1 PROJECT SUMMARY

Project developer SkyPower Corp. (SkyPower) is proposing to construct and operate a wind energy facility located in Digby County in Gulliver's Cove, Nova Scotia (the Digby Wind Power Project; the Project). The Toronto-based renewable energy developer SkyPower has partnered with Nova Scotia-based community economic development organization Scotian WindFields Inc. SkyPower has retained Jacques Whitford Stantec Limited to assist in the environmental assessment (EA) process for this Project. This Project is subject to provincial environmental registration requirements as a Class I Undertaking pursuant to the Nova Scotia *Environment Act*. "The Proponent's Guide to Wind Power Projects: Guide to Preparing an Environmental Assessment Registration Document" (NSEL 2007, updated 2008) was used to ensure provincial requirements for registration are met.

The Proponent has applied for funding from Natural Resources Canada (NRCan) under the ecoEnergy for Renewable Power (EERP) program. Under the new Terms and Conditions of this EERP, NRCan will be identified as a "Responsible Authority" (RA) for the Project once Step 2 (the Technical Project Information (TPI) package has been submitted and approved and a Contribution Agreement has been fully executed. This will then trigger the requirement for a federal environmental assessment under the *Canadian Environmental Assessment Act (CEAA).* At the time of submission, it is unclear whether other agencies such as Fisheries and Oceans Canada (DFO) have regulatory responsibilities under *CEAA*. This document has therefore been prepared in compliance with *CEAA* requirements following NRCan's "Environmental Impact Statement Guidelines for Screenings of Inland Wind Farms under the *Canadian Environmental Assessment Act*" (NRCan 2003).

This report includes:

- a description of the Project, including its location and details regarding its construction, operation and decommissioning;
- a summary of the existing biophysical and socioeconomic features of the area which may be subject to Project-related adverse environmental effects;
- a summary of specific environmental concerns, identified through data collection, consultation with agencies and the public, and/or based on professional judgement;
- an assessment of the positive and/or adverse effects associated with this Project;
- an assessment of cumulative environmental effects of this Project;
- an assessment of the effect of the environment on the Project;
- a summary of mitigation, impact management and monitoring measures of this Project; and
- a summary of the advantages and disadvantages of the Project taking the foregoing into account.

1.1 Project Proponent

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1.2 Title of Project

The Project is referred to as the Digby Wind Power Project.

1.3 Project Location

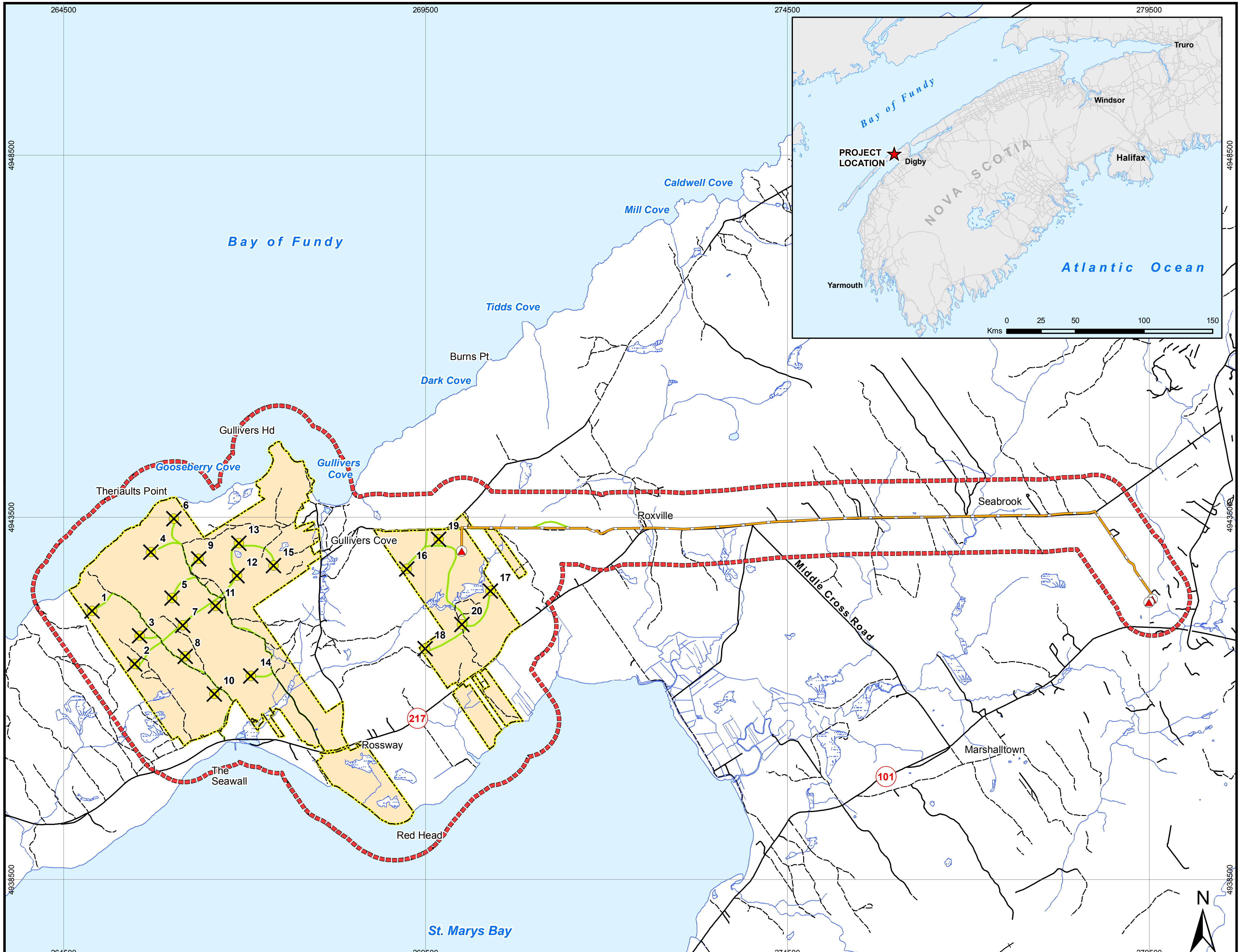
The proposed Project is located in Digby County, near Gulliver's Cove, Nova Scotia (Figure 1.1). The selection of the Digby Wind Power Project site was based on a number of factors including:

- preliminary wind resource assessment;
- review of terrain and topography;
- access to power grid interconnection;
- site access;
- existing land use; and
- community support.

The wind energy facility will be constructed on undeveloped land (primarily forested), approximately 1,132 ha (2,797 acres) in size ("proposed site development area" on Figure 1.1). This area, along with the transmission line corridor is considered the "Project Area "for the purpose of this environmental assessment (EA). The "Study Area" shown on Figure 1.1 includes the proposed site development area, transmission line corridor and surrounding lands.

1.4 Estimated Capacity of Facility

The proposed Project will consist of 20 wind turbine generators (WTGs) and ancillary facilities. The energy produced by the Project will be linked to the Nova Scotia electrical transmission system. Each turbine has a nameplate capacity of 1.5 MW, for a total capacity of 30 MW. This will provide enough power for more than 10,000 homes annually. The electricity will be supplied directly to the Nova Scotia Power Inc. (NSPI) electric grid under a Power Purchase Agreement.



SKYPOWER

Figure 1.1

DIGBY WIND POWER PROJECT

Project Location

Project Components

- Proposed/Existing Power Station
- Proposed Turbine Location
- Proposed Turbine Access Road
- Proposed Transmission Route Nov. 28-08
- Proposed Site Development Area
- Study Area

Map Features

- Road
- Unpaved Road
- Railroad
- Watercourse
- Wetland
- Waterbody

0 0.5 1 1.5 2 2.5

Kilometres

Data Sources:
Planimetric Data - NSGC; Nova Scotia Topographic Database (NSTDB), 1997, 1:10 000 (GeoNOVA)
Project Components - Skypower, Nov. 2008
Wetlands - NSTDB & NSDNR; Wetland Inventory Mapping, 2007, 1:10 000

Map Parameters
Projection: UTM/NAD83/Z20
Scale 1:50,000
Date: April 2009
Project No.: 1030972.01

Stantec

1.5 Construction Schedule

The proposed construction schedule for the Project is presented in Table 1.1. The lifespan of the proposed Project will likely equal or exceed 20 years. Decommissioning activities will last roughly the same amount of time as comparable construction activities.

Table 1.1 Project Activity Schedule

Surveying	August 2009
Clearing	September 2009-February 2010
Development of access roads	September 2009-February 2010
Delivery of equipment	November 2009-January 2010
Foundation construction	October 2009-January 2010
Wind turbine installation	November 2009-February 2010
Construction of overhead collection system	September 2009-January 2010
Installation of substation equipment	November 2009-February 2010
Installation of transmission line	September 2009 –January 2010
Turbine commissioning	February - April 2010
In-service	No later than April 2010

The construction schedule was designed to account for minor delays that could result from delayed equipment arrival and adverse weather conditions.

1.6 Regulatory Framework

1.6.1 Environmental Assessment

Pursuant to the Nova Scotia *Environment Act*, environmental registration with Nova Scotia Environment (NSE) is required for an electric generating facility which has a production rating of two megawatts (2 MW) or more derived from wind energy.

The Digby Wind Power Project will have a capacity exceeding 2 MW and is therefore subject to environmental registration. This EA satisfies the requirements outlined for provincial environmental registration as a Class I Undertaking and was prepared following guidance from "The Proponent's Guide to Wind Power Projects: Guide to Preparing an Environmental Assessment Registration Document" (NSEL 2007, updated 2008).

To date, the Project has one known trigger under *CEAA* due to the application for federal funding under NRCan's ecoEnergy for Renewable Power (EERP) program. This process has been started for the Project with the Notice Project Application (Step 1). Under the new Terms and Conditions of this EERP, NRCan will be identified as a "Responsible Authority" (RA) for the Project once Step 2 (the Technical Project Information (TPI) package has been submitted and approved and a Contribution Agreement has been fully executed. It is currently unknown if other federal agencies such as Environment Canada, Transport Canada, Health Canada and DFO have an interest either as an RA or expert department in the review of the Project under *CEAA*; however there are no obvious *CEAA* triggers besides the federal funding.

To ensure that *CEAA* requirements are met, this EA was undertaken following the guidance provided in NRCan's "Environmental Impact Statement Guidelines for Screenings of Inland Wind Farms Under the *Canadian Environmental Assessment Act"* (NRCan 2003). In the absence of an executed Contribution Agreement under the new EERP Terms and Conditions, NRCan has no formal involvement in the review of this Project at this time.

1.6.2 Environmental and Land Use Approvals

In addition to provincial and federal EA requirements, federal, provincial and municipal environmental and land use permits, licenses and approvals may be required for this Project. Table 1.2 summarizes approvals and authorizations likely to be required for the Project; this list is intended to be illustrative for environmental assessment purposes only.

Table 1.2 Required Environmental and Land Use Approvals

Approvals Required	Summary
Federal	
Canadian Aviation Regulations Standard 621.19	Section 5.9 of these regulations state that a wind turbine should have a flashing white beacon mounted on the highest practical point of the turbine if the structure is taller than 90 m. Lighting requirements have been determined in consultation with Transport Canada. Consultation is required with the appropriate regional Civil Aviation authority, providing information on the planned obstruction using the Aeronautical Obstruction Clearance Form (#26-0427).
Provincial	
Water Approval for Watercourse Alteration (Activities Designation Regulations)	Alteration of any watercourse will require authorization from NSE under the Activities Designation Regulations. SKYPOWER proposes to avoid watercourses to the extent practical during detailed design. Based on the current proposed road layout, it is anticipated that there could potentially be at least one watercourse crossing (*i.e.,* upgrade of culvert at Haight Brook).
Water Approval for Wetland Alteration (Activities Designation Regulations)	Alterations of a wetland will require authorization from NSE under the Activities Designation Regulations. SkyPower proposes to avoid wetlands through turbine siting and road layout design. If however, it is not possible to avoid a wetland, a functional analysis will be conducted and an application will be submitted for approval of the proposed alteration.
Breaking Soil of Highways Permit (*Public Highways Act*)	The proposed transmission line may disturb the surface, soil, or any structure within a highway right-of-way (including the road surface) in Nova Scotia requires a Breaking Soil of Highways Permit from Nova Scotia Department of Transportation and Infrastructure Renewal (NSTIR).
Building Near a Highway and Access to Property Permit (*Public Highways Act*)	Approval from NSTIR may be required for installation of transmission line.
Use of Right-of-Way for Pole Lines Permit (*Public Highways Act*)	Approval from NSTIR may be required for installation of transmission line.
Special Move Permit with Department of Transportation and Infrastructure Renewal (*Public Highways Act*)	A Special Move Permit and any associated approvals will be obtained for heavy load transport as required.

1.7 Structure of this Report

This report is intended to meet both the federal and provincial environmental assessment requirements. To ensure that the federal environmental assessment requirements were met, this report generally follows the structure recommended by NRCan in their guidance document “Environmental Impact Statement Guidelines for Screenings of Inland Wind Farms Under the *Canadian Environmental Assessment Act*” (NRCan 2003). Likewise, in accordance with the Nova Scotia *Environment Act*, this report also documents how the requirements of the provincial registration were met.

The following outlines the structure of the Report:

- Section 1 introduces the Project and summarizes the key elements of the Project and the regulatory regime.
- Section 2 provides additional Project detail on components and activities required to support this EA.
- Section 3 describes the assessment method and scope of the assessment.
- Section 4 describes the existing environment of the Project site, including both biophysical and socioeconomic elements.
- Section 5 presents the assessment of potential environmental effects for each component of the Project, including accidents and malfunctions, and discusses the potential cumulative effects of the Project in association with other existing and planned projects.
- Section 6 identifies follow-up measures that are intended to be implemented for the Project.
- Section 7 describes the consultation program undertaken for this Project.
- The conclusion of this EA is presented in Section 8.
- Section 9 presents the signature page followed by a list of supporting documents used to prepare the report in Section 10.
- Technical reports and supporting information are presented in appendices at the end of this document.

1.8 Author of EA

This EA was completed by Jacques Whitford Stantec Limited, an independent, multi-disciplinary team of consultants with extensive experience in undertaking environmental assessments across Canada and internationally. Specifically, and on behalf of Jacques Whitford Stantec Limited, the report was prepared and reviewed by the following:

Prepared by:

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2 PROJECT DESCRIPTION

The following describes the proponent, background and location of the Project, and detailed Project activities.

2.1 Presentation of the Proponent

SkyPower has partnered with Nova Scotia-based community economic development organization Scotian WindFields Inc. for this Project. Scotian WindFields Inc. is a Nova Scotia based, owned and operated company that develops renewable energy projects through wind, solar and biomass applications. The company was formed in January 2007 as a result of an agreement between eight Nova Scotia community-owned renewable energy companies formed under the Community Economic Development Investment Fund (CEDIF) initiative.

Established in 2003, SkyPower is a leading developer of renewable wind and solar energy projects. The company has interests in over 200 projects at various stages of development, representing over 11,000 MW of potential nameplate capacity. SkyPower is developing significant renewable energy projects in Canada, the United States, India and Panama and the company continues to look for new opportunities in emerging markets. SkyPower drives all phases of project development including exploration, construction and operation. SkyPower has an Atlantic Canada wind project under construction for 27 MW in progress which will be in completion by the first quarter of 2009.

2.2 Background of the Project

SkyPower is proposing to construct and operate a wind energy facility, the Digby Wind Power Project, near Gulliver’s Cove, Digby County, Nova Scotia. The Digby Wind Power Project site will have a nameplate capacity of 30 MW. The Project is planned to connect into the Nova Scotia electrical grid.

Several years worth of wind data has been gathered from the site from five meteorological stations. A combination of consistent wind and community desire to develop the wind potential make the site an ideal location for wind development (refer to Section 2.5 for more information on Project siting).

2.3 Purpose of Project

The Project has been proposed in response to a request for proposals issued by Nova Scotia Power Inc. (NSPI). The Project would have the capacity to contribute up to 30 MW of clean, renewable energy to the provincial grid, producing energy sufficient to power more than 10,000 homes annually. The Digby Wind Power Project is a key part of the Nova Scotia Government's plan to integrate renewable assets into its energy mix and will assist the Province to meet its 2010 renewable energy targets.

2.4 Summary of Project

The Project will consist of 20, 1.5 MW wind turbine generators (refer to Figure 2.1 for site layout). The Proponent intends to use General Electric (GE) turbine (GE 1.5sle) for this Project. Table 2.1 includes the technical specifications for this turbine model.

Table 2.1 Turbine Technical Specifications GE 1.5sle

Turbine Component	Specifications
Rated capacity	1.5 MW
Cut-in wind speed	3.5 m/sec
Cut-out wind speed	25 m/sec (1 minute)
Rated wind speed	12 m/sec
Number of blades	3

Table 2.1 Turbine Technical Specifications GE 1.5sle

Turbine Component	Specifications
Diameter	77 m
Swept area	4657 m^2
Rotor speed (variable)	20.4 rpm
Tower (hub) height	80 m
Gearbox	Three-step planetary spur gear system
Generator	Double-fed three-phase asynchronous generator
Yaw system	Electromechanical driven with wind direction sensor and automatic cable unwind
Control system	Programmable logic controller (PLC)/ remote and monitoring system
Tower design lightning protection	Lighting receptors installed on blade tips / surge protection in electrical components

In addition, the following ancillary facilities are also considered part of the Project:

- 34.5 kV collection lines (to link the wind turbines to the substation);
- 575V – 34.5kV range pad transformers located beside each turbine;
- substation (to step up the electric output from 34.5 kV to 69 kV);
- access roads;
- transmission line to Conway substation (approximately 10.6 km long) (refer to Figure 2.2); and
- crane pads for assembly of wind turbines.

There will be no maintenance buildings on site. The onsite substation area will be fenced and graveled.

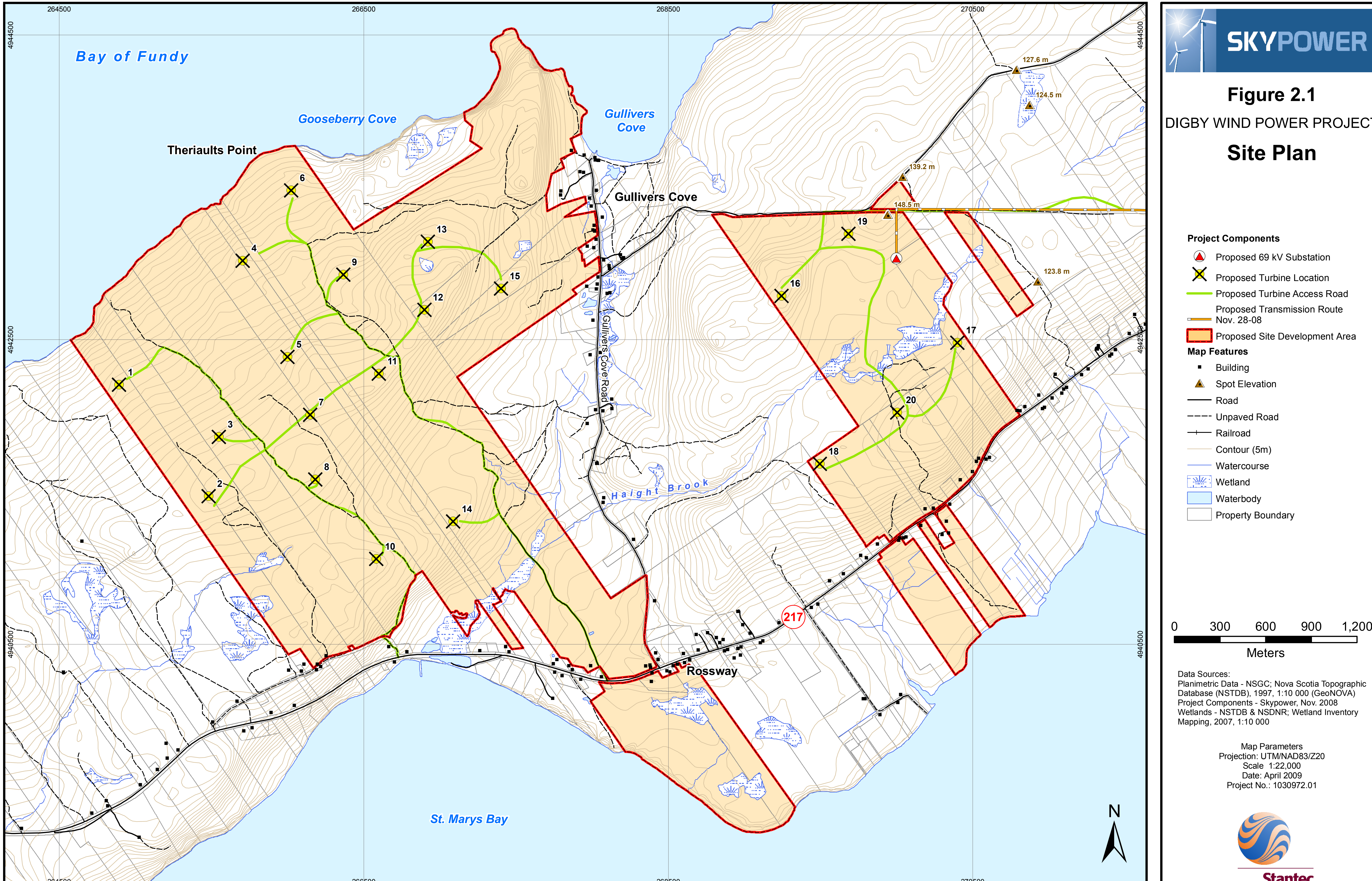
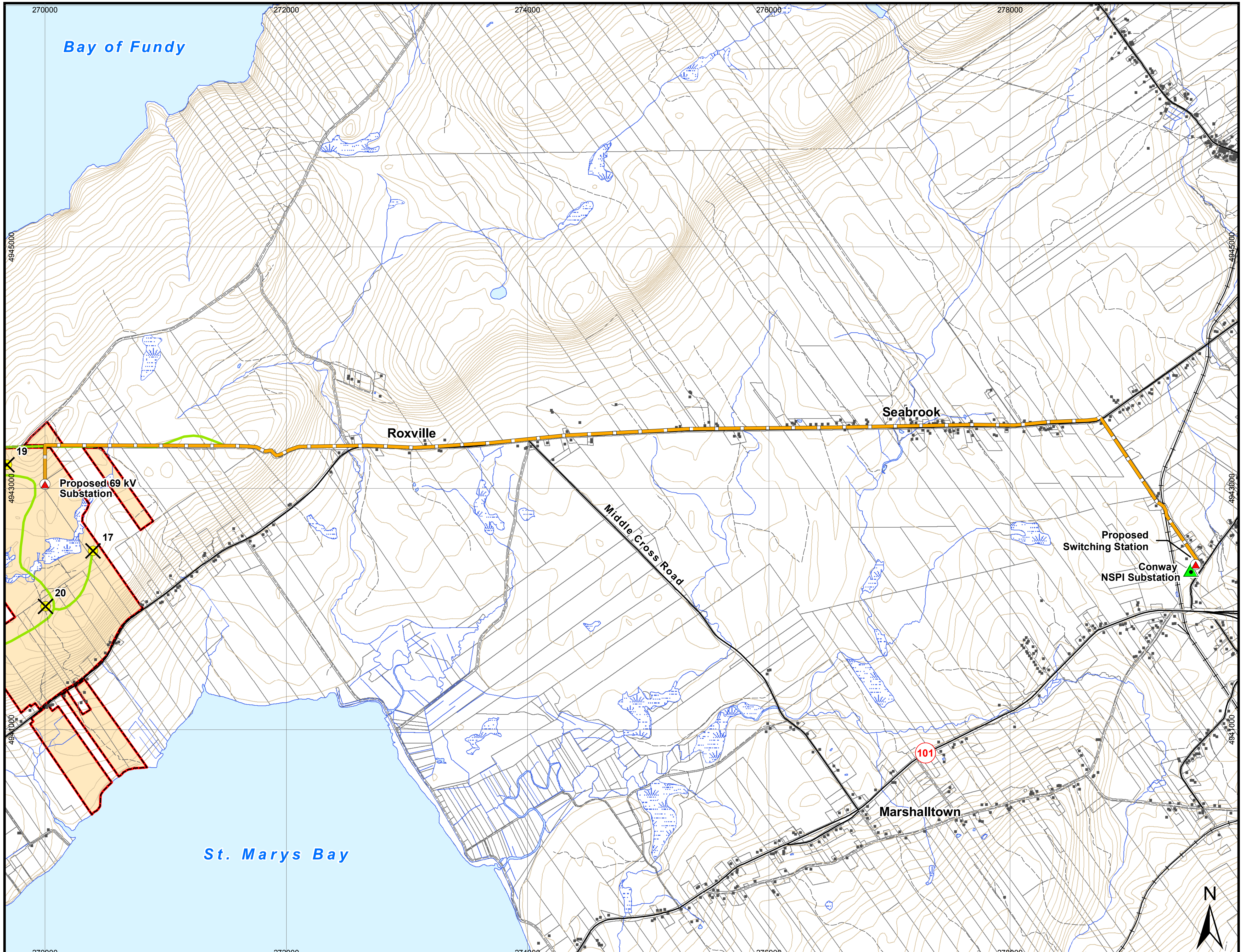


