# Environmental Assessment Volume 1 Report

## Proposed Chebucto Terence Bay Wind Farm


121216.00 ● Report ● June 2014

ISO 9001
Registered Company

Prepared for:
**Chebucto Terence Bay Wind Field Inc.**

Prepared by:
CBCL
CBCL LIMITED
Consulting Engineers

# Contents

**Appendices**



**List of Tables**

**List of Figures**

## Acronyms

| | |
|---|---|
| ACCDC | Atlantic Canada Conservation Data Centre |
| CANWEA | Canada Wind Energy Association |
| CDC | Conservation Data Centres |
| CCPC | Canadian Controlled Private Corporation |
| CEDC | Community Economic Development Corporation |
| CEDIF | Community Economic Development Investment Fund |
| CLC | Community Liaison Committee |
| COMFIT | Community Feed-In Tariff |
| COSEWIC | Committee on the Status of Endangered Wildlife in Canada |
| CTB | Chebucto Terence Bay Wind Field Inc. |
| CWF | Chebucto Wind Field Inc. |
| dBs | decibels |
| DND | Department of National Defence |
| DSIS | Distribution System Impact Study |
| EMF | Electrical Magnetic Field |
| EMP | Environmental Management Plan |
| EPP | Environmental Protection Plan |
| FAC | Facultative |
| FACW | Facultative Wetland |
| FEC | Forest Ecosystem Classification |
| ha | hectare |
| HRM | Halifax Regional Municipality |
| IFC | Issued for Construction |
| km | kilometre |
| KMK | Kwilmu'kw Maw-klusuagn |
| MEKS | Mi'kmaq Ecological Knowledge Study |
| MW | Mega Watts |
| NSE | Nova Scotia Environment |
| NSDNR | Nova Scotia Department of Natural Resources |
| NSPI | Nova Scotia Power Inc. |
| NSTIR | Nova Scotia Department of Transportation and Infrastructural Renewal |
| NSUARB | Nova Scotia Utility and Review Board |
| OBL | Obligate |
| PPA | Power Purchase Agreement |
| PID | Property Identification |
| RESL | Renewable Energy Services Limited |
| RCMP | Royal Canadian Mounted Police |
| *SARA* | *Species at Risk Act* |
| SCADA | Supervisory Control and Data Acquisition |
| SSGIA | Small System Generator Interconnection Agreement |
| VEC | Valued Ecosystem Component |
| VT | Vegetation Type |
| WAM | Wet Areas Mapping |
| WEC | Wind Energy Convertor |
| WTG | Wind Turbine Generator |

CHAPTER 1 **INTRODUCTION**

## 1.1 Proponent Information

| | |
|---|---|
| Project Name: | Chebucto Terence Bay Wind Farm |
| Project Location: | Terence Bay, NS. PID: 00384966 |
| Size of the Project: | Up to 7.2 Megawatts (MW) |
| Proponent Information: | Chebucto Terence Bay Wind Field Limited (CTB)<br>30 Memory Lane<br>Lower Sackville, NS B4C 2J3<br>Attention: Terry Norman, President<br>Tel: (902) 429-8810 |
| Applicant: | CBCL Limited<br>1489 Hollis Street<br>Halifax, Nova Scotia B3J 2R7 |
| Applicant Contact Person: | Ann Wilkie, VP Environment<br>CBCL Limited<br>Phone: (902) 492-6764 Fax: (902) 423-3938<br>Email: annw@cbcl.ca |

The following documentation was prepared as required by the *Nova Scotia Environment Act* and associated regulations.

Proponent's Signature

Date: June 23, 2014

Applicants Signature

Date: June 23, 2014

The proponent, Chebucto Terence Bay Wind Field Limited (CTB), is a Community Economic Development Corporation (CEDC) that is based in the Halifax Regional Municipality (HRM). Thirty-six percent of CTB is owned by 37 individual shareholders who are residents of Nova Scotia; the balance of the outstanding shares are owned by Chebucto Wind Field Limited (CWF) and Renewable Energy Services Limited (RESL).

## 1.2 Project Overview

The Chebucto Terence Bay Wind Farm, approved under the Provincial Community Feed-In Tariff (COMFIT) program, will consist of three wind turbines with a capacity to generate up to 7.2 MW of renewable electricity; the power will be sold to Nova Scotia Power Inc. (NSPI) under a long term Power Purchase Agreement (PPA).

The Government of Nova Scotia has committed to a target of 25 percent renewable electricity supply by 2015 as part of Nova Scotia's Renewable Energy Plan that was announced in 2010. Nova Scotia's total renewable electricity content is expected to more than double from 2009 levels to satisfy this target. Furthermore, the Government of Nova Scotia has committed to a target of 40% renewable electricity supply by 2020. The renewable energy production is expected to include hydro, wind, biomass and tidal sources.

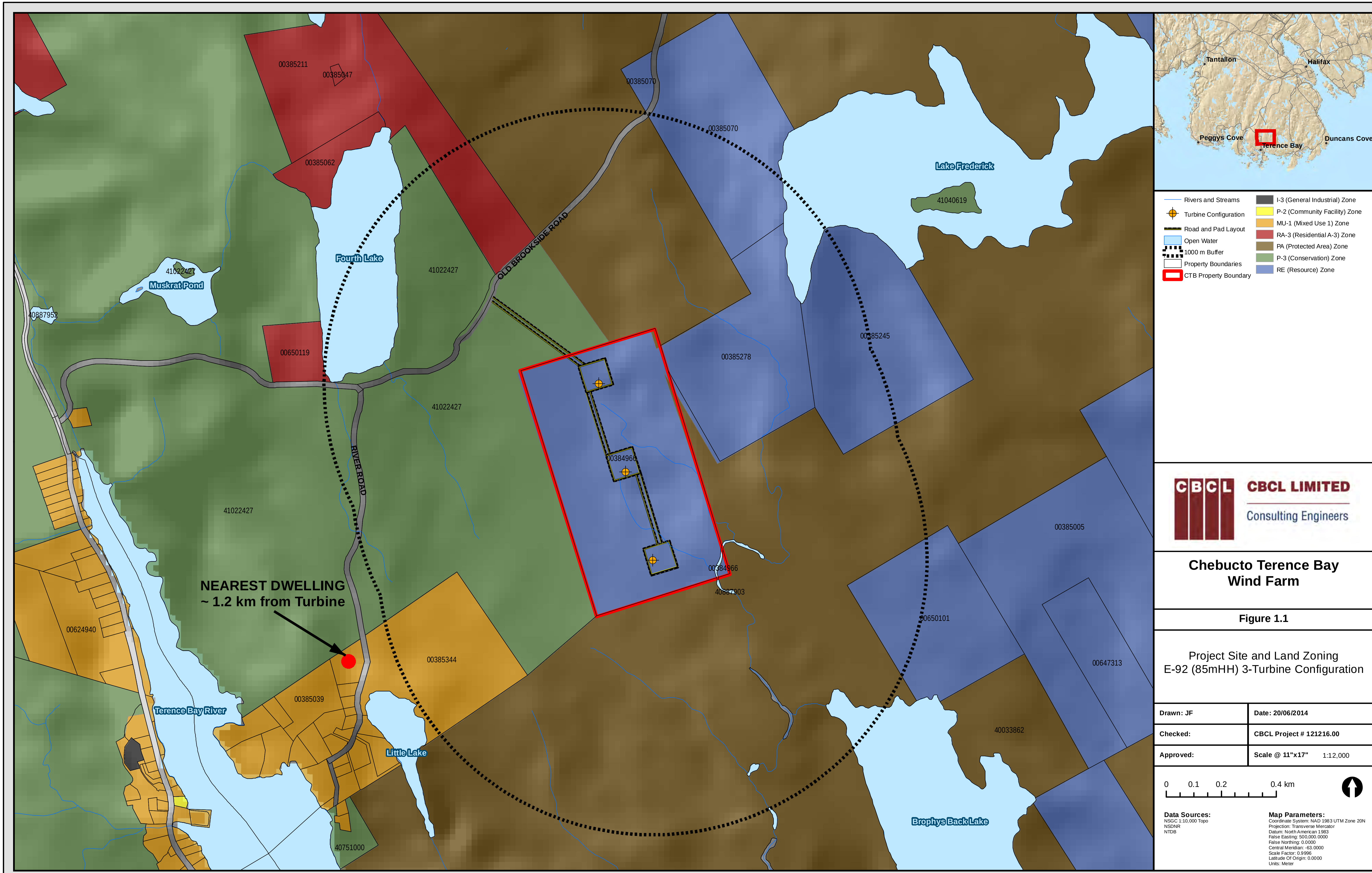
As legislated in the 2010 amendments to the *Electricity Act,* Nova Scotia will produce 25% of total electricity from renewable energy by 2015. To enable the province to achieve this goal, a minimum of 100 MWs will be procured through the COMFIT program administered by the Nova Scotia Department of Energy. COMFIT is designed for locally-based renewable electricity projects. To be eligible, the projects must be community-owned and connected at the distribution level, i.e., typically under 6 MW.

This Project is being developed in response to this government initiative and has received ministerial approval, i.e., COMFIT Certificate from the Nova Scotia Department of Energy. On January 6, 2013 the Minister of Energy issued an approval for a 7.2 MW wind project for the referenced site; this reflected an increase over the 6 MW project that had received approval on March 22, 2012.

As depicted on Figure 1.1, the Chebucto Terence Bay Wind Farm will consist of three wind turbines located on approximately 45 ha of land in the River Road area near Terence Bay to the southwest of downtown Halifax in HRM. The wind farm is located on PIP 00384966 owned by Deal Excavating Services Limited. The proponent has entered into lease agreements for the lands involved. The location of the turbines is shown on Figure 1.1, and their geographical coordinates are provided in Table 1.1. Access to the site will be attained from an abandoned provincial road known as the Old Brookside Road. It extends approximately 1 km from a sharp bend on River Road to a private access road to the site. This access road was rezoned by HRM in 2013 to permit its use to transport heavy equipment and the wind turbines.

**Table 1.1: Geographical Coordinates of the Turbine**

| ***Turbine*** | ***UTM*** | |
|---|---|---|
| | ***Easting*** | ***Northing*** |
| 1 | 443320.8192 | 4928562.174 |
| 2 | 443419.2331 | 4928240.643 |
| 3 | 443517.6676 | 4927919.118 |




L:\121216.00 RESL Terence Bay\GIS\LAYOUT\FINAL REPORT FIGURES\121216.00 FIG 1.1 Terence Bay Site Location and Zoning.

## 1.3 Proponent

CTB was incorporated in Nova Scotia on December 21, 2011. Recently CTB completed an initial closing of a Community Economic Development Investment Fund (CEDIF) Offering whereby it is now a Community Economic Development Corporation based in HRM with 37 individual shareholders, all residents of Nova Scotia, owning 36% of the shares of CTB; the balance of the outstanding shares are owned by CWF and RESL.

CWF was incorporated in Nova Scotia in 2002. It is also a CEDIF with approximately 200 Nova Scotian residents as shareholders. It was the initial COMFIT sponsor for the Chebucto Terence Bay Community Wind project. CWF has invested in several independent renewable energy development companies in Nova Scotia including Scotia Windfields, Chebucto Pockwock Lake Wind Field Limited (a 10 MW COMFIT project at Upper Hammonds Plains, NS) and RESL.

RESL is another major shareholder of CTB. It is a Canadian-Controlled Private Corporation (CCPC) that has been registered in the Province of Nova Scotia since 2000. RESL currently maintains and operates several wind projects in Nova Scotia under long term Power Purchase Agreements with Nova Scotia Power.

CTB has approval from the Nova Scotia Minister of Energy to produce up to 7.2 MW of wind generated electricity at Terence Bay, NS under the COMFIT program. The project is expected to be operational by December 2015.

## 1.4 Spatial and Temporal Boundaries

The study area for this environmental assessment includes the footprint of all works associated with the construction and operation of the proposed wind turbines and those areas within which project-environment interactions could reasonably be expected to occur. It is not possible to establish a single study area boundary that accurately accommodates the spatial characteristics of all potential project-environmental interactions. For example, the study boundary for the archaeological field programs is very much determined by the micro-siting of the turbines, associated access roads and lay down areas, i.e., areas that will be disturbed by the construction of the proposed facility. The study area for flora is larger and takes into account the nature of those habitats in proximity to areas that may be disturbed. The study area for the ornithological work is greater still and that referenced for the socio-economic analysis is geographically the most extensive in order to take into account the consequences of the project for local residents and communities.

Temporal project boundaries include the timeline for the short term construction activities as well as the long term operation of the facility and its eventual decommissioning.

