide) on both the north and south sides of Lake Melville are being evaluated, which will be subject to further analysis as part of on-going site selection for the sea electrodes. Both of these would see the electrode line follow the existing highway and existing and planned transmission lines from Gull Island to Muskrat Falls on the north side of the Churchill River. From there, the northern alternative would follow the existing road and transmission line north and on to a site on the northwest side of Lake Melville. The southern alternative would see the line cross the Churchill River at Muskrat Falls and proceed to a site on the southeast side of Lake Melville (Figure 2.4 and Appendix B).

Again, although several potential alternatives for the Labrador electrode are currently being evaluated, only one option will eventually be selected and implemented.

The proposed electrode line from Soldiers Pond to Conception Bay will generally follow the existing transmission lines to the Holyrood Generating Station (Figure 2.9 and Appendix B).

Planning and design work for the sea electrodes is in progress, and decisions regarding their specific locations and the routing of their associated connector lines will be made during detailed engineering, and with consideration of environmental information and conditions.

2.5 Construction

The Project will include the construction of converter stations, on-land HVdc transmission lines, cable crossings of the Strait of Belle Isle, sea electrodes and associated infrastructure in Labrador and on the Island. A general overview of the primary activities that will be associated with the construction phase of the Project is provided in the following sections.

2.5.1 Transmission Lines, Converter Stations and Sea Electrodes

As indicated, the transmission lines themselves will be very similar to other existing transmission infrastructure in Newfoundland and Labrador and elsewhere. They will therefore be constructed with commonly used construction practices and in accordance with Nalcor Energy's standard practices and procedures and applicable regulatory requirements.

Construction Infrastructure

A key requirement for Project construction will be ensuring adequate access to the Project area for the transportation and distribution of personnel, equipment and materials to the work areas.

In Labrador, access for construction of the Gull Island converter station, the western sections of the transmission line and the electrode will be via the existing transportation network to and within Central Labrador, including the TLH (Phase 1) and the highway between Happy Valley – Goose Bay and North West River (Route 520), as well as existing resource roads in the area. The existing paved Labrador Straits Highway (Route 510) will provide access to the eastern end. Along the remainder of the transmission right of way, one or more additional access trails or tote roads will be established from select points on the Trans Labrador Highway (TLH, Phase 3) and from the southern part of the TLH (Phase 2) (Figure 2.4). On the Island of Newfoundland, considerable access is already available through the existing provincial highway systems and resource road networks, including existing facilities and associated roads and trails (see Figures 2.7 and 2.8). These existing access networks will be of particular use in those areas where sections of the Project follow along or near existing transmission lines on the Island (Figure 1.2 and Appendix B).

In general, access to the Project areas during construction will be through a series of access trails or tote roads established from these existing roadways to select points along the transmission line right of way. Again, wherever possible existing roads and trails will be utilized, with upgrades undertaken as required. New access trails will also be established as necessary to provide construction access to currently inaccessible sections of the transmission line route. Additionally, one or more trails will be constructed along the full length of the right of way itself, to provide the necessary access for construction and eventual maintenance equipment. This trail will be established within the cleared transmission line right of way whenever possible and practical (although in certain areas it may be necessary to route around waterbodies or other difficult terrain). As each transmission structure will require construction and installation activity involving heavy equipment, some degree of access is required to each work site.

The Project will involve a number of different types and classes of construction access trails, depending on location, terrain, timing and type and level of access required. In relatively remote areas, such as the interior of southeastern Labrador and sections of the Island's Northern Peninsula, utilization of the transmission line route itself for access will be maximized. This approach will require transporting materials and equipment over relatively long distances along the right of way, and therefore, a relatively good trail along the route and from one or more points on the existing highway(s) to the line. In more accessible areas, such as central and eastern parts of the Island, the use of existing road networks will be maximized to provide access to sites along the transmission line route. A series of new construction trails will be established in these areas as required, the characteristics and quality of which will be determined by their particular site conditions and use requirements.

The number of new access trails established will be minimized to the degree possible. In addition, as the current plan is to undertake construction year-round, the use of winter access trails will be optimized in order to minimize disturbance. Ground access for materials distribution may also be supplemented by the use of helicopters in particular areas, where this is technically and economically feasible.

The construction of access infrastructure for the Project will involve water crossings. These will take the form of watercourse fording, culvert installation or bridge installation, depending upon local site conditions, environmental characteristics and sensitivities, and other technical, regulatory and economic considerations. In some cases, it will not be possible or practical to cross a waterbody using any method, in which case access to the area will be gained through access trails approaching the watercourse from both sides. In all cases, access trails and any associated watercourse crossings will be selected, designed, constructed and maintained in accordance with good industry practices and in compliance with all applicable legislation and regulations. In keeping with corporate policy and practice and regulatory requirements, each watercourse crossing will be evaluated and applicable permits acquired and complied with prior to and during construction.

The specific number, location and characteristics of all new access trails for the Project will be determined as part of ongoing Project engineering and design, and will be planned and developed in compliance with applicable legislation, regulations and authorizations. Upon completion of Project construction, a select number of access trails will remain in place to provide an appropriate level of access for transmission line maintenance activities. All others will be decommissioned and rehabilitated using applicable and appropriate methods and standards.

Lodging for the construction work force will be provided through small temporary construction camps established at strategic points along the right of way, as well as possibly the use of existing local accommodations where available and appropriate. In Labrador, 4-6 camps are being considered which will be spaced evenly along the corridor. Each camp will have the capacity to lodge approximately 150 workers, occupy an area approximately 135 m by 135 m, and be comprised of bunkhouses, a dining hall and recreation area. As particular construction activities are phased and completed, workers and crews will move between camps. On the Island, small temporary construction camps will be similarly established at strategic sites along the route, especially for particularly inaccessible areas. These camps will be planned and established with consideration of environmental and social issues, in order to reduce the potential for adverse effects, and be removed and decommissioned once construction in that area is completed.

At strategic points along the right of way and other key sites, a series of marshalling yards will be established to receive and temporarily store materials and equipment for use in Project construction. At present, approximately six marshalling yards (each less than 50,000 m^2 in area) are proposed, two in Labrador at each end of the transmission line and four at strategic sites across the Island.

Construction of the lines and associated structures will also require materials for fill and aggregates. Existing quarries and borrow pits will be used where possible, with additional fill also being obtained as required from within the right of way. Any new quarries and borrow pits will be identified, established and decommissioned in accordance with applicable regulatory requirements.

Construction Activities and Sequence

Due to the linear nature of transmission lines, construction activities can typically be conducted in succession and concurrently. The start of each activity is often staggered to allow crews to move down the transmission line route completing each phase of construction ahead of the next. In addition, work programs can begin and proceed separately in different segments of the line. An overview of planned Project construction activities is provided in the following paragraphs.

Converter Stations

Construction activities associated with the converter stations at Gull Island and Soldiers Pond will include site clearing and leveling, excavation, installation of concrete foundations and supporting structures, building construction, and the installation and testing of the associated electrical equipment. These will be undertaken using standard construction practices and in accordance with applicable regulatory requirements.

Clearing and Access

Right of way preparation will be carried out in accordance with standard utility practices and procedures, and will involve the removal of all vegetation that exceeds one metre at maturity. Clearing will consist of cutting tree trunks parallel to, and within 15 cm of, the ground or lower and properly disposing of all standing trees, as well as the removal of all shrubs, debris and other such materials.

Chain saws or other hand-held equipment will be used for clearing. Alternative methods such as mechanical harvesters for removal of trees, brush, and debris may also be used, as appropriate. Brush and slash will be piled along the right of way and all merchantable or forest product timber will be salvaged, stored, and made available for use.

Right of way clearing will take into account:

- the location and identification of watercourse crossings along the route;
- widths of watercourses;
- location of wetlands;
- areas of commercial timber and the method of cutting and storing;
- required buffer zones along watercourses and at sensitive areas;
- any special clearing requirements; and
- locations of roads required to bypass zones of difficult access in the right of way.

As indicated, a travel route will be established along and within the cleared right of way, or as close to it as possible, using standard construction practices and industry/regulator approved mitigation measures.

Material Distribution

An essential activity in transmission line construction is the distribution of materials to particular sites along the line, including all required steel sections, hardware and conductor reels. Material will be distributed by tracked vehicle, such as a nodwell, small tractor or other suitable equipment. Helicopter distribution will also be used as appropriate and required. Where possible and practical, distribution will be carried out during the winter months, which provides for easier access and less ground disturbance.

Tower Foundation Installation

Foundation installation will require the excavation of material at each of the tower locations. Tower foundations may also be on bedrock, which may involve blasting. In order to prepare the foundations, borrow materials may be required. In bog areas, bog material will be removed prior to foundation installation.

Tower Assembly and Erection

Once the materials are distributed along the right of way and the foundations are in place, tower assembly and erection will be completed in stages. The steel components will be bolted together to form the lattice structure, and nodwells and cranes will be used to attach the tower sections and lift the tower into place where it will be bolted to the foundation. As required, guy wires will then be attached to the tower, anchored to the ground and tensioned to keep the tower in place. Hardware such as insulators will then be installed on the towers in preparation for the conductor.

Conductor Stringing

The final stage in transmission line construction is stringing the conductor and attaching it to the tower structures. The conductor will be rolled onto the line using stringing blocks, which are pullies used to facilitate stringing from structure to structure, and attached by specialized crews. Each tower will then be inspected in the eventual commissioning phase to ensure that all connections are in place and that the conductor is tensioned correctly.

Electrode Installation

The construction and installation of the electrodes will include site clearing, excavation and building construction. At both locations, the nearshore cables will be trenched in and protected as necessary from ice and wave action by rock armour. The electrode elements and associated distribution cables will be placed on the surface of the seafloor using barges with cranes and divers. Construction of the overhead wood pole connector lines between the converter stations and electrode sites will generally follow the same procedures as those described above.

At the end of construction activity, clean up and restoration of the right of way and other work sites will take place, in accordance with Nalcor Energy's policies and procedures and as per applicable regulatory requirements.

2.5.2 Strait of Belle Isle Cable Crossings

The construction of the Strait of Belle Isle cable crossings described above will involve preparation activities to construct channels in and adjacent to the marine environment into which the cables will be placed for their protection, as well as the eventual placement of the cables across the Strait. The construction of the proposed subsea cable crossings, as currently defined and planned, will occur as outlined below.

Subsea Preparation for Cable Protection

The Strait of Belle Isle is a pathway for icebergs, which are known to reach approximately 70-80 m in depth, and which have been observed to result in 1-3 m plough marks along the seafloor. This, along with the potential for interaction with other natural and anthropogenic phenomena (such as pack ice or fishing activity), requires that the cables be physically protected for both safety and reliability reasons.

A number of techniques will be used to protect the cables. As discussed in Section 2.4.3, the corridors and eventual routings will primarily make use of natural sea-bed features to shelter the cable in any valleys and trenches to minimize the possibility of iceberg contact or interactions with fishing equipment. The cable will also be buried below the seafloor through tunneling, trenching, drilling, plowing and/or water jetting. Other protection schemes such as rock placement or the laying of concrete mattresses can also aid in areas where trenching, plowing or jetting is not practical.

Within the two cable corridors (Figure 2.6), the cables will travel in essentially independent routes across the Strait, likely with 2-3 cables within one corridor and the other 1-2 cables within the second. These cable routes (including the footprints of the associated cable protection) will each be approximately 1-5 m in width.

On the Labrador side, tunneling and drilling will likely be required for the Forteau Point landing site, extending from the onshore cable station structure and out to and under the Strait. The current plan is to excavate a tunnel with a cross section of approximately 20 m^2 for a distance of approximately 1-1.5 km from the shoreline, terminating at a depth of 30–150 m below the seafloor (depending on rock porosity). If the rock quality is found to be poor, the tunnel may also be lined with concrete. A series of micro-tunnels (one for each cable, each approximately 300 mm in diameter) will then be drilled upwards from the end of the tunnel for a distance of up to approximately 150 m. For the L’Anse Amour landing site alternative, the relatively sandy bottom would allow for the cables to be installed in trenches (each about 1 m wide or less) established through water jetting, plowing or other means for a distance of approximately 3 km from the shoreline. Once the cables are installed, rock-gravel will also be placed in and over the trenches for additional protection.

On the Island side the coastal area is relatively shallow, and the current intent is to trench from the onshore cable station structure out to a distance of approximately 2-4 km from the shoreline (4 km from Mistaken Cove, or alternatively, 2 km from Yankee Point), out to a water depth of approximately 80 m. Each of the cables will be installed in trenches about 1 m or less in width and 1-2 m deep.

Trench excavation work from onshore to 5-6 m water depth will likely be conducted using land-based hydraulic excavators, subsea drilling and dredgers. A subsea excavator (i.e., a crawler operated underwater device with a hydraulic cutter head 800-1000 mm in diameter) will then be used to establish a narrow and deep trench in the seabed from approximately 5-6 m to 80 m water depth. Blasting may also be required in certain areas, depending upon the characteristics of the underlying substrate and bedrock. Any blasting activity within or immediately adjacent to the marine environment will be minimized to the degree possible and practical.

Following cable installation, the nearshore trenches will be backfilled through rock-gravel placement conducted from a fall-pipe vessel. The required rock-gravel material will be sourced from a nearby approved quarry.

At water depths of greater than 80 m, a number of techniques are being considered to provide the required level of cable protection. In areas where the substrate is suitable, water jet trenching will be used to bury the cables to a depth of approximately 1-2 m. Using this method, once the cable is laid on the seafloor (as described below) an apparatus is deployed which follows along the cable and liquefies the soft soils beneath it through a water jet system. This results in the cable essentially sinking to the desired depth. For areas where this method is not practical, plowing of trenches prior to cable installation and eventual backfilling is also an option. Other protection schemes such as the creation of rock berms and/or the laying of concrete mattresses atop the cable are also being evaluated.

Engineering work is ongoing to assess the various possible approaches for protection of the subsea cables. In addition to the above, this also includes exploring the potential option of tunneling to a further distance from various alternative points on either side of the Strait of Belle Isle, in order to establish an underground cable conduit across the Strait to afford maximum protection to the 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.

Cable Pull-In and Laying

The following describes the general process and techniques that will be used for the installation of the submarine cables, using the corridors and cable protection techniques outlined above. Again, this process may vary based on the eventual selection of cable protection approach.

Just prior to the cable laying operation, a survey of the planned cable routes will be conducted using a remote operated vehicle (ROV) or other equipment to verify that there are no debris or other obstructions in the area and that the subsea preparations have been completed and are intact.

The vessel used for laying the cable will be approximately 100–135 m in length. The cable will be loaded onto the installation vessel at the manufacturer's location, and transported to the Strait of Belle Isle. When the installation vessel arrives on site, calibration and navigation trials will be performed. As necessary, the vessel will be assisted by a tug to help keep it in position during the installation process. At the commencement of the installation, the vessel will approach the position of the first landfall. This is currently planned for the Labrador side, but the final decision will be made following further analysis. The vessel will then stay in that position while preparation for the first cable installation is made.

As part of construction at the Labrador landing site, pennant wires will be installed and connected to a hydraulic winch anchored onshore approximately 100-150 m from the shoreline. After a visual inspection of the equipment and seabed, a hoisting wire with hook will be lowered from the installation vessel and connected to the pennant wire assembly. A recovery winch onboard the installation vessel will then start to retrieve the pennant wire from the on-shore winch. Eventually the pennant wire will be connected to the cable onboard the installation vessel, and the cable end lowered overboard. The on-shore pull-in winch will then pull the cable towards and through the tunnels (Forteau Point option) or carefully into position on the seabed (L'Anse Amour option), as the cable is gently deployed overboard by the large laying wheel at the stern of the vessel.

When the cable is in place and secured on the Labrador end, the vessel will begin laying cable across the Strait along the selected route towards the Island of Newfoundland. An ROV will monitor the cable touchdown along the entire route. During the cable installation process, considerable flexibility in the specific location of the cable within the 500 m corridor will be required, in order to select and utilize an optimal path for the cable.

Near the Mistaken Cove / Yankee Point landfall, the laying operation will be temporarily halted when a water depth of 8-10 m is reached. At that point, the vessel will make a 180 degree turn, such that its stern faces shore. In this position, the remaining required cable length will be calculated and the cable cut and sealed. Inflatable floats will then be attached to the cable, with the vessel maneuvering slowly sideways as the remaining cable section is deployed overboard. Workboats will assist and control the floating cable, the end of which will be towed to a pre-installed wire attached to a pull-in winch installed onshore at the landing site.

On the Island side the cables will be installed in separate rock trenches approximately 1 m wide (as described above). As such, special precautions will be required to assist with cable laying in the nearshore area. A special cable positioning system will be used which runs along the cable and provides navigational information and assistance to the installation vessel. During cable pull-in, workboats will carefully monitor and adjust the floating cable section as required. When the floating cable is in the correct position, divers will begin to deflate the floats and the cable will sink into position on the seabed. This process will be repeated for each of the 3-5 cables across the Strait of Belle Isle.

An illustration of a typical cable laying vessel and operation is provided in Figure 2.11. Weather, wave and ice conditions will have a significant influence on the timing of the cable laying operations, which are currently planned to occur within the period of late June or early July to September 2014.