Figure 2.1
DIGBY WIND POWER PROJECT
Site Plan



SKYPOWER

Figure 2.2

DIGBY WIND POWER PROJECT

Proposed Transmission Line

Project Components

- Proposed Turbine Location
- Existing NSPI Sub- Station
- Proposed Power Station Location
- Proposed Turbine Access Road
- Proposed Transmission Route - Nov. 28-08
- Proposed Site Development Area

Map Features

- Building
- Road
- Unpaved Road
- Railroad
- Contour (5m)
- Watercourse
- Waterbody
- Wetland
- Property Boudries

0 400 800 1,200 1,600

Meters

Data Sources:
Planimetric Data - NSGC; Nova Scotia Topographic Database (NSTDB), 1997, 1:10 000 (GeoNOVA)
Project Components - Skypower, Nov. 2008
Wetlands - NSTDB & NSDNR; Wetland Inventory Mapping, 2007, 1:10 000

Map Parameters
Projection: UTM/NAD83/Z20
Scale 1:30,000
Date: April 2009
Project No.: 1030972.01

Stantec

2.5 Location of Project

The proposed Project is to be located in the Municipality of Digby, near Gulliver's Cove, Nova Scotia. The wind energy facility will be constructed on undeveloped woodlands generally bounded to the north by the Bay of Fundy; to the east and west by undeveloped land and sparsely populated residential areas; and to the south by the Evangeline Trail (Route 217), sparsely populated residential areas and St. Mary's Bay (refer to Figures 2.1 and 2.2). Gulliver's Cove Road divides the Project Area. The Study Area identified for the Project is considered that area within which direct Project interactions with the natural environment could occur. It is within this area that information on natural, socioeconomic and environment features and activities has been collected for the purpose of assessing the potential impacts of the proposed Digby Wind Power Project.

The Study Area comprises approximately 1,132 ha (2,797 acres) at the wind farm site with an additional 10.6 km of transmission line following Route 217 to the Conway substation (refer to Figure 2.2). However the actual footprint of the tower structures and ancillary facilities for the proposed wind farm will occupy only a small fraction of the land base within the Study Area.

The location of the turbines and substation is shown in Figure 2.1. This current site configuration is based on a variety of factors. Original turbine layout was based predominantly on land availability and wind regime monitoring results collected on site. The original layout, which included turbines south of Highway 217 in Rossway, was revised based on input received through stakeholder consultation. In particular, feedback received during a council meeting with the Municipality of Digby in November 2008, suggested the community did not wish to have turbines overlooking St. Mary's Bay so those turbines were relocated north to the current Project Area. Furthermore, as additional lands were added to the Project Area, this facilitated a more efficient layout of turbines.

As detailed design and planning progresses (including, but not limited to, site specific geotechnical tests and follow-up biological surveys) SkyPowerwill continue to optimize site layout to minimize biophysical and socioeconomic effects while improving Project efficiencies.

A description of the biophysical and socio-economic features of the Study Area is provided in Section 4.

2.6 Detailed Project Activities

The following section provides details on the planning, construction, operation, maintenance and decommissioning of the Project. Activities that have the potential for environmental effects in the Study Area are addressed in Section 5.

The development of the proposed Project will include several phases: site preparation and construction; operations and maintenance; and decommissioning.

Table 2.2 Typical Project Activities

Site Preparation and Construction	
Surveying	Activities include staking the boundaries of the construction area, temporary workspace, substation site, aboveground collector lines and transmission lines, as well as marking the location of any existing underground pipelines and cables.

Table 2.2 Typical Project Activities

Site Preparation and Construction	
Development of access roads	Access roads will be surveyed and staked/flagged. It is anticipated that the majority of onsite roads will generally involve upgrading existing logging roads, with new access roads added as required. Roads on the wind farm site will be approximately 11 m wide during construction to accommodate crane movements for installation, trailers for transportation of heavy and bulky turbine and substation equipments, maintenance vehicles and equipment for repairs/replacements. In special cases if difficult turns are required, roads may be made wider than 11 m. Construction roads will be designed to accommodate the crane types that will be required to erect the wind turbine generators and towers. Roads will be constructed by placing a layer of geogrid on the native soil, followed by layers of compacted shale or sandstone with a screened stone topping. The thickness of the layers will be in accordance with the geotechnical report's recommendations for Project road construction. Wetlands and watercourses will be avoided to the extent practical in designing access roads. Follow –up surveys will be conducted as necessary to conduct wetland functional analyses and/or assist with design of watercourse crossings if required. Water Approvals will be sought from NSE for wetland/watercourse alterations if these features are unavoidable. Based on the current proposed road layout, it is anticipated that a culvert at Haight Brook will require upgrading as the existing road is upgraded.
Clearing and grubbing	The Project Area generally consists of undeveloped wooded land which will require clearing and grubbing. All roads will be built on top of the topsoil. A layer of geogrid will be rolled out on the surface and the rock or gravel road material would be placed in layers on the geogrid to make the road. Approximately 1.5 ha of land will be cleared for each turbine, within which turbine foundations and crane pads will be located. After construction and installation, the majority of the cleared area will be revegetated; a much smaller pad for service and maintenance vehicles will remain.
Grading	Grading will be necessary to construct the access roads and pad construction. Where possible, existing grades will be maintained.
Soil stockpiling	All soil will be stockpiled on site during construction so that it can be used in revegetation and reclamation of the site once the turbines are erected.
Piling and foundation excavation	The turbine foundations will be determined by the final geotechnical report and structural engineering at each turbine site, as is necessary to properly support the loads. The substation area will consist of a raised pad approximately 2,500 m^2.
Pouring turbine foundation	For excavated foundations, after excavation and piling installation, foundation forms and rebar will be installed. Concrete will be poured into the pile cap forms continuously. Forms will be removed after the concrete is cured and the excavated area is back-filled and compacted such that only the tower base portion of the foundation is above ground.
Equipment lay-down and turbine assembly	To create a safe and level work area for storing and assembling the wind turbine generators and towers, an area of approximately 1.5 ha may have to cleared, grubbed and graded. Each of the turbines and generators will be trucked on a flat-deck trailer to the site and assembled.
Tower, generator, and rotor assembly	The tower will be transported in three sections that will be assembled on site. The blade system, consisting of 3 blades and a hub, will also be assembled on site, attached to the generator and lifted into place at the top of the tower by a crane.
Collection system and transmission line/connection to grid	It is anticipated that the 34.5 kV electrical collection system will consist of aboveground electrical poles between turbines, distributing power from each turbine to the onsite substation where the output will stepped up from 34.5 kV to 69 kV distribution line. Aerial cabling is installed by first drilling and placing poles, then stringing each phase of wire. Approximately 10.6 km of aboveground pole-mounted 69 kV distribution line will be installed along the RoW of Route 217 to link the project to the Conway substation.
Installation of substation equipment	Onsite substation equipment will be installed within a fenced yard that will be surfaced with gravel.

Table 2.2 Typical Project Activities

Site Preparation and Construction	
Clean-up and reclamation	Construction waste will be removed and disposed of at an approved location in accordance with local and provincial waste management requirements. The temporary lay-down areas and disturbed areas around the foundation of each turbine and at the substation will be replaced with the previously excavated and stockpiled topsoil. The disturbed areas will be re-seeded. High voltage signage will be installed at the substation and elsewhere, as necessary.
Turbine commissioning	Turbine commissioning can occur once the wind turbines have been fully installed and when NSPI is ready to accept grid interconnection. Commissioning involves testing and inspection of electrical, mechanical, and communications operability. A detailed set of operating instructions must be followed in order to connect with the electrical grid.
Operations and Maintenance	
Access and inspection	Maintenance inspections will be required approximately once every month for routine servicing. Light 4 x 4 trucks, vehicles, and ATVs may be used to access the towers. Larger trucks and cranes may be required periodically for larger repairs, but this is expected to occur infrequently. In addition, throughout the course of the year, access to the turbines as part of regular non-scheduled maintenance activities will be required for resetting faults, minor component replacement and related activities. New and used lubricants, cleaning supplies and other controlled substances will be delivered, stored, handled and disposed of according to local regulations.
Decommissioning and Abandonment	
Rotor, generator and tower disassembly	The rotor, generator and towers would be disassembled using a crane and removed from the site for re-use, reconditioning or disposal using a flatbed truck.
Access roads	Access roads will be removed where appropriate and in consultation with landowners.
Removal of concrete foundation	Decommissioning and reclamation will be done in accordance with landowner agreements. In some cases, foundations will be removed to a depth of approximately 1 m below original ground level and filled with subsoil to rebuild the grade. Piling and most of the concrete foundation can remain in place. Stockpiled topsoil will be placed over the area to approximate depth of adjacent ground and the area seeded and left for cultivation or grazing, depending on the land use at the time and the preference of the landowner. In some cases, depending on landowner agreements, concrete pads may stay in place.
Decommissioning of distribution lines	Aboveground powerlines will be removed from the ground during decommissioning, or as determined necessary by NSPI.

2.6.1 Construction Phase

Clearing activities will be scheduled outside of the breeding bird season (May to August) to the extent practical. However, in the remote possibility that clearing activities will need to take place during the breeding bird season, an adequately trained specialist will be required to inspect the proposed work area for nesting birds prior to any site clearing. In addition, any clearing and disturbance within 50 m of identified nesting or breeding areas should be avoided, if possible. Current forest roads have been considered to the extent possible as access roads to turbine locations. Compaction of soil will be minimized to the extent possible with compacted soil recovered following turbine installation. In addition, silt fencing will be erected, if required, to help prevent erosion of bare lands caused by construction activities.

Watercourses and wetlands will be avoided to the extent practical. Where applicable, wetland functional analyses will be conducted for unavoidable wetlands and Water Approvals for watercourse and/or wetland alterations will be obtained from NSE. If construction is necessary in or near watercourses or wetlands (*e.g.,* access road crossing Haight Brook) sediment control measures will be put in place for the duration of construction in those areas.

Information and warning signs will be erected adjacent to the wind farm at the start of construction, to provide public information about the facility and to discourage trespassing on private lands. This signage will be maintained and updated as necessary.

Equipment on site during construction could include hydraulic fluid, brake fluid, transmission fluid, and oil from the wind turbine generator. Any refilling activities will take place in designated areas and at a minimum of 30 m from wetlands or watercourses.

The turbine nacelles (which house the gearbox and the generator) and hubs will be delivered directly to the project site. A detailed transport study will be undertaken to determine the appropriate routes and means for the equipment to be delivered to the site. It is anticipated that the current road network (outside of onsite turbine access roads) will not require upgrades to accommodate construction traffic.

Approvals for transporting these materials will be sought from the provincial transportation departments. As the turbine components are oversized, a Special Move Permit and any associated approvals will be obtained through the Nova Scotia Department of Transportation and Infrastructure Renewal (NSTIR) for heavy load transport.

2.6.2 Operation and Maintenance Activities

Activities associated with the operation and maintenance of the Digby Wind Power Project will not be as extensive as during the construction phase. Maintenance inspections are required approximately once a month for routine servicing and lubricant replacement. Light-duty 4x4 trucks, vehicles, and ATVs may be used to access the wind turbines. Larger trucks and cranes may be required infrequently for larger repairs.

Aside from normal recovery of lubricants from the gearbox and yaw mechanism, operation activities do not generate waste. Lubricants will not contain any PCBs. New and used lubricants, cleaning supplies and other controlled substances will be delivered, stored, handled and disposed of according to local regulations.

Each turbine houses a sophisticated Supervisory Control And Data Acquisition (SCADA) system which continuously monitors equipment performance and instantly detects any faults to be addressed. This system will determine the frequency of regular and non-scheduled maintenance activities onsite.

2.6.3 Decommissioning

The Digby Wind Power Project is expected to be operational for at least 20 years. In the event that decommissioning and abandonment is necessary, the activities associated with the Project include:

- rotor, generator and tower disassembly;
- decommissioning of access roadways;
- removal of concrete foundation;
- removal of distribution and transmission lines;
- removal of pad mount transformers; and
- removal of substation.

Well-designed and constructed wind energy facilities may be operated for decades. Individual wind turbines are expected to perform for up to 35 years without significant repair or replacement. Transformer facilities, underground wiring and substation facilities are designed for at least a 50 year life span. Individual wind turbines may be replaced or repaired as their useful life comes to an end, or if more efficient and cost-effective technology becomes available.

Upon a decision to decommission a single wind turbine or the entire wind farm, all equipment above ground, including towers, nacelles, transformers and controllers will be removed. Wind turbines that are operational and have market value would be carefully removed using a crane, essentially in a reverse process to assembly and installation. The resale value of such equipment would cover the cost of removal in such a case. A market for good, used wind turbines has developed in North America, and a number of wind turbines installed in Alberta in the early 1990s originated from the U.S. used wind turbine market.

Other above-ground equipment in the wind farm, including transformers and wiring, has a ready market in either used equipment sales or in salvage. Transformers will be simply removed and sold. Wiring will be removed and sold to metal salvage companies.

As discussed above, wind energy facilities do not use or produce harmful waste products and therefore aside from normal recovery of lubricants from the gearbox and yaw mechanism, there are no requirements for harmful waste handling during decommissioning.

Wind energy facilities removed from undeveloped woodlands which will require minimal remediation; native seed mixtures will be used to revegetate the area. Where necessary, topsoil and re-grading of access roads in the fields will occur as per the landowner’s preference.

All decommissioning activities will be conducted in accordance with landowner agreements and applicable regulations and agreements at that time. It is not anticipated that watercourse crossings would be removed during decommissioning.

2.6.4 Future Phases of Project

At the present time SkyPower does not intend to expand the Digby Wind Power Project.

3 SCOPE OF THE ASSESSMENT

The following section provides the scope of the Project to be assessed as well as the factors and scope of factors to be assessed. The methods used for the environmental assessment are also described.

3.1 Scope of the Assessment

The scope of the Project to be assessed includes:

- surveying activities, such as identifying location of wind turbines and follow-up biophysical and archaeological surveys as required;
- clearing of vegetation;
- constructing and upgrading access roads, including installation of culverts as required;
- delivery of equipment and materials including the wind turbines, foundation materials, electrical cables and ancillary equipment;
- foundation construction;
- wind turbine installation;
- electrical cabling installation (*i.e.,* installation of 34.5 kV aboveground collection system);
- construction of ancillary equipment (*e.g.,* substation);
- installation of a 69 kV transmission line (approximately 10.6 km);
- operation and maintenance of the Project; and
- decommissioning of the turbines and the overall Project.

The potential effects of accidents and malfunctions are also considered within this EA, as are the potential cumulative effects of this Project in relation to other projects/activities in the regional area. The potential effects of the environment on the Project are also addressed.

Environmental Assessments are typically organized and focused according to VECs which are those biophysical and socioeconomic elements that are of particular importance to the proponent, as well as public and regulatory stakeholders involved in the assessment process. This EA evaluates the potential environmental effects of the proposed Project elements and activities, for all Project phases, with regard to each VEC. By assessing potential impacts on VECs within the study boundaries, a meaningful evaluation of project effects on relevant environmental aspects is achieved. VECs evaluated for this assessment include:

- soil;
- water quality (surface and groundwater);
- aquatic environment (including fish and fish habitat);
- terrestrial vegetation;
- wildlife (including birds, mammals, reptiles and amphibians);
- archaeological and heritage resources;
- existing and planned land use (including forestry);
- local community;
- visual aesthetics;
- noise;

- recreation and tourism; and
- safety.

3.2 Methods

The EA is structured to include proposed mitigation to reduce or eliminate potential adverse environmental effects. The determination of significance of adverse environmental effects is based on post-mitigation (residual or net) effects, rather than unmitigated potential effects. The significance of residual or net effects of the Project was determined using the following criteria, based on federal and provincial EA guidance:

- value of the resource affected;
- magnitude of the effect;
- geographic extent of the effect;
- duration and frequency of the effect;
- reversibility of the effect; and
- ecological and/or social context.

A significant adverse effect is defined as a permanent change in the quality or condition of a component of the environment. It must be spatially and temporally extensive and not within acceptable limits in terms of magnitude or nature based on guidelines, standards and professional judgement. Many construction-related environmental effects are not considered to be significant as they are relatively brief in duration (six months or less), restricted to the existing site and temporary laydown area in extent, and reversible over the short term. The potential level of impact (*i.e.,*adverse environmental effect) after mitigation measures (*i.e.,* net or residual effects) were identified based on NRCan's criteria and definitions provided in "Environmental Impact Statement Guidelines for Screenings of Inland Wind Farms Under the Canadian Environmental Assessment Act" (NRCan 2003), presented below in Table 3.1.

Table 3.1 Definitions for the Level of Impact After Mitigation Measures

Level	Definition
High	Potential impact could threaten sustainability of the resource and should be considered a management concern. Research, monitoring and/or recovery initiatives should be considered.
Medium	Potential impact could result in a decline in resource to lower-than baseline but stable levels in the study area after project closure and into the foreseeable future. Regional management actions such as research, monitoring and/or recovery initiatives may be required.
Low	Potential impact may result in a slight decline in resource in study area during the life of the project. Research, monitoring and/or recovery initiatives would not normally be required.
Minimal	Potential impact may result in a slight decline in resource in study area during construction phase, but the resource should return to baseline levels.
N/A	There is no interaction possible between the project activity in question and the associated potential adverse effect.

Source: *Environmental Impact Statement Guidelines for Screenings of Inland Wind Farms Under the Canadian Environmental Assessment Act* (NRCan 2003)

Issues scoping is a critical first step in the environmental assessment process to ensure completeness and focus for the EA process. The issues scoping process included the following activities:

- review of regulatory guidelines;
- public and agency consultation;

- literature and background information review; and
- field studies.

The following sections discuss these activities in more detail.

3.2.1 Regulatory Guidelines

As an energy generating facility that has a production rating of at least 2 MW derived from wind, this Project is Class I Undertaking as defined in Schedule A of the Nova Scotia Environmental Assessment Regulations and as such requires an environmental assessment registration. The *Proponent's Guide to Wind Power Projects: Guide for Preparing an Environmental Assessment Registration Document* (NSEL 2007, updated 2008) provides guidance on EA approach and issues scoping and was used extensively to guide the EA for this Project. Additional provincial legislation and policies that influenced this EA include the *Endangered Species Act,* Activities Designation Regulations, Nova Scotia *Wetlands Designation Policy* (NSEL 2006a), and the *Operational Bulletin Respecting the Alterations of Wetlands* (NSEL 2006b).

Regulatory guidance for this Project was also obtained from several federal documents, including:

- *Environmental Impact Statement Guidelines for Screenings of Inland Wind Farms Under the Canadian Environmental Assessment Act* (NRCan 2003).
- *Wind Turbines and Birds – A Guidance Document for Environmental Assessment* (Environment Canada 2007a).
- *Recommended Protocols for Monitoring Impacts of Wind Turbines on Birds* (Environment Canada 2007b)
- *Cumulative Effects Assessment Practitioners Guide* (Canadian Environmental Assessment Agency 1999).
- *The Responsible Authority's Guide* (Canadian Environmental Assessment Agency 2003).

In addition to these regulatory guidelines, federal legislation has also been used to guide the EA in terms of issues scoping, effects assessment and mitigation requirements, including, but not limited to the *Species at Risk Act* (*SARA*) and *Migratory Birds Convention Act, 1994*.