## 1.5 Regulatory Context

### *1.5.1 Requirement for Provincial Environmental Assessment*

As a result of the Nova Scotia Environmental Assessment Regulations that came into force in February of 2003 and subsequent amendments to those regulations, the proposed wind farm at Terence Bay will be subject to a Class I environmental assessment as defined in those regulations. This necessitates the registration of the Project with Nova Scotia Environment (NSE). The department has prepared the "*Proponent's Guide to Wind Power Projects: Guide to Preparing an Environmental Assessment Registration Document*". The following factors must be addressed and shall be considered by the Minister in formulating a decision:

(a) the location of the proposed undertaking and the nature and sensitivity of the surrounding area;
(b) the size and scope of the proposed undertaking;
(c) concerns expressed by the public about the adverse effects or the environmental effects of the proposed undertaking;
(d) steps taken by the proponent to address environmental concerns expressed by the public;
(e) potential and known adverse effects or environmental effects of the technology to be used in the proposed undertaking;
(f) project schedules;
(g) planned or existing land use in the area of the undertaking;
(h) other undertakings in the area; and
(i) such other information as the Minister may require.

Each of the above factors has been addressed in the documentation that follows.

No later than 60 days following the date of registration, NSE shall advise the proponent in writing of the Minister's decision. At this stage the Minister may require additional information prior to making a decision, may make a decision to enable the project to proceed with or without conditions, or may require the proponent to comply with a more extensive assessment process.

A number of additional permits are required at different stages of development and construction of the wind farm. Table 1.2 identifies these permits.

**Table 1.2: Additional Federal and Provincial Permits**

| ***Permit Required*** | ***Permitting Authority*** | ***Status*** |
|---|---|---|
| Obstruction Marking and Lighting Authorization | Transport Canada | Authorization received December 23, 2013 |
| Community Feed-In Tariff Approval | Department of Energy | Conditional approval for 7.2 MW – January 6, 2013 |
| Heritage Research Permit | Department of Tourism, Culture and Heritage | A2012NS055 – December 20, 2012<br>A2014NS010 – February 27, 2014 (see Appendix J) |
| Environmental Assessment Release | NSE | To be attained on acceptance of this submission. |
| Special Move Permit | Department of Transportation | To be attained to enable transportation |

| Permit Required | Permitting Authority | Status |
|---|---|---|
| | and Infrastructure Renewal (NSTIR) | of the turbines. |
| Transportation Plan | NSTIR | To be attained to enable transportation of the turbines. |
| Easement for Transmission Line | NSDNR | Decision pending. |
| Wetland Alteration Authorization | NSE | To be attained subsequent to release of this submission and before the start of construction. |
| Watercourse Alteration Approvals | NSE | To be attained as required subsequent to the release of this submission and before the start of construction. |

#### *1.5.2 Requirement for Federal Environmental Assessment and Associated Authorizations*

Federal environmental approvals are not required for the proposed project. The proposed works will not impact either fish habitat or navigable waters.

The following Federal Authorities were notified in the fall of 2013 with respect to the proposed project: NavCanada, Transport Canada, the Department of National Defence (DND), Industry Canada, the Royal Canadian Mounted Police (RCMP), the Canadian Coast Guard and Environment Canada. The results of these consultations are provided in section 4.5.3.

#### *1.5.3 Municipal Zoning and Authorizations*

As part of the Municipal Planning Strategy, HRM in October 2012 created a wind energy strategy incorporating wind overlay zones across the Municipality to regulate the location and siting of wind turbines[1]. Based on the conditions set forth in the by-law, the proposed Project is a permitted use and is considered a large wind energy facility and subject to a Development Permit where the setbacks and other guidelines are defined. The site itself is zoned Resource Zone (RE). A development permit from HRM for the project was issued on January 28, 2014 (Appendix A). No building permit is required. No other approvals are required from HRM.

Figure 1.1 shows the zoning of the lands surrounding the proposed wind farm site. There is an area to the southwest that extends from Terence Bay to within approximately 400 m of the edge of the site that is zoned Mixed Use (MU-1). This area could, within the stipulations of the zoning by-law, accommodate a range of residential, commercial and resource related uses; the more eastern stretches of this land are at present undeveloped. To the north of the development site, and on the other side of the Old Brookside Road, there is an area of land zoned Residential A3 (RA-3). This area could within the stipulations of the zoning by-law accommodate single family dwellings and associated uses; the land nearest the wind farm site is at present undeveloped. Lands to the north, south and east of the site are zoned Protected Area (PA) and to the east P-3 (conservation) in HRM's

[1] See www.halifax.ca/planning/documents/PlanningDistrict4_LUB.pdf and http://www.halifax.ca/Commcoun/wrcc/documents/WR12.1.3.PDF

Zoning By-Law. Further information on these and other protected areas in the vicinity is provided in section 4.2.2.

## 1.6 Approach and Expertise Involved

The approach to the preparation of this environmental assessment has been to address regulatory requirements and to focus on the issues raised by the study team, the public and others involved in the process. In addition to the research and the consultation program undertaken, a range of field programs were executed at different times between 2011 and 2014. The field programs executed are described fully in Chapter 3; the consultation undertaken is detailed in Chapter 5. Table 1.3 identifies the team leads responsible for the research and field work undertaken.

**Table 1.3: Team Leads**

| ***Name*** | ***Topic / Activity*** |
|---|---|
| Ann Wilkie, CBCL Limited | Project manager and principal author |
| Ian Bryson, CBCL Limited | Determination of habitats including wetlands, inventory of plant species and Species at Risk |
| Carrie Bentley, CBCL Limited | Determination of fish habitat |
| Christopher Kennedy, CBCL Limited | Design and execution of avian field programs |
| Tom Neily, Independent, and Ian Bryson, CBCL Limited | Design and execution of lichen survey |
| Kirk Schmidt, AL-PRO Wind Energy Consulting Canada Inc. | Noise and flicker modelling |
| Chris Kennedy and Melissa Douglas, CBCL Limited | Design and execution of winter ungulate survey |
| Steffen Käubler and Bruce Mans*, CBCL Limited and Upland Planning | Design and execution of visibility analysis and land use investigations |
| Stephen Davis & April MacIntyre, Davis MacIntyre & Associates Limited | Design and execution of archaeological field programs |
| Jason Googoo, Membertou Geomatics Solutions | Execution of Mi'kmaq Ecological Knowledge Study |

* Steffen Käubler and Bruce Mans initiated the visibility analysis for this project while employed by CBCL Limited; the work was completed by them from a new consultancy, Upland | Urban Planning.

## 1.7 Structure of the Document

This report documents the environmental assessment of the environmental effects of the proposed construction, operation and decommissioning of the Chebucto Terence Bay Wind Turbines; the report consists of the following sections:

- Section 1.0 provides an introduction to the proponent and the proposed Project, an overview of the environmental assessment process and an account of the approach to the environmental assessment;
- Section 2.0 provides information on the site's wind resources, the justification for the Project and a review of Project alternatives. This section also identifies the principal Project components, activities, scheduling, anticipated emissions and discharges, as well as outlining the

Project’s health, safety and environmental management plan and how malfunctions and accidents will be addressed;

- Section 3.0 describes the environmental work program that has been undertaken;
- Section 4.0 provides the environmental baseline, i.e., data on the existing biophysical and socio-economic environment;
- Section 5.0 describes the consultation undertaken by the proponent;
- Section 6.0 describes the approach taken to the environmental evaluation, identifies the Valued Ecosystem Components (VECs), the socio-economic issues, the evaluation criteria and references how cumulative effects and effects of the environment on the project are addressed;
- Section 7.0 details the analysis of anticipated environmental effects, identifies mitigation measures, discusses cumulative effects, provides a summary of the residual environmental effects, references the proposed environmental management system and describes follow-up commitments and monitoring initiatives; and
- Section 8.0 summarizes the assessment results.

This environmental assessment report includes mapping and the following appendices:

A Certificates and Approvals Received
B ENERCON E92 Technical Description
C ENERCON E92 Foundation Construction Concept
D ENERCON E92 Access Roads and Crane Platforms
E ENERCON E92 Rotor Blade De-icing System
F ENERCON E92 Lightning Protection
G ENERCON E92 Extract of Noise Test Report
H ACCDC Shortlist of Species of Concern
I Wetland Indicator Status for Plant Species
J Archaeological Resource Impact Assessment
K Mi’kmaq Ecological Knowledge Study (MEKS)
L Noise Study
M Flicker Study
N List of Vascular Plants on Site
O Open House Questionnaire

# CHAPTER 2 PROJECT DESCRIPTION

## 2.1 Project Background

### *2.1.1 Project History*

On March 22, 2012 CTB received approval from the Minister of Energy for a 6 MW wind energy project at Terence Bay, Nova Scotia. On January 6, 2013 CTB was advised by the Department of Energy that its COMFIT approval had been increased from 6 MW to 7.2 MW subject to certain conditions (see Appendix A). As a result, CTB plans to install three Enercon E92 wind turbines at the site, each with a nameplate capacity of 2.35 MW. On January 7, 2013 CTB received approval from HRM for the rezoning of the driveway to enable access to the project site and on February 20, 2013, CTB received a development permit for the project from HRM (see Appendix A). CTB subsequently erected a MET tower to measure the wind resource; results have indicated the site to have a very good wind resource.

Understanding that a Class I environmental assessment pursuant to the *Environment Act* would be required for the project, CTB initiated the ecological field programs required and embarked on the micro-siting studies and associated engineering works necessary to define the optimum locations for the turbines and to ensure effective access for construction and subsequent maintenance in 2012. At the same time, steps were taken to engage representatives of the local municipalities, to disseminate information about the Project in the area and to initiate the necessary consultation (see Chapter 5 for additional information).

### *2.1.2 Political and Economic Context*

Canadians are among the highest per-capita producers of carbon dioxide ($CO_2$) in the world due to their heavy reliance on fossil based energy; in Atlantic Canada, over 40% of greenhouse gas emissions come from the generation of electricity. To reduce such emissions, both the federal and provincial governments are supportive of the development of alternative energy sources. Their aim, if not to replace power generated from hydrocarbons, is to augment such sources and to halt the growth in and reliance upon such sources. The proposed wind farm at Terence Bay will provide green renewable energy to the Nova Scotia grid in accordance with the provincial COMFIT program.

More specifically, the federal and provincial governments have introduced strategies to facilitate the development of alternative energy sources to reduce the emission of "greenhouse gases". The

Province of Nova Scotia, for example, has enacted the *Environmental Goals and Sustainable Prosperity Act*, which identifies the following long-term objectives:

- To lower greenhouse gas emissions by 2020 by at least 10% below the 1990 emitted levels; and
- To obtain 25% of the total electricity needs of the province from renewable energy sources by 2015.

The conversion of wind power into electricity is an acknowledged means of meeting these objectives. Wind energy is supported because:

- it is pollution free and is an infinitely sustainable form of energy;
- it does not require fuel;
- it does not create greenhouse gases; and
- it does not produce toxic or radioactive waste.

Each megawatt hour of electricity that is generated by wind energy helps to reduce the 0.8 to 0.9 tonnes of greenhouse gas emissions that are produced by coal or diesel fuel generation each year.

#### *2.1.3 Project Justification and Purpose*

The purpose of the proposed works, i.e., the construction of three 2.35MW turbines, is to generate up to 7.2 MW of wind energy under the COMFIT Program for sale to NSPI. The proposed turbines will add to the clean energy generated in Nova Scotia, and its successful generation will contribute to NSPI's initiatives to reduce its greenhouse gas emission targets. It is a project that has been designed to address the province's political goals of reducing greenhouse emissions and of moving NSPI closer to meeting its mandate of accommodating increasing amounts of renewable energy on the grid.

#### *2.1.4 Alternatives*

There are a limited number of areas that can be used for the production of wind energy. For any site to be considered commercially for a wind farm, it must have the following attributes:

- located at a financially viable wind resource;
- in proximity to the end user or the off-taker, i.e., NSPI's electrical grid, at a physical location where the planned capacity of the wind farm can technically be accommodated in the grid and preferably in an area where additional load is welcomed or needed;
- access to the necessary lands at an economical cost; and
- general accessibility.

#### *2.1.5 Location and Land Ownership*

As depicted on Figure 1.1, the Project is situated on private lands near the community of Terence Bay. The project site is defined in its entirety by PID 00384966 and is located 1.3 km off of River Road, approximately 4.5 km from the center of the community of Terence Bay to the southwest. The approximate center of the project site is located at 443419.23m E and 4928240.64m N. The northern boundary of the project area is marked by the unmaintained Old Brookside Road. Fourth Lake is located to the north east and the community of Terence Bay to the south west. The southern boundary of the project area is 8.3 km from the coast of the Atlantic Ocean and 20 km southwest of Halifax. The project area has a general elevation ranging from 50-75 m.

Physical access to the project site will be from Highway 333 to the Terence Bay Road, to River Road, to the unmaintained Old Brookside Road and latterly to the project access road. The connection point to the distribution lines is located at the takeoff pole on River Road on feeder circuit 103H-434. The 25kV feeder runs adjacent River Road from the Lakeside Sub-station (103H). From this point of interconnection to the project site, 2.1 km of new overhead line will be installed. Approximately 50 m of underground cables will be installed to connect to the transformer and switchgear located in each of the towers.

The project area is situated in a sparsely populated rural area set back from residents, roads and other public areas. The turbines are 1,112 m distant from the nearest residence.

## 2.2 Principal Project Components

Although the Project will be located in an area of approximately 45 ha, its footprint will use only 9.2% of that land area. The principle project components associated with the proposed works are the wind turbine generators, i.e., the towers, nacelles and blades, the concrete foundations and lay down areas, access roads, a cable collection system interconnecting the turbines to the grid. No substation is required as this wind farm will be connected directly to the NSPI 25kV distribution system.