Figure 2.11 Typical Cable-Laying Vessel

Photo courtesy of Statnett, via Hatch Ltd.

2.5.3 Construction Work Force

Over its approximately four year construction phase, the Project will create an estimated 2,200 person-years of direct construction employment. It is currently estimated that approximately 70 occupations will be represented in that workforce, including those listed in Table 2.1.

The construction labour force will range from approximately 600 workers at commencement in 2011, rise to 800 in year 2, peak at approximately 1,150 in year 3, and decrease to approximately 100 personnel by late 2014.

Table 2.1 Occupations Likely to be Represented in the Construction Work Force

Occupation (by NOC Code)	Est Peak #	Occupation (by NOC Code)	Est Peak #
0111: Financial Managers	1	6651: Security Guards & Related Occupations	2
0112: Human Resources Managers	1	6663: Janitors, Caretakers & Building Superintendents	35
0113: Purchasing Managers	1	7212: Contractors & Supervisors, Electrical Trades & Telecommunications Occupations	2
0114: Other Administrative Services Managers	1	7213: Contractors & Supervisors, Pipefitting Trades	12
0123: Other Business Services Managers	3	7214: Contractors & Supervisors, Metal Forming, Shaping & Erecting Trades	8
0211: Engineering Managers	1	7215: Contractors & Supervisors, Carpentry Trades	2
0711: Construction Managers / Superintendents	49	7216: Contractors & Supervisors, Mechanic Trades	2
1111: Financial Auditors & Accountants	3	7217: Contractors & Supervisors, Heavy Construction Equipment Crews	78
1241: Secretaries (Except Legal & Medical)	8	7241: Electricians (Except Industrial & Power System)	12
1411: General Office Clerks	6	7242: Industrial Electricians	4
1431: Accounting & Related Clerks	2	7243: Power System Electricians	32
1432: Payroll Clerks	2	7244: Electrical Power Line & Cable Workers	49
1441: Administrative Clerks	2	7252: Steamfitters, Pipefitters & Sprinkler System Installers	20
1463: Couriers, Messengers & Door-to-Door Distributors	6	7261: Sheet Metal Workers	24
1472: Storekeepers & Parts Clerks	2	7264: Ironworkers	70
1474: Purchasing & Inventory Clerks	2	7265: Welders & Related Machine Operators	10
2113: Geologists, Geochemists & Geophysicists	2	7271: Carpenters	32
2131: Civil Engineers	9	7282: Concrete Finishers	24
2132: Mechanical Engineers	1	7291: Roofers & Shinglers	24
2133: Electrical & Electronics Engineers	2	7311: Construction Millwrights & Industrial Mechanics (Except Textile)	4
2143: Mining Engineers	2	7312: Heavy-Duty Equipment Mechanics	8
2144: Geological Engineers	2	7313: Refrigeration & Air Conditioning Mechanics	4
2154: Land Surveyors	2	7371: Crane Operators	16
2212: Geological & Mineral Technologists & Technicians	4	7372: Drillers & Blasters - Surface Mining, Quarrying & Construction	58
2231: Civil Engineering Technologists & Technicians	10	7382: Commercial Divers	6
2234: Construction Estimators	1	7411: Truck Drivers	59
2241: Electrical & Electronics Engineering Technologists & Technicians	4	7421: Heavy Equipment Operators (Except Crane)	178
2243: Industrial Instrument Technicians & Mechanics	2	7433: Deck Crew, Water Transport	128
2253: Drafting Technologists & Technicians	2	7443: Automotive Mechanical Installers & Servicers	6

Occupation (by NOC Code)	Est Peak #	Occupation (by NOC Code)	Est Peak #
2254: Land Survey Technologists & Technicians	5	7611: Construction Trades Helpers & Labourers	157
2261: Non-Destructive Testers & Inspectors	2	7612: Other Trades Helpers & Labourers	28
2264: Construction Inspectors	2	8221: Supervisors, Mining & Quarrying	3
3152: Registered Nurses	3	8231: Underground Production & Development Miners	25
3234: Ambulance Attendants & Other Paramedical Occupations	8	8411: Underground Mine Service & Support Workers	25
6242: Cooks	30		
Note: Construction– related occupations only. Does not include employees involved in overall Project management.			

At peak construction, approximately 30 percent of this labour force will be involved in the construction of the transmission line and associated components in Labrador, 55 percent in construction work on the Island, and 15 percent in the construction of the Strait of Belle Isle subsea crossings.

2.6 Operation and Maintenance

Once construction is completed and following Project commissioning, the Project will be operated on a continuous basis. Transmission line maintenance activities will include regular inspection, repair of the system as required and the management of vegetation along the right of way.

The transmission lines will be inspected on an annual rotational basis, with a portion of the line being inspected each year. The inspections for the on-land portions of the lines will be completed from the air or from the ground on all-terrain vehicles during summer or snowmobiles in the winter. The Strait of Belle Isle cables and sea electrodes will also be inspected regularly through ROV surveys and/or other relevant means. Activities associated with the operation of the HVdc system will likely be integrated into Nalcor Energy's existing inspection and maintenance program for its transmission systems.

Vegetation management will commence eight to ten years after construction is completed, and be conducted every eight to ten years thereafter during Project operations. These activities will be directed towards removing trees which may threaten the security of the system by growing into or falling onto the transmission lines, and the control of fast growing shrubs which impede access by ground or air. Nalcor Energy will incorporate the transmission line into its integrated vegetation management program for its transmission and distribution system, which uses several methods including manual cutting as well as the selective use of herbicides for long term vegetation control. Certified crews will use herbicides in accordance with Nalcor Energy's current standard operating practices and applicable regulations. The management schedule will vary with the type of vegetation, the extent of ground disturbance during construction and terrain.

The Project will be operated for an indeterminate time period, and decommissioning is not contemplated. Should decommissioning activities eventually be considered for some or all of the HVdc system, these will be planned and conducted in accordance with the relevant standards and regulatory requirements of the day.

2.7 Project Schedule

Commencing in 2009 with detailed engineering and the procurement and manufacture of key long-lead components, the current Project schedule would see construction activity in the field beginning in early 2011 and concluding in late 2014, followed by eventual commissioning of the Project and the commencement of operations in 2015.

Construction work will be initiated and proceed separately for the Island and Labrador on-land components and for the Strait of Belle Isle crossings, as well as at various points within these Project sections. A general (and tentative) overview of the Project schedule as it is currently planned is provided below, including the estimated timing and duration of construction for each of the associated Project components and activities.

Construction of the on-land transmission infrastructure is currently scheduled to begin in early 2011 in eastern and central Newfoundland and later that year on the Northern Peninsula and in Labrador, and will proceed from multiple points along the right of way. Construction work will begin with the establishment of construction camps, access infrastructure and marshalling yards, followed by right of way clearing, materials distribution to the sites and the installation of tower foundations and anchors. The transmission towers will be assembled and erected from 2012 to 2013, followed by conductor installation. Construction and installation of the converter stations will begin in early 2012 and continue to late 2014, and the sea electrodes and associated lines will be installed in 2013. Following inspection, construction of the transmission line is currently scheduled for completion in 2014.

For the Strait of Belle Isle cable crossings, the activities associated with engineering and the procurement and offsite manufacture of the cables and associated infrastructure are currently planned to be initiated in 2009. For the cable crossings, construction activities associated with cable protection (tunneling, trenching, etc.) will take place primarily in the summer and fall periods of 2011 and 2012, followed by cable installation which will likely conclude by late 2014. On-site construction of the Labrador and Island onshore landing stations will be carried out from 2012 to 2013. Some of the final cable protection activities in the offshore areas may be completed after Project commissioning in 2015.

2.8 Potential Emissions and Discharges

Potential sources of pollutants during construction will be those associated with a typical construction project. During operation, there is limited potential for unplanned emissions and discharges.

2.8.1 Construction

Potential emissions and discharges during Project construction would result mainly from:

- construction access;
- clearing and excavation;
- quarries and borrow pits;
- work in and near the marine and aquatic environments;
- the use and storage of fuel and other hydrocarbons;

- air emissions from vehicles and heavy equipment; and
- construction-related waste generation.

Project-specific Environmental Protection Plans (EPPs) and Safety, Health and Environmental Emergency Response Plans (SHERPs) will be developed and implemented to manage all Project-related components and activities, including waste materials, pollutants and health and safety. All staff and contractors will comply with provisions of the EPPs and SHERPs, as described in Section 2.9.1.

Although there is existing access available for much of the transmission line, there will, as discussed previously, be a requirement to establish additional access roads and trails for particular sites and along the right of way. Trail construction, fording and the installation of bridges and culverts will be undertaken in accordance with transmission EPPs, applicable permits and regulatory guidance to reduce the potential for sedimentation of watercourses. New access requirements will be determined and designed as part of ongoing Project engineering, and will be minimized to the degree possible. Winter access will be used where possible and practical to minimize disturbance.

Site clearing, excavations for tower foundations and borrow operations can result in the generation of fine (silt) material, which can enter watercourses. Construction site drainage will be controlled to reduce sedimentation, appropriate buffer zones will be maintained around construction areas and at watercourse crossings, and sediment control measures such as silt curtains will be used where appropriate. Any new quarries and borrow pits will be identified, established and decommissioned in accordance with applicable regulatory requirements.

Work within and adjacent to the marine environment, such as during site preparation and installation activities associated with the submarine cable crossing and sea electrodes, will also result in the disturbance of sediment and its introduction into the water column. Analysis and modeling is on-going to assess the nature and likely extent of such sedimentation, for use in identifying and planning appropriate control measures during construction.

As part of construction activity within the marine environment, material will be disturbed on the seafloor, particularly during the subsea preparation and installation activities associated with the submarine cable and sea electrodes. After the cables have been laid in areas where the route has been trenched, the sediment that has been moved will either be left as is, replaced on top of the cable as a protection measure, and/or in some cases, may be removed and disposed of as necessary. Engineering analysis is ongoing to assess approaches and techniques for the movement and disposal of any unwanted material from the seafloor. One possibility is suction dredging, in which such sediment is removed, transported to and stored on a vessel, and disposed of either on-land or in the ocean in an environmentally acceptable manner and in compliance with applicable regulatory requirements. Any required disposal of unwanted sediment created by the use of any other technique, such as tunneling or drilling, will also be planned and conducted in accordance with applicable regulatory requirements.

The handling and use of fuels, oil and lubricants will be carefully controlled. These substances will be stored, handled, delivered, and wastes disposed of according to applicable regulations and corporate policies and procedures.

Engine exhausts will generate air emissions, whose makeup will depend on the type of emission control devices and nature of the fuel. Both diesel and gasoline powered equipment and vehicles will be used on site. Project emissions will include particulate matter, the by-products of combustion of hydrocarbon fuel, and noise.

Construction activity and the work force will produce waste and garbage, which will be sorted prior to disposal on a daily basis. Non-food will be transported to and disposed in approved landfill sites and recycled wherever possible. To reduce the incursion of nuisance bears, a bear management plan will be prepared and implemented. It will include awareness education as well as measures to ensure the proper handling, storage and disposal of all food wastes. Sanitary waste will be treated in accordance with applicable legislation.

2.8.2 Operation

Although HVdc systems are a relatively new technology in Newfoundland and Labrador, there is considerable worldwide experience with such systems and the use of electrodes, including projects in Europe, Asia and North America.

Noise and Field Effects

Projects and activities that involve the generation, transmission and/or use of large amounts of electricity are often the subject of public questions, concerns and uncertainty around their potential emissions. These include possible noise, electromagnetic fields (EMFs) and radio interference, as well as any associated human health and safety or environmental implications.

Technical analyses have been undertaken and are on-going to understand and estimate the potential audible noise, EMFs and radio interference that may be associated with the proposed HVdc system, in order to incorporate and appropriately address these considerations in Project planning and design. Specifically, these analyses consider aspects such as conductor design, and voltage and current specifications, in order to help ensure that any such emissions are well within acceptable limits.

Audible Noise

As is the case with the existing high voltage (ac) transmission lines throughout the province, there is a degree of audible noise produced by HVdc lines. This noise results from ionization reactions known as “Corona”, which occur as small portions of the electrical energy of the conductor interact with the air surrounding the conductor surface. Typically, this can resemble a crackling or sizzling sound. These reactions are very dependent on ambient conditions such as temperature, humidity, wind speed, and wind direction.

Noise level limits for transmission lines are specified at the edge of their right of way, and are measured using standard units known as A-weighted decibels (dB(A)). For the proposed HVdc system, analyses conducted to date indicate that at an operating voltage of ± 450 kV, the specified conductors would emit median sound levels that would be lower than the 50 dB(A) levels emitted by most HVdc systems presently in operation (based on data provided by the Electric Power Research Institute (EPRI) of the United States). The primary difference between HVac and HVdc systems is that the noise levels produced by HVac lines increases in wet weather conditions, whereas HVdc noise levels are at their highest in fair conditions. The EPRI data also indicate that for comparable voltage levels, worst-case noise levels emitted by HVdc lines in fair conditions are lower than those of HVac lines in heavy rain conditions.

Electromagnetic Fields

EMFs are invisible forces that surround electrical equipment and wires that carry electricity, including power lines and associated infrastructure.

Because they utilize a “direct” rather than an “alternating” current, HVdc systems are characterized by more constant and “steady” voltages and currents than those found in HVac systems. Consequently, HVdc systems do not emit time-varying EMFs, and therefore cannot induce voltages or currents in nearby objects. Rather, HVdc lines emit a low static magnetic field that is comparable to the magnetic field of the earth, and which is only detectable in close proximity to the conductors themselves.

As is the case with HVac systems, such those currently operational in Newfoundland and Labrador, electric fields around HVdc lines are produced by collections of ions created by the Corona process. As noted above, these reactions are heavily dependent on ambient conditions, and field strengths will thus vary accordingly. The fields may therefore only be quantified in statistical terms. It should be noted, however, that electric field strengths are dependent on charge concentrations which decrease at a rate relative to the distance from the source.

Further analyses and modeling of these potential fields for the proposed HVdc system is planned, the results of which will be incorporated into detailed Project design and presented as part of any environmental assessment review.

Since the transmission and use of electric power is widespread, humans are constantly being exposed to EMFs. Recent years have, however, seen public interest around EMFs and any potential adverse human health effects that may be associated with them. Indeed, there has been considerable research and discussion of this issue over more than 30 years. National and international health agencies and scientific institutions have concluded that the scientific research does not demonstrate that there is a public health risk from EMFs associated with the transmission and use of electricity. Further information can be found at NLH (2003), Health Canada (2004) and World Health Organization (2008).

Nalcor Energy recognizes, however, that there is a degree of public interest and concern around EMFs, and is committed to monitoring and evaluating scientific research and regulatory requirements as these evolve, and to ensuring that its development and operational activities and associated environmental, health and safety practices consider updated and reliable scientific evidence. Nalcor Energy will also continue to provide its customers, employees and the public with information on EMFs.

Radio Interference Levels

The proposed HVdc system will be designed and implemented to comply with CSA Standard CAN3-C108.3.1-M84 - the same standard that is applied to HVac transmission lines. This standard limits worst-case radio interference levels to 69 dB at a distance of 15 m from the high voltage conductors. Analyses indicate that at an operating voltage of ± 450 kV, emissions from the conductors specified for the proposed HVdc system would be lower than this limit.

Sea Electrodes

During normal Project operations, the electrode lines will carry small unbalance currents between the poles more or less continuously. In several scenarios, such as during converter maintenance, the use of the electrodes is not required to operate the system as it can temporarily function at a reduced capacity.

The use of the electrodes to provide a return path for the full current would therefore occur in only very specific and significant circumstances, such as in the event of a major submarine cable or overhead conductor failure.

The sea electrode elements will be distributed over a relatively large area on the seafloor (approximately 3,600 – 6,000 m^2 overall, see Figure 2.10). This is the case in order to ensure that when the electrodes are operational, the total current will be dissipated over a very wide area in order to reduce any environmental risk.

When an electrical current flows through the earth and ocean, such as during the operation of a sea electrode, electromagnetic fields are created. These may cause interference with electric systems as well as magnetic field effects, including localized magnetic compass interference, in the immediate vicinity of such electrodes. In addition, where the current leaves the electrode an electrochemical oxidation reaction takes place. In seawater, this reaction has been observed to cause corrosion in nearby metallic structures, and to form oxygen and chlorine. Chlorine is unstable in seawater, and reacts to form hypochlorite, chloride, hypobromite and bromide, from which chloroform and bromoform may be formed.

Environmental monitoring conducted for various existing sea electrode systems has not found measurable environmental effects (see, for example, Faugstad et al. 2007), and any environmental, corrosion or field effects can be reduced through electrode design and siting (e.g., ensuring adequate pH levels due to sufficient seawater exchange), which will be a key consideration in electrode siting and detailed design.

Further information on sea electrodes and the experiences of other jurisdictions with them is being gathered, and will be used as part of ongoing Project planning. Further public information and consultation are also planned with regard to the proposed sea electrodes.