3.2.2 Public and Stakeholder Consultation

Over the course of Project planning, SkyPower representatives have consulted with the local community and stakeholders primarily through a public meeting at the Rossway Community Centre with representatives from NSPI (May 2008), a municipal council meeting (November 2008) and a public open house at the Rossway Community Centre (November 2008). These meetings have provided the local public and community leaders an opportunity to learn more about the Project and express issues or concerns about the Project. Additional details and issues that were raised at the Open Houses are discussed in Section 7. Copies of handouts are provided in Appendix A. During the EA review process, additional issues may be raised by the public. The public will be invited to submit written comments on the proposed Project and information contained in the EA document to regulators for consideration. Additional stakeholder and community outreach initiatives are planned for the Spring and Summer of 2009 including the launch of a Project website, mailout of community newsletter, meeting with municipal council, door-to-door community outreach program and a public open house. The public will continue to be consulted in future phases of development (refer to Section 7 for additional information).

3.2.3 Regulatory Consultation

Various regulatory and other agencies were consulted early in the planning process to provide input into the Project and the process, and advice in terms of likely approvals and considerations for environmental assessment. To date, the following agencies have been contacted by SkyPower and/or the Jacques Whitford Stantec Limited Study Team:

- Canadian Environmental Assessment Agency (CEA Agency);
- Canadian Wildlife Service (CWS);
- Nova Scotia Environment (NSE);
- NS Aboriginal Affairs;
- Nova Scotia Department of Natural Resources (NSDNR); and
- Natural Resources Canada (NRCan).

A draft environmental assessment was also submitted for regulatory review and comment. Comments received were taken into consideration in preparing the final EA Registration document. Regulatory consultation is further discussed in Section 7.

3.2.4 First Nation and Aboriginal Engagement

The Project Area consists of privately held land used primarily for forestry and residential uses and there is no known traditional use by First Nation people. SkyPower has commissioned the Confederacy of Mainland Mi'kmaq (CMM) to conduct a Mi'kmaq Ecological Knowledge Study (MEKS) for the Project. The MEKS will identify land and resource use which is of particular importance to the Mi'kmaq people with respect to the Digby Wind Power Project and as well, will seek to identify and document ecological knowledge which may be significant to the project. It is anticipated that this MEKS will be completed by September 2009, with progress updates provided in May and July.

SkyPower also attended a scoping meeting with NSE, NS Aboriginal Affairs, and representatives from the Mi'kmaq Rights Initiative (KMK) in early April 2009 to help NSE facilitate early, meaningful consultation with the Nova Scotia Mi'kmaq community. This meeting allowed SkyPower to provide an overview of the Project and obtain feedback on issues scoping relative to Aboriginal issues. First Nation and Aboriginal communities will also be invited to review and comment on the EA report during the registration process.

3.2.5 Literature Review

For this Project, existing information was collected from a number of sources including, but not limited to:

- municipal documentation from the Municipality of the District of Digby;
- 1:20,000 aerial photos;
- 1:10,000 Nova Scotia Base Mapping;
- NSDNR wetland inventory mapping;
- Atlantic Canada Conservation Data Centre (ACCDC);
- Provincial water well inventory;
- reports, books and other materials on the area's natural history and geology (see Section 10);
- reports, books and other materials relative to wind turbine developments and environmental effects (see Section 10); and
- information available at selected websites (*e.g.*, Statistics Canada, *Species at Risk Act* registry; see Section 10).

3.2.6 Field Studies

Field studies are aimed at characterizing the natural and social-economic environment of the Study Area. This work included:

- spring, summer, winter and fall avian monitoring (2008);
- vegetation surveys (June and August 2008);
- aquatic surveys (September 2008);
- site visits for characterization of socio-economic environment (June 2008);
- ambient sound monitoring (June 2008); and
- site visits to support the visual impact assessment (June and November 2008).

As described in Section 4, various field studies were conducted prior to the availability of the current turbine and access road layout; therefore it will be necessary to conduct localized follow-up surveys to refine mitigation presented in the EA, refine turbine and access road locations, and support additional regulatory permitting (*e.g*., Water Approvals). Follow-up surveys planned for the Spring/Summer of 2009 include:

- additional rare plant surveys along the transmission route and within planned turbine footprints during detailed planning and design ;
- wetland surveys and functional analyses (if wetland impacts cannot be avoided);
- additional breeding bird surveys;
- aquatic surveys (*e.g.,* if watercourses not previously surveyed are likely crossed by a road alignment); and
- follow-up archaeological surveys if required.

3.2.7 Professional Judgment

Project personnel involved in the completion of this EA are trained, professional biologists, scientists, planners and/or EA practitioners. Professional judgment was exercised through the selection of environmental components and in the evaluation of environmental effects in this report. The use of professional judgment in environmental assessment practice is widely accepted and complements the aforementioned scoping techniques.

3.3 Spatial and Temporal Boundaries of the Assessment

For this Project, the assessment of effects was undertaken for the area identified as the Study Area (see Figure 1.1), unless otherwise identified. Use of the term “Project Area” is meant to signify site development areas for the wind farm and transmission line (*i.e.,* Project lands within the Study Area). For the purpose of data collection of the socio-economic environment, the Municipality of the District of Digby was also considered. The temporal scope of this assessment covers the construction, operation and decommissioning phases of the Project, which is expected to extend over the next 20 years.

4 ENVIRONMENTAL CHARACTERISTICS

The general and specific biophysical and socio-economic conditions of the Study Area are described in this section.

4.1 Geophysical Environment

The following sections outline the geophysical environment of the Study Area including the physiography and topography, surficial geology, bedrock geology, and hydrogeology of the area.

4.1.1 Physiography and Topography

The Project is located in the physiographic region known as the Basalt Peninsula, which is part of the Atlantic Coast theme region. The peninsula is an extension of the North Mountain basalt ridge, with topographic elevations declining towards the western end of the peninsula. There are two dominant ridges that form the peninsula and a central valley situated between the ridges.

4.1.2 Surficial Geology

The Study Area consists of four types of surficial geology groups. The first is on the north side of the site, abutting the Bay of Fundy. Here the surficial geology is a glaciomarine deposit, which gently slopes towards the shoreline and has protruding ridges and scarps. This is a marine deposit that has lifted due to isostatic rebound. The primary materials in the deposit are gravel and sand, and secondary materials are silt and clay.

On the south shore, which abuts the Atlantic Ocean, there is a thin band of colluvial deposit. This is composed of a mixture of glacial deposits and weathered and frost shattered rocks and soils. This type of deposit is typically formed through down-slope creep and mass movement. In the south-east area of the site there is a silty till plain deposit, comprised of silt from material derived from local and distant sources. This deposit occurred with ice-sheet basal melting. The largest portion of the site is situated on a stony till plain deposit, which is a stony-sand matrix. This deposit can create a flat or rolling surface and typically has surface boulders. The stony till plain formed from basal ice-sheet melt, derived from local bedrock (Stea *et al.* 1992).

4.1.3 Bedrock Geology

The bedrock geology consists of the North Mountain Formation, which is part of the Fundy Group. The bedrock is a tholeiitic plateau basalt formed in the Jurassic Period of the Mesozoic Era, approximately 202 million years ago. Digby Neck was formed from two thick lava flows, with an intervening erodible layer (Keppie 2000).

4.1.4 Hydrogeology/Groundwater

Two major water-bearing bedrock formations are identified in the Study Area: the North Mountain Formation and the Blomidon Formation, both of the Fundy Group. The North Mountain Formation, located in the northern majority of the Study Area, is comprised of both igneous and metamorphic rocks including volcanic basalt, tuff and ryholite. The Blomidon Formation, along the southern perimeter of the Project area, is comprised of sedimentary sandstone, coal, siltstone, shale and conglomerates of lacustrine, deltaic and aeolian origin.

The North Mountain Basalt is the primary groundwater aquifer in the Digby Neck area. Aquifer permeability in the North Mountain Basalt formation, comprised of the upper, middle and lower flow units, is associated with fracture zones along the contacts between individual flows, and the contacts between each unit. The upper unit of the Formation is extremely permeable, and precipitation recharges through the vertical fractures to the middle unit. The recharge water is intercepted by a series of sub-horizontal basalt layers that comprise the middle unit, and the groundwater follows discontinuous flow paths towards locations where the fractures outcrop near surface. At these outcroppings, springs may form, flowing for several weeks to months until the recharged groundwater storage is exhausted. Due to the layered nature of the basalt flows, several "perched" water tables may be encountered by drilled wells. The highest well yields are expected from the highly fractured bottom zones of the upper flow unit and from the horizontal fracture zones between the individual flows of the middle flow unit.

Aquifer permeability in the Blomidon formation is primarily associated with thin sandstone beds and lenses and to a lesser extent from joints in siltstones and shales. Groundwater seeps may form on cliffs where the more permeable beds and joints may be exposed, or along the contact between the Blomidon sandstone and the North Mountain basalt.

Water supplies within the Study Area are generally derived from individually drilled wells. According to the Nova Scotia Well Log Database of logs for wells constructed between 1940 and 2007, wells within the Study Area are generally installed in either weathered basalt or sandstone. Some wells intersect the sand and gravel deposits in Gulliver's Cove. The majority of wells are for individual domestic potable use. One well field for spring water production is located within the Study Area; however this well field is not currently active. A summary of the pertinent well properties included in these logs is presented in Table 4.1.

Table 4.1 Summary of Water Wells Records Within the Study Area

	Well Depth (m)	Casing Length (m)	Estimated Yield (Lpm)	Water Level (m)	Overburden Thickness (m)	Drilled Date (yr)
Minimum	22.9	6.1	4.5	0.9	0	1953
Maximum	166.1	30.5	1877.5	32.0	25.9	2007
Average	59.7	16.2	221.6	10.6	12.9	1996
Geomean	51.0	14.3	83.7	7.9	9.5	1995
Number	46.0	45.0	46.0	26.0	10.0	46

Source: NS Well Logs Database (NSE 2008)

Groundwater wells constructed in the North Mountain Formation of the Fundy Group are typically moderately yielding and produce excellent quality water with parameters typically meeting the Health Canada Guidelines for Canadian Drinking Water Quality (Health Canada 2006). Groundwater circulation in the North Mountain Formation is typically rapid and contact with the resistive igneous rock is only along planes and fractures. The groundwater from this formation is therefore typically low in total dissolved solids, iron and hardness.

Groundwater wells constructed in the Blomidon Formation can be expected have low to moderate yield and produce moderate quality groundwater. Calcium bicarbonate and calcium sulphate presence contributes to higher total dissolved solids and hardness than in the North Mountain Formation aquifer. Groundwater typically meets Health Canada Guidelines for Canadian Drinking Water Quality (Health Canada 2006).

Domestic wells are scattered throughout the Study Area, coinciding with existing roads and structures. There are reportedly no dug wells in the vicinity of the Project activities, and all drilled wells draw groundwater from bedrock formations. Proposed turbine construction activities are greater than 500 m from any likely domestic well location. The precise location of nearby wells and any specific mitigative measures, if necessary, will be determined as part of preconstruction surveys.

4.2 Aquatic Environment

The following section describes the aquatic environment on site including the aquatic habitat and aquatic species. Watercourses will be avoided to the extent possible. If construction is necessary in or near watercourses, mitigation measures to reduce soil erosion and downstream sediment transport are proposed to ensure the protection of fish and fish habitat. Consultation with NSE and DFO will be required in the event that a watercourse needs to be crossed by a new road and/or an existing crossing requires upgrading. Figures 4.1a and 4.1 b show the location of watercourses within the Study Area.

4.2.1 Aquatic Habitats

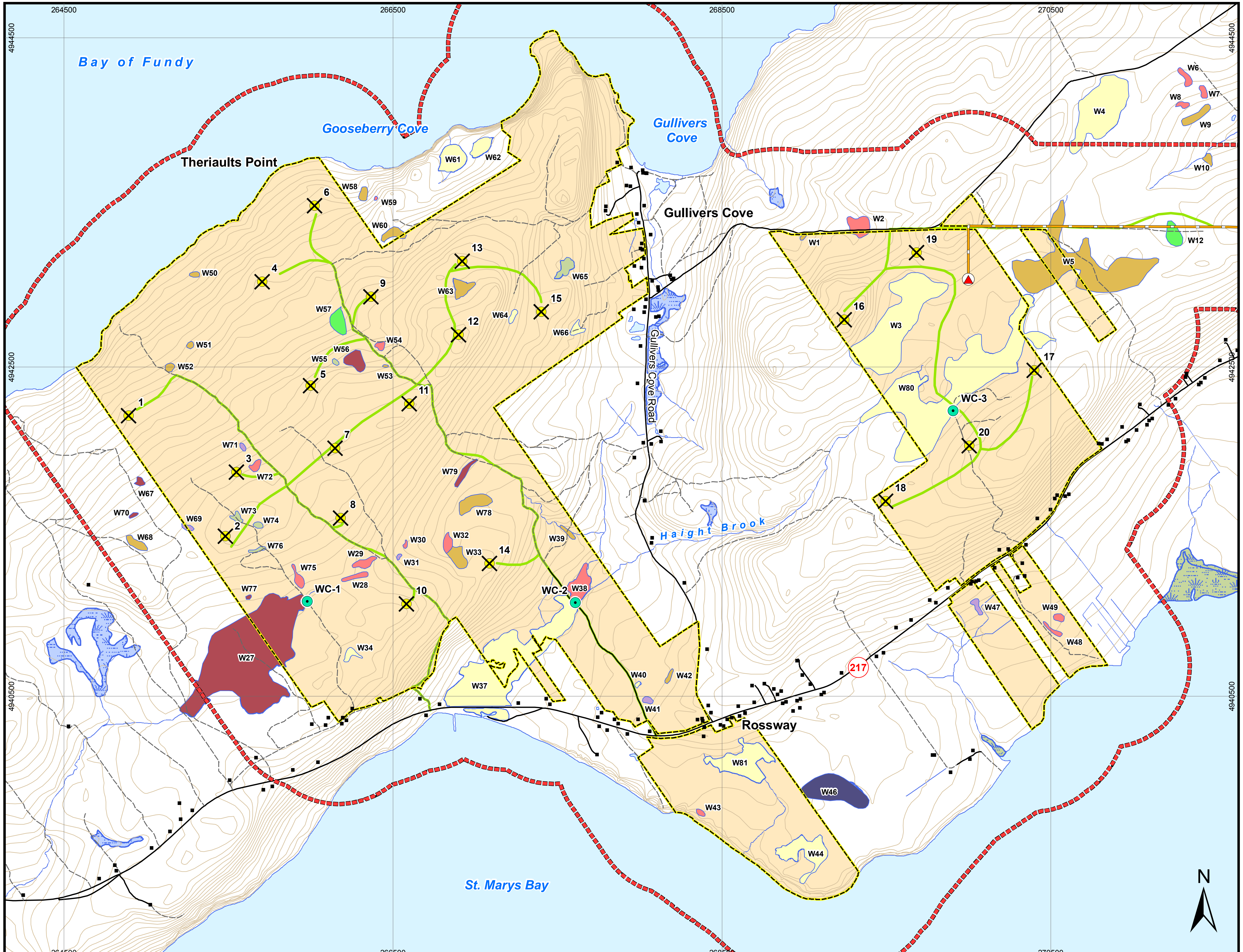
Multiple watercourses run through the Study Area, based on 1:10 000 mapping. Aquatic field surveys in September 2008 were undertaken to assess potential crossing locations identified, based on existing roads in the Study Area. Based on the existing road network, it was anticipated that turbine access roads could require three watercourse crossings in the Study Area (to be determined during final surveys and final design). Two of the crossings would occur on Haight Brook, with a third on an unnamed tributary to St Mary's Bay.

On September 27, 2008, two Jacques Whitford Stantec Limited aquatic specialists conducted a field survey of the Haight Brook and the unnamed tributary to St Mary's Bay at the proposed crossing locations to assess their general condition and categorize their potential for fish habitat. Identification and preliminary evaluations of Haight Brook and the unnamed tributary were based on 1:10 000 mapping and air photos.

The habitat assessments were conducted based on internal Jacques Whitford Stantec Limited sampling protocol, which is a derivative of the Canadian Aquatic Biomonitoring Network (CABIN) protocol published by Environment Canada (Reynoldson *et al.* 2007). Sampling protocol was also derived from the Ontario Benthos Biomonitoring Network (OBBN; Jones *et al.* 2005). The assessments consisted of identifying physical units (*i.e.,* riffles, pools, and runs), instream cover, substrate composition, stream depth and width, overhead cover, and water quality at three transects along a 200 m section of the watercourse: one transect at the proposed crossing location, one 100 m downstream of the proposed crossing and one 100 m upstream. Water quality measurements were taken in-situ with a handheld Yellow Springs Institute (YSI) water quality multimeter. Determination of fish species in the Study Area was completed utilizing a Smith Root Model 12 backpack electrofisher on a 75 m section of the Haight Brook; species are discussed in Section 4.2.1. Photographs were taken along the stream to document habitat (see Appendix B).

Based on 1:10 000 mapping it is estimated that the proposed transmission line route will require crossing five watercourses. It is anticipated that the transmission line poles will be located to avoid interaction with these watercourses. If it is determined during final survey and design that avoidance is not possible, the appropriate approvals will be sought from NSE and DFO.

The following sections provide additional detail on the characteristics of the water crossings surveyed. Discussions focus on the assessment of aquatic habitat at the wind farm site which could potentially be impacted by access road construction. Additional data will be obtained as necessary should watercourse alteration applications be required (*i.e.*, if watercourses are unavoidable during detailed design).



SKYPOWER

Figure 4.1a

DIGBY WIND POWER PROJECT

Watercouses and Wetlands (Site Area)

Watercourses and Wetlands

- Watercourse Assessment Site
- Watercourse
- Freshwater Wetland (NSDNR)
- Saltmarsh (NSDNR)
- Wetland (NSTDB)
- Waterbody

JWSL Identified Wetlands (2001 Air Photo Interpretation)

- Coniferous Treed Swamp
- Deciduous Treed Swamp
- Fresh Marsh
- Low Shrub Swamp
- Mixedwood Treed Swamp
- Shallow Water Wetland
- Treed Bog
- Tall Shrub Swamp
- Wetland Complex

Project Components

- Proposed 69 kV Substation
- Proposed Turbine Location
- Proposed Transmission Route Nov. 28-08
- Proposed Turbine Access Road
- Study Area
- Proposed Site Development Area

0 300 600 900 1,200

Meters

Data Sources:
Planimetric Data - NSGC; Nova Scotia Topographic Database (NSTDB), 1997, 1:10 000 (GeoNOVA)
Project Components - Skypower, Nov. 2008
Wetlands - NSTDB & NSDNR; Wetland Inventory Mapping, 2007, 1:10 000

Map Parameters
Projection: UTM/NAD83/Z20
Scale 1:22,000
Date: April 2009
Project No.: 1030972.01

Stantec

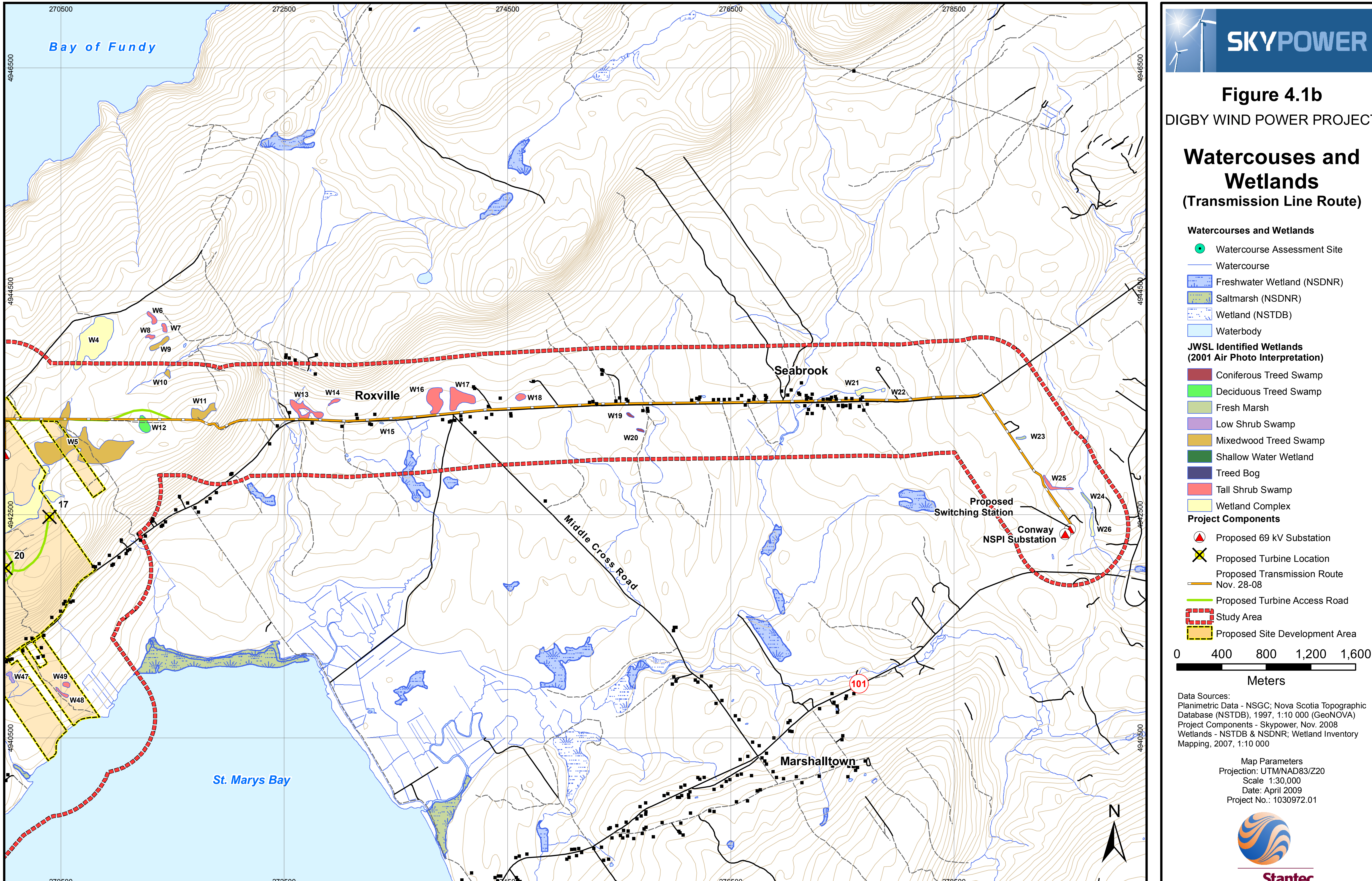


Figure 4.1b

DIGBY WIND POWER PROJECT

Watercouses and Wetlands (Transmission Line Route)

Unnamed Tributary to St. Mary's Bay – WC-1

The unnamed tributary to St. Mary's Bay (referred to as WC-1) is a first order perennial stream with the headwaters (no defined channel) immediately upstream of the potential crossing (refer to Photo 1 in Appendix B). Flow was not detectable at the time of the survey; substrate was primarily composed of small to large pebble (5-50 mm in diameter), interspersed with gravel (2-5 mm in diameter). Upstream of the proposed crossing, flow from the headwaters is impeded by the roadway and diverted to the existing culvert, into which it converges. This creates a defined channel approximately 0.50 m wide and 0.10 m deep for 30 m downstream of the culvert before the channel dissipates into a wetland. A small pool was present 10 m downstream of the proposed crossing and provides an area of heavy cattail (*Typha sp.*) growth. Riparian vegetation was predominately scrubland, dominated by alders and woody growth less than 2 m in height. The land use surrounding the crossing may historically, as well as presently, act as a quarry for general fill.