### *2.2.1 The Turbines*

The project will consist of the development and operation of three 2.35MW Wind Energy Converters (WECs) with a maximum generating capacity of 7.05MW. The wind turbines selected are manufactured by ENERCON. The model, the E92, will start generating electricity at 2 m/s; each turbine has a nameplate capacity of 2.35MW at wind speeds over 12 m/s. The WEC will continue to generate electricity in wind speeds up to 34 m/s. The rotor diameter of the Enercon E92 is 92 m consisting of three fiberglass blades equipped with an integrated lightning protection system. The wind generators will be located on top of 85 m steel towers, anchored in reinforced steel concrete foundations. Table 2.1 summarizes the technical specifications of the selected turbine. Appendix B provides additional technical information of the selected WEC.

**Table 2.1: Summary of WEC Technical Specifications (ENERCON E-92)**

| | |
|---|---|
| Rated capacity | 2,350 (kW) |
| Cut-in wind speed | 2.5 (m/s) |
| Cut-out wind speed | 28-34 (m/s) |
| Rated wind speed | 12 (m/s) |
| Number of blades | 3 |
| Rotor Diameter | 92 (m) |
| Swept Area (m2) | 6,648 |
| Rotor speed (variable) | 5-16 (rpm) ($min^{-1}$) |
| Tower (hub) height | 85 (m) |
| Gearbox | None - gearless |
| Generator – Synchronous DIRECT DRIVE RING GENERATOR | 2,350 (kW) |

| | |
|---|---|
| Braking system (fail safe) AERODYNAMIC (3 Independent Pitch Systems) | Yes |
| Yaw system Active | 0.5 (degrees/sec) |
| Control system – Supervisory Control and Data Acquisition (SCADA) | Yes |
| Noise reduction | Yes |
| Storm control | Yes |
| Ice detection | Yes |
| Lightening protection system (EXTERNAL / INTERNAL) | Yes / Yes |
| Tower design | Steel |

Although there will likely be small modifications as the detailed engineering is executed, the final layout and configuration of the proposed wind farm is based on the environmental studies that have been done to date and the preliminary engineering for the access roads.

In addition to the components described above, each WEC will have its own 2,500 kVA transformer / switchgear unit (E-Module) installed in the base section of the tower; this will provide protection and isolation to the WECs from the grid in the event of a fault. As noted above the E-92 is gearless; this results in less maintenance and less likelihood of the loss of lubricants.

### *2.2.2 Concrete Foundations and Lay Down Areas*

Each wind turbine is situated on and anchored to a circular reinforced concrete base. The advantage of a circular base is the equal distribution of force in all wind directions. Circular base construction reduces the amount of rebar required to reinforce the concrete and reduces the size of the base compared to an asymmetrical base. The disturbed area associated with each 16.7 m diameter foundation will be approximately 220 $m^2$ and will be 18 m in diameter. The associated assembly and erection areas will be approximately 100 m by 100 m. The crane pad will be constructed to withstand maximum surface pressures of 185 $kN/m^2$. The service area required for the E92 will be used for subsequent maintenance, component replacement, possible refit work and ultimate decommissioning. Additional foundation specifications required by ENERCON are provided in Appendix C.

During construction, facilities will be provided for the needs of the construction crews, including equipment storage areas. These facilities will be temporary.

### *2.2.3 Access Roads and Transportation of WEC Components*

In addition to the facilities referenced above, access is required to each of the turbine locations. The turbine components will arrive by ship at the wharf at Sheet Harbour and be trucked to the site in Terence Bay to the laydown/staging area on-site. Given the size and weight of some of the transport equipment that will be used, the Proponent and their engineers will work closely with the road authorities, i.e., NSTIR, to ensure that the roads have the capacity to accommodate the loads involved.

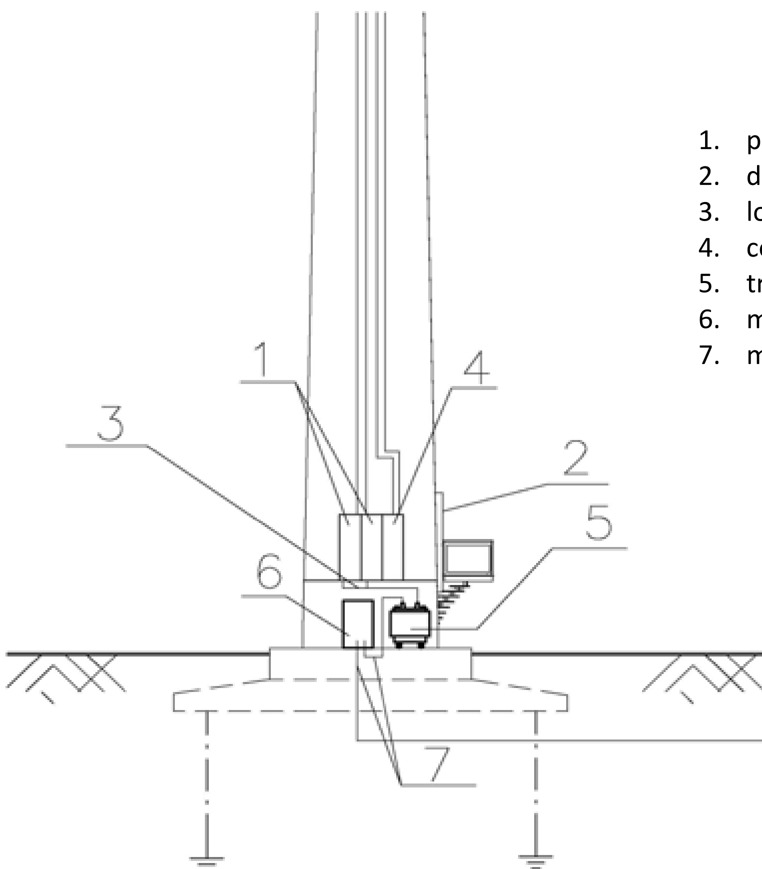
Access on site will be accommodated by the construction of a new access road, approximately 1 km in length. Appendix D provides specifications from ENERCON in a document entitled “DP-09-01 Roads and Crane Requirements”; this provides criteria with respect to the access roads and the crane platforms. At the entrance to the site, the access road will be gated.

### *2.2.4 Connection to the Grid*

The proposed wind farm site is located approximately 16 km south of the Lakeside substation 103H. The nearest 25 kV feeder circuit, 103H-434, is supplied from the Lakeside substation. The feeder circuit 103H-434 is a 60Hz, 3-phase, 4 wire, multi-grounded common neutral circuit (effectively grounded-wye), which is located approximately 2.1 km from the project site. The proposed development is for the installation of three 2.35 MW Enercon E92, 400V wind turbine generators that are stepped up to 25kV, via 2,500 kVA transformers located in the base of each wind turbine and connected to an 25kV overhead collector system and then to the distribution feeder circuit.

For this project, the 25 kV collector system consists of a hybrid of both overhead and underground systems. An underground duct bank from each turbine tower to a riser pole on the overhead 25 kV system installed between each of the wind turbines. The 25kV collector system is then connected to the distribution feeder circuit.

The E92 turbine, as illustrated in Figure 2.1 enables the transformer and switch gear to be located within the tower thereby eliminating the need for external housing.




1. power cabinets
2. door
3. low voltage cable
4. control cabinet
5. transformer
6. medium-voltage cabinet
7. medium-voltage cable

Figure 2.1: Arrangement of Electrical Component Equipment

As mentioned above, a 2,500kVA transformer inside each wind turbine steps up the voltage from 400V to a medium voltage of 25kV, the same as the distribution feeder circuit thereby eliminating the need for a sub-station.

#### *2.2.5 Lighting of WECs*

The wind turbines will be marked in accordance with Transport Canada's Obstruction Marking and Lighting Standards (CAR 621.19). These guidelines have specific directions for marking wind turbines. In short, they require WECs to be marked at least every 900 m around the perimeter of the wind farm with synchronized red flashing beacons atop the nacelles. The intensity and direction of the lighting is also governed by these standards. The proponent recognizes that when satisfying the lighting requirements as imposed by Transport Canada's standards it must also be mindful of the Environment Canada preference to have a flash with a distinct off period. Accordingly, the proponent is considering the use of a LED based technology pointed within Transport Canada acceptable range with all lighting synchronized.

#### *2.2.6 Blade De-Icing*

Ice may form on the rotor blades of the wind turbines in certain weather conditions. Ice formation adversely affects the aerodynamic properties and hence the energy yield. Additionally, with thick ice build-up there is the risk of chunks of ice detaching, creating a safety hazard in the surroundings of the WEC. In addition, ice forming unevenly on the three rotor blades results in an imbalance that can cause undesirable oscillation. Once ice formation is detected, wind energy converters without a rotor blade de-icing system are shut down. This results in yield losses. In many cases, incipient ice build-up can be melted in WECs with a rotor blade de-icing system even with the WEC running. This significantly reduces downtimes. The wind turbines for this project will have ice detection and blade de-icing systems installed. A description of the de-icing systems can be found in Appendix E.

## 2.3 Project Activities

#### *2.3.1 Planning and Design*

A range of criteria has been taken into account in determining the micrositing of the turbines including the following:

- Physical characteristics of the site;
- Land ownership and current and future uses in the surrounding area;
- Ecological relevance of the site and surrounding lands; and
- Routes and pathways that will service the project including access roads and power line connections.

The physical design of the wind farm has been further optimized through the application of sophisticated modeling software which incorporates meteorological data from the site. The design has involved a multi-disciplinary team in the determination of the turbine locations and of the project capacity considering technical ecological, social and economic factors.

To support project planning and the environmental assessment process a range of specific studies and associated field work have been undertaken. This work has involved:

- Determination of flora and fauna terrestrial habitat on the site and surrounding lands;
- Desktop review and surveys for rare and sensitive species, including those protected under the federal *Species at Risk Act (SARA)* and the provincial *Endangered Species Act*;
- Bird studies, including assessment of migration routes;
- Assessment of the archaeological significance of the area; and
- Consultation with local residents, politicians, regulators and other stakeholders.

Site planning continues and will be further refined based on the results of the environmental assessment studies and engineering. This work will be finalized following release from the environmental assessment process by NSE.

### *2.3.2 Construction*

In determining the scope of the Project for environmental assessment, CTB has given consideration to the following:

- What is involved in the construction of the principal structural elements necessary to the Project including the towers, the installation of the cabling and the substation; and
- Other ancillary physical works necessary to accommodate the construction of the principal elements.

It is anticipated that construction activities will begin in late summer/fall of 2014 after appropriate approvals and permits are in place. Table 2.2 summarizes the activities that will occur.

**Table 2.2: Site Preparation and Construction**

| *Activity* | *Schedule* |
|---|---|
| Surveying | Surveying includes gathering of location and elevation data required for the design of the system. It requires the cutting of vegetation along survey lines and cross-section offsets to provide clear line of sight for survey equipment. Given that the site is vegetated with small trees and shrubs and grasses, very little clearing will be required for surveying |
| Geotechnical | Scope of geotechnical Investigation to be finalized. |
| Development of access roads | Approximately 1 km of access road to be constructed. |
| Clearing | A minimal amount of clearing will be required for the turbine connector roads as the vegetation on the site is primarily small trees, brush and scrub. No merchantable timber is expected to be harvested during construction. The site had been cut by the land owner approximately 10 to 15 years ago. Stumps and root systems will be retained to the extent practical except in the access road right of way and where removal is necessary for safe equipment access. The need for, and extent of, stump and root system removal will be determined on site. Merchantable timber, if any, will be salvaged and the remaining debris disposed of in accordance with landowner agreements. |

| ***Activity*** | ***Schedule*** |
|---|---|
| Topsoil stripping and salvage | Environmental control measures such as sediment fencing, diversion ditching or sedimentation ponds will be installed by the crews prior to commencement of grading activities as required. Grading may be required to level the connector roads and the work area. Where required, graded areas will be grubbed and topsoil stripped and stockpiled for reuse. Roots and slash generated from the grubbing operation may be buried. The locations for burial will be determined in consultation with the landowner. |
| Grading | Environmental control measures such as sediment fencing, diversion ditching or sedimentation ponds will be installed by the crews prior to commencement of grading activities as required. Grading may be required to level the connector roads and the work area. Where required, graded areas will be grubbed and topsoil stripped and stockpiled for reuse. Roots and slash generated from the grubbing operation may be buried. The locations for burial will be determined in consultation with the landowner. |
| Ploughing and Trenching for underground collector lines | The turbine collector system will be connected by approximately 1 km of overhead power cables. The power cabling trenches (Direct Buried Ducts) from the foundation to the riser pole shall be prepared according to the requirements of NSPI. E92s are shipped complete with internal transformers and switch gear (Emodule) and are connected to the distribution lines. |
| Piling and Foundation excavation | The turbine foundations consist of a circular reinforced concrete base that is designed to transfer the stress and weight into the ground. The depth of the foundation will be dependent upon the soil's ability to absorb compressive strain. Essentially, softer ground requires a deeper foundation. Material excavated from the foundation pit will be used to fill the foundation, reducing the amount of reinforced concrete needed to stabilize the foundation and reducing the amount of material to stockpile and stabilize on site. |
| Pouring turbine foundation | The foundation is a circular spread footing design 16.7 m in diameter. This design is 2.53 m below grade when complete. The work required, but not limited to, is as follows:<br>• Survey and Layout. Ensure the excavation is large enough to install the 16.7 m diameter mud slab;<br>• Excavation of foundation, level and prepare base as per the geotechnical report recommendations;<br>• Excavate trench for duct bank. (PVC Duct Bank supplied and installed by electrical contractor);<br>• Install compressive layer (Styrophor PS30);<br>• Compact base with plate tamper or vibratory roller; and<br>• Install foundation drainage to keep water from accumulating in the excavation and to protect the founding layer. Once the excavation is prepared, a mud slab approximately 18 m in diameter and 100 mm thick is installed. The Mud Slab must be level. Concrete quality: C 12/15. Concrete Quantity: 22 $m^3$. |