Vegetation Management

Nalcor Energy will incorporate the HVdc transmission line into its integrated vegetation management program for its transmission and distribution systems. Vegetation will be controlled manually, or by application of vegetation-control agents or a combination of the two. All vegetation management activities will be undertaken subject to approval from the Department of Environment and Conservation and in compliance with the *Pesticides Control Regulations*. As is standard practice, there will be a public notification and an evaluation of any environmental sensitivities wherever herbicides are to be used. Vegetation control personnel will be appropriately trained and qualified. The Project will be designed, constructed and operated in accordance with applicable industry and regulatory standards.

Potential resource conflicts and other environmental considerations and interactions which may be associated with the Project are outlined and discussed further in Chapter 5.

2.9 Environmental Management and Protection

The number and diversity of environmental challenges facing large companies and development projects require a structured and consistent management approach. Nalcor Energy's subsidiaries have chosen the ISO 14001 Environmental Management System (EMS) standard developed by the International Organization for Standardization (ISO) to manage environmental aspects. This decision has resulted in continual improvement of environmental performance, while fulfilling the corporation's mandate to provide customers with cost-effective and reliable power. Existing Nalcor Energy facilities, including Churchill Falls, have been individually registered by an external auditor (Quality Management Institute, QMI) as compliant with the ISO 14001 standard. This Project will be constructed and operated in accordance with a project-specific EMS.

2.9.1 Environmental Protection Planning

Environmental protection planning is an integral part of Nalcor Energy's construction, operations and maintenance programs.

As noted previously, the corporation's subsidiaries currently operate an extensive electricity transmission system in Newfoundland and Labrador. This includes interconnected electrical power systems on the Island and in Labrador as well as isolated distribution systems throughout rural areas of the province.

As a corporation with significant experience in constructing and maintaining transmission infrastructure in Newfoundland and Labrador, Nalcor Energy has state-of-the-art and proven policies and procedures related to environmental protection and management which will be implemented during the construction and operation of this proposed Project.

An Environmental Protection Plan (EPP) is an important tool for consolidating environmental information in a format that provides sufficient detail for the implementation of environmental protection measures in the field during construction. An EPP provides concise instructions to personnel regarding protection procedures and descriptions of techniques to reduce potential environmental effects associated with any construction activity. The main objectives are to:

- consolidate information for planning;
- ensure environmental standards are current and complied with;
- provide details of corporate commitments to environmental protection and planning; and
- provide guidelines for field activities and decision-making on environmental issues relevant to construction, operations and maintenance activities.

An EPP has been developed and implemented for the Project's environmental and engineering field studies. This EPP addresses issues relating to environmental orientation, storage and handling of fuel, waste disposal, vessel operation, hunting and fishing, field policies, encounters with wildlife, discovery of historic resources, spills and forest fires.

Depending on construction sequencing, one or several activity-specific EPPs will be prepared and implemented for the Project's construction phase. Each EPP will be a field-useable document, addressing provisions that will avoid or reduce environmental effects which may be associated with construction. As appropriate, each EPP will include items relating to vegetation clearing, grubbing and grading, storage and handling of fuel, blasting, quarrying, dust control, waste and sewage disposal, work in water, contingency plans for unplanned events such as spills, rehabilitation and compliance monitoring.

2.9.2 Safety, Health and Environmental Emergency Response Plan

In the construction, operation and maintenance of a large transmission infrastructure project, an accidental release or other unplanned event is an unlikely, but possible, event. Nalcor Energy proactively identifies potential emergency situations and develops response procedures, including Safety, Health and Environmental Emergency Response Plans (SHERPs).

The purpose of a SHERP is to identify responsibilities in the event of an unplanned incident, including the accidental release of oil or other hazardous material, on-site or during transportation, and to provide the information required for the effective response and reporting of such an incident. Nalcor Energy will conform to both provincial and federal legislation with the intent of meeting both its legal and corporate responsibilities.

The establishment and maintenance of emergency response procedures addresses the:

- protection and maintenance of human health and safety;
- identification of the potential for accidents and emergency situations;
- planned response to accidents and emergency situations; and
- prevention and mitigation of potential environmental effects associated with accidents and emergency situations.

A SHERP was also developed and implemented for the Project's environmental and engineering studies. Depending on construction sequencing, one or several site/activity-specific SHERPs will be prepared and implemented for the Project.

The Project-specific SHERP will address: roles and responsibilities, personal protective equipment, materials storage, driving safety, working at heights, working near or over water, working near or on ice, vessel operation and safety, animal encounters, emergency response communications, spill response, personnel injury response, search and rescue, fire and explosion response, and vehicle / vessel accidents.

2.10 Environmental Permits and Approvals

In addition to approval under the provincial and federal environmental assessment processes, the Project will also require a number of other provincial, federal and municipal authorizations. Nalcor Energy is committed to obtaining, and complying with the conditions of, these required permits and approvals during Project construction and operations.

Environmental permits and approvals that may be required in relation to the Project include those listed in Appendix A.

3.0 ENVIRONMENTAL SETTING

The following provides a general overview of the area within which the Project will be located, based on existing and available information. Environmental baseline studies are ongoing in relation to the proposed Project.

The proposed transmission line will, as described previously, be up to approximately 1,200 km in total length, and include a number of associated components. As such, it will extend across a considerable portion of Newfoundland and Labrador, and thus, through a range of natural and human environments.

As a result of the rather extensive geographic area involved, the following profile of the existing environmental setting for the Project is necessarily high-level. It focuses on the general area around the proposed HVdc corridor, and is structured according to the following areas:

- Central and Southeastern Labrador;
- Strait of Belle Isle, and the
- Island of Newfoundland

3.1 The Natural Environment

Newfoundland and Labrador is the easternmost province of Canada, and consists of the Island of Newfoundland (111,390 km^2), as well as Labrador (294,330 km^2), which is located to the northwest of the Island on the Canadian mainland.

The Strait of Belle Isle divides the province into its two geographical components, and closely approximates a division of great geological significance. Labrador is the easternmost portion of the Canadian Shield, a vast area of Precambrian rocks, some of which are the oldest known on Earth. Newfoundland represents the northeasternmost extension of the Appalachian mountain system in North America, and is much younger than Labrador (Rogerson 1981; Bell and Liverman 1997).

Labrador exhibits a varied topography, with much of the interior comprised of uneven plateau, mountainous areas in the east-central (Mealy Mountains) and northern parts of the region, and a lowland area around Lake Melville.

On the Island of Newfoundland, the Appalachian Region comprises a number of physiographic units. The Newfoundland Highlands is a rugged region with steep slopes and elevations that includes the Long Range Mountains. To the north, the Newfoundland Central Lowland has a low and gently rolling topography, while the Atlantic Uplands encompass the southeastern part of the Island. A narrow coastal plain along the western coastline of the Island and segments of the southeast coast of Labrador is part of the Saint Lawrence Lowland (NRCan 2007).

The proposed Project will extend through two of Canada's Ecozones (Wilkin 1986), which represent large, general ecological units characterized by key physical and ecological features, as well as various Ecoregions within them:

1) *Boreal Shield Ecozone*: The Island of Newfoundland and the Churchill River valley and southeast coast of Labrador form the eastern extent of this region. A massive rolling plain of ancient bedrock blanketed with gravel, sand and other glacial deposits, its topography is comprised of broadly rolling uplands that form poorly drained depressions covered by lakes, ponds and wetlands. The climate of the Boreal Shield is generally continental with long cold winters, short warm summers and abundant precipitation. Cool temperatures and a short growing season along with acidic soils challenge plant life in the ecozone, although most of the area is forested (primarily coniferous species, intermixed with hardwoods), which is mixed with bogs, marshes and other wetlands. Lichens and shrubs are common on areas of exposed bedrock.

2) *Taiga Shield Ecozone*: The interior of southeastern Labrador is within this ecozone, which consists of the taiga forest and the Canadian Shield, a primarily coniferous forest area located south of the tundra. The terrain is broadly rolling, and the landscape is composed of many lakes and wetlands. The subarctic climate is characterized by short, cool summers and long, cold winters, and precipitation is low to moderate. The open, stunted forests are dominated by species such as black spruce, and are mixed with numerous bogs and other wetlands, scattered hardwood stands, and rock outcrops dominated by lichens and low shrubs.

Ecoregions are smaller land units with these larger areas that have distinctive, recurring patterns of vegetation and soil which are determined and controlled by local climate and geology. Also called "natural regions", ecoregions differ from each other in their combinations of plant communities, landscapes, geology and other features (PNAD 2008).

Nine ecoregions have been identified on the Island of Newfoundland (Damman 1983), which are further subdivided into 21 subregions, and there are 10 identified ecoregions in Labrador (Meades 1989).

The proposed Project will pass through 11 of the province's ecoregions (Figure 3.1). These are described briefly in the following sections, in the context of the general regions outlined previously.

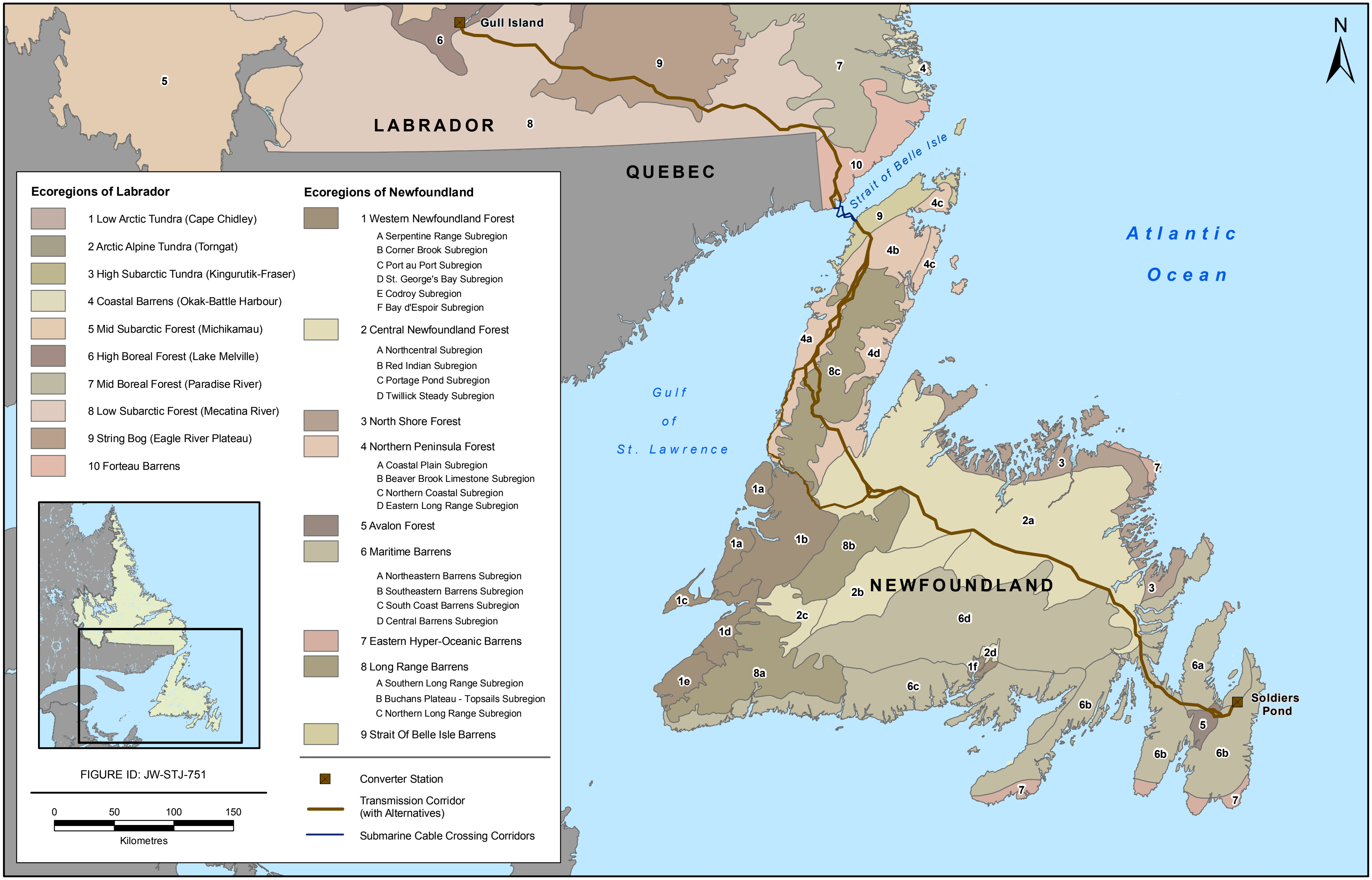


FIGURE 3.1

Ecoregions of Newfoundland and Labrador

3.1.1 Central and Southeastern Labrador

In Labrador as a whole (294,330 km^2), approximately 60 percent of the land base is forested, of which 70 percent is scrub and the remainder is productive forest. Barren ground covers nearly 30 percent of the area of Labrador, six percent is water and three percent is bog (DFRA 2003).

The approximately 407 km section of proposed transmission line from Gull Island to the Strait of Belle Isle will pass through four of Labrador's ecoregions (Figure 3.1 and Table 3.1), some of the key characteristics of which are described briefly below (after Meades 1990).

Climate, Topography and Vegetation

Geographical position, altitude, and coastal exposure influence the climate of central and southeastern Labrador. Its northern location and combination of inland and maritime characteristics place the Project area in the Inner Lake Melville / Interior Labrador, Southeastern Labrador Interior and Coastal Labrador zones. The climatic characteristics of the area range from a continental regime in the low lying interior characterized by warm summers and long, cold winters, to warmer winters and cooler summers with abundant precipitation on the coast (Banfield 1981).

The region lies on the eastern edge of the Canadian Shield, which forms the central core of the North American continent. The Project area lies in Grenville Province, which extends in a band along the southern edge of the Shield and is comprised mainly of felsic metamorphic rocks. Topographically, much of the southeastern area of Labrador consists of a large plateau, with hilly and rugged terrain. Inland, the landscape consists predominantly of thin ground moraine draped over a rugged bedrock-controlled topography that is characterized by numerous exposed outcrops. Most of the larger river valleys contain small glaciofluvial deposits such as deltas, outwash plains, terraces and eskers. The coastal region is comprised mostly of bare rock outcrops and headlands, with small areas with till and other surficial materials (Greene 1974).

The area immediately surrounding the lower Churchill River and Lake Melville is comprised primarily of undulating upland topography and coastal plain, with flat river terraces. The lower Churchill River valley is located at elevations less than 400 m, and exhibits microclimatic conditions that allow boreal species to dominate over sub-arctic species, especially on south-facing slopes. The area is highly productive, with boreal plant species assemblages including large conifers such as white and black spruce and balsam fir and associated deciduous species and understory vegetation typical of the boreal forest.

Moving southeast, the landscape is initially characterized by rolling terrain and broad river valleys covered by shallow till and glacial landforms such as drumlins and eskers. Vegetation is comprised mostly of fairly open black spruce forests, with extensive ribbed fen and string bog complexes and sporadic hardwoods and lichen woodlands on drier sites. Further inland, the Eagle River Plateau occupies much of the area between Lake Melville and the coast. This flat to rolling upland area is comprised of large peatlands, interrupted by glacial landforms and shallow river valleys. Extensive string bogs with much open water are surrounded by fen vegetation dominated by sedge grasses and moss. Patches of scrub black spruce and associated plants and mosses are also interspersed throughout.

Along the coastal strip adjacent to the Strait of Belle Isle, low hills throughout the area are covered primarily with barren vegetation and pockets of scrub spruce and bog (Figure 3.1, Table 3.1).

Table 3.1 Ecoregions of Labrador Crossed by the Transmission Corridor

Ecoregion	Apx Length of HVdc Corridor Within and % of Total*
6) *High Boreal Forest - Lake Melville Ecoregion (Boreal Shield Ecozone)* Encompasses the Churchill River Valley and the coastal plain surrounding Lake Melville. River terraces are composed of coarse-textured, alluvial soils, and uplands have shallow, well-drained soils. This region has the most favorable climate in Labrador. Summers are cool and winters cold. The forests are closed-canopied and highly productive. Richer slopes are dominated by balsam fir, white birch, and trembling aspen. Black spruce is present in most stands, but only dominates in upland areas and lichen woodlands, which occupy river terraces. Ribbed fens occur in upland depressions; plateau bogs occur on coastal plains.	6 km 0.5%
8) *Low Subarctic Forest - Mecatina River Ecoregion (Taiga Shield Ecozone)* The main portion of this ecoregion is located in southern Labrador, with two separate areas to the north of Lake Melville and the Red Wine Mountains. Broad river valleys and rolling hills covered by shallow till, drumlins, and eskers are characteristic of the region. Summers are cool and winters are long. Somewhat open black spruce forests are the dominant vegetation. String bog-ribbed fen complexes cover extensive areas throughout the region.	198 km 17.0 %
9) *String Bog - Eagle River Plateau Ecoregion (Taiga Shield Ecozone)* The Eagle River Plateau comprises most of this ecoregion. This upland plateau is composed of extensive string bogs with numerous open pools surrounded by fen vegetation. Bog hummocks are dominated by scrub spruce, Labrador tea, and feathermoss. The peatland expanses are occasionally interrupted by only a few conspicuous eskers, which support open, lichen woodland. Alder thickets are common along river banks.	122 km 10.5%
10) *Forteau Barrens Ecoregion (Boreal Shield Ecozone)* Located at the southeastern most tip of Labrador, adjacent to the Strait of Belle Isle. Low hills are covered with scrub spruce, crowberry barren and slope bogs. Strong winds and frequent storms occur because of the ecoregion's proximity to the Strait of Belle Isle. Tree growth is limited by a combination of wind, wet soils, and a history of repeated burns. Black spruce and larch can reach 10 to 12 m only along rivers, where soils are better drained.	81 km 7.0%
Total	407 km 35.0%
After: Meades (1990); DFRA (2003); NFS (n.d.) * Distances and percentages are approximate	

Wildlife

The lower Churchill River valley supports a wide variety of wildlife species that reside there year-round, seasonally, or use the waterway as a travel route. Wildlife species that use the river and valley include beaver, porcupine, muskrat, mink and otter. Large mammals that use the valley for shelter and/or as a travel corridor include caribou, moose and black bear. Waterfowl species include common loons, Canada geese and black ducks.