Water quality was indicative of a watercourse with low flow and stagnant conditions. Dissolved oxygen was low at 4.15 mg/L (39.1%), which is outside the CCME range for the protection of aquatic life (6.5-9.0 mg/L). Specific conductivity and pH were also slightly low but were representative of typical levels found in inland waters of Nova Scotia. This watercourse would not be considered potential fish habitat. There is a lack of connectivity to a fish bearing watercourse, as downstream of the channel a wetland serves as an interruption to fish passage. It is likely that the culvert installation increased water velocity immediately downstream of the road such that substrate scouring and bank erosion occurred and resulted in the development of a channel downstream of the culvert where none existed before. In addition to the lack of connectivity, dissolved oxygen concentrations are inadequate to sustain aquatic fauna. Physical characteristics for WC-1 are summarized in Table 4.2.

Table 4.2 Summary of Water Quality and Channel Characteristic for Site WC-1

Crossing[1]	Location (NAD83, Z20T)	Wetted Width (m)	Bankfull Width (m)	Average Depth (m)	Maximum Depth (m)	Temp. (°C)	pH	D.O. (mg/L)	D.O. (%)	Conductivity (µs/cm)
WC-1 Unnamed Tributary	0265978E, 4941075N	0.49	0.64	0.07	0.09	12.54	6.11	4.15	39.1	79

[1] All measurements and calculations were taken at the Right of Way of the anticipated road crossing.

West Haight Brook – WC-2

West Haight Brook is a second order perennial stream, which flows into St Mary's Bay through the Rossway seawall (refer to Photos 2-6 in Appendix B). At the proposed crossing, a culvert is presently installed under a private road (refer to Photo 6 in Appendix B). Upstream of the proposed crossing the channel narrows from 1.70 m to 0.94 m; the narrowest section of the reach surveyed occurs above the fork where a tributary of equal size joins with Haight Brook upstream of the proposed crossing.

The brook runs through two distinct riparian zones. The upstream zone consists of scrubland with stands of mature deciduous and coniferous trees. This riparian vegetation provides shade to 75-100 % of the brook upstream of the proposed crossing. Downstream of the proposed crossing the vegetation changes into pastureland with meadows extending to 100 m from each bank, resulting in canopy cover being reduced to 0-25%. Substrate varies along the assessment area ranging from silt/sand in the downstream section to large cobble at the upstream reach. The variance in substrate size can be attributed to decreased flow velocity downstream as the watercourse widens and slope decreases. This allows the smaller particles held in suspension to fall out of the water column during high flow events. Also of note, in the upper reach multiple pools and gravel beds exist, which are prime habitat resources for salmonid spawning. The dissolved oxygen concentration was 9.61 mg/L (89.6%) at the time of the survey. Conductivity and pH are higher than in WC-1 and all water quality measurements taken are within their respective CCME guidelines for the protection of aquatic life.

WC-2 exhibits diverse fish habitat as is evidenced by the habitat survey results and the variety of fish species captured during electrofishing. Haight brook is connected to a fish bearing watercourse (St. Mary's Bay), and suitable physical habitat exists for both small and large bodied fish.

Physical characteristics for WC-2 are summarized in Table 4.3.

Table 4.3 Summary of Water Quality and Channel Characteristic for Site WC-2

Crossing[1]	Location (NAD83, Z20T)	Wetted Width (m)	Bankfull Width (m)	Average Depth (m)	Maximum Depth (m)	Temp. (°C)	pH	D.O. (mg/L)	D.O. (%)	Conductivity (µs/cm)
WC-2 West Haight Brook	0267609E, 4941068N	1.70	2.44	0.24	0.29	12.12	6.71	9.61	89.6	145

[1] All measurements and calculations were taken at the Right of Way of the anticipated road crossing.

East Haight Brook – WC-3

This crossing (0269887E, 4942276N) is located in a wet area, potentially above the headwaters of the Haight Brook (refer to Photo 7 in Appendix B). No watercourse was present at the location at the time of the survey.

4.2.2 Freshwater Fish

The Digby Neck region of Nova Scotia is unique in its fish populations as there is a lack of freshwater connectivity to the remainder of Nova Scotia, thus there is an absence of any purely freshwater species (Nova Scotia Museum 2006). As identified above, only one site within the Project Area (WC-2) interacted with a freshwater aquatic environment with the potential to bear fish. The results presented below reflect the findings of a backpack electrofishing survey carried out at West Haight Brook, site WC-2.

The results of electrofishing indicate the presence of multiple fish species in the Haight Brook. No fish were observed or are anticipated to inhabit the unnamed tributary to Saint Mary's Bay at the location of the proposed crossing (WC-1). The unnamed tributary does not provide adequate flow, connectivity, habitat, or water quality in the area of the proposed crossing to support fish, as described above. Table 4.4 provides information on the species caught while electrofishing in the Haight Brook within the vicinity of the proposed road crossing; total numbers caught and mean fork length are also provided.

Table 4.4 Fish Catch Results (WC-2)

Fish Species	Number caught	Mean Fork Length (cm)
Brook Trout (*Salvelinus frontinalis*)	4	14.2
Fourspine stickleback (*Apeltes quadracus*)	1	4.2
Ninespine stickleback (*Pungitius pungitius*)	10	5.2
American eel (*Anguilla rostrata*)	8	11.4

Brook trout, a game fish, is one of the more popular choices for anglers in the Atlantic Canada sport fishery. Brook trout tend to occur in cool, clear, well oxygenated streams and lakes; spawning generally occurs in the headwaters or shallows of spring fed streams with gravel beds and riffles (Scott and Crossman 1998). The disturbed state of the water in the riffle allows for increased oxygenation/mixing of the water column. Sea run brook trout populations are also present in Nova Scotia which is likely what is present in the Haight Brook. These anadromous populations are born in freshwater redds (gravel spawing areas) and migrate to the Atlantic Ocean where they stay close to shore within large estuaries.

The stickleback family (Gasterosteidae) includes two species caught during the fish survey (ninespine, and fourspine). Ninespine species inhabit salt, brackish, and fresh water. The fourspine stickleback is typically considered marine although, as in this case, have been known to inhabit freshwater; both species tend to occur in shallow areas of streams and estuaries (Scott and Crossman 1998). Sticklebacks are tolerant of a range of water conditions (*e.g.,* salinity) and can be found in shallow, turbid waters not considered favourable by other species.

American eels are a member of the Anguillidae family and were found within Haight Brook. The species is catadromous (live in fresh water, spawn in salt water) and as such can be found in lakes, streams, rivers and estuaries, depending on the lifecycle stage of the individuals. The American eel has been designated a “species of special concern” by COSEWIC. While it has not been listed under the *Species at Risk Act* (SARA) by DFO at this time, it is likely that the species will be listed (and therefore protected) in the future.

4.3 Terrestrial Environment

The terrestrial environment section details the flora and fauna, including any species of special conservation concern, which may be present within the Study Area.

4.3.1 Habitats

The Project Area is mostly forested but does support other habitats including wetlands, abandoned agricultural land, disturbed habitats and sea cliffs. Table 4.5 lists the habitats present in the Project Area and the areas of each habitat type. Figure 4.2a presents the distribution of habitats in the wind farm site development area while Figure 4.2b presents the distribution of habitats along the proposed transmission line route.

Table 4.5 Habitat Types found in the Project Area

Habitat Type	Area (ha)	Proportion of Total Habitat Area (%)
Softwood Forest	388	33.3
Mixedwood Forest	237	20.3
Hardwood Forest	9.53	0.82
Natural Stand	22.8	1.96
Treated Stand	22.7	1.95
Clear-cut	333	28.6
Dead Stand	0.80	0.07
Tall Shrub Thicket	43.7	3.75
Old Field	1.75	0.15
Agriculture	44.1	3.78
Barrens	1.50	0.13
Beach	1.19	0.10
Cliff, Dunes, Coastal Rock	3.16	0.27
Gravel Pit	3.33	0.29
Road Corridor	0.75	0.06
Urban	7.97	0.68

Table 4.5 Habitat Types found in the Project Area

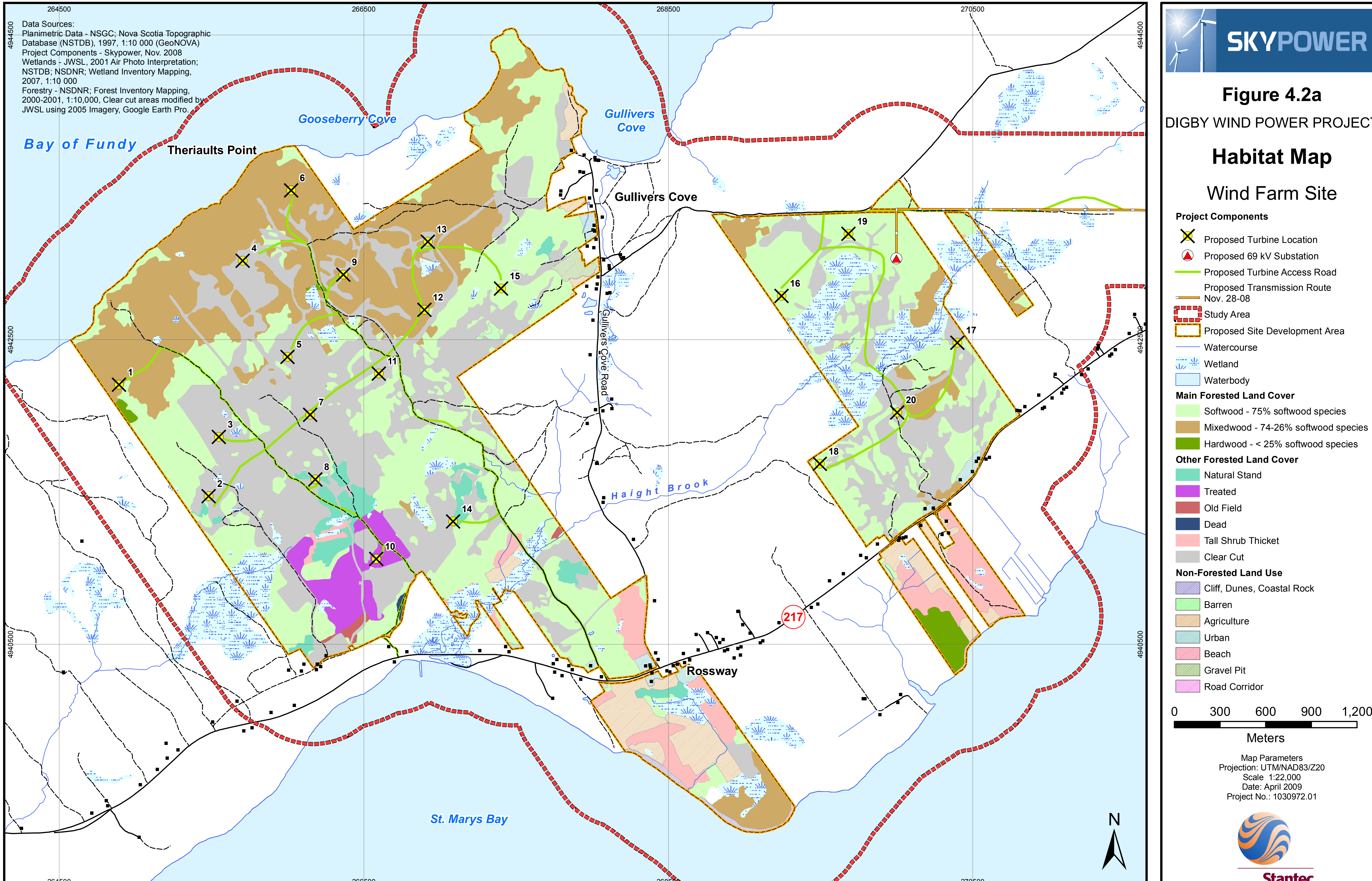
Habitat Type	Area (ha)	Proportion of Total Habitat Area (%)
Wetland	44.1	3.78
Inland Water	0.01	0.001

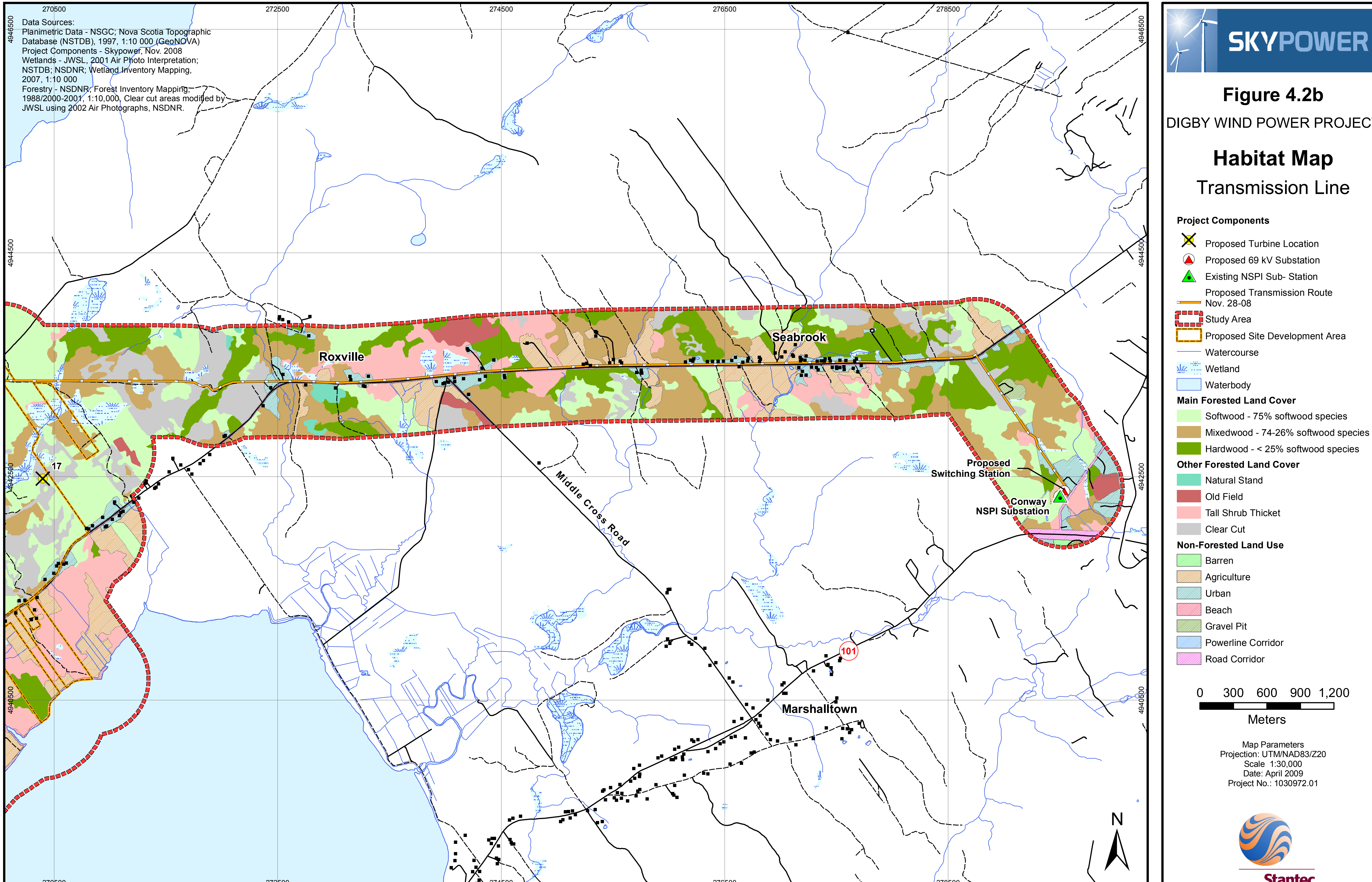
Forests in the Study Area consist mainly of softwood stands (388 ha, 33% of the Project area) and mixedwood stands (237 ha, 20% of the Project area). Mixedwood stands are mostly found along the Bay of Fundy coast along well drained ridge crests (Figure 4.2a). These stands are dominated by red maple (*Acer rubrum*), yellow birch (*Betula allegheniensis*), red spruce (*Picea rubens*), and balsam fir (*Abies balsamea*).

Softwood stands are most frequently encountered at lower elevations particularly in areas where soils are imperfectly drained or in areas that have been used for agriculture in the past. Areas that have been previously cleared for agriculture support stands composed mainly of white spruce (*Picea glauca*) and balsam fir. Red spruce (*Picea rubens*) and balsam fir are the dominant species in stands that have not developed on abandoned agricultural land.

Much of the Project Area (333 ha, 29%) has been harvested for timber in the last twenty years. Most of the harvesting appears to have occurred within the last five years. The presence of old woods roads suggests that timber harvesting has been conducted in the area for many decades. The intact forested areas are secondary growth forests with species composition typical of mainland Nova Scotia. Vascular plant diversity, based on vascular plant surveys conducted in 2008 and an Atlantic Canada Conservation Data Center Search for the area, is considered moderate (refer to Section 4.3.2).

Wetland habitat is not particularly abundant in the overall Study Area owing to the rolling topography. A total of 65 wetlands are present in the Project Area. These wetlands comprise 44 ha (4%) of the Project area. Most wetlands are small but a few large wetlands are present mainly at the southern and eastern ends of the Study Area which are situated at the bases of long slopes. Most wetlands in the Study Area are tall shrub dominated swamps dominated by speckled alder (*Alnus incana*) or mixedwood treed swamps characterized by a cover of red maple, white ash (*Fraxinus americana*), balsam fir and black spruce (*Picea mariana*). Some bog habitat is present in the southern portion of the Study Area and salt marsh and brackish marsh habitat is present near the southwestern corner of the Study Area (refer to Section 4.3.3 for more information on wetlands).


Data Sources:
Planimetric Data - NSGC; Nova Scotia Topographic Database (NSTDB), 1997, 1:10 000 (GeoNOVA)
Project Components - Skypower, Nov. 2008
Wetlands - JWSL, 2001 Air Photo Interpretation; NSTDB; NSDNR; Wetland Inventory Mapping, 2007, 1:10 000
Forestry - NSDNR; Forest Inventory Mapping, 2000-2001, 1:10,000, Clear cut areas modified by JWSL using 2005 Imagery, Google Earth Pro.
264500
266500
268500
270500
4944500
4942500
4940500
Bay of Fundy
Gooseberry Cove
Gullivers Cove
Theriaults Point
Gullivers Cove
Gullivers Cove Road
Haight Brook
217
Rossway
St. Marys Bay
N
SKYPOWER
Figure 4.2a
DIGBY WIND POWER PROJECT
Habitat Map
Wind Farm Site
Project Components
Proposed Turbine Location
Proposed 69 kV Substation
Proposed Turbine Access Road
Proposed Transmission Route Nov. 28-08
Study Area
Proposed Site Development Area
Watercourse
Wetland
Waterbody
Main Forested Land Cover
Softwood - 75% softwood species
Mixedwood - 74-26% softwood species
Hardwood - < 25% softwood species
Other Forested Land Cover
Natural Stand
Treated
Old Field
Dead
Tall Shrub Thicket
Clear Cut
Non-Forested Land Use
Cliff, Dunes, Coastal Rock
Barren
Agriculture
Urban
Beach
Gravel Pit
Road Corridor
0 300 600 900 1,200
Meters
Map Parameters
Projection: UTM/NAD83/Z20
Scale 1:22,000
Date: April 2009
Project No.: 1030972.01
Stantec


Data Sources:
Planimetric Data - NSGC; Nova Scotia Topographic Database (NSTDB), 1997, 1:10 000 (GeoNOVA)
Project Components - Skypower, Nov. 2008
Wetlands - JWSL, 2001 Air Photo Interpretation; NSTDB; NSDNR; Wetland Inventory Mapping, 2007, 1:10 000
Forestry - NSDNR; Forest Inventory Mapping, 1988/2000-2001, 1:10,000, Clear cut areas modified by JWSL using 2002 Air Photographs, NSDNR.
270500
272500
274500
276500
278500
4946500
4944500
4942500
4940500
Roxville
Seabrook
17
Middle Cross Road
Proposed Switching Station
Conway NSPI Substation
101
Marshalltown
N
SKYPOWER
Figure 4.2b
DIGBY WIND POWER PROJECT
Habitat Map
Transmission Line
Project Components
Proposed Turbine Location
Proposed 69 kV Substation
Existing NSPI Sub- Station
Proposed Transmission Route Nov. 28-08
Study Area
Proposed Site Development Area
Watercourse
Wetland
Waterbody
Main Forested Land Cover
Softwood - 75% softwood species
Mixedwood - 74-26% softwood species
Hardwood - < 25% softwood species
Other Forested Land Cover
Natural Stand
Old Field
Tall Shrub Thicket
Clear Cut
Non-Forested Land Use
Barren
Agriculture
Urban
Beach
Gravel Pit
Powerline Corridor
Road Corridor
0 300 600 900 1,200
Meters
Map Parameters
Projection: UTM/NAD83/Z20
Scale 1:30,000
Date: April 2009
Project No.: 1030972.01
Stantec

Forty-four hectares of active agricultural land is present in the southern part of the Project Area along the shores of St. Mary's Bay. Old field habitat is present at various locations in the Project Area but is most frequently encountered along public roads where agricultural activity has persisted the longest. Approximately 2 ha of old field habitat is present in the Project Area. Tall shrub thickets composed mainly of speckled alder and green alder (*Alnus viridis*) are present at a number of locations where old fields have begun to revert to forest. These stands comprise 44 ha (4%) of the Project Area.