| *Activity* | *Schedule* |
|---|---|
| | The foundation excavation/base preparation will be inspected and approved by a Geotechnical Engineer prior to the mud slab installation. The next step is to place the reinforcement steel and foundation section and to install the electrical grounding system according to the issued for construction (IFC) Drawings. The reinforcement steel will be inspected and approved by the Structural Engineer and the electrical grounding system will be inspected by NSPI prior to concrete installation.<br><br>Finally, supply, place and finish concrete. Concrete quality: C 25/30. Concrete quantity: 311 $m^3$. No additives will be used. A minimum of two vibrators will be used to ensure coverage over reinforcing steel. Minimum cover 50 mm. Broomed finish with rounded edge on upper exposed foundation. Smooth finish required on lower foundation.<br>Concrete testing will be performed by Stantec. Foundation level measurements must be taken and verified prior to casting of the concrete. NSPI must inspect and approve the grounding prior to the casting of the concrete. |
| Equipment lay-down | The turbine components will be shipped from ENERCON Germany and arrive in Sheet Harbour. The components will be trucked to the site and placed at each turbine location ready for installation. |
| Tower, generator, and rotor assembly | The wind turbine components will be erected using a DEMAG CC2400-1 440 crawler crane. Each turbine can be erected in approximately seven days. |
| Installation of Powerline | The overhead collector system will be installed by NSPI as per Small System Generator Interconnection Agreement (SSGIA). This consists of poles and power cables as per scoping and Distribution System Impact Study (DSIS) requirements. |
| Turbine commissioning | The commissioning phase is conducted by ENERCON and takes approximately two to three days for each turbine. The turbine is then monitored for 300 hours before handover. |

Once the active construction work has been completed, site remediation will be instigated. This will include, but will not necessarily be limited to, the following:

- Demobilization of the construction equipment;
- Restoration of the vegetation around the towers; and
- Removal of sediment and erosion control structures once the site is stabilized.

### *2.3.3 Operation and Maintenance*

The wind turbines will be operational on a continual basis except under circumstances of mechanical breakdown, extreme weather conditions or maintenance activities. Each turbine will be subject to periodic maintenance and inspection. Table 2.3 provides further detail on access and inspection.

**Table 2.3: Operations and Maintenance**

| | |
|---|---|
| Access and Inspection | ENERCON will conduct routine maintenance through their ENERCON Partner Concept agreement. The equipment will be serviced and maintained four times per year as well as any unscheduled repairs. The operations and maintenance requirements of the turbines will be monitored remotely by ENERCON's SCADA system. Each wind turbine has a modem link to the central remote data transmission facility. If the turbine signals malfunction, the Service Centre and the responsible service branch are notified via the SCADA remote monitoring system. |

Regular servicing will involve oil changes. Any waste products, e.g., waste oil, will be disposed of in accordance with appropriate legislation. No on-site storage of hazardous materials will be necessary. A spill kit, including absorbent material, will be either stored in the base of the tower, or it will be brought to the site during maintenance visits.

The turbines feature sophisticated grounding and lighting protection features. Please refer to Appendix F: Earth and Lightning Protection.

### *2.3.4 Reclamation and Decommissioning*

The design life of a wind turbine is typically 20 years, and capital improvement and replacement programs can extend safe and efficient operations beyond 25 years. Decommissioning of both the turbines and the site, when it is necessary or desirable, will be undertaken in accordance with the regulatory regime in place at the time.

At the end of their useful life, the wind turbines will be decommissioned, and all equipment will be dismantled and disposed of in a manner that meets all regulatory requirements. Such activities would likely involve the preparation of the site, e.g., the establishment of access for construction equipment and the mobilization of that equipment including cranes. The sections of the towers would be taken apart and would be reused, recycled or disposed of in accordance with regulatory requirements. After the towers have been dismantled and removed from the site, the site itself would be restored to a state similar to what currently exists through regrading and revegetation (see also Table 2.4).

**Table 2.4: Decommissioning and Abandonment**

| | |
|---|---|
| Rotor, generator and tower disassembly | Once the wind farm has reached the end of its life span (anticipated being approximately 25 years), the site will be decommissioned. The turbines will be removed from the site and the foundations will be covered over to the existing grade and reseeded. Depending on the planned use for the site following decommissioning, the access roads, crane pads and conduits will either be removed or left in place for re-use. If these ancillary components are removed, the site will be restored to the condition prior to construction. |

## 2.4 Construction Schedule

The proposed construction schedule is summarized below in Table 2.5.

**Table 2.5: Construction Schedule**

| ***Activity*** | ***Schedule*** |
|---|---|
| Surveying | Spring /Summer 2014 |
| Geotechnical | Spring / Summer 2014 |
| Development of access roads | Summer / Fall 2014 |
| Clearing | Late Fall/Early Winter 2014 |
| Topsoil stripping and salvage | Late Fall/Early Winter 2014 |
| Grading | Late Fall/Early Winter 2014 |
| Ploughing and Trenching for underground collector lines | May – July 2015 |
| Foundation excavation | Late Fall/Early Winter 2014 |
| Pouring turbine foundation | Late Fall/Early Winter 2014 |
| Equipment lay-down | Spring 2015 |
| Tower, generator, and rotor assembly | May / June 2015 |
| Installation of Powerline | April –July 2015 |
| Turbine commissioning | October/November 2015 |

## 2.5 Anticipated Emissions and Waste Streams

During Project operation the proposed wind farm will not generate air emissions; anticipated discharges are limited to the waste oils that will be handled during the course of construction and regular maintenance. These wastes will be managed and disposed of in accordance with all applicable regulations.

### *2.5.1 Site Runoff*

During the construction phase of the Project, the control of silt-laden run-off will be an important issue. Erosion and sediment control measures will be detailed in an Environmental Management Plan (EMP) and stringently applied during construction and will be maintained until soil cover has been re-established. Construction debris will be managed on site or at offsite disposal locations in an approved manner. Solid wastes will be recovered for reuse or recycling as required by provincial legislation.

### *2.5.2 Hazardous Wastes*

A limited number of hazardous materials will be required for the construction and operation of the proposed turbines. As referenced above, prior to commercial operation, an EMP will be developed and implemented to ensure that all staff working at the wind farm are appropriately trained to handle, store and dispose of these materials which may include one or more of the following:

- Corrosion and fouling inhibitors;
- Paints;

- Industrial cleaners; and
- Lubricating oils and fuels.

The EMP will be updated to address the specific needs of Project Operation. All hazardous materials will be stored and handled according to relevant federal and provincial regulations. Staff will receive the training specified by law.

#### *2.5.3 Other Emissions*

##### 2.5.3.1 Noise

Noise is often brought up as an issue associated with wind farms. Generally, there are two types of noise associated with a wind turbine generator (WTG): the noise created by the generator and gearbox inside the nacelle; and the noise created by the blades or rotors passing through the air.

The selected turbine, the E92, is a gearless turbine with a direct drive variable speed generator. These machines have no gear box or drive train and consequently no high speed mechanical (or electrical) components. Direct drive turbines are, therefore, quieter than gearbox machines as they do not produce mechanical or tonal noise. Variable speed machines change speed continuously in response to changes in wind speed and, although noise output may be higher at higher wind speeds, it is lower at low wind speeds where the low background levels occur (British Wind Energy website, 2005). The blade of the E92 has been designed to reduce noise created by turbulence. Turbulence that occurs at the blade tips due to over pressure and under pressure is effectively removed from the rotor plane. The entire length of the blade is therefore utilized without any loss of energy caused by turbulences (ENERCON, 2010). An upwind orientation of the blades to the tower reduces airflow changes as the blades pass the tower in contrast to some older models that had the blades downwind of the tower, which would result in a pulse as the blade passes the tower. An extract of a noise test report for the ENERCON E92 is provided in Appendix G.

##### 2.5.3.2 Electrical Magnetic Fields

Electrical magnetic fields (EMFs) are created when electrical charges flow within any object that conducts electricity. For a transmission line, these fields are created by current in a conductor. When a voltage is applied to a conductor, a magnetic field is created in the space around the conductor, but field intensity decreases rapidly with distance. There has been public concern expressed with respect to a perception that exposure to magnetic fields has an adverse impact on health. The available EMF research does not establish this linkage. Indeed, the National Research Council has concluded that "…. the current body of evidence does not show that exposures to (magnetic) fields present a human-health hazard" (National Research Council, 1996). This subject is addressed further in Section 7.4.5.

## 2.6 Environmental Management

The objective of environmental management is to implement safe, environmentally responsible, and sound engineering, construction, operation, and training practices. CTB is committed to articulate and adhere to systems, procedures, practices and materials that will ensure the development and operation of the wind farm at Terence Bay is executed in a manner that protects the environment and facilitates the safety of all who work or visit the site. To the extent practical CTB will seek to eliminate sources of pollution at source. The principle components of an environmental management system include the preparation of the following:

- Environmental Protection Plan (EPP); and
- Contingency and Safety Plan.

The intent of the environmental management system is to:

- define environmental, health and safety responsibilities and accountabilities for personnel;
- ensure compliance with regulations, goals and objectives;
- establish minimum standards for a contractor safety and the implementation of environmental protocols in the field;
- establish safe work practices and procedures documentation that ensure basic precautions for preventing accidents, injuries or illnesses in the performance of work;
- define environmental practices and procedures that establish minimum standards for all operations that have a potential to cause environmental problems;
- define minimum safety training standards to ensure that all personnel are aware of potential hazards and know safe work practices and emergency procedures; and
- establish an accident/incident reporting system that standardizes prompt reporting of all injuries and environmental incidents.

### *2.6.1 Environmental Protection Plan (EPP)*

The EPP will be developed in consultation with relevant provincial agencies specifically NSE and will be completed prior to construction; it will outline specific environmental and engineering measures that will be employed during construction, e.g., the deployment of techniques to control erosion and sedimentation and measures to prevent spills of hazardous materials. The EPP will expand upon measures identified in this environmental assessment report and will accommodate recommendations from the regulatory authorities. These requirements will be brought to the attention of all personnel working on the site, including contractors.

### *2.6.2 Contingency and Safety Plan*

The goal of the Contingency and Safety Plan is to reduce the frequency, extent and duration of accidental events and to reduce the risk to the environment and public safety from such events. A contingency and safety plan will be developed in consultation with relevant federal and provincial agencies for both the construction and operation of the Project. The plan will designate personnel responsible for specific actions, and ensure that an effective communications and reporting system is in place.

These plans can only be completed once the project design is finalized.

## 2.7 Malfunctions and Accidents

CTB is cognisant that malfunctions and accidents that pose a risk to human health and safety and to the environment can occur and are committed to ensuring that all requisite protocols are established to:

- minimize the risk to human health and safety during both construction and operation; and
- minimize the risk to the environment during both construction and operation.

These protocols will include the formulation of a site specific EPP to ensure the application of environmental protection measures and good engineering practices throughout construction; and the preparation of an emergency response plan to address responses in the event of an accident during either construction or operation.

The construction and operation of a wind farm employs techniques and technologies that are familiar to the construction industry.

The likelihood of serious malfunctions or accidents associated with the operation of a wind farm that would pose a risk to human health and safety or the environment are substantially less than those associated with many alternative forms of power generation. Icing is perhaps the predominant safety concern, but public injury from ice throw is unlikely for two reasons:

- the turbines will be located in a rural area, at a minimum distance of 1,100 m from the nearest residence; and
- since the ice reduces rotation, modern turbines such as ENERCON E92, are equipped with an ice detection and de-icing system that will shut down the unit should a build-up of ice be detected on the blades (see Appendix E).

The E92 wind turbine will cease operation in winds exceeding 34 m/s reducing the potential for damage to the turbine by excessive wind speed and minimizing excessive ice throw.

Like any electrical system, a wind turbine can be exposed to internal and external electrical faults. These include internal failures, such as short circuits or earth faults in the electrical components, and external faults including over voltage caused by lighting. Appendix F provides detail of earth and lighting protection system for the selected wind turbine.

Fire is a third potential concern. Again the likelihood of this occurrence can be mitigated by training and the establishment of response protocols.