The interior of southeastern Labrador, with its open, stunted forests and extensive wetlands, also provides habitats for a range of wildlife species. Caribou numbers are generally low in southeastern Labrador, and other large mammals such as moose and black bear are found in low to moderate densities, particularly in association with forested river valleys. The area supports furbearer and small mammal species such as marten, snowshoe hare, porcupine and voles, as well as ptarmigan and grouse. Raptors found in the region, particularly in the spring breeding season, include various species of eagle, osprey, hawk, merlin, kestrel and owls. Waterfowl such as ducks, teals, mergansers, goldeneyes, geese, scoters, and loons often inhabit the large waterbodies and extensive wetland areas throughout this area, and a range of passerine birds are also present, many of them migrants that come to Labrador to breed.

There are three recognized boreal populations of woodland caribou in Labrador, each of which is currently listed as threatened under provincial and federal legislation. The Red Wine herd is found in south-central Labrador in the Red Wine Mountains and immediately south of the Churchill River. The Mealy Mountains herd is found in southeastern Labrador, in the Mealy Mountains and adjacent areas immediately south of Lake Melville. The Lac Joseph herd is found in western Labrador (Schmelzer *et al.* 2004). In addition, a small group of woodland caribou were also located in 2000 in the Joir River area of southern Labrador. The Joir River caribou population occurs outside of the known ranges of the three other woodland caribou herds in Labrador (Jeffery 2006). Several other designated species may also be found in the general area, including harlequin duck, short-eared owl, common nighthawk and wolverine (eastern population) (IFWD n.d.; CWS 2007).

Aquatic and Marine Environments

The Labrador section of the proposed transmission corridor will cross and/or be located adjacent to a number of large watersheds, including the Churchill, Kenamu, Mecatina, St. Augustine, St. Paul, Pinware and Forteau Rivers (see Appendix B). Watercourse crossings range in size from small, intermittent streams to the main stem of the Churchill River, and are known to support a range of fish species. There are three Scheduled Salmon Rivers in this general area (DFO 2008a).

There are some 20 species of fish reported in the Churchill River and/or its tributaries (only some of which occur above Muskrat Falls), including brook trout, lake trout, lake whitefish, round whitefish, longnose and white sucker, northern pike, lake chub, burbot, pearl dace, stickleback, sculpin, rainbow smelt, Arctic char and ouananiche (land-locked Atlantic salmon). The Kenamu River is known to contain approximately 10 fish species including, most commonly, Atlantic salmon, brook trout, stickleback, lake and round whitefish, longnose and white sucker and rainbow smelt. The most common species reported in the major rivers in the Labrador Straits area include ouananiche, anadromous Atlantic salmon, sea run and resident brook trout, rainbow smelt, northern pike, American eel and sticklebacks (Anderson 1985).

Lake Melville is a large tidal estuary in east-central Labrador which stretches from Hamilton Inlet on the Labrador coast inland to Goose Bay. The lake covers an area of about 3,000 km^2, and is approximately 170 km long with a maximum width of 35 km and an average depth of 86 m (Cardoso and deYoung 2002). A number of large watersheds drain into Lake Melville, with an annual average of 3,000 m^3/s of freshwater discharge entering Lake Melville from five major rivers: the Churchill and Goose Rivers drain into Goose Bay, the lake's 25 km long western extension, while the Naskaupi, Kenamu and Grand Rivers drain into Grand Lake (Syvitski and Lee 1997). Lake Melville contains brackish waters, with the freshwater inputs and overall depth of the basin resulting in a layered saline system. Because of its location and low salinity, winter freeze-up is early and often continuous from December to mid-June.

Lake Melville contains very thick deposits of glaciomarine sediment (Syvitski and Lee 1997). The current major source of sediment is fluvial, while raised marine deposits may supply a limited amount of sediment from coastal erosion (Vilks et al. 1987). The lake's bottom sediment is primarily glacio-marine mud, while the post glacial basin sediment consists mainly of silt and clay, with occasional fine sandy layers and thin silty layers. The sediment becomes increasingly fine with distance from the river mouths (Vilks and Mudie 1983; AMEC 2001).

Groundfish and pelagic fish species that occur in Lake Melville include cod, salmon, trout and smelt, while shellfish species include mussels and whelk (DFO 2007a). Seals, particularly ringed but also harp seals, are also found in Lake Melville (Sikumiut 2007).

Protected Areas

There are a number of provincial and federal parks (existing and proposed) and wilderness and ecological reserves in Labrador, with protected areas currently covering approximately 3.3 percent of the region's land base (PNAD 2008). The Mealy Mountains area (extending from the south side of Lake Melville and to the north of the TLH Phase 3) has been identified as a candidate National Park. Pinware River Provincial Park is located in the Labrador Straits area approximately 20 km to the northeast of the proposed transmission corridor. The Grand Lake Park Reserve protects a portion of forested area between North West River and Goose Bay (PNAD 2008), but is not crossed by the potential electrode corridor to the north side of Lake Melville.

The HVdc corridor also does not cross any existing National Wildlife Areas, Migratory Bird Sanctuaries or Marine Protected Areas (DFO 2008b; Environment Canada 2008).

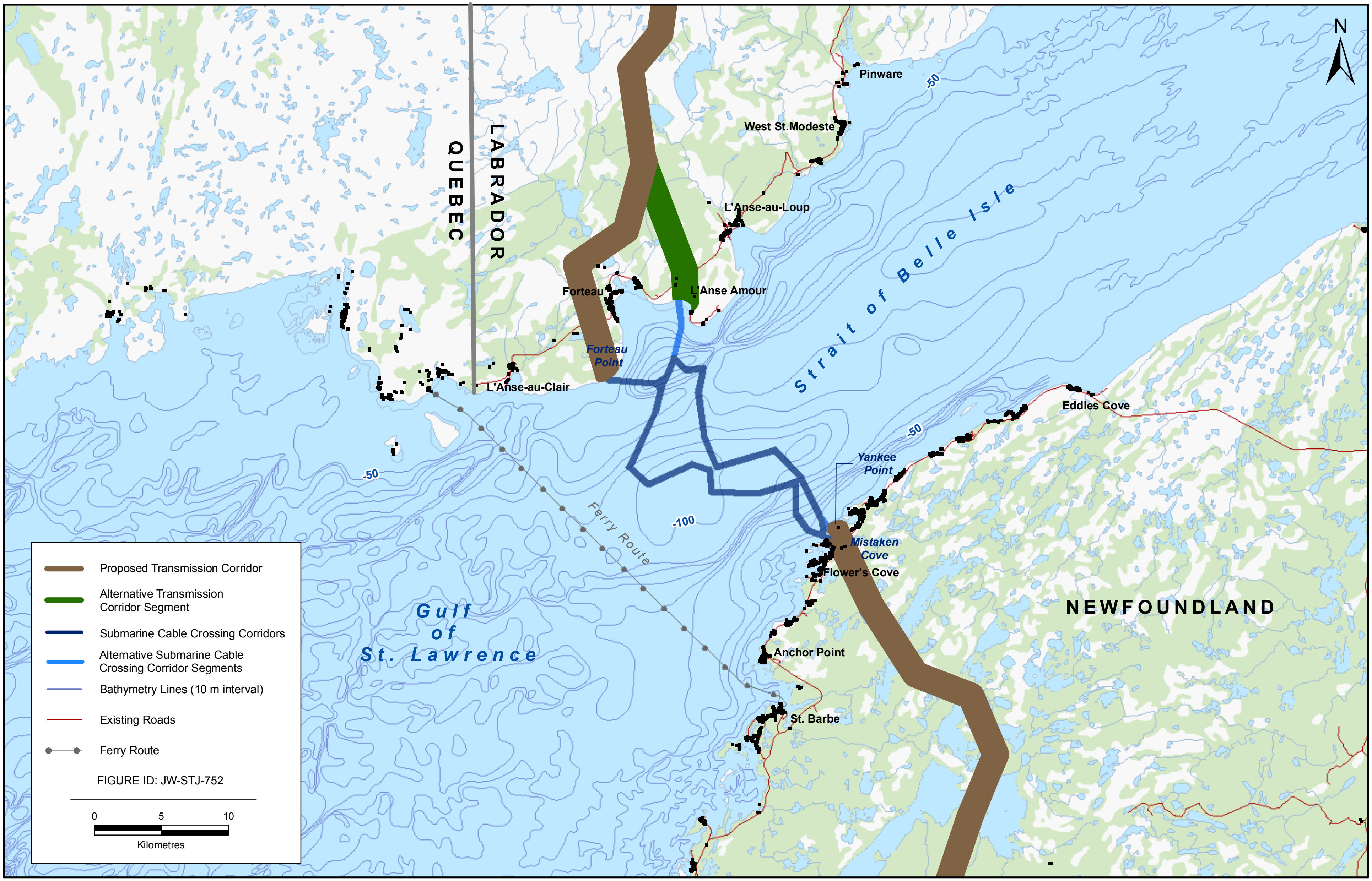
3.1.2 Strait of Belle Isle

The Strait of Belle Isle is a marine channel that separates the southeast coast of Labrador from the northwest portion of the Island of Newfoundland's Northern Peninsula. It extends for approximately 118 km in a northeast-southwest direction. At its narrowest point the Strait is approximately 17 km wide, between Point Amour and Yankee Point near the southwest end (Figure 3.2).

Physical Environment

The coast along the Labrador side is steep granite which rises to flat-topped ridges and summits from 300 to 390 m above sea level. The Newfoundland coast is much lower, with shorelines rising to approximately 30 m. Water depths within the Strait vary significantly over its length, and reach over 120 m in places. A deep central trough shallows towards narrow, bedrock-controlled coastal platforms on both sides of the Strait. In the general Project area, water depths are greater on the Labrador side and the coastal zone on the Island side is relatively shallow with depths increasing more gradually.

The Strait is underlain by Precambrian gneisses that belong to the Grenville Province and consist of a complex of metamorphic and granitic rocks. The Strait of Belle Isle is topographically complex, with seabed sediments consisting of thin, discontinuous glacial and marine sediments overlying bedrock. Across most of the Strait, the seabed comprises coarse-grained armour of pebbles, cobbles and boulders overlying glacial till and localized glaciomarine deposits. Marine sands form a discontinuous surficial veneer in shallow water areas and thicken locally in some coastal embayments. Bedrock is exposed at the seabed in places, and consists of sandstone, dolomite and limestone with some interbedded shale.



nalcor energy

FIGURE 3.2

Strait of Belle Isle

The inshore branch of the Labrador Current flows southwesterly into the Strait and along the Labrador coast before entering the Gulf of St. Lawrence. Warmer and less saline water from the Gulf flows northeasterly into the Strait along the coast of Newfoundland. Water movement through the Strait is primarily through strong tidal currents. The turbulence and mixing created by these water masses and movements creates an area of nutrient-rich water and relatively high productivity.

Sea ice and icebergs occur in the Strait from about December to June. Sea ice is a combination of locally formed ice and pack ice that drifts down from the Arctic and Labrador Sea. Of the approximately 600 icebergs that pass the Strait's latitude on average each year, 10-15 percent (60-90) drift into the Strait, with the largest number being seen in May and June. Most of these enter on the Labrador side and exit on the Island of Newfoundland side in concert with the prevailing currents (HMM 2005). Iceberg grounding and associated seabed scouring occur seasonally.

Marine Fish and Wildlife

A variety of fish species are present in the Strait of Belle Isle, including a number of commercially important and non-commercial species in the general vicinity of the proposed cable crossings. These include shellfish such as scallop, lobster, whelk and toad crab, groundfish such as cod, lumpfish, flounder and halibut, and pelagic species such as capelin, squid, herring, salmon and mackerel (DFO 2007a). The Strait itself is a spawning area for Atlantic herring (fall), and a feeding area for species such as herring, sand lance, capelin and spiny dogfish. Relatively high concentrations of shrimp are also found in parts of the Strait, as well as a wide range of other benthic invertebrates (DFO 2007b).

Marine mammals, including whales, porpoises, dolphins and seals, are present in the Strait of Belle Isle at specific times of the year (DFO 2007a; 2007b), particularly from May to August. Aerial and boat-based surveys undertaken by Newfoundland and Labrador Hydro in 1998 identified nine species of whales and dolphins (including blue, fin, humpback, minke, pothead and sei whales, white-beaked and white-sides dolphins, and harbour porpoises) and two species of seals (harp and grey) (JW 2000). The Atlantic population of blue whale is designated as endangered under the federal *Species at Risk Act* (CWS 2007). The spatial and temporal occurrence and distribution of marine mammals in the Strait varies considerably between species (JW 2000). Polar bears also occasionally drift south to the Strait of Belle Isle and beyond on spring ice.

The Strait of Belle Isle is also used by a variety of avifauna that may breed locally, overwinter and/or as feeding and resting areas for migrating through the area. Marine birds and waterfowl often congregate on the rounded headlands along the Strait as they move along the coast (Russell 2001). A total of 29 species of seabirds were observed in the Strait during a 1998 survey program by Newfoundland and Labrador Hydro, the most common being northern fulmar, sooty shearwater, northern gannet, common eider, greater black-backed gull, herring gull, black-legged kittiwake, Atlantic puffin, razorbill auk and dovekie (JW 2000).

In December 2006, a zonal workshop involving DFO scientists from the Newfoundland and Labrador, Quebec and Gulf Regions identified 10 ecologically and biologically significant areas (EBSAs) in the Estuary and Gulf of St. Lawrence, one of which was the Strait of Belle Isle area. This identification process was intended as a step towards specifying objectives for integrated oceans management in these areas (DFO 2007b).

3.1.3 Island of Newfoundland

On the Island of Newfoundland (111,390 km^2), approximately 46 percent of the inventoried land area is forested, of which nearly 60 percent is productive and the remainder is scrub. Bog covers approximately 10 percent of the land base, seven percent is water, six percent is barrens and less than one percent is cleared or developed (DFRA 2003).

The HVdc transmission line corridors on the Island of Newfoundland from the Strait of Belle Isle to Soldier's Pond pass through up to seven of the Island's ecoregions (and nine subregions) (Figure 3.1 and Table 3.2). These areas are described briefly below (after Meades 1990).