Sea cliffs are present along the northern and southern margins of the Study Area. The highest cliffs are present along the northern margin. These areas have high potential to harbour rare plant species, however, since this habitat type will not be affected by construction and operation of wind turbines, no sampling was conducted in this habitat type.

4.3.2 Rare Plants and Species Richness

Rare plants and floral species richness in the Study Area was described using a combination of desktop and field surveys. Prior to conducting field surveys, aerial photography of the site was reviewed to determine the types and distribution of various habitats within the area. The air photo interpretation exercise was used to assist in a rare plant modeling exercise.

The rare plant modeling exercise was performed to determine the likelihood of presence of rare or sensitive plants within the Study Area. As part of the modelling exercise, all records of vascular plant species listed by the Nova Scotia Department of Natural Resources (NSDNR) as at risk (Red listed) or sensitive to human activities or natural events (Yellow listed) (NSDNR 2007) within a radius of 100 km of the Project site were compiled by means of an Atlantic Canada Conservation Data Centre (ACCDC) data search. The habitat requirements of these species were compared to the habitat descriptions compiled for the Study Area to determine if suitable habitat was present for these species. In instances where appropriate habitat was present for a particular species, that species was considered to be potentially present and the suitable habitat in the Study Area was identified as a target for field surveys. The phenology and ease of identification of each of the species potentially present in the area was also incorporated into the model in order to determine the best times to conduct the field surveys. Based on the results of the habitat model, 20 Red and 29 Yellow-listed species could potentially be present in the Study Area. Table C1 in Appendix C lists these species and their habitat preferences.

Vegetation surveys were conducted by experienced Jacques Whitford Stantec Limited botanists on June 3 to 7, and August 12 to 13, 2008. Figure 4.3 shows the survey sites (SS) relative to the current proposed turbine layout.

The June and August survey periods were sufficient to capture the flowering periods of all but five of the red and yellow listed plants identified in the model. During these early surveys, flowering green ash (*Fraxinus pennsylvanica*), round-leaved liverwort (*Hepatica nobilis*) and silky willow (*Salix sericea*) were not encountered. However, all of these species were readily identified by the botanists based on their fruit and vegetative characteristics. Case's ladies' tresses (*Spiranthes casei*) and yellow nodding ladies'-tresses (*Spiranthes ochroleuca*) both flower in September. These species could be present in the Study Area but were not detected. Habitats where these species would be most likely to be found would include disturbed areas such as woods roads, disturbed portions of abandoned pasture, ditches, and skidder ruts.

SKYPOWER

Figure 4.3

DIGBY WIND POWER PROJECT

Terrestrial Plant Survey Results

Survey Observations

ACCDC Ranking

- Undetermine
- Exotic
- Green
- Yellow

Project Components

- Survey Site Location (Previous Turbine Layout - May, 2008)
- Proposed Turbine Location
- Proposed 69 kV Substation
- Proposed Transmission Route Nov. 28-08
- Proposed Turbine Access Road
- Proposed Site Development Area

Map Features

- Building
- Road
- Unpaved Road
- Railroad
- Contour (5m)
- Watercourse
- Wetland
- Waterbody

0 300 600 900 1,200

Meters

Data Sources:
Planimetric Data - NSGC; Nova Scotia Topographic Database (NSTDB), 1997, 1:10 000 (GeoNOVA)
Project Components - Skypower, Nov. 2008
Wetlands - NSTDB & NSDNR; Wetland Inventory Mapping, 2007, 1:10 000

Map Parameters
Projection: UTM/NAD83/Z20
Scale 1:22,000
Date: April 2009
Project No.: 1030972.01

Stantec

All species of vascular plants encountered during the surveys were identified and their population status in Nova Scotia was determined through a review of the species status reports prepared by NSDNR, ACCDC, and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). A list of the 334 vascular plant species found on the site is presented in Appendix C. Species richness in the Study Area is relatively high. This is attributable mainly to the large size of the Study Area as well as the presence of forest stands in a variety of successional stages. The Study Area has been subjected to a substantial amount of disturbance in the form of past agricultural activity and more recently large scale timber harvesting. These disturbances have contributed to increased species richness by allowing ruderal species (*i.e.,* species growing in poor, disturbed land) to become established. Many of these ruderal species are non-native plant species that have become established in Nova Scotia following European settlement of the area. Sixteen percent of the species recorded in the Study Area are non-native species. This proportion of non-native species richness is similar to levels observed in other areas Nova Scotia that have a history of European occupation.

The plant species composition of the Study Area suggests a moderately productive site. Species characteristic of very fertile sites were not present, and species such as ericaceous shrubs that are abundant on infertile acidic sites were not well established in the Study Area.

Two of the species identified as potentially present in the Study Area by the rare plant modelling exercise were found on the property during the field surveys: Swan sedge (*Carex swanii*) and American pennyroyal (*Hedeoma pulegioides*). Both of these species are Yellow listed by NSDNR indicating that the Nova Scotia population is considered to be sensitive to human activities and natural events. ACCDC lists Swan sedge as S2? indicating that it is believed to be rare in Nova Scotia but there is some uncertainty regarding its population status. American pennyroyal is listed as S2S3 by ACCDC indicating that the species is considered to be rare to uncommon in Nova Scotia.

Swan sedge was noted at 20 locations in the Study Area including 11 of the 20 survey sites. Between 1 and 20 clumps of Swan sedge were found at these locations. This species was found mainly in young clearcuts where there was little overhead plant cover. A few plants were found in mature mixedwood forest, however, they were growing near the edge of a recent clearcut and the plants may have derived sufficient insolation from side lighting from the clearcut. The information collected during the field survey suggests that Swan sedge is widely distributed and relatively abundant in the Study Area. It can be expected to be encountered in recently harvested areas throughout the Study Area.

American pennyroyal was recorded at 36 locations in the Study Area, largely in the western portion. Several thousand plants were encountered during the field survey. American pennyroyal was found growing on disturbed sandy or gravelly sites generally along woods roads. It was also found in a gravel pit, along skidder trails in light soil and in heavily disturbed areas in clearcuts. Like Swan sedge, this species appears to be relatively abundant and widely distributed throughout the Study Area. It tends to be associated with linear features such as roads more so than Swan sedge.

Four species that have been listed by NSDNR as status “Undetermined” were encountered during the field survey including Appalachian polypody (*Polypodium appalachianum*), Hickey’s clubmoss (*Lycopodium hickeyi*), narrow-leaved sundrops (*Oenothera fruticosa*), and New England Blackberry (*Rubus setosus*). Status Undetermined indicates that there is insufficient information available to assess the population status of a particular species. For all four of these species the uncertainty regarding the population status of the species in Nova Scotia derives from confusion regarding the taxonomy of these species.

Until recently, Appalachian polypody and Hickey’s clubmoss were considered to be varieties of common species. Appalachian polypody was a variety of rock polypody (*Polypodium virginianum*) while Hickey’s clubmoss was a variety of tree clubmoss (*Lycopodium obscurum*). In addition, these new species are difficult to distinguish from the species that they were originally varieties of, making it more difficult to assess the population statuses of the new species. Until a sufficient number of new records of these species have been compiled or old specimens have been re-examined, the general status ranks of these two species will remain as undetermined.

The status of narrow-leaved sundrops is uncertain due to the possibility that some or all of the population is derived from a non-native population. New England blackberry has an undetermined status due to the fact that blackberry species hybridize frequently making it difficult to assign specimens to species. In addition the taxonomy of the genus Rubus has undergone substantial changes in recent years creating considerable confusion regarding the population statuses of many species in this genus.

Appalachian polypody was found at one location in the Study Area at SS16 near Gulliver's Cove. A small population of this species was found growing on an exposed boulder. Cliff faces and boulders are the typical habitats for this species. The current turbine layout does not include any turbines in this area.

Hickey's clubmoss was found in a small remnant stand of mature mixedwood forest found on a steep slope at SS18 (south of Turbine 12). Hickey's clubmoss occurs in a variety of forest types in Nova Scotia although it is most frequently encountered in second growth mixedwood and deciduous forests.

Narrow-leaved sundrops were found at 12 locations in the Study Area during the field surveys. The number of plants encountered was estimated to be approximately 50 plants. This species is generally associated with old fields, the edges of thickets and along the edges of roads. It is typically found on dry or sandy soils. In the Study Area, narrow-leaved sundrops were found along the edges of woods roads in the eastern half of the Study Area (Figure 4.2).

New England blackberry typically grows on open or poorly drained soils in disturbed areas. In the Study Area it was found at one location along the edge of a woods road at the western end of the Study Area.

Four species were encountered during the field surveys that are listed as uncommon by ACCDC but are considered to be secure (Green listed) in Nova Scotia by NSDNR. These include panicled hawkweed (*Hieracium paniculatum*) deer-tongue witchgrass (*Dichanthelium clandestinum*), Pennsylvania blackberry (*Rubus pensilvanicus*), and arrow-leaved violet (*Viola sagitatta*).

Panicled hawkweed generally grows in mixed or dry deciduous forest. It is most frequently associated with oak. In the Study Area it was found in a recent clearcut at SS8 (Turbine 11).

Deer-tongue witchgrass is typically associated with rich alluvial soils in thickets along rivers. In the Study Area it was found at two locations (SS6 and SS7) in the northern portion of the Study Area growing in recent clearcuts.

Pennsylvania blackberry is typically found in thickets, the edges of woods and in clearings. In the Study Area it was found growing on the banks of a drainage ditch in old field habitat at SS11.

In Nova Scotia, arrow-leaved violet is typically found growing on dry soils in woods, clearings and fields. Its distribution in Nova Scotia is focused mainly in the Annapolis Valley. Arrow-leaved violet was found at eight locations in the Study Area (Figure 4.2). Most plants were found growing in cracks in bedrock outcrops and along woods roads.

Follow-up plant surveys will be conducted in 2009 to assist with micrositing of turbines and access roads.

4.3.3 Wetlands

The distribution and abundance of wetlands in the Study Area was determined through a review of the Nova Scotia Wetland Atlas database and air photo interpretation. Air photo interpretation, using 1:10 000 scale colour air photos taken in 2001, was conducted within the properties that comprise the wind farm site and within a 200 m buffer extending on either side of the proposed transmission line route. This exercise was conducted by a wetland ecologist familiar with the Project area and experienced in delineating wetlands. Wetlands were identified using topographic location and the physiognomy of the plant communities. A conservative approach was used for delineating the wetlands in order to capture transitional wetland habitat such as treed swamps that are often present at the edges of wetlands. These swamps are often difficult to detect on air photos since they are similar in appearance to adjacent upland forest habitat. This conservative approach increases the probability of misclassifying terrestrial habitat as wetland habitat but also reduces the likelihood of missing wetland habitats that are present or underestimating the sizes of wetlands in the Project Area.

Wetlands detected during the air photo interpretation were classified using the Canadian Wetland Classification System (National Wetlands Working Group Canada 1987). This system categorizes wetlands into five general types, bogs, fens, marshes, swamps, and shallow water wetlands based on characteristics of vegetation, substrate and hydrology. In the Canadian Wetland Classification System, modifiers are used to further define the wetland. These include wetland morphological descriptors and vegetation descriptors. Only vegetation descriptors were used as modifiers for wetlands detected using air photo interpretation since vegetation type was visible on the air photo but morphological features such as the presence of streams or springs were not always visible. In instances where more than one wetland type was present in a particular wetland, the wetland was classified as a wetland complex.

The air photo interpretation exercise revealed the presence of 65 wetlands in the Project Area (Figure 4.1a and 4.1b). Wetland types present included low shrub bog, treed bog, coniferous treed swamp, deciduous treed swamp, mixedwood treed swamp, tall shrub swamp, low shrub swamp, fresh marsh, salt marsh, brackish marsh, and shallow water wetland (refer to Appendix D, Table D1). The most abundant wetland types in the Study Area are tall shrub swamp (present in 37% of wetlands), mixedwood treed swamp (present in 21% of wetlands) and fresh marsh (present in20% of wetlands). In regards to total area of wetland by wetland type, wetland complexes, coniferous treed swamp and mixedwood treed swamp accounted for 54% of the wetland area. Wetland complexes consist of mixtures of various wetland types. Most of the largest wetlands in the Project Area were wetland complexes (Wetlands 3, 37, 44, 80, and 81). This is to be expected since the larger wetland basins provide a wide variety of hydrological, morphological and fertility conditions that can promote the development of various wetland types within the same basin.

Most wetlands in the Project Area are relatively small; 71% of the wetlands are less than one hectare in size. Eight wetlands are between one and two hectares and 11 wetlands are greater than two hectares in size. The largest wetlands are located in the southern and western parts of the Project Area (Wetlands 3, 5, 27, 37, 44, 46, 80 and 81) where large areas of relatively flat terrain are present which allows poorly drained conditions to develop. Wetlands are scattered about the southwestern part of the Project Area where there is greater relief however, these wetlands tend to be small.

Each of the wetland types present in the Project Area is discussed below, followed by a description of wetland functions.

4.3.3.1 Wetland Types

Bogs

Bogs are peatlands in which the water table is situated at or near the surface. The rooting zone is typically isolated from nutrient rich groundwater resulting in the development of an acidic and nutrient impoverished environment that promotes the growth of sphagnum moss. Sphagnum moss is effective at scavenging available cation nutrients which it replaces with hydrogen ions to maintain an ionic balance. This further increases the acidity of the wetland which greatly reduces decomposition rates leading to the accumulation of peat. Bogs are uncommon in the Study Area and are restricted to three of the 65 wetlands (Wetlands 44, 46 and 80). They are typically restricted to flat low lying areas where groundwater discharge is limited.

Low shrub bog and treed bog are the bog types that are present in the Project Area. Low shrub bog is typically found in the centers of the bogs where conditions are wetter and particularly nutrient deficient. These areas also represent an earlier stage in plant community succession on the bog. The dominant species of this bog type are sphagnum moss (*Sphagnum* spp.), sheep laurel (*Kalmia angustifolia*), pale laurel (*Kalmia polifolia*), leatherleaf (*Chamaedaphne calyculata*), and rhodora (*Rhododendron canadense*).

Treed bog is typically found around the landward margin of the bogs. These areas represent a later stage in plant community succession on the bog and are also situated close enough to sources of groundwater to be somewhat more fertile than the center of the bog. This bog type differs from the low shrub bog mainly in the presence of an open tree canopy composed mainly of stunted black spruce (*Picea mariana*) and American larch (*Larix laricina*).

Swamps

Swamps are mineral wetlands or peatlands with standing water or water flowing slowly through pools or channels. The water table is generally at or near the surface of the swamp. There is internal water movement from the margin of the swamp or from other sources of mineral enriched waters. If peat is present, it consists mainly of well-decomposed wood, underlain at times by sedge peat. The vegetation typically consists of a dense cover of trees or shrubs, herbs and some mosses.

Five types of swamp are present in the Project Area including: mixedwood treed swamp; coniferous treed swamp; deciduous treed swamp; tall shrub swamp; and low shrub swamp. Mixedwood treed basin swamps situated in areas of moderate fertility in Nova Scotia such as the Project Area are characterized by a tree canopy dominated by red maple (*Acer rubrum*), balsam fir (*Abies balsamea*) and black spruce. The shrub understory of this wetland type is typically composed largely of speckled alder (*Alnus incana*), black holly (*Ilex veticillata*) and mountain holly (*Nemopanthus mucronata*).

Coniferous treed basin swamps in southwestern Nova Scotia typically have a tree layer composed largely of black spruce and balsam fir with scattered tamarack (*Larix laricina*) and red maple. The shrub understory is similar in species composition to mixedwood treed basin swamp.

Deciduous treed basin swamps are characterized by a tree canopy composed largely of red maple and white ash (*Fraxinus americana*). The shrub layer is typically dominated by a mixture of speckled alder, red maple saplings, narrow-leaved meadowsweet (*Spiraea alba*), and black holly.

Tall shrub basin swamps typically have a diffuse tree canopy composed largely of red maple, white ash, balsam fir, and black spruce. The shrub understory consists of a moderately dense shrub layer dominated by speckled alder, black holly and narrow-leaved meadowsweet.

Low shrub swamp is typically found in very wet areas and often forms a transition zone between marsh habitats and tall shrub swamp. The shrub layer is typically dominated by narrow-leaved meadowsweet , sweet bayberry (*Myrica gale*) and leatherleaf. Stunted speckled alder are often mixed in with these species.

Marshes

Marshes are mineral wetlands or peatlands that are periodically inundated by standing or slow flowing water. Surface water levels generally fluctuate seasonally. During drier periods declining water levels may expose areas of matted vegetation or mud flats. The surface waters are typically rich in nutrients. The substrate is usually mineral material although well-decomposed peat may occasionally be present. Marshes typically display zones or surface patterns consisting of pools or channels interspersed with patches of emergent vegetation, bordering wet meadows and peripheral bands of shrubs or trees.

Fresh marsh, salt marsh and brackish marsh are marsh types present in the Study Area. Fresh marsh habitat occurs in a variety of locations including riparian areas, anthropogenic (human-made) basins, seepage tracks and at the landward edge of brackish marshes. Plant species composition is highly variable depending on the hydrology and successional status of the marsh. Marshes found along streams often support a dense sward of blue-joint reedgrass (*Calamagrostis canadensis*). Fresh marshes that have developed in anthropogenic basins or in disturbed wetland habitat typically support a mixture of graminoid species including broad-leaved cat-tail (*Typha latifolia*), cottongrass bulrush (*Scirpus cyperinus*) and rushes (*Juncus* spp.). Most fresh marshes support a sparse shrub layer composed mainly of speckled alder and narrow-leaved meadowsweet.

Salt marsh is restricted to Wetland 37, a large wetland complex located on the southern edge of the Project Area. It occurs along the southern half of the wetland where seawater regularly enters the wetland from St. Mary’s Bay. The vegetation of this wetland type is characterized by a dense grass sward dominated by saltwater cordgrass (*Spartina alterniflora*) and salt-meadow cordgrass (*Spartina patens*).

Brackish marsh occurs on the landward side of the salt marsh habitat in areas that are only occassionally inundated by seawater. Brackish marsh vegetation is dominated by a mixture of grasses, sedges, bulrushes, and rushes. Some of the more abundant species include freshwater cordgrass (*Spartina pectinata*), chaffy sedge (*Carex paleacea*), soft-stem bulrush (*Scirpus validus*), and black-grass rush (*Juncus gerardii*).

Shallow Water Wetlands

Shallow water wetlands are characterized by the presence of open expanses of shallow water that are less than 2 m deep in summer and occupy greater than 75% of the surface area of the wetland. Shallow water wetlands typically support a heavy growth of submerged aquatic plants such as pondweeds (*Potamogeton* spp.) or floating leaf aquatic plants such as yellow pond-lily (*Nuphar variegata*) and American water-lily (*Nymphaea odorata*). Shallow water wetlands are uncommon in the Project Area and are generally restricted to anthropogenic basins such as fire ponds and impoundments.

4.3.3.2 Wetland Functions

Wetlands provide a number of functions including water flow moderation, groundwater recharge, shoreline and erosion protection, climate regulation, water quality treatment, nutrient and organic export, carbon sequestration and storage, and biological productivity and support for biodiversity. In instances where wetlands are adversely affected by a development, the functions associated with the affected wetland must be assessed as part of the wetland functional analysis. The wetland functional analysis is used to determine the functional attributes of the potentially affected wetland so that its value can be assessed. This assessment is then used to first determine whether permission to alter the wetland can be granted and second to determine what wetland functions must be recreated as part of a wetland compensation program, should permission to alter the wetland be granted.

SkyPower has committed to avoiding wetlands to the extent possible through detailed design of the Project components. While it was not feasible to conduct wetland functional analyses on all 65 wetlands located within the Project Area, in the event that the Project is likely to affect wetland habitat, site specific wetland functional analyses will be conducted by a qualified wetland ecologist for the potentially affected wetlands in the summer of 2009, prior to any wetland disturbance. These analyses would be used to support application for Water Approvals for wetland alteration.

The following provides general observations of the functionality of wetlands in the Project Area, based on aerial photography and general knowledge gained from the terrestrial field surveys.

Water Flow Moderation

Watercourses in the Study Area are short so the magnitude of potential flooding is low. Haight Brook is the longest watercourse in the Study Area and has the greatest potential for flooding. Two large wetlands (Wetlands 5 and 80) are located at the headwaters of this stream. These wetlands have potential to moderate stream flow by slowing the flow of water and by temporarily storing surface water.

Groundwater Recharge

The ability of wetlands to contribute to groundwater recharge is difficult to assess. However, it is possible that some of the small wetlands situated in perched basins near the tops of hills could contribute to local groundwater recharge. The importance of this function in these wetlands would depend on their location. Wetlands such as Wetlands 74 and 76 which lie on slopes facing inhabited areas to the south would have more value than wetlands such as Wetlands 56 and 57 which are located on slopes that are uninhabited and drain into the sea.

Shoreline and Erosion Protection

Some wetlands such as coastal salt marshes and riparian swamps provide effective protection from shoreline erosion. These wetlands are able to absorb energy from waves, tides and flowing water without experiencing extensive damage to vegetation or wetland substrates. Wetland 37 is the only wetland in the Project Area that is likely to provide this function. It is a wetland complex with a salt marsh component that borders on St. Mary's Bay. The portion of Wetland 37 located south of Highway 217 would be the area most heavily impacted by storm surges, large waves and possibly ice scour. This portion of the wetland is outside of the Project Area and would not be affected by the Project. The northern end of Wetland 37 could be affected by the Project if it is necessary to widen the woods road that crosses the wetland. This is the most quiescent part of the wetland and partial infilling of the wetland in this area would not be expected to adversely affect the ability of the wetland to provide shoreline and erosion protection.