The operating staff will be trained to respond appropriately in the event of different scenarios including, but not limited to, technical failure, icing, fire and a lighting strike.

# CHAPTER 3 ENVIRONMENTAL WORK PROGRAM

## 3.1 Overview and Approach

The environmental assessment methodology has been developed to meet the requirements of the environmental assessment regulations of the Nova Scotia *Environment Act*. The approach also reflects the technical and professional competency of the study team and their ability to address specific issues in a rigorous and pragmatic manner. In general, the approach has been designed to produce an environmental assessment registration document that:

- focuses on issues of greatest concern whether these have been identified by the study team, by the public or by the regulators;
- clearly addresses regulatory requirements; and
- integrates engineering design and mitigative measures into a framework that will enable, as the engineering proceeds, the preparation of a comprehensive EMP for the Project.

Figure 3.1 depicts the key steps in the environmental assessment process.

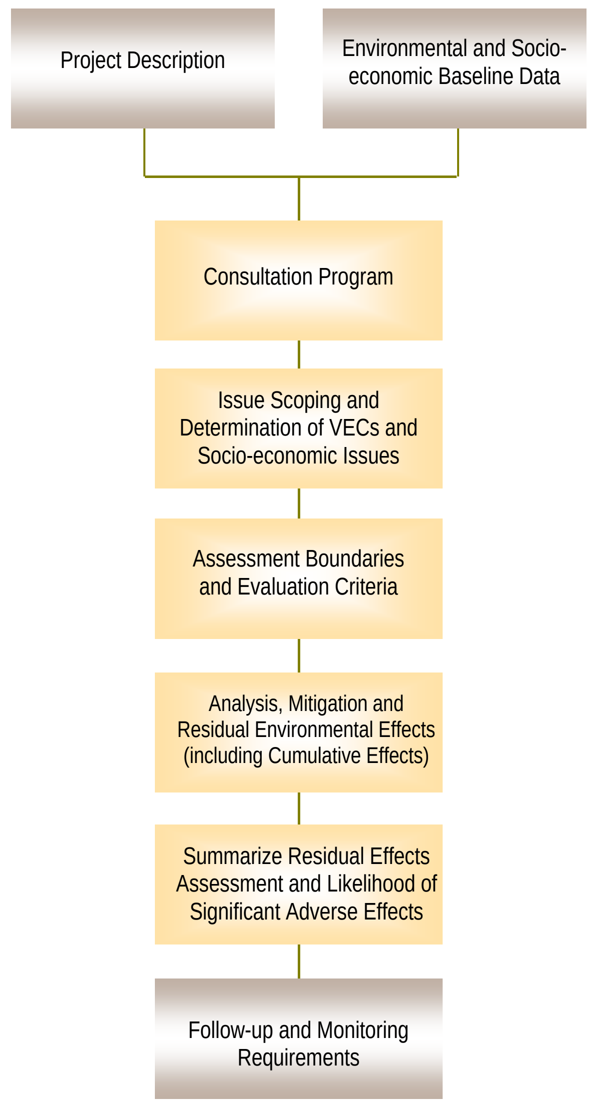


Figure 3.1: Environmental Assessment Process

The preparation of the Project description and the environmental and socio- economic baseline are the two fundamental building blocks necessary for the environmental analysis. The former is derived from the work undertaken by the Proponent and their engineering team. The latter is derived from the review and compilation of pertinent secondary data sources and the execution of selected field programs. The integrity of these building blocks is critical to the credibility of the subsequent analysis; the preparation of the two, however, is iterative. This allows the environmental assessment to be used as a planning tool and to influence Project design.

To compile the environmental and socio-economic baseline, the study team drew on its collective knowledge and experience and considered input and opinions expressed by the community, the relevant regulations and guidelines and pertinent research including the field work undertaken.  The team is familiar with both the Project site and the broader study area.  Studies addressing the Project site are restricted to the 45 hectare property boundary.  The study area encompasses the Project site and surrounding area, varying in size depending on the individual study and is defined in its methodology.  Knowledge of the area and the work undertaken for this Project has generated a substantial data base and enabled the identification of those matters that warrant evaluation.  The assessment examines the potential effects of each Project phase, i.e., construction, operation and decommissioning, as well as malfunctions and accidents, with regard to each VEC or socio-economic issue. VECs represent "key" or "indicator" species, communities, species groups or ecosystems, as well as specific media, e.g., water or air, which may transport environmental effects. Social, cultural or economic factors, or issues, may also be affected by the proposed works and are identified as such.

The final selection of VECs and socio-economic issues that provide the focus of this assessment reflect an informed understanding of the consequences of the proposed works in the physical, ecological and socio-economic context of the receiving environment.  These were determined through reference to pertinent literature, through consultation, as a result of work done on other like projects and through the execution of the field programs.  There have also been a number of local meetings, a public open house, and meetings with staff at the municipal and provincial levels. Chapter 5 provides an account of the consultation that has been undertaken to date.

## 3.2 Research and Field Work Undertaken

Environmental assessment is a process that is executed early in Project planning to enable environmental factors to influence decisions and detailed engineering.  It is in part a planning tool, the underlying intent of which is to ensure that all works associated with the Project's construction, operation and decommissioning are executed in a manner that causes minimal harm to the physical, ecological and socio-economic environments.  The location of the proposed turbines is on a relatively undisturbed and land-locked site approximately 1,500 m to the east of Terence Bay as depicted on Figure 1.1.

In addition to the research and the consultation undertaken, a number of specific field programs were designed and executed in 2012, 2013 and 2014 to facilitate both the compilation of the environmental and socio-economic baseline and the determination of VECs and socio-economic issues of interest.  The field programs undertaken included investigations and surveys to identify the following:

- ecological habitats and vegetation patterns to determine locations that were subsequently subject to further field examination as habitat for rare or endangered plants, including lichens, or other species of conservation concern;
- breeding and migratory birds;
- moose;
- wetland boundaries;

- locations of archaeological value;
- sites and locations of value to First Nations; and
- locations from which to base the visibility analysis.

The above and other programs are described below.

### *3.2.1 Secondary Data Research*

The initial step in the environmental assessment process for this Project was to compile, review and evaluate secondary data essential to the definition of the field programs and to the scoping of the environmental assessment. In broad terms, this phase of the work included the following:

- acquisition of data sets from various government sources including the Nova Scotia Department of Natural Resources (NSDNR);
- the acquisition and examination of aerial photographs;
- review of key texts, e.g., the Natural History of Nova Scotia (Davis and Brown, 1996);
- consideration of the *SARA*, the *Endangered Species Act* and examination of the listings compiled by the Committee on the Status of Endangered Wildlife in Canada ("COSEWIC"), the Atlantic Canada Conservation Data Centre ("ACCDC") and NSDNR; and
- compilation of demographic and related data from Statistics Canada to facilitate the preparation of the socio-economic profile.

A number of specific areas of research are further identified in the following sections.

#### 3.2.1.1 Species of Conservation Concern

Since *SARA* is legislation of general application, the requirements of that Act must be addressed in any assessment. In addition, the provincial environmental assessment process requires a "Species at Risk" review. *SARA,* in conjunction with the provincial *Endangered Species Act,* provides the regulatory framework pertinent to the protection of valued rare and endangered species.

In Nova Scotia, species of concern are tracked and designated at four levels. *SARA* and the *Endangered Species Act* provide legislative designations while the NSDNR - General Status Ranks and the ACCDC provide technical tracking lists. The NSDNR-General Status Ranks are, by design, high level in nature. The results of the General Status Assessment provide more in-depth scientific assessment approaches and a "first-step tool" to help identify priorities, i.e., to establish a list of priority species, for more detailed status evaluations, inventory, research and management. The ACCDC is a member of NatureServe, an international non-profit organization that provides science and technical support to various Conservation Data Centres ("CDC"). The ACCDC provides objective data and expertise about species and ecological conservation concerns in Atlantic Canada. Table 3.1 provides a summary of definitions of rarity ranks associated with these designations.

**Table 3.1: Definitions of Rarity Rankings**

| **Atlantic CDC Ranks Definitions** | |
|---|---|
| S1 | Extremely rare throughout its range in the province (typically five or fewer occurrences or very few remaining individuals). May be especially vulnerable to extirpation. |
| S2 | Rare throughout its range in the province (six to 20 occurrences or few remaining individuals). May be vulnerable to extirpation due to rarity or other factors. |
| S3 | Uncommon throughout its range in the province, or found only in a restricted range, even if abundant at some locations (21 to 100 occurrences). |
| S4 | Usually widespread, fairly common throughout its range in the province, and apparently secure with many occurrences, but the species is of long-term concern, e.g., watch list (100+ occurrences). |
| SU | Unrankable: Possibly in peril throughout its range in the province, but status uncertain: need more information. Used for new species not previously identified. |
| SX | Extinct/Extirpated: Believed to be extirpated within the province. |
| S#S# | Numeric range rank: A range between two consecutive numeric ranks. Denotes uncertainty about the exact rarity of the species, e.g., S1S2. |
| ? | Inexact or uncertain: For numeric ranks, denotes uncertainty, e.g., SE? Denotes uncertainty of exotic status. |
| **NSDNR General Status Ranks** | |
| Undetermined | Species for which insufficient data, information or knowledge is available or reliably evaluate their status. |
| At Risk | Species that are known to be or is thought to be at risk. |
| May Be At Risk | Species that may be at risk of extirpation or extinction. |
| Sensitive | Species that are not believed to be at risk of immediate extirpation or extinction but which may require special attention or protection to prevent them from becoming at risk. |
| Secure | Species that are not believed to be at risk or sensitive. This category includes some species that have declined in numbers but remain relatively widespread or abundant. |
| ***NS Endangered Species Act*** | |
| Endangered | A species that faces imminent extinction or extirpation and it listed as an endangered species pursuant to Section 12 |
| Threatened | A species that is likely to become endangered if the factors affecting its vulnerability are not reversed and is listed as a threatened species pursuant to section 12 |
| Vulnerable | A species of special concern due to characteristics that make it particularly sensitive to human activities or natural events and that is listed as a vulnerable species pursuant to section 12 |
| ***SARA* Ranks** | |
| Endangered | A species facing imminent extirpation or extinction |
| Threatened | A species likely to become endangered if limited factors are not reversed |
| Special Concern | A species of concern because of characteristics that make it particularly sensitive to human activities or natural events. |

The methodology followed to determine potential species of concern was the protocol developed by NSDNR, *Standards and Processes Applied to Provincial Environmental Impact Assessment, Wild Species Priorities Inventory and Mitigation Standards for Reporting*. This protocol provides a framework through which listed species can be ruled in or out of an environmental assessment based, in the first instance, on geographical occurrence, and secondly, on the presence or absence of appropriate habitat within the study area. The observed distance of each species from the Project site (as noted in the ACCDC guidance list) was also taken into consideration. Additional sources used to determine the regional distribution and habitat preferences for birds included the *Atlas of Breeding Birds of the Maritime Provinces* (Erskine, 1992) and *Eastern Birds* (Peterson, 1980). For plants, a key reference was *Roland's Flora of Nova Scotia* (Zinck, 1998).

A list of sightings of rare and endangered species within 100 km of the Terence Bay Project site was acquired from the ACCDC. The original list was summarized to include only the sightings that occurred within 25 km (see Appendix H). This short-list included 161 species, the largest group of which is birds (70 species) followed by vascular plants (42 species) and invertebrates (33 species). Those species listed by *SARA*, COSEWIC, or by the Nova Scotia *Endangered Species Act* as "Endangered", "Threatened" or of "Special Concern", and/or by NSDNR General Status as "Sensitive", "May Be At Risk" or "At Risk were identified as species of concern. As depicted in Table 3.2, of the 161 species found within a 25 km radius, 103 were identified as species of concern.

**Table 3.2: ACCDC shortlisted species found within 25 km of the Terence Bay proposed wind site**

| | ***Total Number of Species*** | ***Species of Concern*** |
|---|---|---|
| Birds | 70 | 57 |
| Vascular Plants | 42 | 26 |
| Invertebrates | 33 | 7 |
| Lichen | 7 | 7 |
| Herpetofauna | 4 | 3 |
| Mammals | 5 | 2 |
| Fish | 1 | 1 |
| Total | 161 | 103 |

Forest stand GIS data from NSDNR was acquired and scrutinized prior to the execution of the field programs in order to achieve a high-level overview of the site's vegetation and forest structure. Additionally, NSDNR's Forest Ecosystem Classification (FEC) guides were reviewed to determine which of the vegetation types might be encountered. The previously mentioned rare taxa report acquired from ACCDC was scrutinized in terms of the potential species of rare flora which could be present on site.

The NSDNR wetlands database, wet areas mapping, forest cover mapping and recent aerial photographs were also reviewed prior to fieldwork. The NSDNR wetlands database (NSDNR, 2001) identified one major wetland at the southeastern portion of the Project site. NSDNR's wet areas mapping (WAM), which depicts depth to water table (NSDNR, 2012a), coupled with the sites overall low topographic relief, indicated moderately high potential for additional wetlands on site.

The referenced materials enabled the compilation of field maps and briefing notes which facilitated both the design and execution of the necessary field programs with respect to the terrestrial characteristics of the study area.