Table 3.2 Ecoregions of the Island of Newfoundland Crossed by the Transmission Corridor

Ecoregion / Subregion	Apx Length of HVdc Corridor Within and % of Total*
9) Strait of Belle Isle Barrens Ecoregion Dominated by an almost treeless tundra vegetation. White Spruce and Balsam Fir occur as krummholz interspersed with arctic-alpine plants even near sea level. The soils are generally very shallow and outcrops of calcareous bedrock are common throughout. Large stone polygons created by freeze-thaw cycles are common on shallow-exposed mineral soil. Rare and endangered species of calciphillic plants are numerous in these rock barrens.	17 km 1.5%
4) Northern Peninsula Forest Ecoregion Differs from most other forested parts of the island by the shortness of the vegetation season. The frost-free period is similar to other areas and somewhat longer than central Newfoundland. Soils are comparable to those of western Newfoundland, with limestone underlying most of the region. Acidic rock is more common on the eastern side of the peninsula. Balsam fir is the dominant tree in forest stands, except at high elevations on the eastern side of the peninsula, where it is replaced by black spruce. Limestone barrens are common along the west coast, with dwarf shrub and crowberry barrens on the east coast. Plateau bogs cover extensive areas of the coastal lowlands. *a) Coastal Plain Subregion* This includes the western side of the Great Northern Peninsula to the lower slopes of the Long Range Mountains. Most of the coastal plain is dominated by bogs and scrub forest. The area around Hawkes Bay and the foothills of the mountains are important exceptions to this generalisation. *b) Beaver Brook Limestone Subregion* Occupies the central lowlands north of the Highlands of St. John on the Great Northern Peninsula. This sheltered outlier maintains the most productive forests in the ecoregion. Limestone, shale and sandstone bedrock types occur in this area. On the western side of the peninsula, east and south of Ten Mile Pond, the till is formed from sandstone. The landscape is undulating to hilly in the extreme west. The Dryopteris-Balsam Fir and Clintonia-Balsam Fir types are most common on moderate to deep tills. On shallow tills the Pleurozium-Balsam Fir and Black Spruce-Feathermoss on bedrock are dominant. Soil textures in these types are generally sandy loam to loamy sand. *d) Eastern Long Range Subregion* Includes the productive but inaccessible forest on the eastern slopes of the Long Range Mountains up to 450 m in elevation. The forests tend to be somewhat open Balsam Fir-Black Spruce mixtures. Treeline decreases towards the northern end of the subregion.	196 km 17.0 %

Ecoregion / Subregion	Apx Length of HVdc Corridor Within and % of Total*
8) Long Range Barrens Ecoregion, c) *Northern Long Range Subregion* Encompasses the mountainous areas above the tree-line on the Long Range Mountains. Trees occur only as krummholz (i.e., stunted forest) which is usually dominated by eastern larch and black spruce; however, sheltered valleys may contain small patches of forest. The vegetation is primarily alpine barren, dominated by Arctic-alpine plants, or crowberry barren. Shallow ribbed fens and slope bogs often cover extensive areas.	44 km 4.0%
1) Western Newfoundland Forest Ecoregion, b) *Corner Brook Subregion* Hilly to undulating terrain from Bonne Bay to Stephenville and east to Grand Lake. The parent materials in this subregion are dominated by slates and limestone till. Areas with calcareous till are distinguished by the occurrence of light coloured marl deposits around ponds and in valleys. The parent material consists of shallow, stony silt loam underlain by limestone bedrock or calcareous basal till. The rugged topography is dominated by the Taxus-Balsam Fir and Dryopteris-Rhytidiadelphus-Balsam Fir forest types. The hilly, non-calcareous terrain in this subregion is dominated by shallow loamy soils over shale bedrock. However, the shallowness of the till does not adversely affect forest growth since nutrient rich seepage waters are held in the rooting zone by bedrock or a fragipan layer. The steep topography is dominated by the Dryopteris-Balsam Fir forest and supports some of the most productive stands in Newfoundland.	44 km 4.0%
2) Central Newfoundland Ecoregion Has the most continental climate of any part of insular Newfoundland. It has the highest summer temperatures and the lowest winter temperatures. Because of warm summers and high evapo-transpiration rate, soils in the northern part of this ecoregion exhibit actual soil-moisture deficiency. The Hylocomium-Balsam Fir forest type is characteristic of this area. Forest fires have played a more important role in this ecoregion's natural history than in other regions. Thus, much of the Balsam Fir-Feathermoss forest types have been converted to black spruce and some of the richer site types are dominated by white birch and aspen. In areas that have been burned repeatedly, dwarf shrub (Kalmia) barrens have replaced forest stands. Raised bogs are the characteristic wetland type. *a) Northcentral Subregion* Has higher summer maximum temperatures, lower rainfall and higher fire frequency than anywhere else in Newfoundland. The subregion extends from Clarenville in the east to Deer Lake in the west and for the most part has a rolling topography below 200m. Pure Black Spruce forests and Aspen stands dominate this area because of the prevalence of fire in the natural history of the subregion. Also, the high summer temperatures are thought to stimulate Aspen root suckering and contribute to the local success of Aspen (Damman 1983). Relatively low moisture, coarse soils and the prevalence of Black Spruce cover types make this subregion particularly susceptible to regeneration failure. Furthermore, where tree regeneration is lacking, succession to dwarf shrub heath dominated by Kalmia angustifolia occurs on the nutrient-poor coarse textured till that is prevalent through much of this area. The rolling to undulating topography is characterized by shallow, medium quality till with a soil texture range from sandy loam to loam. Midslopes are dominated by the Hylocomium-Balsam Fir type, or the Black Spruce-Feathermoss type on seepage gleysols after fire. There are also local areas covered by poor sandy till over galcio-fluvial deposits and outwash deposits along some of the major river systems such as the Terra Nova, Exploits and Indian River. It is in these land types that succession of productive Black Spruce forest types to ericaceous heath dominated by Kalmia angustifolia is most prevalent.	329 km 28.0 %

Ecoregion / Subregion	Apx Length of HVdc Corridor Within and % of Total*
6) Maritime Barrens Ecoregion Extends from the east to the west coast of Newfoundland along the south-central portion of the Island. This ecoregion has the coldest summers, with frequent fog and strong winds. Winters are relatively mild, with intermittent snow cover, particularly near the coastline. The landscape pattern usually consists of stunted balsam fir broken by extensive open Kalmia barren, which developed because of indiscriminate burning by European settlers. Good forest growth is restricted to the long slopes of a few protected valleys. Slope and basin bogs are the most common wetland type. *a) Northeastern Barrens Subregion* Lower fog frequency and somewhat warmer summers compared to other parts of the ecoregion. Arctic-alpine species are absent from the heath vegetation and Yellow Birch is absent from the forest. The landscape is extensively forested with local heath vegetation particularly along the coast. The tills in the area are generally a shallow rolling ground moraine with sandy loam to loam texture. The Hylocomium-Balsam Fir type occupies mid-slopes and it is usually associated with gleyed podzols or gleysols. *b) Southeastern Barrens Subregion* The landscape is dominated by heathlands and the forest only occurs in small acreages which escaped fire. The dominant heath shrub on uplands is Empetrum nigrum with Kalmia angustifolia forming a dense cover only in protected valleys. The topography is generally undulating with shallow heavily compacted till and numerous large erratics. The Clintonia-Balsam Fir type is most common where the forest is still present. Good forest growth only occurs in a few large protected valleys where the Dryopteris-Balsam Fir type dominates the slopes. Good specimens of Yellow Birch are also found in these stands. *d) Central Barrens Subregion* Occurs south of the Central Newfoundland Ecoregion and north of the South Coast Barrens Subregion. Residual forests that have not been destroyed by fire have moderate forest capability. The dwarf shrub heaths are robust and Rhododendron canadense is a conspicuous component suggesting deep snow cover. Arctic-alpine species are poorly represented and Yellow Birch is absent from the forest.	119 km 10.0%
5) Avalon Forest Ecoregion Represents a sheltered outlier within the more open and exposed Maritime Barrens Ecoregion. Pure stands of balsam fir with a significant mixture of white and yellow birch dominate this region. The Avalon Forest Ecoregion has been spared the ravages of fire that decimated the forests in the surrounding landscape, converting them to open heathland. The very moist climate and ribbed moraine topography give this small (500 km^2) ecoregion its uniqueness. Raised bogs occur between moraines. The excessive frequency of fog is clearly evidenced by the abundance of pendant, arboreal lichens hanging from the branches of balsam fir.	11 km 1.0%
Total	760 km 65.0%

After: Meades (1990); DFRA (2003); NFS (n.d.)
* Distances and percentages are approximate, and are for the proposed (rather than alternative) HVdc corridor (Figures 2.7 and 2.8)

Northern Peninsula

The Northern Peninsula comprises the northwestern portion of the Island of Newfoundland. It is the Island's largest peninsula, approximately 300 km long and 80 km at its widest point and comprising an area of 17,500 km^2. Extending from the Strait of Belle Isle south to Bonne Bay, it is bounded by the Gulf of St. Lawrence to the west and the Labrador Sea and White Bay to the east.

The proposed transmission line corridor extends south along the western portion of the Northern Peninsula, crosses the Peninsula near its southern end, and continues southeast across the Island. In doing so, it will intersect up to four ecoregions (and five subregions) on the Northern Peninsula (Figure 3.1, Table 3.2).

The extreme northwestern edge of the Peninsula, along the Strait of Belle Isle, is a rocky, flat coastal stretch. Calcareous bedrock is common, and the area is covered by shallow soils with extensive areas of exposed bedrock. The vegetation cover is comprised almost exclusively of barren and tundra-like assemblages, with alternating dry barrens and shallow fens. The calcareous barrens are home to a rich and unique mixture of endemic, arctic and calciphillic plant species.

Along the western side and interior portions of the Northern Peninsula, coastal, forested and barren areas are present. Much of the interior is dominated by mountainous highland areas and plateau associated with the Long Range Mountains, with mostly barren vegetation and shallow ribbed fen and tuckamoor dominating the landscape. Along the western edge of the peninsula, the lower portions of the Long Range Mountains are characterized by forested areas along the slopes and a flat coastal plain occupied by bogs and scrub vegetation. Relatively productive forested areas of balsam fir - black spruce mixtures are found along the eastern lower slopes of the Long Range Mountains.

A number of plants that are considered to be species of special conservation concern, and are thus protected by provincial and/or federal legislation, may be found in the area. Several such species are known to or may extend into the general vicinity of the proposed corridor, such as Long's Braya and Fernald's Braya. Other protected plant species that occur at locations along the peninsula's northwest coast include barrens willow, boreal felt lichen and Fernald's milk–vetch (IFWD n.d.; CWS 2007).

The areas along the northwestern portion of the Northern Peninsula, across the Long Range Mountains and south to Gros Morne National Park are home to a number of caribou populations, including the St. Anthony, Northern Peninsula, Humber, Gregory Plateau and Gros Morne Herds. Other large and small mammals such as moose, black bear, lynx, fox, hare and others also occupy the forest, scrub and aquatic habitats throughout the peninsula. Raptors, waterfowl and other avifauna are also found here, including bald eagle, osprey and merlin in the forested areas, ptarmigan and grouse in the barrens and scrublands and geese, ducks and merganser in the wetland areas along the coast. Wildlife species of special conservation concern that are currently designated under federal and/or provincial legislation, and that do or may occur on the Northern Peninsula include: Newfoundland pine marten, harlequin duck, grey-cheeked thrush, common nighthawk, short-eared owl and red crossbill (IFWD n.d. CWS 2007).

This section of the proposed transmission corridor will similarly cross and/or be located adjacent to a number of watersheds (Appendix B), which are known to support a variety of species. Fish species that commonly occur in waterbodies and watercourses in the region include Atlantic salmon, brook trout, rainbow smelt, sticklebacks and American eel, with occasional Arctic char. There are nine Scheduled Salmon Rivers on the Northern Peninsula in the general vicinity of the proposed transmission corridor (DFO 2008a).

Existing protected areas on the northern and western sides of the peninsula include the Watt's Point and Table Point Ecological Reserves and The Arches Provincial Park, which are along the coast and outside of the proposed transmission corridor. The Main River, on the southeast portion of the peninsula, was designated as a Canadian Heritage River in February 2001 (PNAD 2008). The HVdc corridor does not cross any existing National Wildlife Areas, Migratory Bird Sanctuaries or Marine Protected Areas on the Island of Newfoundland (DFO 2008b; Environment Canada 2008).

Gros Morne National Park is located on the west coast of the Island of Newfoundland, near the base of the Northern Peninsula. The Park was established in 1973 and formally designated under the federal *National Parks Act* in October 2005. Gros Morne was also designated a UNESCO World Heritage Site in 1987 for both its geological history and its exceptional natural beauty.

The Park covers an area of 1,805 km^2, comprising part of the Long Range Mountains and facing the Gulf of St Lawrence with 69 km of coastline. It therefore exhibits two distinct landscapes - coastal lowlands and alpine plateau. Glacial action has resulted in fjords, glacial valleys, sheer cliffs, waterfalls and numerous lakes, while coastal geologic features such as marine inlets, sea stacks and sandy beaches are also present. Geology and glacial history, proximity to the ocean, topography, and wind exposure contribute to the Park's diversity of habitats. These varied ecosystems support a diverse range of flora and fauna, including a mixture of temperate, boreal, and arctic species including lichens, bryophytes, flowering plants, birds, mammals and fish (Parks Canada 2007; UNESCO 2008).

Plant life in the Park is diverse, with over 700 species of flowering plants, 400 species of bryophytes and an estimated 400 species of lichens. Habitat is provided in shorelines, lowland bogs, heath barrens, riverine thickets, meadows, tundra, felsenmeer, cliffs and forests, as well as the unique serpentine barrens of the Tablelands. Birds are also abundant, with a total of 239 species having been documented. Land mammals that live within Gros Morne include moose, woodland caribou, black bear, red fox, beaver, snowshoe hare and red squirrel. Within the Park, 12 fish species can be found, including Atlantic salmon. rainbow and brook trout, arctic char and rainbow smelt. Marine mammals such as whales and harbour seals can also be seen along the shores in the summer months (Parks Canada 2007).

Central and Eastern Newfoundland

From the base of the Northern Peninsula to the Isthmus of Avalon, the proposed HVdc transmission corridor passes almost entirely through one ecoregion (and subregion), which occupies most of north-central Newfoundland (Figure 3.1, Table 3.2).

This area exhibits the most continental climate on the Island, with relatively high summer temperatures, low rainfall and harsh winters. The topography is predominantly low and rolling. This is also most heavily forested and distinctly boreal of any part of Newfoundland, with pure black spruce forests and white birch and aspen stands, as well as dwarf shrub heath.

Wildlife in this region are typical of the boreal forest, and include moose, snowshoe hare, muskrat, otter, mink, black bear, beaver, and lynx, as well as small mammals such as voles and shrews. Caribou populations in the general area include the Gros Morne, Hampden Downs and Humber Herds at the base of the Northern

Peninsula and in the White Bay area, the Gaff Topsails herd, the Hodges Hill herd and the larger Middle Ridge herd to the southeast. Birds that typically live in forested areas are also found throughout, including raptors such as bald eagle, osprey, merlin, boreal and great horned owls and sharp-shinned hawk, as well as ruffed and spruce grouse. Waterfowl such as green-winged teal, ring-necked duck and Canada geese are also present.

Wildlife species protected by provincial and/or federal legislation that are or may be found in central and eastern Newfoundland include harlequin duck, red crossbill, grey-cheeked thrush, common nighthawk, short-eared owl and Newfoundland marten (IFWD n.d. CWS 2007).

Fish species that are common in waterbodies and watercourses in the region include Atlantic salmon, brook trout, rainbow smelt, sticklebacks and American eel and Arctic char, with rainbow trout, alefish and sea lamprey occurring less commonly. Major rivers systems such as the Exploits, Gander, Gambo and Terra Nova Rivers are located in this general area, many of which are designated as Scheduled Salmon Rivers (DFO 2008a).

There are a number of existing provincial and federal parks and reserves in central and eastern Newfoundland, including Squires Memorial Provincial Park, West Brook Ecological Reserve, the Bay du Nord Wilderness Reserve and Terra Nova National Park. The proposed HVdc transmission corridor avoids each of these. The T'Railway Provincial Park was established in 1997 and stretches almost 900 km from St. John's to Port aux Basques along the main line of the former Canadian National railbed (PNAD 2008).

Avalon Peninsula

As the proposed transmission line corridor nears the Avalon Peninsula, it passes through an area of extensive maritime barrens. This includes two ecoregions and three subregions (Figure 3.1, Table 3.2).

The Isthmus and western and northern portions of the Avalon Peninsula are characterized by undulating terrain with extensive areas of barren heath, small pockets of forest in sheltered valleys (particularly in the north), and bogs and shallow fens interspersed throughout.

The sheltered, central portion of the Avalon Peninsula is characterized by low elevations and relatively hilly terrain with numerous lakes and bogs within. It sees cool summers and mild winters, high precipitation and frequent fog. The region is relatively heavily forested, and exhibits very distinctive vegetation patterns which include pure stands of balsam fir–fern forests with a mixture of yellow birch, scrub forests with peatmoss understory and ericaceous shrubs, and convex raised bogs. Lichens are abundant on tree stems and branches. This includes the boreal felt lichen in some areas, which is protected under federal and provincial legislation.

The barren and bog areas and forested pockets on and adjacent to the Avalon Peninsula are home to a number of large and small mammals such as moose, black bear, lynx, fox, hare, mink, beaver, otter, voles and shrews, as well as raptors, waterfowl and other avifauna throughout its barren, forest, scrub, wetland and marine habitats. The barren areas are also home to a number of caribou populations, particularly the northern and southern portions of the peninsula.

Fish species that are known to commonly occur in waterbodies and watercourses in the region include Atlantic salmon, sticklebacks, brook and brown trout, rainbow smelt and American eel, with rainbow trout, Arctic char and other species found less commonly.

Existing protected areas on the Isthmus and central portion of the Avalon Peninsula include Jack's Pond, Bellevue Beach and Butterpot Provincial Parks, and the Hawke Hill Ecological Reserve and Avalon Wilderness Reserve (PNAD 2008). The HVdc transmission corridor (and/or the eventual routing) will avoid each of these.

Conception Bay, on the northeastern side of the Avalon Peninsula, is one of the principal bays of the Island of Newfoundland, extending for approximately 70 km and covering an area of 1,295 km^2. Holyrood Bay comprises its southernmost portion, with the community of Holyrood located at the head. The surrounding topography largely governs the bathymetry of Holyrood Bay, with steeply sloping shorelines on both sides, reaching depths of 80 m about 0.5 km offshore (NLH 1990; Blundon 2006).

The substrate of Holyrood Bay is variable, consisting of large stable boulders intermixed with smaller boulders and cobbles, combined with sand patches (Whittick and Hooper 1977; LGL 1993). In shallow water, substrate types are quite heterogeneous, ranging from solid bedrock, through unstable boulders to sand. The percentage area of sand substrate increases with depth, until the entire bottom becomes sandy with occasional boulder clusters. Plant and animal communities are representative of eastern Conception Bay and similar areas elsewhere in Newfoundland (Whittick and Hooper 1977). Fish species that occur in Holyrood Bay include winter flounder, cod, mackerel, herring, and capelin, with shellfish such as squid, scallop and lobster also present (DFO 2007a).