Climate Regulation

Evapotranspiration of water from wetland vegetation and evaporation of water from the surface of the wetland can help to cool areas adjacent to the wetland. The ability of the wetland to perform this function is related to the size of the wetland and the types of vegetation present as well the area of exposed surface water. Marshes and swamps typically have high rates of evapotranspiration while bogs typically have low rates of evapotranspiration. Swamps and marshes are the most abundant wetland types in the Project Area so this may be an important wetland function for many of the wetlands present.

Water Quality Treatment

Some wetlands are quite effective at removing a variety of contaminants from surface water. This includes uptake of nutrients by plants and microbes, conversion of soluble metals to insoluble forms, degradation of organic chemicals, and deposition of solids. In instances where contaminant degradation is mediated by microbes, highly productive wetlands such as marshes and swamps typically perform better than unproductive wetlands such as bogs. The ability of a wetland to facilitate water quality treatment is dependent on various factors including the degree of channelization of flow through the wetland, degree of water flow through the substrate, the amount of oxygen in the water, and water temperature. The value of this function is dependent on two factors which include the ability of the wetland to perform and whether or not the wetland currently performs this function. It is likely that marshes and swamps in the Project Area have the capacity to facilitate water quality treatment; however, the Project is located in a relatively uncontaminated area so most wetlands probably do not currently perform this function. Possible sources of contaminants in the Project Area would include sediment inputs from woods roads and nutrient inputs from agricultural areas and septic fields. As such, wetlands (particularly marshes and swamps) located down gradient from woods roads, farms and houses would have the greatest potential to be performing this function.

Nutrient and Organic Export

Wetlands can be sources of nutrients and organic matter for downstream aquatic ecosystems. Peatlands such as bogs that are located at the headwaters of streams can export substantial amounts of organic matter although they typically act as sinks for nutrients. Productive wetlands such as marshes and swamps can also act as nutrient sinks but may export organic matter seasonally when vegetation senesces, dies and decomposes. Salt marshes can be particularly important in providing organic matter to adjacent marine ecosystems. Most wetlands found in the Project Area that are hydraulically linked to downstream freshwater or marine ecosystems can be expected to provide this function to varying degrees. The importance of the function would be related to the size of the wetland and the ability of nutrients and organic matter to flow through the system.

Carbon Sequestration and Storage

Wetlands can act as both sinks and sources for green house gases. Peatlands such as bogs and fens can be important carbon sinks by storing large volumes of organic matter in the form of peat. Marshes and swamps that remain saturated throughout the year also tend to accumulate peat and also act as carbon sinks. Wetlands with large seasonal water level fluctuations such as experienced by many marshes are typically poor at sequestering carbon since exposure of the substrate to air during draw down periods promotes rapid decomposition of organic matter deposited in the sediment. In the Project Area, wetlands contain bogs elements such as Wetlands 44, 46 and 80 as well as the salt marsh component of Wetland 37 would be expected to function highly in regards to carbon sequestration. The larger swamps such as Wetlands 3, 5, 27, and 81 would also be expected to function highly in this regard.

Biological Productivity and Support for Biodiversity

Wetlands provide habitat for a wide variety of plants and animals. Some wetlands are highly productive and support very high numbers of species or particularly high abundances of a few species. Other wetlands provide uncommon habitat types that support rare species that cannot survive in other habitats. The value of a wetland in regards to biological productivity and biodiversity cannot be accurately assessed without conducting site specific surveys; however, there are some general patterns that can be used to help identify wetlands that may have high functionality in regards to biological productivity and biodiversity. Typically, larger and more fertile wetlands support larger numbers of species and are more productive. Uncommon habitat types tend to support greater numbers of rare species than common habitat types. Hostile environments often support highly specialized species that cannot persist in more benign environments and are therefore rare or geographically restricted in their range. Based on these assumptions, several wetlands in the Study Area can be expected to support high species richness, have high potential to support rare species or be highly productive. Wetlands that have high potential to support rare species include Wetlands 37, 44, 46, and 80. Wetlands that have high potential to have high species richness include Wetlands 3, 5, 27, 37, 44, and 81. Wetlands likely to be highly productive would include Wetlands 21, 37 and 80.

4.4 Birds and Other Wildlife

4.4.1 Birds

The Study Area contains land features that may concentrate birds including shorelines, cliffs, and ridges. The Project Area itself is predominantly forested (60% of wind farm site), although approximately 34% of the site is characterized as disturbed (*e.g.,* clear cut, agriculture, gravel pit, roads) (refer to Section 4.3.1 for more information on habitats in the Project Area).

Information on the distribution and abundance of birds in the Study Area was derived from field surveys, publicly available documents and other sources. The methodologies and results of desktop and field studies conducted in support of the Project are described in the following sections.

4.4.1.1 Desktop Studies

An important source of information is the Maritimes Breeding Bird Atlas (MBBA) database (Erskine 1992 and updates), which contains a summary of bird distribution and abundance across the Maritime Provinces of Canada. The MBBA data was used to provide a general inventory of breeding birds in the vicinity of the Study Area. The MBBA also provides a list of bird species of special conservation concern which may be present in the Study Area. The Study Area includes parts of two Maritime Breeding Bird Atlas (MBBA) map squares: 20KQ64 and 20KQ74. In the first breeding bird atlas (1986-1990) (Erskine 1992), there was no data collected in square 20KQ64, and the limited efforts from the first three years of the second breeding bird atlas (2006-2010) have only revealed two species with a probable breeding status: Nelson’s Sharp-tailed Sparrow (*Ammodramus nelsoni*) and Alder Flycatcher (*Empidonax alnorum*). Neither species is considered to be of conservation concern in Nova Scotia and neither species was recorded during the bird surveys conducted in the Study Area for the Project.

In the first breeding atlas there were 90 bird species possibly, probably, or confirmed breeding in square 20KQ74, and in the initial years of the second breeding atlas, 38 bird species have been identified as possibly, probably, or confirmed breeding in this square. To-date, observations for the second breeding atlas have not revealed any breeding species that were not recorded in 1986-1990.

According to MBBA data, species observed or heard singing in suitable nesting habitat are classified as possible breeders. Species exhibiting the following behaviours are classed as probable breeders:

- courtship behaviour between a male and female;

- birds visiting a probable nest site;
- birds displaying agitated behaviour; and
- male and female observed together in suitable nesting habitat.

Species are confirmed as breeding if any of the following items or activities were observed:

- nest building or adults carrying nesting material;
- distraction display or injury feigning;
- recently fledged young;
- occupied nest located; and
- adult observed carrying food or fecal sac for young.

A review of the ACCDC database was conducted to obtain a list of provincially rare or sensitive bird species found within a 100 km radius of the Project Area. ACCDC provides information on species and ecological communities that require consideration for their conservation (ACCDC 2007). The ACCDC listing and ranking system is useful since it provides a georeferenced outlook on rare or sensitive species and habitats. The ACCDC list, however, is generated on a radius that is considered to be in excess of the ecological footprint of the Project. A model was therefore employed by the Study Team to determine the likelihood of the presence of the ACCDC ranked bird species within the Project Area. Likelihood of presence was determined by crosschecking the habitat requirements of the ACCDC listed species with the habitat description within the Study Area. Table E1 in Appendix E presents the results of the ACCDC search and related modelling exercise.

The model identifies four species of conservation concern that could be present within the Study Area, namely: Peregrine Falcon (*Falco peregrines anatum*), Northern Goshawk (*Accipiter gentilis*), Long-eared Owl (*Asio otus*), and Harlequin Duck (*Histrionicus histrionicus*).

4.4.1.2 Field Surveys

A pre-construction (baseline) bird monitoring program was conducted by a local naturalist experienced in bird identification between November 2007 and October 2008. The scope of the monitoring program and the survey protocol used was based on previous protocols developed in consultation with the Canadian Wildlife Service (CWS), as well as Environment Canada's Recommended Protocols for Monitoring Impacts of Wind Turbines on Birds (Environment Canada 2007). Bird surveys conducted included fall and spring migration surveys, breeding bird surveys and surveys of overwintering bird activity in the Project Area. The monitoring protocol and summary of survey results are provided in Appendix E. Weather conditions recorded during each site visit are included in Table E2 of Appendix E.

Breeding Birds

Breeding surveys, consisting of point counts and standardized area searches, were conducted for this assessment in June, July, and early August of 2008. A total of nine breeding bird surveys were conducted over this period, with each survey lasting 4 hours; this exceeded requirements of the proposed protocol (refer to Appendix E) which provided only two surveys. A total of 56 bird species were recorded during these surveys (refer to Table E3 in Appendix E).

A variety of raptors were recorded in the Study Area during the breeding season, including Broad-winged Hawk (*Buteo platypterus)*, Red-shouldered Hawk (*Buteo lineatus)* Red-tailed Hawk (*Buteo jamaicensis)*, Rough-legged Hawk (*Buteo lagopus*) Sharp-shinned Hawk (*Accipiter striatus)*, Turkey Vulture (*Cathartes aura)*, Merlin (*Falco columbarius)*, and Peregrine Falcon (*Falco peregrinus anatum)*. Breeding activity could not be confirmed for any of these raptors, with the highest confirmed breeding status for any of these species determined to be "Probable" (Peregrine Falcon). No raptor nests were found in the Study Area.

Red-shouldered Hawk is considered an accidental species in Nova Scotia and is not likely to be breeding in the province. Turkey Vultures have not been recorded as breeding in Nova Scotia but are regularly observed in southern Nova Scotia suggesting that they may already nest in the province. Rough-legged Hawks regularly winter in Nova Scotia and immature birds occasionally spend the summer in the province. The Rough-legged Hawk observed during the breeding bird surveys was probably a non-breeding bird. In the Maritime Breeding Bird Atlas for square 20KQ74, the breeding status for Red-tailed Hawk is listed as possible, and that of Broad-winged Hawk is listed as probable.

A single Peregrine Falcon was observed in June 2008 during vegetation surveys in the Study Area. This species is ranked provincially as “red” and listed as “Threatened” under the *Species at Risk Act*. This species has been recorded by the Brier Island Bird Monitoring Station as occurring on Brier Island between May and October, noting that the number of Peregrines occurring at Brier Island has been increasing steadily over the last 15 years (L. Laviolette, pers. comm. 2009). The bird noted during the June vegetation survey was observed near a cliff face on the headland just west of Gulliver’s Cove. The bird was agitated and circled the observer several times before leaving. This evidence would suggest that there may have been a nest nearby although none was observed.

Notable observations among other bird groups included two species of conservation concern: the Boreal Chickadee (*Parus hudsonicus*), a “yellow” listed species (NSDNR 2007) with three individuals noted during the breeding bird surveys; and the Canada Warbler (*Wilsonia canadensis,)* ranked “yellow” provincially (NSDNR 2007) and “threatened” by COSEWIC (COSEWIC 2008) with only one individual recorded during the breeding season.

The Boreal Chickadee occurs almost entirely in coniferous forests, but is found to a lesser extent in mixed woodlands. The forest habitats utilized by Boreal Chickadees are often damp, well-shaded coniferous woods (Tufts 1986). The Canada Warbler uses a wide range of deciduous, coniferous and mixed forests, with a well-developed shrub layer and a structurally complex forest floor. It is most abundant in moist, mixed forests. It also occurs in riparian shrub forest on slopes and in ravines, in stands regenerating after natural and anthropogenic disturbances and in old-growth forests with canopy openings and a well-developed shrub layer (COSEWIC 2008).

As indicated on Figures 4.3a and 4.3b, these habitats do exist in the Study Area, although given the small numbers recorded during the surveys and the extent of fragmented habitat in the Study Area, it is not anticipated that the Project Area provides important habitat for these species. However, given the variety of raptors observed, the probable breeding status of the Peregrine Falcon in the Study Area and the updated turbine layout and transmission line, follow-up breeding bird surveys will be conducted in June 2009 prior to construction.

Wintering Birds

The abundance and diversity of wintering birds is largely dictated by weather conditions, time of year, available habitat and the biological cycle of each species. Owls, crossbills, and finches dramatically fluctuate in numbers depending upon conditions elsewhere in their ranges. As a result, one may find many individuals of a certain species in one winter and none the next winter.

Wintering bird surveys consisted of standardized area searches at various locations on the study site, conducted monthly for 4 hours. Table E4 in Appendix E summarizes the results from six wintering bird surveys conducted between November 2007 and April 2008. A total of 527 individuals of 30 species were detected over the course of the six surveys.

The most abundant species observed included the Common Redpoll (*Carduelis flammea*) (122 individuals), Black-capped Chickadee (*Parus atricapillus)*, Herring Gull (*Larus argentatus*), Cedar Waxwing (*Bombycilla cedrorum*), and Common Eider (*Somateria mollissima*). Flock sizes were generally quite low, with the exception of Common Redpolls, which were observed in two large flocks in December, and fairly large flocks of Herring Gulls observed in November and December. Birds were most abundant in November and

December, accounting for approximately 70% of the observed individuals during the winter surveys. This was due in part to the large flocks of Common Redpolls observed in December.

Bird species of conservation concern observed in the Study Area during the winter include the Boreal Chickadee and the Harlequin Duck (*Histrionicus histrionicus)*. Boreal Chickadees were observed during five of the six surveys conducted, with a total of 10 individuals being observed. Two Harlequin Ducks were observed during the December survey. Harlequin Ducks are known to winter in parts of the Bay of Fundy and sightings are not uncommon during this time of year. It is expected that this species would not be using the Project Area, but the adjacent marine environment.

Although they will occasionally range across the general area, most of the landbirds that linger in the Study Area during the winter remain close to vegetation cover, which provides shelter, food, and protection from predators. The Project Area does not provide important wintering habitat for birds, and provides foraging habitat similar or lower in quality to that present elsewhere in the Digby Neck area.

Spring Migration

Ten spring migration surveys were conducted between mid-April and the end of May. The surveys consisted primarily of standardized area searches, and were 4 hours in duration. Surveys were conducted once a week during the shoulder period for spring migration and twice a week during the core migration period.

There was a total of 53 species of birds observed during the spring monitoring period, totalling 1,235 individual birds (refer to Table E5 in Appendix E for a summary of spring migration survey results). The majority of birds observed were recorded as flying or residing below 50 metres. The most frequently recorded birds were White-throated Sparrow (*Zonotrichia albiocollis*), Dark-eyed Juncos (*Junco hyemalis*), Black-throated Green Warblers (*Dendroica virens*), Yellow-rumped Warblers (*Dendroica coronata*), and Black-capped Chickadees (*Parus atricapillus*). These species also demonstrated the largest flock sizes relative to the other species observed, although all but one flock of these species were less than 40 individuals. Waterfowl observations were rare, while five species of waterbirds were observed.

Species of conservation concern that were observed during spring migration included three yellow-listed species: Common Loon (*Gavia immer*), Boreal Chickadee (*Parus hudsonicus*), and Gray Jay (*Perisoreus canadensis*) (NSDNR 2007). Common Loons were observed on three separate occasions, totalling 28 individuals, and were observed flying past the site rather than utilizing the site. One Boreal Chickadee was observed on the site in April, and was observed at less than 50 m height. Five Gray Jays were observed over the course of three separate sightings, flying over the site. Turkey Vultures (*Cathartes aura*), an accidental bird species in Nova Scotia, were observed flying over the site on six separate occasions during the spring migration surveys.

There is no evidence of a migratory peak of passage in any of the species or groups (refer to Appendix E).

Fall Migration

Ten fall migration surveys were conducted between late-August and the end of October. The surveys consisted primarily of standardized area searches, and were 4 hours in duration. Surveys were conducted once a week during the shoulder period for fall migration and twice a week during the core migration period (*i.e.,* the first three weeks of September).

There was a total of 57 species of birds observed during the fall migration surveys, totalling 1,199 individual birds (refer to Table E6 in Appendix E). The most frequently recorded birds were White-winged Crossbills (*Loxia leucoptera*), Purple Finches (*Carpodacus purpureus*), Dark-eyed Juncos, American Robins (*Turdus migratorius*), and Herring Gulls (*Larus argentatus*). These species also generally demonstrated the largest flock sizes relative to the other species observed, with the largest flock being a group of 72 Purple Finches. No waterfowl were observed during fall migration, while seven species of waterbird, and six species of raptors were observed.

Species of conservation concern that were observed during fall migration include two yellow-listed species (Common Loon and Gray Jay) and a number of accidental species that are rarely observed in Nova Scotia. A group of four Common Loons was observed on one occasion in October, and two Gray Jays were observed on one occasion in September. Several accidental species were observed, including Pine Warbler (*Dendroica pinus*), Red-bellied Woodpecker, (*Melanerpes carolinus*), Cattle Egret (*Bubulcus ibis*), and Turkey Vultures. These species are not of particular concern to the Project, as they are species that are not commonly found in the area or in Nova Scotia, and are not known to breed in the area or in Nova Scotia.

Likewise with the spring migration, the counts generally show no evidence of major peaks of arrival or departure. Neither was there evidence of major raptor flights over the Study Area during the fall migration period.

Survey Summary

As indicated in Appendix E (McLaren 2009), the survey data suggests that the Project Area is not a major "corridor" or stopover site for waves of migrants arriving or leaving the province. The counts generally show no evidence of major peaks of arrival or departure of the sort observed every spring and autumn on Brier Island, where on some days many hundreds of sparrows, warblers, and other species can be observed near North Point light station. Neither was there evidence of major raptor flights over the Study Area whereas hundreds of Broad-winged Hawks are observed on Brier Island in fall. However, the absence of birds in the study area during the observation period does not preclude birds in nightly transit through the area. It may be that the degraded upland habitat, while suitable for nesting species like seed-eating sparrows and attractive to cone-feeding species (good counts of Purple Finches. White-crossbills, Purple Finches) is not very suitable for insect-fueled night-migrants like flycatchers, vireos, warblers, and *Catharus* thrushes. Post-construction surveys will be used to verify bird use and mortality rates.

4.4.2 Mammals

4.4.2.1 Overview

Nova Scotia is home to 57 species of terrestrial mammal (Davis and Browne 1996). The mammal fauna of Nova Scotia has been altered dramatically since the arrival of Europeans. A number of species have been extirpated, such as the caribou (*Rangifer tarandus*) and the wolf (*Canis lupus*), due to habitat destruction, human encroachment and hunting (Davis and Browne 1996; Banfield 1974). Others species, such as the white-tailed deer *(Odocoileus virginianus)* and coyote *(Canis latrans)*, appear to have benefited from human disturbance, and are relatively recent arrivals to the province (Davis and Browne 1996). The abundant mammal species are generally mobile and widespread in Nova Scotia, and the mammal fauna of the province has not been delineated into distinct communities (Davis and Browne 1996). However, a number of mammal species native to Nova Scotia currently have restricted ranges and exist in disjunct populations.

Information regarding the presence of mammals, including rare species, and sensitive mammal habitat within the Study Area was derived from existing data sources, a review of data for the area obtained from ACCDC and field surveys which were conducted in June and August of 2008.

Habitat types in the Study Area are described in Section 4.3.1. Given the types of habitat present in the Study Area, it can be expected to support a variety of mammal species characteristic of forested and open habitats. However, given the fairly heavily disturbed nature of the habitats and the close proximity of human habitation, it is unlikely that mammal species characteristic of remote areas or large tracts of mature forest such as American Marten (*Martes americana*) and Fisher (*Martes pennanti*) would be present. A discussion with the regional NSDNR biologist confirmed there are no records of these species in the Digby Neck area and that suitable habitat for these species is not likely present (P. MacDonald, pers. comm. 2009).

Evidence of the presence of mammals was collected during the field surveys. This included visual sightings, distinctive calls, tracks, scat, dens, lodges and other distinctive spoor that could be used to identify mammals. A total of 11 mammal species were detected during the field surveys including white-tailed deer, coyote, red fox (*Vulpes vulpes*), American black bear (*Ursus americanus*), racoon (*Procyon lotor*), red-backed vole

(*Clethrionomys gapperi*), woodland jumping mouse (*Napaeozapus insignis*), porcupine (*Erithizon dorsatum*), eastern chipmunk (*Tamias striatus*), American red squirrel (*Tamiasciurus hudsonicus*), and varying hare (*Lepus americanus*) (Table 4.6). None of these species are rare or sensitive to human activities. Table 4.6 also presents a list of mammals that are expected to make use of habitats in the Study Area. All of these species are relatively common in the province; however, two species-- little brown bat (*Myotis lucifugus*) and northern long-eared bat (*Myotis septentrionalis*) -- are Yellow listed by NSDNR indicating that they are sensitive to human activities and natural events. This general status designation is attributable to the fact that these bats gather in large numbers in a limited number of caves and abandoned mines to hibernate. This concentration of their populations places them at higher risk. These species are discussed in more detail in the following text.