### *3.2.2 Ecological Field Programs Executed*

To augment the work reference above, a number of specific field programs were undertaken. These are identified in Table 3.3 and outlined in the following sections.

**Table 3.3: Field Programs Undertaken**

| *Field Program* | *Program Description* | *Lead Researcher* |
|---|---|---|
| General ecological field investigations | Ecological reconnaissance, including the identification of wetlands, habitat descriptions and location of streams | Ian Bryson and Carrie Bentley (CBCL Limited) |
| Breeding and migratory bird programs | Field work to identify breeding and migratory bird populations | Chris Kennedy (CBCL Limited) |
| Botanical survey | Field investigation to identify priority plant species | Ian Bryson (CBCL Limited) |
| Lichen program | Field investigation to identify valued lichen species | Tom Neily (MTRI) and Ian Bryson (CBCL Limited) |
| Presence/Absence ungulate survey | Determination of moose presence on site | Melissa Douglas and Chris Kennedy (CBCL Limited) |
| Stream investigations | Field inspections of streams onsite | Carrie Bentley and Melissa Douglas (CBCL Limited) |
| Archaeological program | Field programs in support of desktop study | April MacIntyre (Davis MacIntyre & Associates Limited |
| MEKS program | Investigation of First Nation past and present use of the Project site | Membertou Geomatics Solutions[1] |
| Visibility analysis | Field program to support desktop analysis | Steffen Kaubler and Bruce Mans (Upland)[2] |

1 Ian Bryson (CBCL Limited) went out into the field with representatives from Membertou Geomatics during the latter's field program.

2 Steffen Kaubler and Bruce Mans were at the outset of the environmental assessment employees of CBCL Limited. In 2013 they established their own consultancy.

#### 3.2.2.1 Vegetation and Rare Flora

A comprehensive site survey was conducted to assess the sites overall vegetative communities and to determine the presence of rare species of flora. In order to capture the most species in flower (which is optimal for proper species identification), the surveys were conducted over the course of three separate visits: in mid-June, mid-July and mid-August 2012. This approach is intended to capture the variability in species' flowering times to the greatest extent possible; the timing also aligned well with the forecasted flowering times for the potential rare flora species identified in the ACCDC screening.

In forested areas, individual sites were classified in the field per NSDNR's FEC manual. This system describes all currently recognized forest groups and vegetation types (VTs) in the Province of Nova Scotia (Neily et al., 2011). This information was captured whenever stand conditions changed notably, or whenever otherwise appropriate.

Over the course of the surveys, a general plant species list was generated for all species of vascular flora encountered. Lichens and bryophytes were not documented during these surveys, but were subject to a separate field program (see Section 3.2.2.3). The list of vascular flora encountered was cross referenced against current databases of conservation ranks (ACCDC S-Ranks and NSDNR General Status) as well as against pertinent provincial and federal legislation (i.e., *SARA* and the *Endangered Species Act*).

A handheld GPS (Garmin Map76 Cx) was used for all fieldwork (±5 m spatial accuracy typical), with Project boundaries loaded for guidance while conducting the surveys. Rare species sightings were georeferenced with the same unit. For any rare species sightings, abundance estimates and habitat descriptions were recorded. All GPS waypoints and the track-logs representing the survey routes taken were downloaded upon completion of fieldwork, and incorporated into a GIS map product (Figure 3.2).

The results of the fieldwork undertaken with respect to vegetation and rare flora is presented in Sections 4.3.4 and 4.4.2.

#### 3.2.2.2 Wetlands

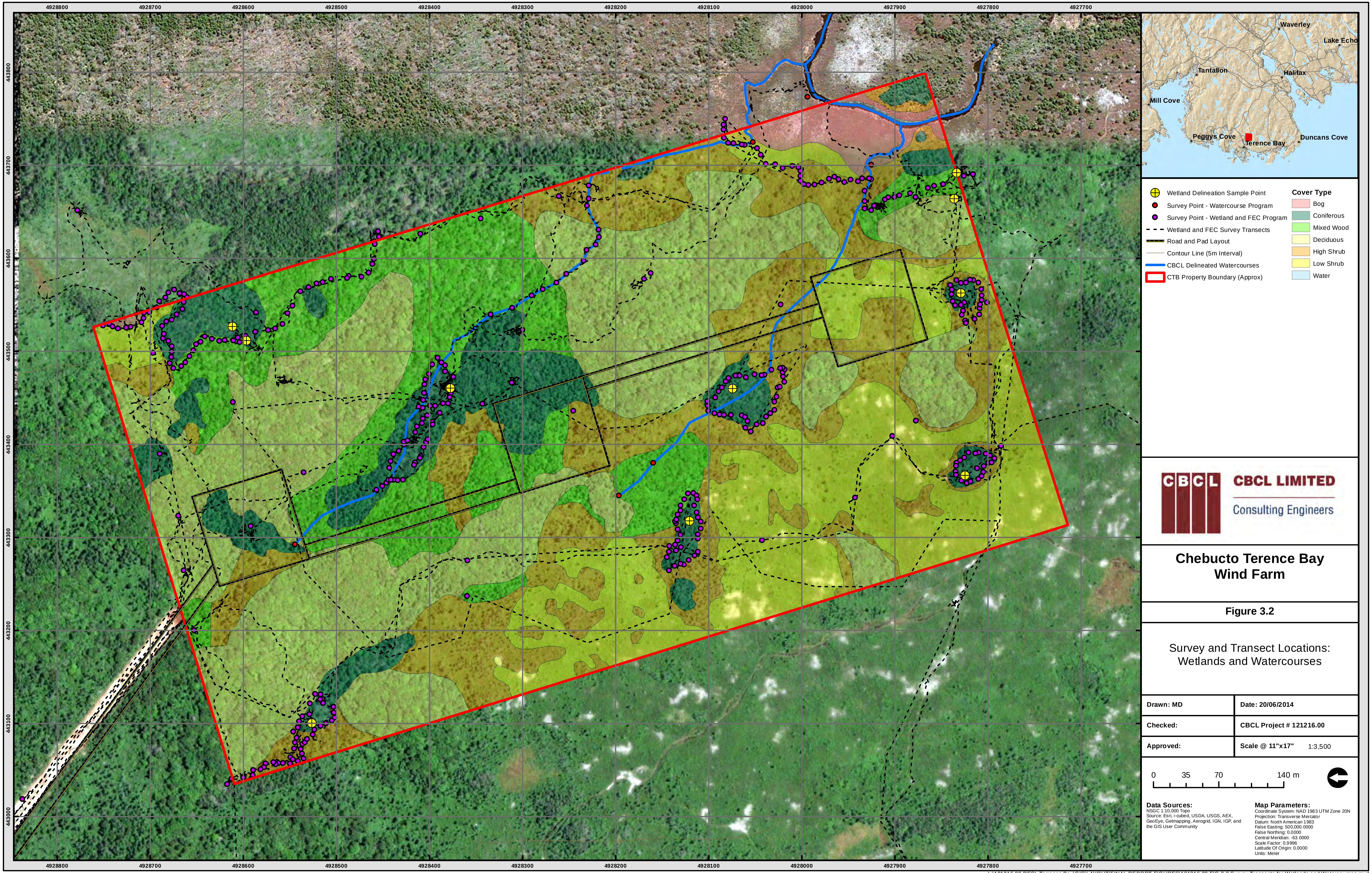
Ground level determination and delineation of wetlands was performed as per the protocols outlined by the US Army Corps of Engineers Wetland Delineation Manual (Environmental Laboratory, 1987). Wetland determination and delineation focused on establishing the wetland-upland edge and was based upon the presence of positive indicators for the following three parameters:

- Hydrophytic vegetation;
- Hydric soils; and
- Wetland hydrology.

In most situations, a positive indicator must be present for all three parameters in order to definitively identify any given site as a wetland. Sample points for these three parameters were established at representative locations, both within the suspected wetlands themselves, and in adjacent upland control sites.

*i) Hydrophytic Vegetation*

Hydrophytic vegetation arises in areas where saturation or inundation by water is of sufficient duration to exert a controlling influence on plant species presence. In such areas, plant species which are adapted to a high-moisture environment tend to dominate. In order for a given area to classify as a wetland, hydrophytic vegetation should account for the majority (>50%) of the sample sites' total vegetation.




L:\121216.00 RESL Terrence Bay\GIS\LAYOUT\FINAL REPORT FIGURES\121216.00 FIG 3.2 Survey Transects for Wetlands and Watercourses.mxd

For every plant species there is a wetland indicator status (see Appendix I), which may be interpreted as that species' estimated probability of occurring within a wetland. If the majority of plant cover in the sample area is comprised of species with facultative (FAC), facultative wetland (FACW) or obligate (OBL) statuses, then the positive indicator for hydrophytic vegetation is met.

Dominant species encountered at each of the sample locations were analyzed at three strata (tree, shrub, and herb) and were documented in terms of their percent cover within a given plot size (10 m, 5 m and 2 m radius, respectively) and their wetland indicator status.

*ii) Hydric Soils*

Hydric soil conditions are formed when an area is exposed to flooding or saturation for a sufficient length of time during the growing season, such that an anaerobic (oxygen free) environment is formed in the soil. These anaerobic conditions may manifest themselves in a variety of ways, such as through the formation of redox features (reduction-oxidation), organic soils, i.e., peat, formation of hydrogen sulphide (rotten egg odour), among other indicators. Interpretation of soil profiles, their associated colour, texture and presence/absence of any hydric soil indicators provides the basis for judgement of whether or not any given soil is a hydric soil.

Soil samples were acquired via test pits and supplemented by soil auger samples to identify conditions in both wetland and upland soils. Soil horizons were documented in terms of their texture, thickness, color (Munsell chroma/value) and presence of hydric soil indicators (where applicable). Hydric soil indicators were determined as per US Department of Agriculture "Field Indicators of Hydric Soils in the United States".

*iii) Wetland Hydrology*

Both at the formal sample locations and over the greater area of each individual wetland, observations were made concerning the presence of a hydrological regime, which would sustain wetland processes. The locations of the site in general, as well as the micro-topography of the specific wetland area, were taken into consideration. Primary hydrology indicators (of which at least one must be present) include surface water, high water table, saturation, sediment deposits, among others. Secondary indicators (of which two are required, in the absence of a primary indicator) include surface soil cracks, drainage patterns among others.

*iv) Wetland Delineation*

Upon positive wetland determination, i.e., positive indicators identified for soils, hydrology and vegetation, a wetland edge condition was established based on the indicators identified at the three-parameter sample points. This edge condition was used to navigate around the periphery of the wetlands. As the wetlands were delineated, flags were placed at the wetland-upland boundary, in order to facilitate a relocation or surveying by others, if required. Handheld GPS waypoints were recorded at each flag location as the delineation was performed. This handheld GPS boundary provides the basis for the final wetland habitat mapping. Wetland inflows and outflows were georeferenced where these were encountered. Whenever possible, hydrological connections to other wetlands, watercourses or waterbodies were determined during the course of this field program.  All wetland boundaries and sampling locations were downloaded into a GIS map product (see Figure 3.2).

The results of the wetland field program are presented in Section 4.4.3.

#### 3.2.2.3 Lichen Field Survey

Predictive mapping has been created using GIS to identify suitable habitat in Nova Scotia for boreal felt lichen (*Erioderma pedicellatum*). This mapping is based on data collected at sites of known occurrences of this endangered cyanolichen species. While this has been found to be a very useful tool, it is not definitive in determining where boreal felt lichen will be found. Areas of mapped or suspected suitable habitat are searched on foot, focusing where conditions exist that create the necessary microclimate and one or more indicator species are present. For the Project site, preferential searches were conduct in areas of coniferous forest composed chiefly of balsam fir (*Abies balsamea*), and in close proximity to sphagnous treed swamps. Upon arriving at a chosen survey site, indicator species were sought first; these are relatively conspicuous species which, when present, indicate the need to assess the site more comprehensively for boreal felt lichen. For this site, indicator species sought included the lichens *Coccocarpia palmicola*, *Lobaria scrobiculata*, *Moelleropsis nebulosa*, as well as the liverwort *Frullania tamarisci*.  In addition to targeted searches for boreal felt lichen, the presence of other cyanolichens was noted.  The results are presented in section 4.3.5.

#### 3.2.2.4 Avifauna Assessment

In accordance with provincial regulatory requirements and Environment Canada recommendations (Environment Canada, 2007a), the primary objective of the avian survey program was to assess avian abundance and diversity during the spring migratory period, the breeding season, the fall migration and the winter months.

During the spring and fall migrations, two types of surveys were employed: migration stop-over counts and diurnal fly-over counts.  The former determines the number and kinds of birds that land in the Project site during this period of migration, while the diurnal fly-over counts examine the number, species, altitude and behaviour of birds flying over the Project site during the daytime.  A clear division between these, however, does not always exist.  Birds that are detected during a migration stop-over survey may have stopped only momentarily while migrating during the day time.  Birds that have migrated all night can sometimes be seen flying in great numbers during the early hours of a diurnal fly-over count as they attempt to gain their bearings, or seek suitable feeding areas.