3.2 The Human Environment

The following sections provide a general overview of the socioeconomic setting for the Project. As described previously, the Project will extend across much of Newfoundland and Labrador, and will therefore involve and potentially interact with a range of socioeconomic environments and communities.

3.2.1 Central and Southeastern Labrador

Labrador has a rich history and cultural heritage, which extends over a period of nearly 9,000 years. Today, approximately 26,400 people live in Labrador (Statistics Canada 2006), distributed in 32 communities which range from small settlements along the coast to larger centres in central and western Labrador.

Historical Overview and Archaeology

Archaeological research in Labrador has revealed a cultural-historical sequence that is long and complex. The area was colonized initially by Maritime Archaic groups from the south shortly after deglaciation. These groups arrived in the southeast part of Labrador by 8,000 years before present (BP), expanding northward along the coast to central and then northern Labrador by 7,500 years BP (Fitzhugh 1972; McGhee and Tuck 1975). After 4,000 BP, coastal Labrador was also colonized by Arctic-adapted peoples from the north (Cox 1978), and thereafter, Labrador pre-contact history is characterized by a sequence of Intermediate Indian (Nagle 1978). Recent Indian and historic Innu (Fitzhugh 1978; Loring 1992; Maihot 1997) occupations, overlapping with Palaeo Eskimo occupations (Pre-Dorset, Groswater, Dorset), and culminating with the arrival of the Thule, ancestors of the modern Labrador Inuit, approximately 700 BP (Kaplan 1983; Fitzhugh 1994).

Archaeological and historical records also confirm a lengthy European presence throughout the region. The first Europeans reported to have seen Labrador were the Norse approximately 1,000 years ago and after approximately 500 BP, Labrador became a focus for European activities, including whaling, fishing, sealing, and fur-trading (Tuck and Grenier 1989; McAleese 1991; Kennedy 1995). The abundant resources resulted in European fishers and merchants making annual treks to the coast of Labrador to fish, which continued through the succeeding centuries. Non-aboriginal settlement in Labrador began in the 18th century, with the introduction and growth of new economic pursuits (such as the expansion of fisheries and the fur trade). Large scale resource developments in the 20th century such as mining, hydroelectric development and military operations saw further year-round settlement by non-Aboriginal residents.

Previous archaeological research in Labrador has focused primarily on the coast, and has generally established that historic resources in that area are relatively rich and abundant, particularly along the shoreline within the major bays. There are 25 reported archaeological sites in the area between L'Anse au Clair and L'Anse au Loup, including Maritime Archaic Indian, Groswater, Dorset, Recent Indian and a number of undetermined precontact sites, as well as archaeological evidence of Basque, French and other European occupations. While the coast has seen detailed investigation, less archaeological research has been undertaken in the Labrador interior until quite recently, including extensive historic resources research undertaken by Newfoundland and Labrador Hydro in 1998-2000 and 2006. Archaeological fieldwork conducted in 1998 and 2006 along the proposed transmission corridor from Gull Island to the Strait of Belle Isle found no archaeological sites in the area, and there appears to be a clear distinction between the relatively high archaeological potential of the Strait of Belle Isle coastal strip and the generally lower potential of the interior.

Aboriginal Communities and Organizations

The Innu (previously known as Montagnais and Naskapi Indians) are indigenous inhabitants of an area they refer to as Nitassinan, which comprises much of the Québec-Labrador peninsula. They were traditionally a nomadic people, whose movements responded to the seasons and to the migrations of the animals they relied upon. This traditional way of life continued until the mid-20th century, when many Innu were settled into communities. Innu continue to attach great importance to time spent in Nutshimit (the country), which for many Innu is seen as an opportunity for cultural and physical renewal.

The Innu of Labrador currently number about 2,500 and reside primarily in two communities - Sheshatshiu in Central Labrador and Natuashish on the North Coast. The Mushuau Innu resettled from Davis Inlet to Natuashish in 2002-03. Small numbers of Innu also reside in Happy-Valley-Goose Bay and elsewhere. The Sheshatshiu Innu and the Mushuau Innu of Natuashish comprise separate Bands, with each community currently a Reserve with an elected Chief and Council. Both are represented by Innu Nation in land claims negotiations and on other matters of common interest. The Innu of Labrador claim aboriginal rights and title to much of Labrador. The Labrador Innu land claim area overlaps the proposed Project area, and is the only such claim that has been accepted for negotiation by both the federal and provincial governments. Innu Rights Agreement negotiations are ongoing between Innu Nation and the Governments of Newfoundland and Labrador and Canada.

On September 26, 2008 the Government of Newfoundland and Labrador and Innu Nation announced the signing of the *Tshash Petapen Agreement* (which translates as the "New Dawn Agreement"), which resolved key issues relating to matters between the Province and Innu Nation surrounding the Innu Rights Agreement, the Lower Churchill Impacts and Benefits Agreement (IBA) and Innu redress for the Upper Churchill Hydroelectric Development. Final agreements based on the *Tshash Petapen Agreement* are currently being negotiated, and will be subject to ratification by the Innu people.

In addition to Innu resident in Labrador, there are 11 Innu communities in Quebec. The land claim areas of several of these First Nations extend into Labrador, including communities along the Lower North Shore (Natashquan, Mingan, La Romaine, Saint-Augustin, Sept-Iles) and Schefferville. The land claims of Québec Innu groups in Labrador have not, however, been accepted for negotiation by the Government of Newfoundland and Labrador. Quebec Innu are known to undertake land use and harvesting activities (particularly hunting) in Labrador as well.

The Inuit of Labrador are descended from the eastern Thule people. By the late 18th century the Inuit had established themselves along portions of the Labrador coast. The Inuit were a mobile people, but their harvesting efforts focused on the sea. As Europeans settled the Labrador coast, the Labrador Inuit became more sedentary and participated increasingly in the fishery and fur trade.

Labrador Inuit are now primarily resident on the Labrador North Coast in the communities of Nain, Hopedale, Makkovik, Postville, and Rigolet, and in the Central Labrador communities of North West River and Happy Valley-Goose Bay, with other Inuit residing in Southern and Western Labrador, St. John's and elsewhere. The *Labrador Inuit Land Claims Agreement* was signed by the Labrador Inuit and the provincial and federal governments in January 2005 and came into effect on December 1st of that year. The Agreement is a modern comprehensive treaty, and sets out the details of land ownership, resource sharing and self-government in the area covered by the Agreement in Northern Labrador. It also resulted in the establishment of the Nunatsiavut Government, which represents the over 6,000 beneficiaries of the Agreement.

The Labrador Métis Association was established in 1985, and renamed the Labrador Métis Nation (LMN) in 1998. The LMN reports a membership of over 6,000 members, who reside primarily in Central Labrador and along the southeastern coast of Labrador. The LMN has asserted a land claim in the region, but this has not been accepted for negotiation by the federal or provincial governments.

Contemporary Socioeconomic Setting

Labrador encompasses a vast area with diverse social, cultural and economic landscapes, and is often thought of as being comprised of a number of regions - Central Labrador, Southern Labrador, the Labrador Straits, Labrador West and the North Coast. The Project itself will extend through two of these areas – Central Labrador and the Labrador Straits (Figure 3.3).

Central Labrador (or Upper Lake Melville, Economic Zone 3) includes the Town of Happy Valley-Goose Bay, the Town of North West River, the Innu reserve community of Sheshatshiu and the smaller settlement of Mud Lake. In 2006, the region had a population of 9,176 (a decrease of 10 percent over the past decade), comprising about 35 percent of the population of Labrador (Statistics Canada 2006).

Happy Valley-Goose Bay is the largest community in Labrador (7,570 residents), and has a relatively well-developed and diverse economy and a range of services and infrastructure. An Air Force base (5 Wing Goose Bay) has been operating since World War II, and military activities long formed the basis of the area's economy. Declining demand for foreign military training in recent years has, however, resulted in the need to explore other opportunities and investments to help the town and region diversify their economies. The area has, in recent years, been benefiting from growth in mineral exploration and development and other activities. There are currently over 300 businesses in the region, which provide a variety of goods and services (Economics and Statistics Branch 2007). Government agencies and other organizations involved in the provision of health care, transportation, education and other services to central and coastal Labrador are also located in the town.

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FIGURE 3.3

Regional Economic Zones

The communities of North West River and Sheshatshiu are located approximately 25 km northeast of Happy Valley – Goose Bay, and also include a number of businesses and service agencies, while Mud Lake is about 10 km to the southeast.

Happy Valley-Goose Bay, North West River and Sheshatshiu are connected to each other by paved road, whereas Mud Lake is accessed by boat and snowmobile. The TLH (Phase 1) also connects the region to Labrador West and beyond, and when completed later in 2009, the TLH (Phase 3) will provide year-round road access to Southern Labrador and the Straits (Figure 2.4). Year-round air service and seasonal ferry services to coastal Labrador and the Island of Newfoundland are also available.

The Labrador Straits (Economic Zone 5) is the region across the Strait of Belle Isle from the Island of Newfoundland. It includes the communities of L'Anse au Clair, Forteau, L'Anse Amour, L'Anse au Loup, Capstan Island, West St. Modeste, Pinware and Red Bay. In 2006, that area had a population of 1,817 persons (a decline of 12 percent since 1996), which comprised approximately seven percent of the population of Labrador as a whole (Statistics Canada 2006). Communities in the Labrador Straits region are connected to each other and to the Quebec North Shore by an 80 km paved highway which was constructed in the 1950s. The TLH (Phase 2), constructed in the late 1990s, also extends from Red Bay north to Cartwright, and a ferry service between Blanc-Sablon and St. Barbe connects the region to the Island of Newfoundland.

The economy of the Labrador Straits region has traditionally been based on the fishery, and recent years have seen considerable activity and growth in shellfish and groundfish harvesting and processing. The area has also seen a considerable expansion in the number and diversity of small businesses, and there are currently approximately 90 businesses in the region, primarily in the retail trade and service sectors (Economics and Statistics Branch 2007). The tourism sector also contributes greatly to the economy of the region, with a number of significant natural and historic attractions.

Historic and heritage sites in the general area include the Point Amour Lighthouse Provincial Historic Site and the Maritime Archaic Burial Mound National Historic Site of Canada near L'Anse Amour, as well as the Red Bay National Historic Site located approximately 30 km to the north.

Adjacent to the proposed transmission corridor, Southern Labrador (Economic Zone 4) is the region between Groswater Bay and Cape Charles. It includes the towns of Cartwright, Charlottetown, Port Hope Simpson, St. Lewis and Mary's Harbour, and the communities of Paradise River, Black Tickle-Domino, Norman Bay, Pinsent's Arm, Williams Harbour and Lodge Bay. There are also a number of smaller coastal settlements in the region which are inhabited on a seasonal basis.

A variety of land and resource use activities are undertaken in the general Project area, including recreational, subsistence and commercial pursuits by aboriginal and non-aboriginal persons. Large and small game are found throughout the area, and hunting has long been an integral part of the lifestyle of area residents. Trapping was historically an important economic activity, but today is pursued primarily for recreation and/or as a supplementary income source. Residents also harvest the area's forest resources for firewood and lumber.

Fishing is also an important recreational and subsistence activity, with salmon, trout, pike, smelt and/or other fish species taken from numerous rivers and ponds and in Lake Melville through angling and net fisheries.

Cabins are located throughout the area, and are used in association with various recreational and subsistence pursuits. Snowmobiling is also a popular activity in the winter months. Local trail networks are also used by residents for hunting, fishing and gathering activities. There are approximately 80 commercial outfitting camps in Labrador, which offer big game hunting and/or angling adventures (Hull et al. 2006). A number of fishing lodges are located throughout southeastern Labrador, including facilities on the Upper Eagle River, Minipi River, St. Paul’s River, Forteau River, Pinware River and others. The completion of the TLH (Phase 3) between Happy Valley-Goose Bay and Cartwright Junction in 2009 will provide increased access to and within the region and may result in a shift in local land and resource use patterns.

3.2.2 Strait of Belle Isle

The economy of the areas on both sides of the Strait of Belle Isle (Figure 3.2) has traditionally been based on the fishery. The principal fisheries which presently occur within the Strait itself include lobster, scallop, shrimp and cod. Fisheries data for NAFO Unit Area 4Ra (Strait of Belle Isle) show lobster (35 percent) making up the greatest proportion of landings by value in recent years, followed by capelin (20 percent), Atlantic cod (15 percent), Iceland scallop (10 percent) and shrimp (10 percent). Lumpfish, flounder, mackerel, herring, whelk and other species are also found and fished in the general area (JW 2001).

Fishing in the Strait of Belle Isle generally takes place between May and November, primarily by small vessels fishing relatively close to their home communities, although fishing seasons, areas and techniques vary according to species. Lobster pots are set primarily on rocky grounds throughout the Newfoundland side of the Strait of Belle Isle, with the usual season being from May to June or July each year. Lumpfish nets are often set in the nearshore areas around the same time. Atlantic cod are fished using longlines, gillnets, cod traps, trawls and/or hand lines. Capelin are harvested during a relatively short summer season, using purse seines, capelin traps or dip nets. Scallop are fished throughout the area using rakes or drags (dredges) pulled by mid-sized vessels, with the typical season being from early summer to the fall. Shrimp are fished by both the offshore and inshore fleets, using otter trawls and beam trawls (JW 2001). There are currently no existing or proposed aquaculture facilities in the vicinity of the proposed subsea cable corridors.

There is a relatively high volume of vessel traffic in the general area, particularly between June and late November. There are vessel lanes with designated directions in the Strait, as well as a separation zone between the routing lanes.

The ferry route between St. Barbe, Newfoundland and Blanc-Sablon, Quebec is just south of the proposed Project area. The MV Apollo makes at least one and frequently two or more crossings of the Strait of Belle Isle per day during the operating season, which typically extends from mid April or early May to mid January.

There are no pipelines within the Project area, nor are there any cables identified on the Canadian Hydrographic Service’s (CHS) charts or other known seabed infrastructure.

3.2.3 Island of Newfoundland

The Island of Newfoundland (111,390 km^2), like Labrador, is characterized by distinct and varied socio-cultural and economic landscapes. The profile of the existing socioeconomic setting which follows focuses upon the general areas of the Island through which the proposed HVdc transmission corridor will extend, namely the Northern Peninsula, Central and Eastern Newfoundland and the Avalon Peninsula.

Historical Overview and Archaeology

Newfoundland and Labrador's cultural history is interesting and complex, and encompasses a period of up to 9,000 years. The first evidence of human occupation comes from sites in the Strait of Belle Isle in Southern Labrador, which were occupied by descendants of Palaeo-Indians (Section 3.2.1). This was followed by a succession of peoples and cultural traditions in various parts of Newfoundland and Labrador.

The Maritime Archaic Indian Tradition in Labrador lasted from approximately 7,500 to 3,500 years BP, with these people reaching the Island of Newfoundland about 5,000 years BP and eventually occupying much of the coastline. Early Palaeo-Eskimos reached northern Labrador about 4,000 years BP and spread southward to the Island before 3,000 BP and up until about 2,200 years BP. They were eventually replaced by other Palaeo-Eskimo people, known as Dorset Eskimos. In the three to four centuries following their first appearance in northern Labrador, the Dorset spread throughout the province until they also began to diminish in numbers after 1,400 years BP. A Recent Indian period (about 2,000 to 500 years BP) saw a number of successional cultural subdivisions, extending to the historic Beothuk. Their sites include a coastal as well as an interior distribution based on caribou hunting and use of other terrestrial resources. The last known Beothuk, Shanawdithit, died in 1829. Later, the Mi'kmaq appeared on the Island, with a culture almost entirely dependant upon interior resources (Pastore 1997; Tuck 2006).

The history of European exploration and eventual settlement extends over a period of about 1,000 years, beginning with the Norse who arrived about 1,000 AD and established a settlement at L'Anse au Meadows. John Cabot eventually reached the Island and claimed it for England in 1497, after which fishermen from various European countries began to travel to the Island during the summer months on a regular basis shortly thereafter. Despite various colonization attempts in the 17th century, it was not until the second half of the 18th century that permanent settlements were established by Europeans in Newfoundland.

There are approximately 4,000 known archaeological sites in the province, which range in age from nearly 9,000 years BP to sites dating to the 20th century. Different parts of the Island of Newfoundland clearly have varying degrees of historic resources potential, with a great many of the known sites located along the coast, with other concentrations in the north-central and eastern portions of the Island including along major watercourses (PAO 2008).

Contemporary Socioeconomic Setting

The Island of Newfoundland comprises less than 30 percent of Newfoundland and Labrador's total land area, but is home to nearly 95 percent of its population. The Island's residents live in approximately 250 municipalities as well as numerous smaller unincorporated communities (DMA 2008), which range in size from less than five to over 100,000 persons (Statistics Canada 2006), and are widely distributed along the Island's nearly 10,000 km of coastline and throughout its interior. The proposed transmission corridor will pass through nine of the Island of Newfoundland's Regional Economic Zones (Figure 3.3).