Table 4.6 Mammal Species Recorded in and/or Likely to Occur in the Study Area

Common Name	Binomial	Habitat	NSDNR Ranking	ACCDC Ranking
Little Brown Bat	*Myotis lucifugus*	In summer they inhabit forests, and inhabited areas. Natal colonies often established in houses. In winter they hibernate in caves and abandoned mines.	Yellow	S4
Northern Long-eared Bat	*Myotis septentrionalis*	In summer they inhabit forested areas. In winter they hibernate in caves and abandoned mine shafts.	Yellow	S2
Star-nosed Mole	*Condylura cristata*	Lowlying woods, meadows, marshes, lake and stream banks.	Green	S5
Masked Shrew	*Sorex cinereus*	Wide variety of habitats including forest, fields, wetlands and seashores. Prefers areas with high humidity.	Green	S5
Smoky Shrew	*Sorex fumeus*	Mature deciduous forest and under cover objects along stream banks.	Green	S5
American Water Shrew	*Sorex palustris*	Lakeshores, stream banks and marshes. Can be found in forest habitat in close proximity to shores.	Green	S5
Short-tailed Shrew	*Blarina brevicauda*	Hardwood forest, high humidity and loose humus.	Green	S5
White-tailed Deer	*Odocoileus virginianus*	Forested habitat in various stages of succession. Also wetlands, agricultural land, suburban areas and seashores.	Green	S5
River Otter	*Lutra canadensis*	Rivers, lakes and coastal marine habitats.	Green	S5
Ermine	*Mustella erminea*	Inhabit a wide range of habitats including coniferous and mixedwood forest, stream margins and lake shores.	Green	S5
American Mink	*Mustela vison*	Near waterbodies.	Green	S5
Striped Skunk	*Mephitis mephitis*	Forests, river valleys and agricultural areas.	Green	S5
Bobcat	*Lynx rufus*	Swamps, woodlots, second growth forest and agricultural areas.	Green	S5
Coyote	*Canis latrans*	A wide variety of habitats including forested areas, agricultural areas, wetlands, barrens, and suburban areas.	Green	S5

Table 4.6 Mammal Species Recorded in and/or Likely to Occur in the Study Area

Common Name	Binomial	Habitat	NSDNR Ranking	ACCDC Ranking
Red Fox	*Vulpes vulpes*	Agricultural areas, lakeshores, river valleys, natural clearings.	Green	S5
American Black Bear	*Ursus americanus*	Coniferous or deciduous regions, swamps, barrens, and berry patches.	Green	S5
Racoon	*Procyon lotor*	Forested areas near watercourses, river valleys, trees in grasslands.	Green	S5
Meadow Vole	*Microtus pennsylvanicus*	Wet meadows, grasslands, salt marshes, abandoned fields, prairies, vacant lots, edges and openings of forest.	Green	S5
Red-backed Vole	*Clethionomys gapperi*	Mainly found in coniferous forest but also occur in deciduous forest. Typically found near sources of water such as streams, springs and bogs.	Green	S5
Southern Bog Lemming	*Synaptomys cooperi*	Bogs, grassy marshes, damp mixed forest	Green	S3/S4
Deer Mouse	*Peromyscus maniculatus*	Found in a wide variety of dry habitats including forests and grasslands.	Green	S5
White-footed Mouse	*Peromyscus leucopus*	Dry deciduous forest.	Green	S5
Woodland Jumping Mouse	*Napaeozapus insignis*	Forested habitat along the shores of streams, springs and lakes.	Green	S5
Meadow Jumping Mouse	*Zapus hudsonius*	Moist grassland, grassy stream banks, marsh borders, alder-willow borders, low fields, edges of forests, and fence rows.	Green	S5
Muskrat	*Ondatra zibethicus*	Lakes, rivers, ponds, and marshes.	Green	S5
Beaver	*Castor canadensis*	Slow-flowing streams, lakes, rivers, and marshes.	Green	S5
Porcupine	*Erethizon dorsatum*	Deciduous and coniferous regions, farmland.	Green	S5
Eastern Chipmunk	*Tamias striatus*	Dry hardwood forest, hedgerows, fences, stone piles, gardens.	Green	S5
Red Squirrel	*Tamiasciurus hudsonicus*	Boreal coniferous forest, eastern hardwood deciduous forest, mixed forests, urban areas with trees.	Green	S5
Varying Hare	*Lepus americanus*	Forests, swamps, riverside thickets.	Green	S5

4.4.2.2 Rare, Sensitive and at Risk Mammals

According to ACCDC, the moose (*Alces americanus*), American Marten (*Martes americana*), fisher (*Martes pennanti*), eastern pipistrelle (*Pipistrellus subflavus),* Southern Flying Squirrel (*Glaucomys volans*), and northern right whale (*Eubalaena glacialis*) have been reported within a 100 km radius of the Study Area. The northern right whale is listed as Endangered under the federal *Species at Risk Act* (SARA). The mainland moose population in Nova Scotia is listed as Endangered under the Nova Scotia *Endangered Species Act* as is the American Marten. Fisher, southern flying squirrel and eastern pipistrelle are Yellow listed by NSDNR indicating that the Nova Scotia populations of these species are sensitive human activities and natural events. In addition to these species several other Yellow listed bat species have been recorded within 100 km of the Study Area, including red bat (*Lasiurus borealis*), hoary bat (*Lasiurus cinereus*), silver-haired bat (*Lasionycteris noctivagans*), little brown bat (*Myotis lucifugus*) and northern long-eared bat (*Myotis septentrionalis*).

Northern right whales are found at the mouth of the Bay of Fundy in areas where plankton is abundant. The Project does not have a marine component and will not introduce any toxic material into the Bay of Fundy so there will be no interaction with this species.

The mainland moose population in southern Nova Scotia is focused mainly in the Lake Rossingnol area. The nearest ACCDC record is approximately 50 km from the Project area. Suitable moose habitat is present within the Project Area and this species is capable of ranging widely over the landscape so there is some potential for it to be present. The presence of moose can be easily determined by means of tracks, feces and evidence of winter browsing. No moose sign was encountered during the various field surveys conducted in the Study Area suggesting that this area is not regularly used by moose.

American Marten are typically found in mature conifer or mixedwood forest. In Nova Scotia, two distinct populations have been identified, one in the Cape Breton highlands and one in southernwestern Nova Scotia. It is believed that the mainland American Marten population is largely derived from New Brunswick American Martens that were released in Kejimkujik National Park. The current distribution of this population is believed to extend into southern Digby County and does not include the Study Area. In addition, the Study Area has been subjected to extensive forest harvesting in recent years which would render it as poor American Marten habitat. As such, it is unlikely that the Project would interact with American Marten.

Fisher prefer habitat containing large expanses of mature mixedwood forest, particularly areas containing abundant prey and suitable denning sites such as hollow trees. Fisher were extirpated from Nova Scotia by the early 1920s but were reintroduced in southwestern Nova Scotia and central Nova Scotia. The two reintroductions were successful; however, the eastern population, located within Cumberland, Colchester and Pictou Counties has reestablished much more successfully than the southwestern population which occupies the central portion of southwestern Nova Scotia. As mentioned earlier, the Study Area has been extensively logged in recent years and does not provide good fisher habitat. In addition, the Study Area is located outside of the area of southwestern Nova Scotia believed to be occupied by fisher. As such, it is unlikely that the Project would adversely affect fisher populations.

Southern flying squirrels require mature hardwood or mixedwood forest containing mast crop producing trees such as oak and beech as well as plentiful snags in which to establish dens (usually in woodpecker holes). The known distribution of southern flying squirrels encompasses the central portion of southern Nova Scotia extending from Wolfville to the Tobeatic Wildlife Management Area. The nearest known location is approximately 20 km east of the Project area near Bear River. The Study Area is unlikely to provide suitable habitat for southern flying squirrels for several reasons. Firstly, most of the Study Area has been subjected to forest harvesting and few large intact stands of hardwood or mixedwood forest remain. Secondly, mast producing trees such as northern red oak (*Quercus rubra*) and American beech (*Fagus grandifolia*) which provide winter food for southern flying squirrels are uncommon in the Study Area.

All bat species native to Nova Scotia are considered to be sensitive to anthropogenic disturbance. However, the risk of bat collision with wind turbines is generally greater for migrating bats than for resident breeding, commuting or foraging bats, which generally forage between 1-10 m above ground level and seldom above 25 m, thus avoiding turbine blades (Erickson *et al.* 2002). Migratory bat species such as the red bat, hoary bat, and silver-haired bat may be present in the Study Area. These migratory bats are found across North America, but there have been few accounts of these species in the province.

Digby Neck is a well known migration route for birds and it is likely that it would provide a migration route for migratory bats as well. Broders *et al.* (2003) investigated this possibility by conducting trapping and echolocation surveys on Brier Island (located at the southern end of Digby Neck) during the spring, summer and autumn in 2001. Similar surveys were also conducted at an inland site away from expected migration routes (Kejimkujik National Park) and at another potential migratory landfall site (Bon Portage Island). During the study very little migratory bat activity was recorded with migratory species comprising only 0.02% of all of the echolocation sequences recorded. At Brier Island migratory bat activity consisted of two echolocation sequences identified as hoary bat that were recorded on the night of September 11, 2001. These data suggest that migratory bat species are not abundant in Nova Scotia and that Digby Neck is not heavily used by migratory bat species. Broders *et al.* (2003) also concluded that records of migratory bat species in Nova Scotia represent extralimital occurences.

Three non-migratory bat species are regularly encountered in Nova Scotia including little brown bat, northern long-eared bat and eastern pipistrelle. Little brown bats are found in both forests and human-dominated landscapes (Jung *et al.* 1999; Broders and Forbes 2004). The northern long-eared bat is found in forest habitats (Broders *et al.* 2003; Broders and Forbes 2004). Eastern pipistrelles roost in trees and in buildings. They prefer to forage over open water rather than under the forest canopy. Broders *et al.* (2003) recorded the presence of little brown bat and northern long-eared bat at Brier Island but did not record any eastern pipistrelles. However, they recorded relatively large numbers of eastern pipistrelles at Kejimkujik. These data would suggest that little brown bat and northern long-eared bat are the species most likely to be present in the Study Area. These species are unlikely candidates for high mortality due to wind turbines based on their low flight paths. Yet, non-migratory bats may have increased sensitivity during the winter months when regional populations congregate into a few hibernation locations. Disturbance at these sites can potentially result in the deaths of large numbers of bats. In addition, the presence of a nearby hibernaculum site could result in seasonal increases in bat abundance as bats leave the hibernaculum in the spring and return to it in the autumn.

The Nova Scotia Abandoned Mine Openings Database was used to identify potential hibernaculum sites near the Study Area. One possible hibernaculum site has been identified approximately 7 km west of the Project area near Centreville. This abandoned iron mine known as the Johnson Pit has a 5.5 m deep shaft. It is not known if the mine is occupied by hibernating bats. Given the distance from the Johnson Pit to the Project site, it is unlikely that any onsite activities would cause disturbance to bats that might be hibernating in the mine. If the mine serves as a hibernaculum, there is some potential for elevated numbers of bats to be present in the Study Area during the spring and autumn as regional populations leave and return to the hibernaculum.

4.4.3 Reptiles and Amphibians

4.4.3.1 Overview

Amphibians and reptiles are normally treated together as herpetiles. There are 22 terrestrial and freshwater herpetile species recorded from Nova Scotia. The herpetofauna of Nova Scotia is relatively sparse when compared to adjacent mainland areas of the continent, mostly because of the difficulty of post-glacial colonization of this peninsula and a relatively harsh climate.

Information regarding the herpetofauna in the Project area was obtained from existing information sources (*e.g.,* ACCDC 2007; Gilhen 1984; Gilhen and Scott 1981; and Scott 1994) and field surveys. Eight herpetile species were encountered during the field surveys including green frog (*Rana clamitans melanota*), pickerel frog (*Rana palustris*), wood frog (*Rana sylvatica*), northern spring peeper (*Pseudacris crucifer crucifer*), American toad (*Bufo americanus americanus*), yellow spotted salamander (*Ambystoma maculatum*), redback salamander (*Plethodon cinereus*), and maritime garter snake (*Thamnophis sirtalis pallidula*) (Table 4.7). None of these species is considered to be rare or sensitive to human activities in Nova Scotia. Table 4.7 also lists herpetile species that can be expected to occur in the Study Area.

Table 4.7 Herpetile Species Recorded in and Likely Occur in the Study Area

Common Name	Binomial	Habitat	NSDNR Ranking	ACCDC Ranking
Maritime garter snake	*Thamnophis sirtalis pallidula*	Woods, meadows, marshes, lakes, farmlands, edges of developed areas and stream banks; wide ranging.	Green	S5
Ringneck Snake	*Diadophis punctatus edwardsii*	Most commonly encountered in deciduous and mixedwood forest particularly near the shores of ponds, lakes, and streams. Also found near the edges of bogs, fields, pits and roads.	Green	S5
Red-bellied Snake	*Storeria o.occipitomaculata*	Prefer open habitats such as roadsides, grassy heaths, clear-cuts, abandoned gravel pits and the shores of lakes, ponds and streams	Green	S5
Eastern smooth green snake	*Liochlorophis vernalis borealis*	Grassy and shrubby areas along the shores of watercourses, fields, and lawns in suburban areas.	Green	S5
Leopard frog	*Rana pipiens*	Forages in terrestrial habitats such as fields, woodlands and roadside ditches; breeds in the shallows of lakes and ponds.	Green	S5
Wood Frog	*Rana sylvatica*	Damp woodlands, particularly in deciduous and mixed woods; breeds in roadside ditches and ephemeral pools.	Green	S5
Pickerel Frog	*Rana palustris*	Agricultural areas, lakeshores, river valleys, natural clearings; breeds in ponds and small streams.	Green	S5
American Toad	*Bufo a. americanus*	Flexible habitat requirements; breeds in shallows of lakes, ephemeral pools, small streams.	Green	S5
Northern Spring Peeper	*Psendacris c. crucifer*	Forested areas near watercourses; breeds in standing water, often where there is dense submerged plant debris.	Green	S5
Red-spotted Newt	*Notophthalmus v. viridescens*	Red eft larval stage lives in damp deciduous, coniferous or mixed woodlands for approximately two years. Adults and aquatic larval stage live in ponds, vegetated coves of lakes and sluggish streams.	Green	S5
Yellow-spotted salamander	*Ambystoma maculatum*	Inhabits coniferous, deciduous and mixed woodlands adjacent to aquatic breeding sites; breeds in ponds and vegetated coves, in lakes and vegetated sluggish streams.	Green	S5
Red-backed salamander	*Plethodon cinereus*	Woodland areas; breeds under rocks or in decaying tree stumps. The larval stage occurs within the egg and the young hatch as juveniles.	Green	S5

4.4.3.2 Rare, Sensitive and at Risk Herpetiles

The ACCDC database search identified three rare or endangered herpetile species that have been recorded within a 100 km radius of the Project; including wood turtle (*Glyptemys insculpta*), Blanding's turtle (*Emydoidea blandingi*) and northern ribbon snake (*Thamnophis sauritus septentrionalis*).

The wood turtle is listed as vulnerable under the Nova Scotia *Endangered Species Act*. It is also listed under *SARA* as a species of special concern. No wood turtles were encountered during field surveys. Wood turtles are almost invariably associated with streams, creeks, and rivers and the adjacent rich intervale forest and shrub communities, as well as with the meadows and farmland terrestrial habitat associated with these watercourses. Streams with sand and/or gravel bottoms are preferred, but rocky streams are used occasionally. Wood turtles may wander some distance from watercourses during summer foraging, but characteristically remain within linear home ranges. These home ranges are 1 to 6 ha in size and are centred on a suitable river or stream where non-vegetated or sparsely vegetated sandy beaches and banks serve as nesting sites. Natural nesting sites consist of sandy river beaches, but may also include select disturbed sites, such as railway grades and roadsides. Some turtles may travel considerable distances up small tributaries that lack suitable nesting sites and hibernacula during the summer months that offer good foraging opportunities. These smaller streams may serve as dispersal corridors between populations on different river systems.

The Study Area does not provide good wood turtle habitat. The Study Area is surrounded on three sides by seawater and only small streams are present. The lack of large rivers limits the availability of suitable nesting and hibernaculum sites. In addition, the Study Area is located outside of the known range of wood turtles in Nova Scotia. The nearest population is in the Annapolis Valley. As such, it is unlikely that wood turtles would be present in the Study Area.

Blanding's turtle is listed as endangered under both *SARA* and the Nova Scotia *Endangered Species Act*. This species is typically found in still-water streams, swamps, marshes and bogs in south central Nova Scotia. Blanding's turtles prefer water bodies with slow flowing water and muddy bottoms that support dense aquatic vegetation. Between early June and early July female Blanding's turtles move to gravelly or sandy lake shores to lay their eggs. In the fall, Blanding's turtles move to aquatic habitats where they hibernate underwater. The Study Area contains no suitable Blanding's turtle habitat. Slow portions of Haight Brook could provide summer foraging habitat and hibernation habitat; however, there are no lakes in the area that would provide suitable beach nesting sites. The Study Area is also located outside of the known range of the Blanding's turtle. As such, it is unlikely that this species would be found in the Study Area.

Northern ribbon snake is listed as a threatened species under *SARA* and the Nova Scotia *Endangered Species Act*. This species is associated with sluggish streams, marshes, swamps, bogs and lake shores. Northern ribbon snakes are typically found within 30 m of open water. They prefer areas that have a heavy cover of aquatic vegetation that provides cover for them and the amphibians and small fish that they feed on. Some potential northern ribbon snake habitat is present in the Study Area particularly along Haight Brook and along the southern lowland portion of the Study Area where ponds and sluggish streams are more plentiful. The Study Area is located outside of the known range of northern ribbon snake in Nova Scotia and as such the probability that this species is present in the Study Area is low.

4.5 Atmospheric Environment

The following section describes the climate and air quality of the site.

4.5.1 Climate

Weather data was acquired from the Annapolis Royal meteorological station, which is located approximately 35 km east of the Project site. Based on Environment Canada climate normals or averages for the period of 1971-2000, the average annual temperature in the region is 7.1ºC, with the average daily maximum and minimum being 11.5ºC and 2.7ºC, respectively. The warmest period during the year is typically from June to August (daily mean of 17.4ºC), while the coldest period is between December and February (daily mean of -3.3ºC). The site's close proximity to the coast allows for the ocean to have a temperature moderating effect, which also allows for Nova Scotia's coastal regions to have a significantly longer frost-free season in comparison to inland localities.

According to 1971-2000 precipitation data at the Annapolis Royal station, precipitation occurs approximately 140.6 days per year and averages approximately 1,209 mm of precipitation throughout the year, where 85% is rain and the remainder is snow. Overall, late spring and early summer are the foggiest time of year in southwestern Nova Scotia, with an average of 118 days of fog per year recorded at Yarmouth which is located approximately 86 kilometers south of the Study Area (Environment Canada 2008).

4.5.2 Air Quality

A network of ambient air monitoring stations is set up throughout the province to measure ambient concentrations of various air contaminants. The closest air quality monitoring station to the Study Area is located at Kejimkujik National Park. However, only ozone is monitored at this location. The next closest ambient air quality monitoring stations to the Project site include Yarmouth, Halifax, Aylesford Mountain, and Kentville. A list of the contaminants monitored at each of these locations, their distance to the Project Area, and annual averages is presented in Table 4.8.

Table 4.8 Various Ambient Air Monitoring Stations Located Near the Study Area

Monitoring Station	Contaminant	Approximate Distance from Project (km)	Annual Averages	
			2005	2006
Kejimkujik	O_3 (ppb)	50	32	31
Yarmouth	O_3 (ppb)	100	27	27
Aylesford Mountain	O_3 (ppb)	105	33	35
Kentville	O_3 (ppb)	112	23	20
Halifax	SO_2 (ppb)	175	6	6
	CO (ppm)		0.5*(10 months)	0
	NO_2 (ppb)		16*(7 months)	16
	O_3 (ppb)		13	21
	$PM_{2.5}$ (µg/m^3)(TEOM)		5*(9 months)	4*(9 months)
	$PM_{2.5}$ (µg/m^3) (BAM)		NA	7*(6 months)
	$PM_{2.5}$ (µg/m^3)(Dichot)		NA	8*(9 months)
	PM_{10} (µg/m^3)(Dichot)		NA	14*(9 months)

* - Annual mean calculated over the number of months indicated.
NA - Data Not Available
Reference: Environment Canada, 2008

Based on monitoring results from the most recently published National Air Pollution Surveillance (NAPS) Network ambient air quality monitoring reports for 2005 and 2006 (Environment Canada 2008), the following general conclusions can be made:

- The monitored concentrations of particulate matter less than 2.5 microns in diameter ($PM_{2.5}$) at the Halifax monitoring station have generally been low.
- None of the monitored concentrations of carbon monoxide exceeded the 1-hour or 8-hour objectives (35,000 µg/m^3 and 15,000 µg/m^3, respectively).
- None of the monitored concentrations of nitrogen dioxide exceeded the 1-hour or Annual objectives (400 µg/m^3 and 100 µg/m^3, respectively).
- None of the monitored concentrations of sulphur dioxide exceeded the 1-hour or 24-hour objectives (900 µg/m^3 and 300 µg/m^3, respectively).
- In 2005 and 2006 the ambient air quality 1-hour objective for ozone of 82 ppb was not exceeded at any of the monitoring stations.

Given the fact that there is no ambient air monitoring station located on or in the immediate vicinity of the Project site, that there is limited data available from the ambient air monitoring station at Kejimkujik National Park, and that the Halifax ambient air monitoring stations include emissions from industrial activities (which is not characteristic of the Digby County), it can be reasonably estimated that the Study Area is representative of a rural environment where all contaminant concentrations would meet the Ambient Air Quality Objectives

4.6 Socio-economic Conditions

4.6.1 Population

The Project is located in Gulliver's Cove in Digby County, Nova Scotia. Population statistics for Digby County from the 2006 census are summarized in Table 4.9 below.

Table 4.9 Population statistics for the County of Digby

Population and Dwelling Counts	County of Digby
Population in 2006	18,992
Population in 2001	19,548
2001 to 2006 population change (%)	-2.8
Total private dwellings	9,905
Population density per square kilometer	7.6
Land area (square km)	2,515

Source: Statistics Canada 2006 Census

Digby County has experienced population decline from 2001 to 2006. The 2006 population of Digby County was distributed fairly evenly across various age groups with the age ranges 40-44, 45-49 50-54 and 55-59 being significantly higher than other age ranges. The median age of the population was 45.2, which is slightly older than the provincial median of 41.8. Approximately 19.1% of the population was over the age of 65, which is somewhat higher than the province's statistic of 15.1%. Approximately 5.8% of the population identified as Aboriginal, while 3.2% identified as foreign-born (Statistics Canada 2008a).

4.6.2 Health, Industry, and Employment

The Town of Digby was developed as an active fishing and lumber-producing community by United Empire Loyalists from New York and New England in 1783 (Town of Digby 2008). While fishing and forestry remain dominant forms of work, Digby has evolved into a popular tourist attraction.

Table 4.10 illustrates the participation in local industry for Digby County. Tourism likely falls into the category of "Other Services", as it is not specifically listed by Statistics Canada. The relatively high numbers of people working in "Other Services" and "Retail Trade" reflect the county's tourism industry. Note that the largest industry in the county remains as "Agriculture and Other Resource-Based Activities". Health care, education, construction and business services are other significant industries in the county, with at least 8% of the labour force working in each of these sectors.

Table 4.10 Local Industries in Digby County

Industry	Digby County		
	Total	Male	Female
Total – Experienced Labour Force 15 Years and Over	9,285	4,910	4,380
Agriculture and Other Resource-Based Industries	1,665	1,330	335
Construction	605	560	50
Manufacturing	1,360	910	450
Wholesale Trade	230	180	55
Retail Trade	1,195	435	765
Finance and Real Estate	230	70	160
Health Care and Social Services	900	115	785
Educational Services	795	255	540
Business Services	850	470	380
Other Services	1,440	585	855

Source: Statistics Canada 2008a

Digby County is under the jurisdiction of the Southwest Health Authority. Health care services are provided by the Roseway, Yarmouth and Digby General Hospitals.