Migration stop-over counts provide an estimate of the overall magnitude of bird migration that occurs in the area.  Diurnal fly-over counts provide a measure of the importance of an area for migrating birds, and are an important component in evaluating the risk posed to birds from collisions with both the lighted towers and the rotating blades of wind turbines.

The breeding bird survey was designed to determine the number and species of birds that breed in the study area.  This survey was supplemented by a nocturnal count of bird sounds made by species that may breed in the area, but that are typically only detectable at night, or during twilight hours. Breeding bird surveys provide important information on the abundance, diversity and habitat use of bird species that nest on site, or in nearby areas. During the peak breeding survey, for example, control point counts were conducted outside the Project site approximately 1 km distant from the proposed turbine locations, these counts may serve as a pre-construction baseline and control reference for avian breeding activity in the area.

The winter survey was designed to determine the number and species of birds that overwinter in the Project site. The winter surveys provide information on the abundance and species of bird that use the habitat to survive over the winter months.

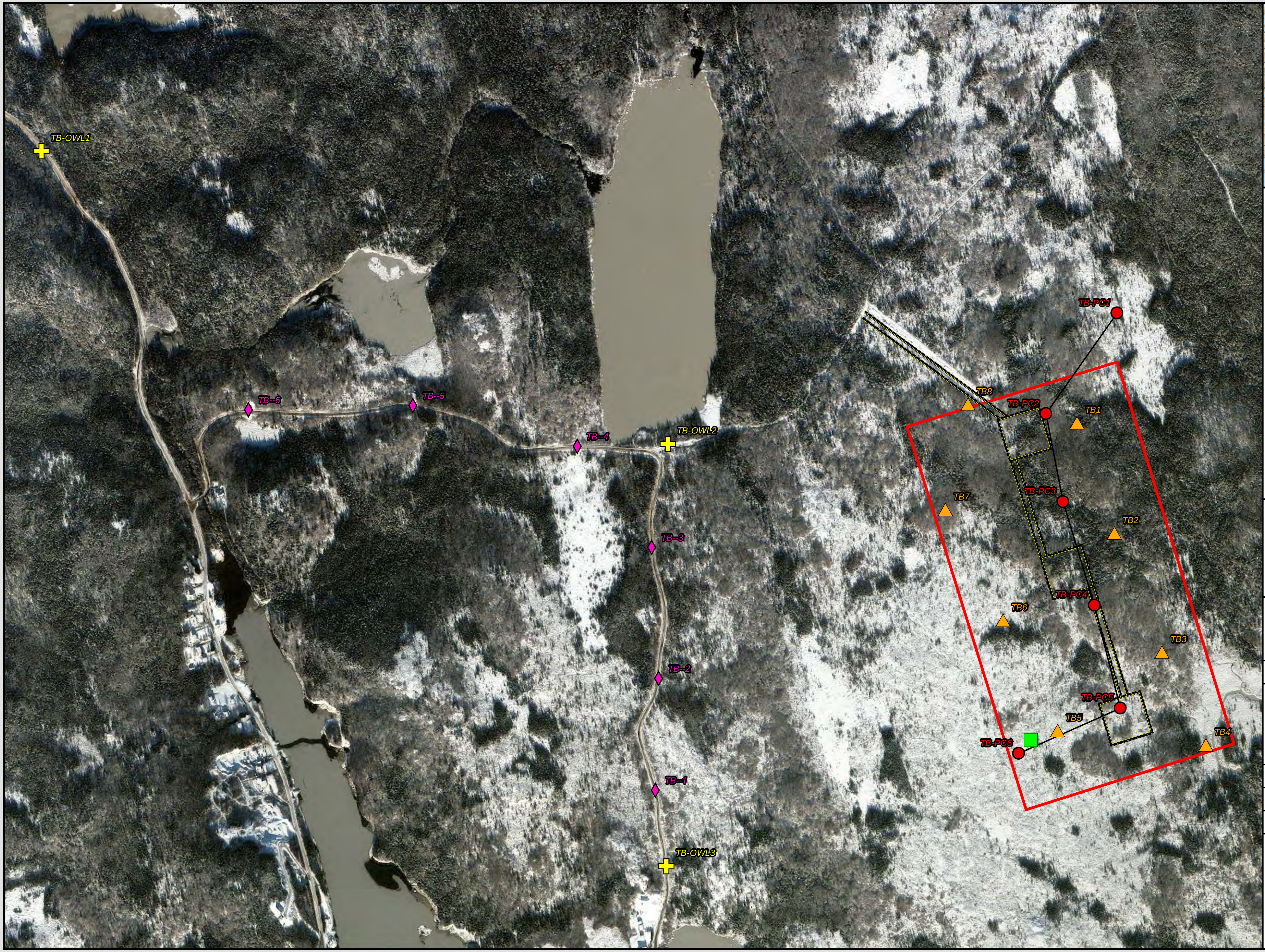
Weather conditions can pose problems in obtaining valid point counts as wind makes it difficult to hear birds. This problem can be compounded in a forested area due to the rustling of leaves. Fog also makes it difficult to see birds and depresses overall bird activity; birds also become inactive during periods of heavy rain. The execution of the avian field program at Terence Bay necessitated some flexibility in approach to take account of weather conditions. Point counts, for example, were not made when wind conditions exceeded 29 km/hour, when visibility was less than 100 m, or when precipitation was greater than a light rain. Weather observations were recorded at the beginning of each transect, at each point count and at the beginning of each 40-minute block in the diurnal fly-over counts. These observations included temperature, sky cover, precipitation, wind direction and speed, and visibility.

The following sections provide more detail on the approach taken to the surveys.

*i) Spring and Fall Migration Stop-over Surveys*

As depicted in Figure 3.3, a transect was established spanning the Project site in proximity to the proposed turbine locations. Due to the relatively small size of the site area, approximately 250 m of the transect is located outside the site boundaries. The transect was 1,500 m in total length and consisted of three segments of 500 m with different habitats dominating in each of the segments. There were six point counts located at 100 m, 350 m, 600 m, 850 m, 1,100 m and 1,350 m along the length of the transect. All birds seen or heard within the distance bands of <50 m, 50-100 m, >100 m, and flying overhead were recorded. During the spring migration, the transect was surveyed five times between April 27 and May 25, 2012. During the fall migration, the transect was surveyed six times between August 29 and October 10, 2012. The transect surveys were started approximately one-half hour after sunrise.

The survey methods employed represent a best attempt to measure bird populations in a dynamic and complex situation. During the spring and fall migratory periods, birds are often moving rapidly and can be concentrated in flocks that have the ability to bias results in one direction or another depending on whether they are detected or not. Furthermore, many species of birds have behaviours that make them more or less easy to detect as compared to other species. Sudden changes in weather conditions can also cause large-scale movements of birds that can last for a very short period and can easily be missed if one is not at the right place at the right time. Survey methods must therefore try to take into account to the extent possible these 'normal'





- Transect Points
- Fly-Over Observation Point
- Breeding Season Point Count Locations
- Control Point Breeding Point Count Locations
- Nocturnal Stations
- Point Count Transect
- Road and Pad Layout
- CTB Property Boundary (Approx)

**CBCL LIMITED**
Consulting Engineers

## Chebucto Terence Bay Wind Farm

**Figure 3.3**

Avian Survey Locations

| | |
|---|---|
| **Drawn:** MD | **Date:** 20/06/2014 |
| **Checked:** | **CBCL Project #** 121216.00 |
| **Approved:** | **Scale @ 11"x17"** 1:8,500 |

0 87.5 175 350 m

**Data Sources:**
NSGC 1:10,000 Topo
Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

**Map Parameters:**
Coordinate System: NAD 1983 UTM Zone 20N
Projection: Transverse Mercator
Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -63.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

inconsistencies of bird migration. Transects are a common approach to measuring bird populations during the migration season; the method that is recommended by the Canadian Wildlife Service (Environment Canada, 2007b) for the environmental impact assessment of wind farms is a variation on the 'fixed-width line transect'. In this method, all birds detected within pre-determined distance bands from the observer walking the transect line are recorded. While all line-transect methods have been shown to have significant biases when compared to more intensive and costly survey methods, they remain a viable alternative for environmental impact assessments subject to time constraints (Tilghman and Rusch, 1981). Point counts are the most common survey method for measuring populations of breeding birds and, like transects, provide the most accurate results relative to the time and cost invested (Ralph et al., 1995). Using a combination of both the line transect and point count methodologies in this study provided for a more accurate depiction of the main migratory movements of birds through the Project site.

*ii) Diurnal Fly-over Surveys*

Diurnal fly-over surveys were conducted from one observation point in the Project site. The choice of the observation point was based on the extent to which it provided as close as possible a 360 degree extended view of the air space, its proximity to wind turbine locations and its elevation relative to the surrounding landscape. The location of the observation point is shown Figure 3.3. Most of the diurnal fly-over surveys were conducted from mid-morning to early afternoon, the time when warm air thermals rise from the land. The movements of birds such as raptors (hawks & eagles) and corvids (ravens & crows) are often timed so they can ride these thermals. The diurnal fly-over survey consisted of twelve 40-minute observation blocks completed between May 2 and May 15, 2012, for a total of 8 hours of observation and twenty-eight 40 minute observation blocks completed between August 29 and October 19, 2012, for a total of 18 hours and 40 minutes of observation. All birds seen during this time period were recorded according to their species, number of individuals, direction of flight and altitude relative to the forest canopy. Groups of birds passing through the observation space were recorded as one observation of multiple individuals.

*iii) Breeding Bird Survey*

Bird species that began their nesting season before June 1 were considered early breeders. The six point counts along the migration stop-over transect were used to survey these birds. As each species entered their nesting season, they were counted on these point counts as breeders rather than migrants. Between April 27 and May 25, 2012, each of these point counts was surveyed five times. For each species, only the data obtained during their particular time of breeding was compiled.

Nesting in the study area can begin as early as the last week of February (Great Horned Owl) and first week of March (Common Raven) and continue to mid-September (Red-eyed Vireo, American Goldfinch and others). The vast majority of birds, however, including many of the early and late breeders, are engaged in nesting activities during the months of June and early July. The weeks extending from June 1 to July 15 are referred to in this study as the peak breeding season. The peak breeding survey consisted of eight point count locations dispersed throughout the Project site (Figure 3.3). Each point count location was surveyed twice: once on June 9$^{th}$ and again on June 21$^{st}$. Point counts were conducted from one-half hour before sunrise to four hours after sunrise. A

further six point counts, surveyed twice, were conducted outside of the Project site as control points. In contrast to the early breeding season point counts, priority was given to broad geographical coverage at the cost of intensive coverage at the station level.
The point counts conducted as part of the spring migration stop-over survey served to measure the abundance of early breeders. The start of the breeding period, as opposed to the migration period, of these early nesters was determined by using data from the Maritime Breeding Bird Atlas (http://www.mba-aom.ca/english/breeding_dates.pdf).

A transect search was also conducted to detect breeding crepuscular and nocturnal species that are not normally seen during the daytime (Figure 3.3). In the study area, this includes the American Woodcock, Great Horned Owl, Barred Owl and the Northern Saw-whet Owl. This took place on May 11, 2012 and followed the *Guidelines for Nocturnal Owl Monitoring in North America* (Takats et al., 2001). It is recommended point counts have 1.6 km between locations. Due to space constraints within the Project site and for safety reasons, the crepuscular and nocturnal breeding survey was done outside of the Project site in proximity to River Road.

As mentioned in reference to migration stop-over surveys, the detectability of birds can greatly influence survey results. Point counts made during the breeding season are greatly skewed toward detecting singing males. Many birds are likely neither seen nor heard. Studies suggest that point counts detect anywhere from 50-80% of the birds present depending on the length of each count and the number of counts performed repeatedly at the same station (Cyr et al., 1995; Petit et al., 1995; Barker and Sauer, 1995). To detect all of the species and individuals present in forested areas, the ideal sampling time at each station was found to be 100 minutes (Buskirk and McDonald, 1995). Concessions must be made regarding the time spent at each sampling point, the size of the area to be sampled and the number of habitats surveyed. Point counts of 10-minute duration do not provide good estimates of the absolute population of birds, but as noted by Petit et al. (1995), studies have shown that the mean number of birds of each species detected using these shorter point counts corresponds well proportionately with measures of absolute numbers. Hence, they can be used to estimate the relative abundance of the species present. Moreover, if one assumes that a constant fraction of the total population is counted in particular habitats, or from one year to the next, then point counts can provide a useful index of habitat use, population trends over time and responses to changing habitat conditions (Pendleton, 1995; Dawson et al., 1995; Ralph et al., 1995). The objective of the breeding survey was to provide baseline data to facilitate monitoring population trends both generally and in relation to habitat changes over time.

*iv) Overwintering Bird Survey*

The winter season survey is designed to detect and record those species which use the study area to survive over the winter months (November to March). The overwintering bird survey transect was the same as that used for the spring and fall migration surveys (Figure 3.3). The transect was surveyed three times between November 28 and January 16, 2012, and began between one-half hour and one hour after sunrise as many birds become active later in the morning in response to the cold dawn temperatures.

#### 3.2.2.5 Aquatic Ecology

Reconnaissance level fish and fish habitat assessments were conducted for three watercourses identified in the Project site on September 12, 2012. Locations are identified on Figure 3.2.