Northern Peninsula

The Northern Peninsula constitutes the largest distinctive geographical region on the Island of Newfoundland (Red Ochre Regional Board Inc. 2006), and is home to approximately 18,000 residents in 70 communities. Its population has been steadily declining and aging in recent years, similar to the situation for much of rural Newfoundland and Labrador (Statistics Canada 2006). The largest community in the region is St. Anthony, which provides key services to other communities throughout the area, as do other centres such as Port au Choix, Roddickton, Rocky Harbour and others. A highway extends from Deer Lake along the western coastline of the peninsula and north to the Straits, and across to communities on the northeast side.

The area has a longstanding linkage to the fishery. The collapse of the groundfish sector and subsequent closure of many of the fish processing plants in the area had a significant social and economic impact on the region. However, recent years have seen transition, diversification and growth as a result of the harvesting and processing of alternative species such as shellfish. Tourism has also become a key component of the local economy, as a result of world class tourism attractions such as Gros Morne National Park, as well as the L'Anse aux Meadows and Port au Choix National Historic Sites (located well outside the Project area) and other attractions, activities and services. There are a number of commercial outfitters in the region, with hunting and/or fishing camps along the northern and eastern sides and concentrated within the south-central part of the peninsula (Hull et al. 2006).

Collectively, the fishery and the tourism industry, together with the forestry sector, currently comprise the principal economic drivers and opportunities within the region’s economy. Other private sector enterprises and government services also employ a significant proportion of the local labour force (Great Northern Peninsula Fisheries Task Force 2006; Red Ochre Regional Board Inc. 2006; Nordic Economic Development Corporation 2008).

Approximately 160,000 people visit Gros Morne National Park each year. Tourism facilities and activities include boat tours, camping, swimming, hiking, picnicking, cross country skiing and others. The cultural heritage of the area and its associated sites also draws many visitors, including the fishing villages which dot the shores, as well as other attractions such as the Lobster Cove Head Lighthouse and the S.S. Ethie Shipwreck (Parks Canada 2007).

The Gros Morne National Park boundary is adjacent to but excludes eight coastal settlements: Trout River, Woody Point, Glenburnie-Birchy Head–Shoal Brook, Norris Point, Rocky Harbour, Sally’s Cove, St. Paul’s and Cow Head, which have an overall population of about 5,000 residents. The Park includes approximately 120 km of paved roads, including Route 430 through Wiltondale which continues to the northern section of the Park and beyond, as well as existing transmission lines within and through the southern and western areas of the Park (Figure 1.2).

Central and Eastern Newfoundland

For the purposes of this overview, Central and Eastern Newfoundland are generally defined as the areas located to the southeast of the Northern Peninsula, through the north-central portion of the Island, and southeast to the Isthmus of Avalon. The proposed HVdc transmission corridor extends primarily through the interior region of the Island to the Isthmus.

Approximately 72,000 people reside in this general area (Statistics Canada 2006), in numerous communities that stretch along the TransCanada Highway and various roads that extend into interior and coastal areas. The overall population has been steadily aging and declining, similar to the situation in much of rural Newfoundland and Labrador. However, in portions of the central region the population has remained relatively steady in recent years, due primarily to growth in various communities (Exploits Valley Economic Development Corporation 2007; Statistics Canada 2006).

The economy of Central Newfoundland has traditionally been based primarily on natural resource extraction and industrial development. Much of the population lives in the Grand Falls-Windsor and Bishop's Falls area, which is the industrial, service and government centre for Central Newfoundland. The forestry sector and associated pulp and paper industry has been a major employer in this area for decades. In early December 2008, however, Abitibi-Bowater announced it would cease to operate the Grand Falls-Windsor paper mill in the first quarter of 2009. Since that time, employees, local residents, industry and stakeholder groups, and municipal and provincial governments have been working together and taking action to help the town and region retain its current economic activity, as well as exploring employment, business and economic diversification opportunities.

Manufacturing, commercial, retail and government services also employ a significant portion of the Central Newfoundland labour force (Exploits Valley Economic Development Corporation 2007). The Town of Gander also serves as a public and private service centre and transportation hub for surrounding communities (Town of Gander 2006). Tourism and recreational activities and associated facilities are also currently a key component of the area's economy (Kittiwake Economic Development Corporation 2003). Clarenville is the primary service hub for much of Eastern Newfoundland, serving as the commercial and service centre for the surrounding area including the Bonavista Peninsula. The fishery is an important part of the economy along the east coast, and the tourism industry has grown steadily over the past decade (Discovery Regional Development Board 2005).

Avalon Peninsula

The Avalon Peninsula (10,360 km^2) comprises the southeastern portion of Newfoundland, and is connected to the rest of the Island by a narrow Isthmus. The peninsula is home to 244,550 people, nearly half of the population of Newfoundland and Labrador as a whole. The area has seen a population increase of 2.4 percent since 2001, while over the same period the province as a whole experienced a population decline of 1.5 percent (Statistics Canada 2006).

The Avalon region includes approximately 200 communities, ranging from larger urban areas such as St. John's (the provincial capital) and Mount Pearl, to towns such as Conception Bay South, Paradise and Bay Roberts, to numerous smaller rural communities throughout. A large majority of the region's population live in communities with populations of more than 5,000 people (Rural Secretariat 2008).

The region has a well-developed and diverse economy, being the provincial centre for government and many services and industries. Given its relatively large and concentrated population, portions of the Avalon Peninsula are also subject to fairly intensive land use, such as residential and cottage development, industry and agricultural areas.

In the northeastern part of the Avalon Peninsula, Holyrood Bay sees considerable marine activity, including commercial and recreational fishing and associated vessel traffic, as well as sailing boats, pleasure craft and boat tours from Holyrood Marina, which is situated near the head of the south arm of the Bay, and other vessel movements. Nalcor Energy's Holyrood Thermal Generating Station (490 MW) is located on the eastern side of the Bay near its entrance (see Figure 2.9). Fuel oil for the facility is delivered by ocean-going tankers to the marine terminal just south of the generating plant. The Town of Holyrood is located at the head of the Bay, and has a population of approximately 2,000 residents (Statistics Canada 2006).

4.0 CONSULTATION

Consultation is the cornerstone of the environmental assessment process, and is a key aspect of Nalcor Energy's approach to Project planning and development. A number of consultation programs and activities have been undertaken, are in progress, or are being planned in relation to the proposed Project. These include discussions with relevant government departments and agencies, Aboriginal groups, communities, interest groups, businesses and industry organizations and interested members of the public.

4.1 Public and Stakeholder Consultation

Both the provincial and federal environmental assessment processes provide considerable opportunity for interested parties to bring forward their views and to identify issues and ask questions about a Project for consideration in review and decision-making. This includes consultation by governments and by the proponent.

The governmental and public review of this Environmental Assessment Registration and Project Description will help to identify any important environmental questions and issues related to the proposed Project, for consideration by governments in determining whether and what environmental assessment is required. If further assessment is required, public input will also be invited by governments in the development of Guidelines, and in the eventual review of the environmental assessment report.

As part of its conduct of any such environmental assessment, Nalcor Energy will itself implement a public and stakeholder consultation program, including meetings, open houses and other processes. The results of this consultation will be used to identify key issues and questions to be considered and addressed in the environmental assessment, and thus, to appropriately focus the analysis. Discussions have also been undertaken with government regulatory and resource management agencies and researchers regarding the 2008 environmental baseline study program for the Project.

Parallel with, and relevant to, the environmental assessment process, Nalcor Energy will also be consulting directly with stakeholders as part of its ongoing Project planning and design process (as described in Section 2.2). This will include consultation with:

- persons or groups possessing information relevant to the Project and its potential environmental and socioeconomic implications, including government agencies, organizations and individuals;
- those involved in decision-making associated with the Project; and
- those who may be affected by the Project through associated physical, social or economic changes.

There will be opportunities throughout the process for potentially affected and other interested individuals and groups to come forward and ask questions and receive information about the Project, as well as to contribute information and their views and input about the Project and its potential effects. The overall objective of this consultation program will be to provide timely and accurate Project information to the public and stakeholders, and to obtain feedback on associated issues and concerns for consideration in Project planning and design.

A variety of methods and materials has been and will be used to ensure that all interested parties have full opportunity to participate in the consultation process. For example, open houses, key informant workshops, and directed stakeholder meetings or focus groups will be conducted at various locations throughout the province. In addition, the corporation's website (*www.nalcorenergy.com)* provides relevant information on an ongoing basis, and a toll free telephone number (1-888-576-5454) has also been established and advertised. Nalcor Energy will also continue to be available to meet with and make presentations to interested groups.

Identified questions and issues will be recorded at each interface, for consideration in Project planning and assessment, and for follow up as appropriate.

4.2 Labrador and Quebec Aboriginal Groups

Nalcor Energy is committed to ensuring that Aboriginal communities and organizations are consulted appropriately on the proposed Project.

The Labrador portion of the Project is located within the Labrador Innu land claim area. The Labrador Innu land claim has been accepted for negotiation by the federal and provincial governments, and negotiations are ongoing between Innu Nation and the Governments of Newfoundland and Labrador and Canada.

Nalcor Energy and Innu Nation have worked together to conduct consultation within the Innu communities of Sheshatshiu and Natuashish, and to consult the Innu on the environmental and technical work being carried out for the Project. Previous and proposed consultation mechanisms in the Innu communities provide a means of informing Innu about the nature and status of the development, and to find out what Innu think about it and its potential environmental effects. Representatives from Nalcor Energy and Innu Nation have also been involved in planning and reviewing environmental and technical work for the Project. These processes are designed to share information, both in terms of informing Innu Nation and the Innu communities about the development, and in identifying and attempting to address any associated questions, concerns and issues.

The land claim areas of a number of Quebec Innu First Nations extend into Labrador, although these have not been accepted for negotiation by the Government of Newfoundland and Labrador. Nalcor Energy is planning discussions with various Quebec Innu groups to provide Project information, and to define and discuss the nature of any associated issues and interests.

The Inuit of Labrador are primarily resident on the Labrador North Coast in the communities of Nain, Hopedale, Makkovik, Postville and Rigolet and in Central Labrador. The *Labrador Inuit Land Claims Agreement* came into effect in December 2005, and saw the establishment of the Nunatsiavut Government. Although the proposed Project area does not extend into the land areas covered by the *Labrador Inuit Land Claims Agreement.* Nalcor Energy has met with the Nunatsiavut Government on several occasions, and plans to continue to do so and to provide Project information and receive and consider Inuit views on the development and its potential effects and benefits.

The Labrador Métis Nation (LMN) reports a membership of more than 6,000 members, who reside primarily in Central Labrador and along the southeastern coast. The LMN has asserted a land claim in the region, but this has not been accepted for negotiation by the federal or provincial governments. Nalcor Energy has met with LMN representatives previously, and plans to provide further consultation opportunities in relation to the Project, in order to provide and receive information as part of ongoing planning and any environmental assessment review.

5.0 ENVIRONMENTAL CONSIDERATIONS AND EFFECTS MANAGEMENT

As a result of on-going and previous environmental studies and consultation, Nalcor Energy has a very good understanding of potential environmental issues that may be associated with the Project.

There exists a considerable amount of information about the Project, the natural and human environments through which it will extend, and the key potential interactions between the Project and these environments. This information and understanding have been, and will continue to be, invaluable in Project planning and design, and have helped to define the current environmental studies.

The environmental effects of transmission lines are also considered to be relatively well understood and generally manageable. Through its subsidiaries, Nalcor Energy has well over four decades of experience in planning, designing, assessing, building and operating transmission infrastructure projects, and currently maintains an extensive electricity transmission and distribution system throughout Newfoundland and Labrador.

5.1 Potential Environmental Issues

The following sections introduce and discuss a number of potential environmental issues and considerations that may be associated with the Project, which have been identified to date through the processes outlined previously. These include questions and issues related to both potential environmental and socioeconomic effects and benefits. It is expected that these will continue to evolve and be further defined through the environmental assessment process and during further regulatory, stakeholder and public consultation.

5.1.1 Vegetation and Wetlands

Project construction will include clearing along the right of way, access trails and other infrastructure. Ground disturbance will also occur as a result of excavation for tower foundations and at the converter stations. During Project operations and maintenance, vegetation management along the right of way will include manual cutting as well as the selective use of herbicides.

The proposed transmission corridor extends for a distance of up to approximately 1,200 km and passes through a number of ecoregions, which include areas of productive forest, scrub, bogs, fens and barren heathland. The ground surface along the centre line of the transmission corridor is comprised of approximately 30 percent vegetation and soil cover, 45 percent bog and 25 percent rock barrens. These areas support a variety of vegetation types and plant species, which provide habitat for wildlife and which are used by humans for subsistence, recreational and commercial purposes.

Wetlands are generally widespread across much of Newfoundland and Labrador. Approximately 18 percent of the province's total land area (or 67,920 km^2) is covered by wetlands, the third highest amongst Canadian provinces and comprising approximately five percent of Canada's overall wetland areas (Canadian Wetlands Conservation Task Force 1993). Wetlands are, however, important and valued because of their hydrologic, biogeochemical and anthropogenic functions, including their role in the natural purification and storage of freshwater, in runoff and flood control, and as habitats for waterfowl, fish and other wildlife. Their protection is also the subject of various federal, provincial and municipal agreements, legislation and policies.

In addition, a number of plant species in the province are considered to be species of special conservation concern, and are therefore protected by provincial and/or federal legislation. This includes rare species of calciphillic plants that occur in the rock barrens near the Strait of Belle Isle, as well as various other species throughout the province.

Transmission line routing will play a key role in addressing potential effects on vegetation and wetlands. This will involve identifying (and attempting to avoid) certain areas such as bogs and areas of known rare plant potential, for both practical and environmental reasons. As part of its route planning processes, Nalcor Energy has gathered existing and available information on vegetation along the transmission corridor. Additional fieldwork was undertaken in 2008 and a regional Ecological Land Classification (ELC) is being developed to further identify and delineate wetland areas, other vegetation and habitats, and areas of rare plant potential along the transmission line corridor.

Through its standard construction and operating procedures, including its EPPs and integrated vegetation management program, Nalcor Energy currently has in place effective processes and proven measures to minimize the effects of its activities on vegetation and wetlands.

5.1.2 Caribou

Caribou are distributed in several different herds across the Island of Newfoundland and in Labrador. Numbers on the Island have decreased by approximately 60 percent in recent years, from about 90,000 animals in the mid-1990s to approximately 37,000 today. In February 2008, the provincial government announced a five-year research program and management strategy for the Island's woodland herds (DEC 2008). In south-central Labrador, there are three recognized boreal populations of woodland caribou: the Lac Joseph, Red Wine Mountains and Mealy Mountains herds. The Red Wine Mountains herd is found in the mountains of the same name and immediately south of the Churchill River. There is also a small group of woodland caribou in the Joir River area of southern Labrador. The Mealy Mountains herd inhabits an area of south-eastern Labrador south of Lake Melville. Labrador woodland caribou populations are currently listed as threatened under provincial and federal legislation.

Linear developments such as transmission lines have the potential to affect caribou in a number of ways, such as through the noise, human presence, clearing and ground disturbance associated with construction, as well as eventual increased hunting made possible by improved access.

The identification and analysis of caribou habitats and distributions has and will continue to be a key aspect of the transmission line planning process. A considerable amount of research has been conducted on woodland caribou populations in Newfoundland and Labrador in recent years, and as a result of the Province's recently announced five-year research program and management strategy, a great deal more is being undertaken and planned.

Nalcor Energy will work cooperatively with relevant government departments and other organizations to ensure that it has access to the best and most current caribou data available, and will collaborate with these agencies to obtain and incorporate such information into its planning process. The Project's on-going terrestrial environmental study program and associated ELC includes mapping and analyzing wildlife habitats along the proposed transmission line corridor for various species, including caribou.

Mitigation to avoid or reduce potential effects on caribou and their habitats are integrated into the corporation's existing plans and procedures, and will be adapted and implemented for the construction and operation of this Project. Potential measures include minimizing areas of clearing and any new access, scheduling high disturbance activities to occur outside of sensitive periods when caribou are present in the vicinity of construction and/or shut-down procedures, prohibitions on hunting, harassing or feeding wildlife by Project personnel, standard procedures for wildlife encounters, and others.

5.1.3 Avifauna

A number of bird species inhabit the terrestrial, aquatic and marine environments along the transmission line corridor and adjacent areas, including raptors, waterfowl and passerine species. Avifauna may be affected by developments through habitat alteration or loss due to clearing, potential collision with project structures, and disturbance from the presence of people and machinery. Some raptors are also known to benefit from transmission line infrastructure, as the towers themselves are often used as nesting structures.

Transmission line planning and routing activities have and will include the compilation and consideration of information on avifauna and habitats in the Project area, in order to attempt to avoid particularly important areas and times. This has included a literature review and aerial raptor and waterfowl surveys of the proposed transmission line corridor and a marine bird survey in the Strait of Belle Isle in 1998.

In June and July 2008, a passerine bird survey was carried out along the proposed transmission corridor, as well as an investigation of coastal areas along the Strait of Belle Isle. The results of these surveys are currently being compiled and analysed, and further wildlife habitat and wetlands fieldwork and mapping is currently being completed, as outlined above.

As a result of its history of designing and maintaining transmission lines throughout the province, Nalcor Energy and its subsidiaries have significant experience and expertise in carrying out these activities so as to minimize any environmental effects on raptors, waterfowl or other birds, including long-standing and effective procedures in place through its EPPs and other mechanisms.