In 2005, 15,270 residents of Digby County, 15 years of age or more, earned an income (from either full time or part time jobs). The median income for all persons working was $18,602, which is below the provincial median of $22,815. For those in Digby who had full-time work all year-round, median earnings were $28,736, which is still well below the provincial average of $36,917 (Statistics Canada 2008a).

Based on the 2006 census, the unemployment rate for Digby County is 12.9%, which is slightly higher than the provincial unemployment rate of 9.1%. Overall, Digby labour force indicators have improved significantly since 1996, when the unemployment rate was 18.9% (Statistics Canada 2008b).

4.6.3 Recreation and Tourism

Digby is famous for its delicious scallops, spectacular vistas of the Annapolis Basin, and the incredible tides of the Bay of Fundy in Digby Harbour. Annual scallop festivals, excellent whale watching, and the Digby Pines Golf Resort and Spa are popular tourist attractions. The town of Digby offers a variety of accommodations, cafes, restaurants, shops, and a full service marina (Town of Digby 2008). The Digby Neck area primarily provides scenic training experiences that focus on the coastal view of the area as well as offering birding, seal viewing and whale watching opportunities, particularly on Long Island and Brier Island off the tip of Digby Neck. Within the Study Area, there is an outdoor adventure company (Fundy Adventures) and rental oceanview cottage (Gulliver's Retreat) on Gulliver's Cove Road.

The number of visitors counseled at the Digby Visitor Information Centre each year can be used as an indicator of tourism activity in the area. In 2004, 20,300 people visited the Centre, compared to 16,800 people in 2005, 16,500 in 2006, and 16,100 in 2007 (Nova Scotia Department of Tourism, Culture and Heritage 2008a). Despite a noticeable drop in numbers between 2004 and 2005, visits to the centre have remained similar, with slight decreases over time.

The Nova Scotia Department of Tourism, Culture and Heritage has calculated preliminary estimates for the economic impact of tourism in the province by county. Table 4.11 presents this data for Digby County from 2004 to 2007.

Table 4.11 Estimated Economic Impacts of Tourism in Digby County

Year	2004	2005	2006	2007
Revenues	$40,370,000	$35,300,000	$37,690,000	$35,740,000
Taxes				
Federal	$2,700,000	$2,300,000	$2,300,000	$2,200,000
Provincial	$3,000,000	$2,700,000	$2,800,000	$2,700,000
Municipal	$700,000	$600,000	$700,000	$600,000
Total Taxes	$6,400,000	$5,600,000	$5,800,000	$5,500,000
Employment				
Direct Jobs	800	700	700	600
Indirect Jobs	300	200	300	200
Total Jobs	1,000	900	900	900
Direct FTEs	400	300	300	300
Indirect FTEs	100	100	100	100
Total FTEs	500	400	400	400
Payroll				
Direct Payroll	$11,200,000	$9,800,000	$10,500,000	$9,900,000
Indirect Payroll	$4,600,000	$4,000,000	$4,300,000	$4,000,000
Total Payroll	$15,800,000	$13,800,000	$14,700,000	$14,000,000

Source: Nova Scotia Department of Tourism, Culture and Heritage 2008b.

While the total estimated revenue from tourism for Digby County has decreased from 2004 to 2007, it remains a significant contribution to the economy, particularly with respect to local employment. I

Informal recreational activities within the Study Area appear to take advantage of the logging road network. Evidence of recreational vehicle use (*i.e.,* ATVs) and hunting activities were noted during field surveys in the Study Area.

4.6.4 Land Use

The Study Area is located in the Municipality of Digby, west of the Town of Digby, and spans Digby Neck from north to south. The Study Area is characterized as a rural area with forestry, agriculture and fishing activities providing the economic base for the area. Land use in the Study Area is predominantly resource-based and residential. Gulliver’s Cove hosts a few small business operations including an emu farm, dulse company, greenhouse and a rental oceanview cottage (Gulliver’s Retreat). The presence of old woods roads indicates that timber harvesting has been conducted in the Study Area for many decades. Some of this harvesting appears to have occurred in the last five years. Abandoned agricultural land is present at various locations but is more prevalent along the public roads. Residences are located along Highway 217 and Gulliver’s Cove Road, which bisect the Study Area.

Recently, tourism has become a more significant contributor to the local economy. The Municipality has two areas that are subject to Municipal Planning Strategies and Land Use By-laws, The Conway Area and The Well Field Protection Area (Municipality of Digby 2008). These two areas are adjacent to the Town of Digby in the northeastern part of the municipality. The balance of the Municipality is unregulated from a land use perspective (Municipality of Digby 2008).

4.6.5 Property Values

In 2006, there were 9,905 dwellings in Digby County, of which 6,530 were owned and 1,500 were rented. Approximately 66% of the dwellings in Digby County were constructed before 1986. The average value of a home in 2006 was $130,862, approximately $27,138 less than the provincial average (Statistics Canada 2008a).

4.6.6 Acoustic Environment

The existing acoustic environment within the Study Area was determined by performing baseline sound pressure level monitoring at three sites. The noise monitoring sites selected represent some of the nearest residential areas to the proposed Project site (refer to Figure 4.4).

The baseline study was conducted using a Larson Davis Model 824 Type 1 integrating sound pressure level meter and a Quest Model 2900 Type 2 integrating sound pressure level meter. These instruments average the energy level of sound over a selected period of time and express it as an equivalent sound pressure level, L_{eq}, in dB_A (A-weighted decibels). In this study, each measurement session consisted of one-minute readings logged over a 24-hour period to establish variation over time. The logged values were then used to calculate hourly L_{eq} values (1-hour L_{eq}) and day (L_D) (7:00 to 19:00), evening (L_E) (19:00 to 23:00) and night (L_N) (23:00 to 7:00) equivalent sound pressure levels.

The collected data are representative of the existing conditions during the monitoring periods and includes cumulative environmental effects due to contributions from traffic and any other substantial sources of noise at the baseline noise monitoring sites, including those that are natural (*i.e.,* wind in trees, birds, and animals).

The calculated 1-hour L_{eq} values for each baseline noise monitoring site are presented in Table 4.12.

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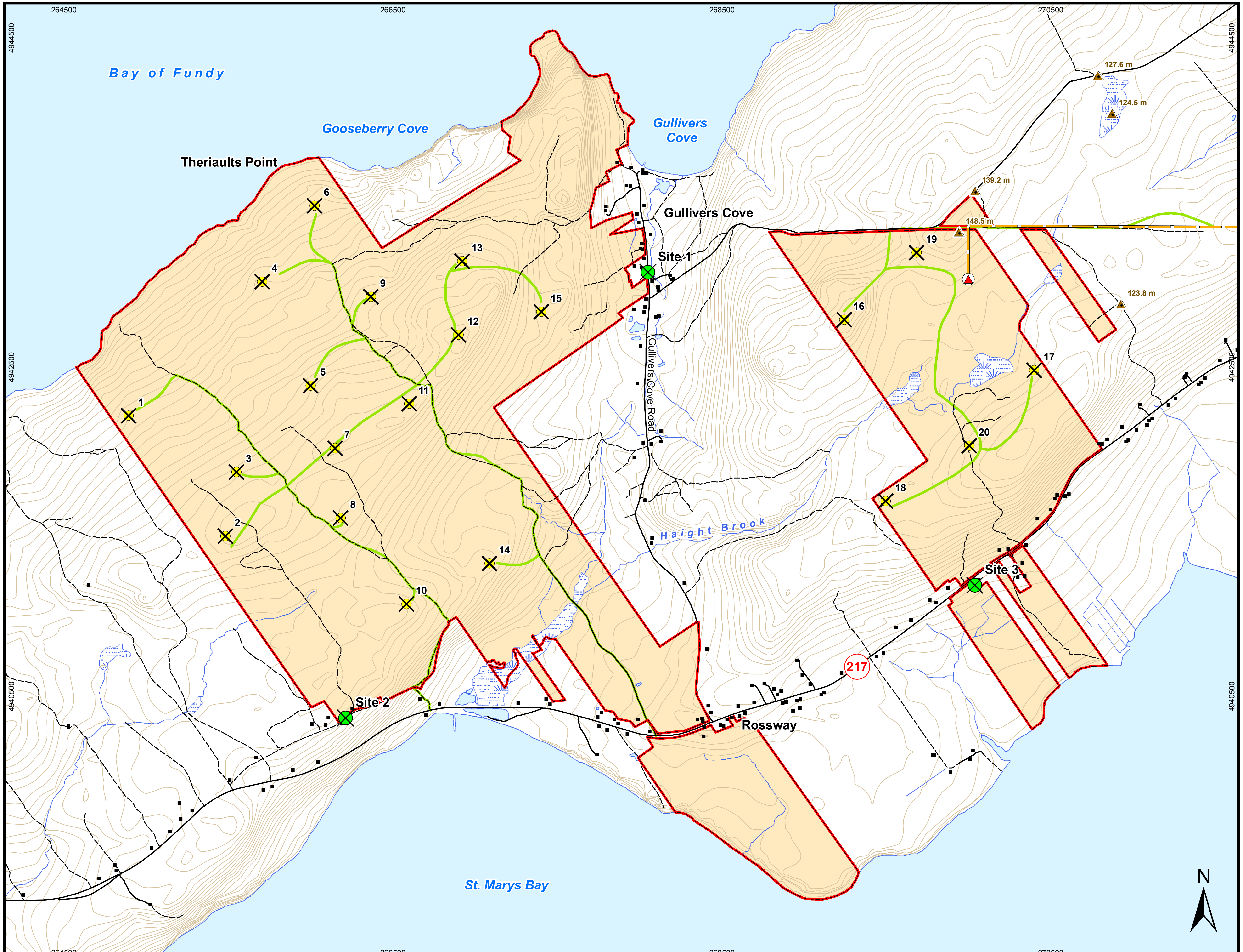
Figure 4.4

DIGBY WIND POWER PROJECT

Baseline Noise Monitoring Sites



Baseline Noise Monitoring Station

Project Components

Proposed 69 kV Substation

Proposed Turbine Location

Proposed Turbine Access Road

Proposed Transmission Route Nov. 28-08

Proposed Site Development Area

Map Features

Building

Spot Elevation

Road

Unpaved Road

Railroad

Contour (5m)

Watercourse

Wetland

Waterbody

0 300 600 900 1,200

Meters

Data Sources:
Planimetric Data - NSGC; Nova Scotia Topographic Database (NSTDB), 1997, 1:10 000 (GeoNOVA)
Project Components - Skypower, Nov. 2008
Wetlands - NSTDB & NSDNR; Wetland Inventory Mapping, 2007, 1:10 000

Map Parameters
Projection: UTM/NAD83/Z20
Scale 1:22,000
Date: April 2009
Project No.: 1030972.01

Stantec

Table 4.12 Measured 1-Hour Baseline Sound Pressure Levels

Time	Site 1	Site 2	Site 3	NSE Guideline
15:00	-	-	-	65
16:00	57	38	-	65
17:00	48	38	48	65
18:00	47	37	45	65
19:00	56	36	44	60
20:00	54	44	46	60
21:00	**65**	41	41	60
22:00	**65**	34	38	60
23:00	**62**	30	34	55
0:00	**58**	27	36	55
1:00	**56**	28	29	55
2:00	53	36	33	55
3:00	55	41	26	55
4:00	**57**	45	36	55
5:00	49	40	45	55
6:00	49	40	40	55
7:00	49	47	47	65
8:00	49	37	46	65
9:00	53	37	45	65
10:00	50	40	45	65
11:00	49	38	46	65
12:00	48	40	46	65
13:00	46	44	46	65
14:00	47	50	47	65
15:00	49	48	50	65
16:00	50	-	48	65

Note: Bold indicates an exceedance of the NSE Guidelines

There were several exceedances of the NSE Noise Guidelines (1989) for evening (L_E), and night time (L_N) periods for Site 1, Gulliver's Cove (refer to Table 4.12). An analysis of the digital sound recording taken during the 24-hour noise monitoring session indicated the presence of sounds from several different animal species, including:

- chorus of Northern Spring Peeper (*Pseudacris crucifer*);
- dawn chorus of assorted song birds; and
- buzzing of the common bumblebee (*Bombus sp.*)

4.6.7 Heritage Sites, Archaeological Sites and Other Cultural Resources

The assessment of archaeological potential for the site considered both prehistoric and historic period resources. Archaeological potential modeling for prehistoric era sites is based largely on the identification of landscape features which are either known to have attracted past habitation or land use, or which appear to have potential for attracting human use. These features include the availability of potable water, suitability for habitation (*e.g.,* ground conditions), proximity to desirable resources (such as workable stone), and proximity to water transportation routes, coastal areas, portage routes and food supplies. A desktop archaeological assessment was completed by professional archaeologist Laird Niven with results summarized below.

4.6.7.1 Historical Background

While there are very historic areas close to Digby Neck, it wasn't really until the late Eighteenth Century and the influx of United Empire Loyalists that the Digby Neck area became settled. The original town lots, as laid out by Charles Morris, stop just short of the Study Area, although there is a large triangular grant just east of Gulliver's Cove. This doesn't mean the Loyalists didn't settle in the area, however, as the first muster roll at Gulliver's Cove took place between June 1 and 6, 1784. While the Acadians did not seem to be attracted to the area in large numbers, the 1784 Charles Morris survey plan indicates an area near the inlet west of Rossway that was "settled by French Acadians", referring to post-Expulsion reoccupation (Dawson 1988). Oliver Robichaud settled near Rossway around 1764 (Province of Nova Scotia 2009). Although no deed research was conducted, it seems certain that settlement in the Loyalist period and later would have taken place along the road between the communities of Rossway and Gulliver's Cove. There is no evidence that this area was ever more than sparsely settled.

4.6.7.2 Previous Archaeology

There is no record of previous archaeology work being done within the Study Area.

4.6.7.3 Archaeological Potential

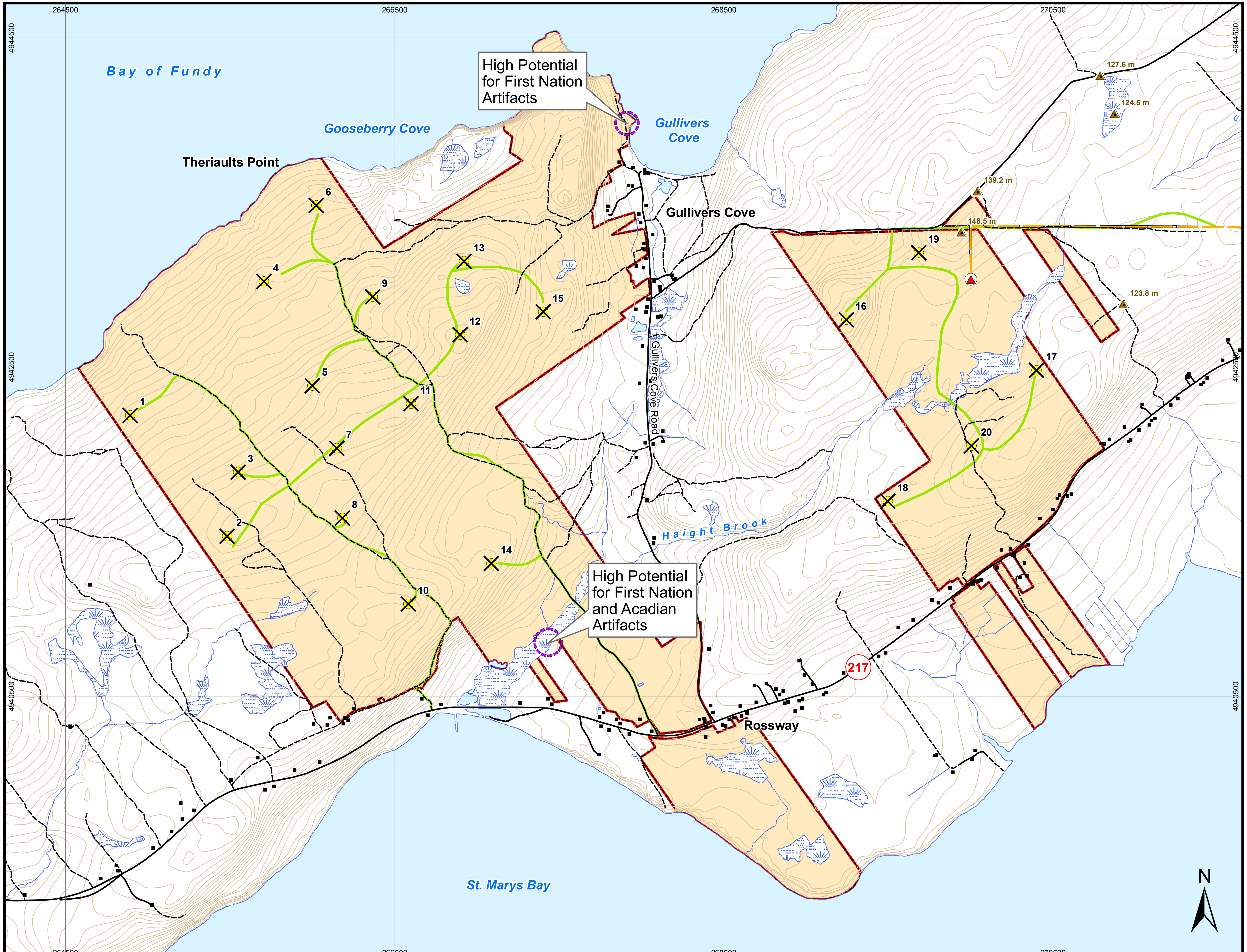
First Nations

The Digby Neck area has many natural resources that would have attracted Mi'kmaq settlement from very early times. There is some evidence, for example, that the Archaic peoples were using the exposed shelves of the Bay of Fundy to hunt large sea mammals like walrus (Tuck 1984). The beach at Gulliver's Cove would have been a significant feature, particularly if seals were known to have used it as a place to pup. It would have also been one of the only places to land canoes in the area. The St. Mary's Bay side of the Study Area would have been more sheltered and would also have provided access to both the Bay of Fundy and the interior of the province. The small inlet and stream west of Rossway may have provided many resources for the Mi'kmaq and would also have been a sheltered landing spot.

In summary, there are at least two areas near the Study Area, Gulliver's Cove and the inlet west of Rossway, which should be considered as having a high potential for containing First Nation's archaeological resources (refer to Figure 4.5).

Historic

The historic potential of the Study Area should be considered as high for the areas near the inlet west of Rossway and Gulliver's Cove. While the majority of the relatively sparse historic occupation would have been along the road that leads between the two settlements, there is documentary evidence for post-Expulsion Acadian settlement near Rossway and Loyalist settlement near Gulliver's Cove (Dawson 1988).



SKYPOWER

Figure 4.5

DIGBY WIND POWER PROJECT

Areas of High Archaeological Potential

Area of High Archaeological Potential

Project Components

- Proposed 69 kV Substation
- Proposed Turbine Location
- Proposed Turbine Access Road
- Proposed Transmission Route Nov. 28-08
- Proposed Site Development Area

Map Features

- Building
- Spot Elevation
- Road
- Unpaved Road
- Railroad
- Contour (5m)
- Watercourse
- Wetland
- Waterbody

0 300 600 900 1,200

Meters

Data Sources:
Planimetric Data - NSGC; Nova Scotia Topographic Database (NSTDB), 1997, 1:10 000 (GeoNOVA)
Project Components - Skypower, Nov. 2008
Wetlands - NSTDB & NSDNR; Wetland Inventory Mapping, 2007, 1:10 000

Map Parameters
Projection: UTM/NAD83/Z20
Scale 1:22,000
Date: April 2009
Project No.: 1030972.01

Stantec

4.6.7.4 Summary

The preliminary background research indicates that the areas around Gulliver's Cove and Rossway have a high potential for containing both First Nations and historic period archaeological resources. It is recommended that archaeological follow-up work be considered based on final design and layout of Project infrastructure and proximity to areas deemed to have high potential for First Nation's archaeological resources. Such work could include more in-depth background research, a pedestrian survey of the high potential areas, possibly, sub-surface testing and/or monitoring of high potential areas subject to excavation.

4.6.8 Land and Resources Used for Traditional Purposes by Aboriginal Persons

The closest First Nations to the Study Area is the Bear River First Nation which has reserve land approximately 25 km from the Study Area. SkyPower has commissioned the Confederacy of Mainland Mi'kmaq (CMM) to conduct a Mikmaq Ecological Knowledge Study (MEKS) to determine traditional and current use of lands for traditional purposes. It is anticipated that preliminary results will be available in May and July with the final report completed in September 2009. It is noted that the lands to be used for the Project are all privately owned (*i.e.,* no Crown lands involved).

4.6.9 Transportation Infrastructure

The Study Area receives little traffic other than movements of local residents and occasional visits by tourists and other outdoor enthusiasts. The site is approximately 8 km from Highway 101. Middle Cross Road, Route 217 (Evangeline Trail) and Culloden Road comprise the key transportation network expected to be used for transport of materials to the site. It is anticipated that the current road network (outside of onsite turbine access roads) will not require upgrades to accommodate construction traffic.

4.6.10 Safety Issues

Lands within the Study Area could present safety issues (*e.g.,* steep cliffs). Construction and decommissioning activities associated with the wind farm may present some safety challenges with respect to these hazards and routine hazards associated with construction activities. In the operational phase, safety issues such as potential for ice throw must be considered in the context of local populace and public access issues. All safety issues will be addressed with the appropriate design and mitigation measures (*e.g.,* setbacks, restricted access, public notification).

4.6.11 Visual Landscape

The Project site is located primarily on a forested ridge. Vertical relief within and around the Study Area is created by small woodlot fragments and natural areas associated with ravines, residential yards and farm buildings.

A visual landscape assessment was conducted for the Project. This assessment was completed with the use of a computerized simulation that superimposed wind turbine images, which are located and scaled to size, onto a photograph of an existing view in the area for the purpose of creating a realistic representation of the proposed wind farm from a specific view.

Further information and viewshed photographs on the area's visual landscape are presented in Section 5.2.1.5).