5.1.4 Fish and Fish Habitat

The Project will potentially interact with fish and their habitat primarily during in-water construction of submarine cable crossings in the Strait of Belle Isle. To ensure adequate protection from icebergs, fishing equipment and other natural hazards and human activities, the cables will be installed below the seafloor and/or covered. This may be undertaken through a number of methods, including tunneling, trenching, water-jetting where conditions permit, plowing, rock placement and/or the laying of concrete mattresses along portions of the cable routes as required.

These activities will have implications for suspended sediment concentrations in the marine environment during periods of in-water construction. Construction activities will also affect and disturb the sea bottom, including any associated fish habitats. Once the cable is laid, however, any trenches will be refilled and water-jetting results in those cable sections being covered by a layer of natural sediment.

The federal *Fisheries Act* prohibits the Harmful Alteration, Disruption or Destruction (HADD) of fish habitat without the authorization of the Minister. In evaluating the potential for the Project to affect fish and fish habitat, DFO will determine whether the undertaking will result in a HADD, and has developed related principles, policies and procedures. If it is determined that productive fish habitat will be harmfully altered, disrupted or destroyed as a result of the Project, this would be the subject of compensation to meet the requirements of DFO's "No Net Loss" policy. Any required compensation plan will need to take into account the value placed on the fish resource by users of that resource.

As indicated in Section 1.4, a requirement for such an authorization from DFO pursuant to sub-section 35(2) of the *Fisheries Act*, is a "Law List" trigger that necessitates an environmental assessment under *CEAA*. One purpose of this Project Description document is therefore to initiate the appropriate review, consideration and discussion of this, to determine the nature of any relevant federal regulatory interests and requirements.

As part of its engineering and environmental work to date, Nalcor Energy has collected detailed information on the bottom characteristics in the Strait of Belle Isle crossing area, including side-scan sonar, multi-beam and sub-bottom profile surveys in 2007 and an extensive underwater video program in 2008. Additional marine environmental data collection and analysis is also planned to order to gather further information on fish and fish habitat, including at the potential sea electrode sites in Labrador and the Island.

In the aquatic environment, construction and maintenance work associated with watercourse crossings, access trails and vehicular traffic, vegetation clearing and ground excavation, fuel and herbicide use and storage and other activities have the potential to affect water quality and fish and fish habitat. Such effects can and will be managed through the use of sound Project planning and design, including the use of proven construction and operating practices. The Project will also be undertaken in accordance with applicable permits and other regulatory requirements and guidance, as well as Nalcor Energy's own plans and procedures. Moreover, overhead line construction and other activities are addressed specifically in DFO's *Newfoundland and Labrador Operational Statements* (NLOS). These NLOS outline protection measures that, if incorporated, will result in no HADD or contravention of Section 35 of the *Fisheries Act*.

Nalcor Energy is currently undertaking a detailed identification and analysis of all of the watercourse crossings that may be associated with the proposed and alternative transmission line corridors. A review of existing and available information (maps, air photos and literature) has been undertaken to identify and characterize all of the potential watercourse crossings, as well as an aquatic field study in August-September 2008 to survey a representative sample of these watercourses to gather information on their key physical and biological characteristics.

5.1.5 Marine Mammals

Marine mammals are known to occur in the Strait of Belle Isle, as well as in the general vicinity of the proposed sea electrodes in Lake Melville and Conception Bay. These include various species of whales, porpoises, dolphins and seals at particular times of the year.

Construction activity in the marine environment, such as that which may be associated with trenching, cable laying, material deposition, and general vessel traffic, will generate noise and turbidity. Since many marine mammals depend on acoustics to communicate and to gather information on their environment, excessive underwater noise can impede and contribute to changes in their feeding and social behaviors, or in some cases, result in impairment or injury from extremely loud sounds.

An extensive field study involving aerial and boat-based marine mammal surveys in relation to the proposed Strait of Belle Isle cable crossings was undertaken in 1998, as well as a 2006 seal survey in Lake Melville. As a result, there is an appropriate understanding of marine mammal presence and distribution in the Project area to support Project planning and assessment. This information is also currently being updated through the identification and review of any additional literature that has become available since that time.

A number of standard mitigative measures are available to help reduce potential environmental effects on marine mammals, including having vessels maintain a steady course and speed, use existing travel routes, and generally avoid any marine mammal concentrations. Another important tool is the development and implementation of comprehensive spill prevention and management plans and procedures.

The most likely effect to marine mammals is a temporary avoidance of a particular area due to construction-related noise. As indicated, subsea preparation and cable-laying will be relatively short-term activities. Any avoidance effects are considered highly reversible, with any affected marine mammals expected to eventually return to the site.

5.1.6 Historic and Heritage Resources

Construction activities and associated ground disturbance have the potential to disturb or destroy archaeological sites and other historic and heritage resources. Historic resources are protected under provincial legislation and valued by Aboriginal and other people in the province. For Aboriginal people, archaeological sites often represent the physical archives of their history. Particular segments of the proposed transmission line corridor have varying degrees of historic and heritage resources potential.

Information on known historic resources has been compiled and used in Project planning to date. Archaeological field surveys in the Project area in Labrador and on the Island were carried out in 1998-2000 and in 2006, with further background research, fieldwork and potential mapping undertaken in 2008. This information has and will continue to be used in Project design to avoid potential interactions where possible, to develop a management plan to gather and record information contained in any sites that may be affected, and to develop measures in the event that a historic resource is discovered during Project activities.

Nalcor Energy has procedures in place to address such issues in the field, including standard precautionary and reporting procedures for Project construction and maintenance. Should an accidental discovery of historic resources occur, all work would cease in the immediate area of the discovery until authorization is given for the resumption of the work. Any archaeological materials encountered must be reported to the Provincial Archaeology Office, including information on the nature of the material discovered and the location and date of the find.

5.1.7 Land Use and Marine Activities

A variety of land and resource use activities occur within and adjacent to the Project area. These include recreational and subsistence pursuits such as hunting, trapping, fishing, cabins, wood cutting, boating and berry-picking, as well as tourism, outfitting, forestry, mineral exploration and development, agriculture and other commercial activities.

Transmission line construction has the potential to affect other land and resource users as a result of noise, dust, presence of workers and machinery and other disturbances, and potential interference in particular parts of the Project area at specific times. In addition to potential direct interactions, visual and aesthetic issues are also often key considerations in the design and construction of transmission infrastructure in certain areas.

During operations, while the degree of on-site activity will be much less, the transmission line itself may provide greater access to particular areas, which may affect existing resource users and the fish and wildlife populations that they use. Linear and other developments may also render tracts of land unsuitable or unavailable for other existing or potential future uses, such as cabins, forestry operations, agriculture and others.

The economy of the Strait of Belle Isle region has traditionally been based on the fishery, with important lobster, scallop, shrimp, cod and other fisheries occurring in the general area. There is also considerable fishing activity and vessel traffic through and within Lake Melville and Conception Bay. Project activities in the marine environment, particularly trenching and installing the cables and the construction and operation of sea electrodes, has some potential for interference with adjacent fishing activity and other vessel traffic. Again, these construction activities will be relatively short-term in duration, and once installed, the cables themselves will be protected as required to reduce the potential for interactions with fishing equipment.

The on-land transmission line components of the Project will also be designed and constructed to meet applicable Canadian Standards (Section 2.4.2), which ensure that overhead transmission lines have sufficient clearance to allow navigation on water and road crossings.

Such issues have and will continue to be identified and evaluated through ongoing stakeholder consultation and any environmental assessment review. Attempts will be made to address these through appropriate Project planning, both in terms of transmission line routing, infrastructure design, and in scheduling and implementing construction and maintenance activities. Effective and ongoing communication with resource managers and other land and resource users will also be important to ensure safety and to minimize any potential for interference.

5.1.8 Community Services and Infrastructure

A major construction project can result in increased demands on local, regional and provincial services and infrastructure. This may include both direct Project requirements, such as in the use of local transportation and accommodations, as well as indirect demands from project workers and their families. This will likely vary in nature and magnitude among different communities and regions throughout the province, depending upon their proximity to the Project area, existing services and infrastructure, and current levels of use and capacities.

Potential requirements and issues will continue to be identified and evaluated through ongoing consultations, and efforts will be made to address these in Project design (such as through the use of work camps, etc) and in the scheduling and coordination of construction and maintenance activities.

5.1.9 Employment and Business

The Project, through its construction and operations phases, will result in positive economic effects. The Project will create employment opportunities for the province's labor force in a variety of occupations (Section 2.5.3). In addition, the requirement for goods and services during Project construction and operation will provide opportunities for local businesses. These direct economic benefits will be supplemented by indirect and induced "spin-off" effects through, for example, spending by Project employees and contractors.

As a result, the Project will make a strong contribution to local and provincial economies as a result of this employment and business activity, and by providing energy and infrastructure for the province to help facilitate future development and economic growth.

Nalcor Energy intends to establish policies and procedures to help optimize the participation of Newfoundland and Labrador workers and companies in the Project, and therefore, the employment and business benefits that accrue to the province. Employment policies and measures will address such topics as: employee recruitment and selection (including employment equity considerations); employee development and retention; and workplace conditions and services. Contracting strategies will also be developed that will outline processes and requirements for the procurement of Project works, goods or services, including the participation of provincial firms. An Employment Diversity Plan is also being developed for the Project. Monitoring and feedback mechanisms will be in place to monitor benefits and the implementation and effectiveness of such measures.

The development of employment and contracting policies and procedures for the Project is an ongoing process, and will continue to evolve based on stakeholder input. The results and findings of the environmental assessment process and associated discussions and consultations will therefore be a key source of information and input into this process.

5.2 Approach to Environmental Effects Management

As a result of its considerable experience with transmission developments overall, and the previous and ongoing environmental studies and consultations undertaken in relation to this Project, Nalcor Energy has a very good understanding of potential environmental issues and considerations that may be associated with the Project.

The preceding provided a brief introduction and overview of a number of potential environmental issues and considerations that have been identified to date. It is fully expected that Project-related environmental questions and issues will continue to evolve as Project planning activities continue, and as a result of any environmental review and additional regulatory, public and stakeholder consultation.

The consideration of environmental issues from the earliest stages of Project planning is an integral part of Nalcor Energy's approach to its development projects and activities. Engineering and environmental work for this Project is ongoing, with a view to designing the development so as to avoid or reduce potential adverse environmental effects. This environmental assessment review, including the associated and additional public and stakeholder involvement, will play an important role in that regard.

Through its standard construction and operating procedures, Nalcor Energy has long-standing and effective processes and measures in place to manage the environmental effects of its activities throughout the life of the Project.

6.0 CONCLUSION AND CORPORATE COMMITMENT

The *Labrador – Island Transmission Link* will involve the construction and operation of an approximately 1,200 km long transmission line and associated infrastructure within and between Labrador and the Island of Newfoundland. A High Voltage Direct Current (HVdc) transmission system is proposed to be established from Gull Island in Central Labrador to Soldiers Pond on the Island's Avalon Peninsula.

This *Environmental Assessment Registration* and *Project Description* is intended to initiate the provincial and federal environmental assessment processes for the Project, which will undergo review in accordance with applicable regulatory requirements. Engineering and environmental work for the Project is underway, with extensive study programs carried out from 2006 – 2008 and additional studies and analysis on-going and planned for 2009 and beyond.

Nalcor Energy is very encouraged by the substantial environmental and socioeconomic benefits that will be realized through this Project, and is confident that any environmental considerations that may be associated with it can be addressed through sound Project planning, supported by public and stakeholder consultation and involvement throughout. The Project will be planned and implemented so as to avoid or reduce potential adverse environmental effects and to optimize benefits. It will be undertaken in accordance with the corporation's environmental policies, plans and practices to help ensure that it is constructed and operated in a safe and environmentally-responsible manner.

On-going and planned consultations on the Project will provide opportunities for interested parties to bring forward their views and ask questions, including relevant government departments, Aboriginal groups, stakeholder organizations and the interested public. Issues and concerns raised through such consultation will be considered throughout Project planning and eventual implementation.

A key purpose and rationale for the proposed *Labrador – Island Transmission Link* is to put in place infrastructure to further interconnect Newfoundland and Labrador with the North American electricity system, and thus, set the stage for further development and growth in the province's energy sector and overall economy. This Project will also play an important part in ongoing efforts towards securing an adequate, reliable and sustainable electricity supply for Newfoundland and Labrador to address the current and future needs of the province's residents and industries. It will enable the displacement of existing generation from the Holyrood Thermal Generating Station with clean and renewable energy.

The Project is in keeping with, and represents a key aspect of, the province's *Energy Plan*, which was released by the Government of Newfoundland and Labrador in September 2007.

Signature

January 29, 2009

Date

Name: Edmund J. Martin
Position: President and CEO

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8.0 GLOSSARY AND ACRONYMS

ac	Alternating current
Alternatives	Different means of meeting a specific objective
Angle Structures	Transmission towers used at points of intersection and turns
Ballast	Heavy material that is placed within an object to enhance stability
Baseline Information	Data collected on the existing or pre-project environment
Bathymetry	The measurement of the depth of bodies of water
Bedrock	A general term for the rock, usually solid, that underlies soil or other unconsolidated, superficial material
Boreal	Northern regions, but not arctic. Related to the northern biotic area characterized by dominance of coniferous forests
Borrow Pit	An excavation dug to provide material (borrow) for fill elsewhere
BP	Before present
Calciphile	Plants adapted to calcium-rich (or calcareous) soils
CEAA	*Canadian Environmental Assessment Act*
CF(L)Co	Churchill Falls (Labrador) Corporation
Circuit	A complete path over which electrons can flow from the negative terminals of a voltage source through parts and wires to the positive terminals of the same voltage source
Concrete Mattress	A layer of concrete placed on the ground or over an object to provide support or protection
Conductor	A wire (or combination of wires not insulated from one another) suitable for carrying electric current
Constraint Mapping	A mapping exercise to identify key technical and environmental considerations and potential restricting factors as input to development planning
Construction Phase	The period usually beginning with the initiation of in-field physical work and ending with the commencement of project operations
Corona	An electrical discharge accompanied by ionization of surrounding atmosphere
Corridor	A pathway or linear study area from within which a transmission line routing and right of way are eventually selected
dB	Decibel

dB(A)	A-weighted decibel
dc	Direct current
Dead-End Structures	Transmission towers where the conductors mechanically terminate. These can carry large conductor tensions and address large angles, and are placed strategically along the line
DFO	Fisheries and Oceans Canada
Ecoregion	An areas that has distinctive, recurring patterns of vegetation and soil, which is determined by local climate and geology
Ecosystem	A naturally occurring group of organisms (plant, animal and other living beings) living together with their environment, functioning as a unit
Electrode	A conductor used to establish electrical contact with a nonmetallic part of a circuit
EMS	Environmental Management System
Environmental Assessment	A review and planning process to predict the environmental effects of a proposed development before it is carried out, in order to incorporate environmental considerations into decision-making
EPP	Environmental Protection Plan
Follow-up	A monitoring program designed to verify the accuracy of the environmental assessment of a project, and determine the effectiveness of measures taken to mitigate the adverse environmental effects of a project
Guy Wire	A tensioned cable installed to add stability to tall structures
Habitat	The place where an animal or plant lives, often characterized by some physical characteristic or condition (e.g., stream habitat)
HADD	Harmful Alteration, Disruption or Destruction of fish habitat
Herbicide	A substance used for the control of vegetation
Historic Resource	A work of nature or of humans that is primarily of value for its archaeological, prehistoric, historic, cultural, natural, scientific or aesthetic interest
HVac	High voltage alternating current
HVdc	High voltage direct current
Hydrology	The scientific study of the properties, distribution, and effects of water on the earth's surface, in the soil, in the underlying rocks and in the atmosphere
ISO	International Organization for Standardization
km	Kilometre

km^2	Square kilometre
kV	Kilovolts
LMN	Labrador Métis Nation
Loading	Maximum forces that may be applied to a structure by elements (ice or wind)
m	Metre
MI	Mass Impregnated
Mitigation	A procedure designed to avoid or reduce the possible adverse effects of a project or activity on the environment. Also mitigative or mitigating measure
MW	Megawatt
NL EPA	Newfoundland and Labrador *Environmental Protection Act*
Nodwell	A multi-purpose two-tracked vehicle capable of traversing adverse terrain
RA	Responsible Authority
ROV	Remotely operated vehicle
ROW	Right of way
Ruling Span	The tower span length at which the conductor tension, under changes in temperature and loading, will most likely agree with the average tension in a series of spans between dead-end structures. It is the span length estimated to design a transmission line
Sediment	Particulate matter that can be transported by water, which eventually is deposited as a layer of solid particles on the bed or bottom of a body of water
SHERP	Safety, Health and Environmental Emergency Response Plans
Sonar	A system using transmitted and reflected underwater sound waves to detect objects or measure distance or depth
Stakeholder	A person or group with an interest or concern with respect to a project or issue
Tangent Structures	Standard towers used primarily in straight-line sections of a transmission line
TLH	Trans Labrador Highway
Transmission Line	Wires and structures that transmit electricity
TWh	TeraWatt Hour; equivalent to 1,000,000 MW hours
V	Volt
Watershed	The region or area drained by a river or stream