Data collected for the reconnaissance level assessments was adapted from the Reconnaissance (1:20000) Fish and Fish Habitat Inventory for British Columbia: Standards and Procedures (RIC, 2001) and was in accordance with Fisheries and Oceans Canada (DFO) protocols. Observed fish habitat conditions were quantified in order to adequately evaluate the quality of fish habitat for overwintering, rearing and spawning. In general, the fish habitat data collected included information on the following:

- Substrate (types and percent);
- Cover (types and percent);
- Wetted and channel width (where applicable);
- Approximate water depth;
- Morphology;
- Unique watercourse characteristics (e.g., bars, islands, pattern);
- Approximate velocity (where applicable);
- Crown closure;
- Water Quality (Dissolved Oxygen, Temperature and pH)
- Incidental vegetation; and
- Photographs and UTM locations.

Watercourses were classified as ephemeral, intermittent or small permanent. Definitions for each type of watercourse found within the Project site are provided below:

- Ephemeral watercourses are not considered fish habitat. These watercourses have no defined bed or banks and are often vegetated across with grasses or mosses. Ephemeral watercourses are usually dry, but can flow or have pockets of water during certain times of the year, especially after heavy rainfall or spring runoff;
- Intermittent watercourses have defined channels, beds and banks and the channel widths are typically less than 2 m in size. These watercourses can flow during part or most of the year, but have a period of no flow at some point in the year;
- Small permanent watercourses have defined channels, beds and banks. The channel widths are typically between 2 m and 5 m in size and flow throughout the year; and
- Large permanent watercourses have defined channels, beds and banks. The channel widths are typically greater than 5 m in size and flow throughout the year.

Spawning habitat quality was based on water flow and substrate. Rearing habitat quality was based on cover and water flow. Overwintering habitat quality was based on the presence or absence of deep pools or ponds (≥ 50 cm) and the potential for year round flow. The potential for fish presence year round was based on the results from the specific water quality measurements (e.g., dissolved oxygen and pH), habitat quality at the time of the assessment and the quality of habitat in conjunction with connectivity to other watercourses.

#### 3.2.2.6 Ungulate Survey

A presence/absence ungulate survey was conducted on February 17 and 18, 2014, and consisted of 10 transects separated by 50 m running parallel with the site boundaries (Figure 3.4). Each transect ran from one end of the site to the other, a distance of approximately 900 m. Each habitat type in the Project site was surveyed several times, with the exception of habitats only occurring once or twice. Habitat types have been categorized as follows:

- Mixed-wood forest;
- Coniferous forest (inclusive of treed swamps)(>75% conifers);
- Deciduous forest (>75% deciduous trees);
- High shrub barren;
- Low shrub barren; and
- Bog.

For each transect surveyed, all observed evidence, i.e., visual observation, call, scat, tracks, antlers, skeletons, height of browse, of either moose or white-tailed deer (*Odocoileus virginianus*) was recorded; these locations were marked with a GPS. The height of browse from the ground was used to determine the likelihood that it was caused by an eastern moose. Distinguishing between the different browsing ungulates is difficult, but the height of browsing can be a clue; for example, large moose may browse as high as 2.3 m, while deer browse is typically below 1.5 m (BCMOF/CFS, 2001). Height measurements and photographs were taken whenever possible. All incidental evidence of moose or deer enroute between transects was also documented. Additionally, the locations of other wildlife such as snowshoe hare (*Lepus americanus*) and North American porcupine (*Erethizon dorsatum*) were noted and mapped. The results of the winter ungulate survey are provided in Section 4.4.7.

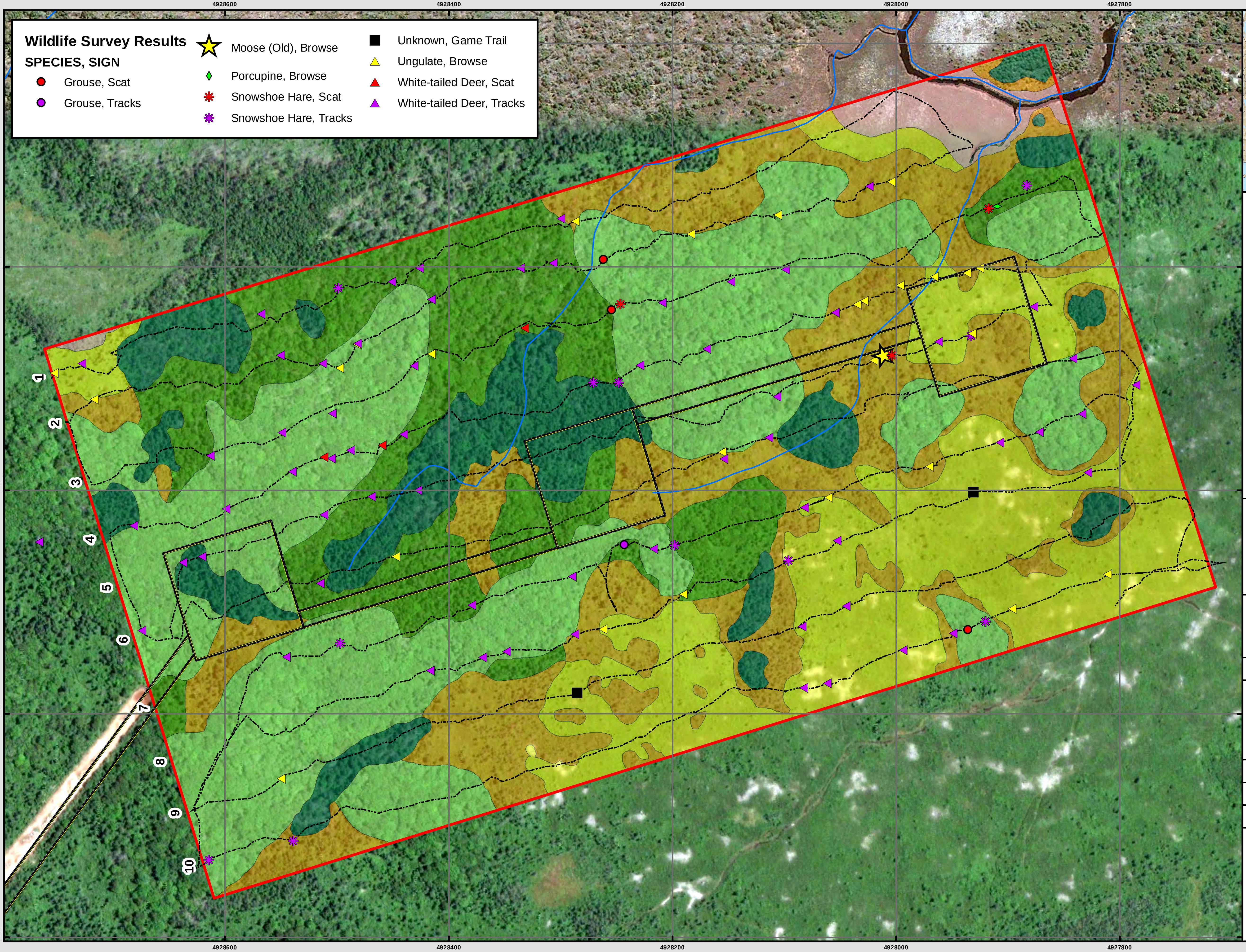
### *3.2.3 Other Field Programs Executed*

#### 3.2.3.1 Archaeological

Davis MacIntyre & Associates Limited was contracted in August, 2012 to conduct an Archaeological Resource Impact Assessment for the proposed project. The assessment performed under Heritage Research Permit A2012NS055 (December 20, 2012) consisted of three main components:

- Historical maps and manuscripts and published literature were consulted at Nova Scotia Archives in Halifax;
- The Maritime Archaeological Resource Inventory, a database of known archaeological resources in the Maritime region, was searched to understand prior archaeological research and known archaeological resources neighboring the study area; and
- A field reconnaissance was conducted in order to further evaluate the potential for both buried and surficial archaeological resources. Each of the proposed turbine sites was located with the aid of a hand-help GPS unit and field notes and photographs were taken at each site and in areas between the turbine sites.

In early 2014 Davis MacIntyre and Associates Ltd. were asked to visit the site and complete the work with respect to the access road (Heritage Research Permit A2014NS010). The Archaeological





Survey Transects
CBCL Delineated Streams 2013
Road and Pad Layout
CTB Property Boundary (Approx)

**Cover Type**

- Bog
- Coniferous
- Mixed Wood
- Deciduous
- High Shrub
- Low Shrub

**CBCL LIMITED**
Consulting Engineers

## Chebucto Terence Bay Wind Farm

**Figure 3.4**

Ungulate Survey Transects and Habitat Mapping

| | |
|---|---|
| Drawn: MD | Date: 20/06/2014 |
| Checked: | CBCL Project # 121216.00 |
| Approved: | Scale @ 11"x17" 1:3,200 |

0 30 60 120 m

**Data Sources:**
NSGC 1:10,000 Topo

**Map Parameters:**
Coordinate System: NAD 1983 UTM Zone 20N
Projection: Transverse Mercator
Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -63.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

L:\121216.00 RESL Terrence Bay\GIS\LAYOUT\FINAL REPORT FIGURES\121216.00 FIG 3-4 Ungulate Survey Results.mxd

Resource Impact Assessment is reproduced in its entirety in Appendix J; the results are summarized in section 4.5.5.

### 3.2.3.2 Mi'kmaq Ecological Knowledge Study (MEKS)

A Mi'kmaq Ecological Knowledge Study (MEKS) was undertaken by Membertou Geomatics Solutions in the fall of 2013. The MEKS mandate was to consider the land and water areas which the proposed project will utilize and to identify what Mi'kmaq traditional use activities have occurred, or are currently occurring within and in proximity to the Project site. In addition, consideration was given to the Mi'kmaq ecological knowledge that presently exists in regards to the area. In order to ensure accountability and ethic responsibility for the MEKS, its development adhered to the 'Mi'kmaq Ecological Knowledge Protocol', a document established by the Assembly of Nova Scotia Mi'kmaq Chiefs, which speaks to the process, procedures and results that are expected of a MEKS.

The work program involved two major components:

- The identification of Mi'kmaq traditional land and resource use activities, both past and present, that take or took place in the vicinity of the Project site; and
- A Mi'kmaq significance species analysis that considered the resources in and in the vicinity of the Project site that are important to Mi'kmaq use.

The execution of the MEKS involved the following key activities:

- interviews with informants in Gold River, Wildcat, Cole Harbour, Shubenacadie and Millbrook who had knowledge of, or undertook, traditional land use activities within the study area;
- research or archival material including documents, maps, oral histories and published works; and
- site visits and field sampling to identify any species of plant, animal or bird, or other land or water feature, that would be of importance to the Mi'kmaq.

The MEKS is reproduced in its entirety in Appendix K and the results are summarized in section 4.5.6.

### 3.2.3.3 Visibility Analysis

Aesthetics are often a fundamental question for those who have concerns about wind-energy projects. The question is not whether wind turbines are beautiful or not, but rather to what degree they may affect important visual resources in the surrounding area. Therefore the evaluation needs to focus on the relationship of the Project to the scenic features of the surrounding landscape. In understanding visual impacts it is useful to understand the broader context of the view. Furthermore, it is essential to create technically accurate simulations of the wind farm. The methodology used to assess the visual impact of the proposed Terence Bay Wind Farm is outlined in Figure 3.5.

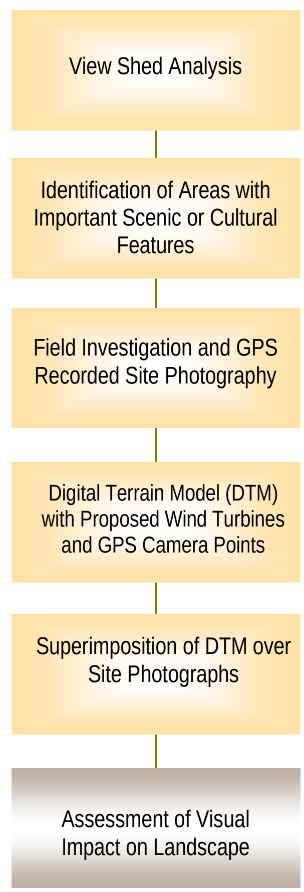



Figure 3.5: Visual Assessment Methodology

*View Shed Analysis*

A computer generated map based on a digital terrain model of the area was prepared that illustrates where the proposed wind farm could potentially be visible within the study area (Figure 3.6). This map, however, based on a digital terrain model, does not take into account surface elements like vegetation or buildings that might block views. Field analysis was therefore essential to verify actual visibility.

The identification of areas with important scenic or cultural features typically focuses on areas of public use. These include public roads, recreation areas, trails, wilderness or natural areas, historic sites, village centres and other important scenic or cultural features identified in planning documents, or by the public themselves. To facilitate the visual assessment, high resolution photographs were taken from six locally important viewpoints with a 50 mm focal length lens (this most closely matches the human eye). Each of the viewing points was recorded by GPS (see Figure 3.7); these are as follows:

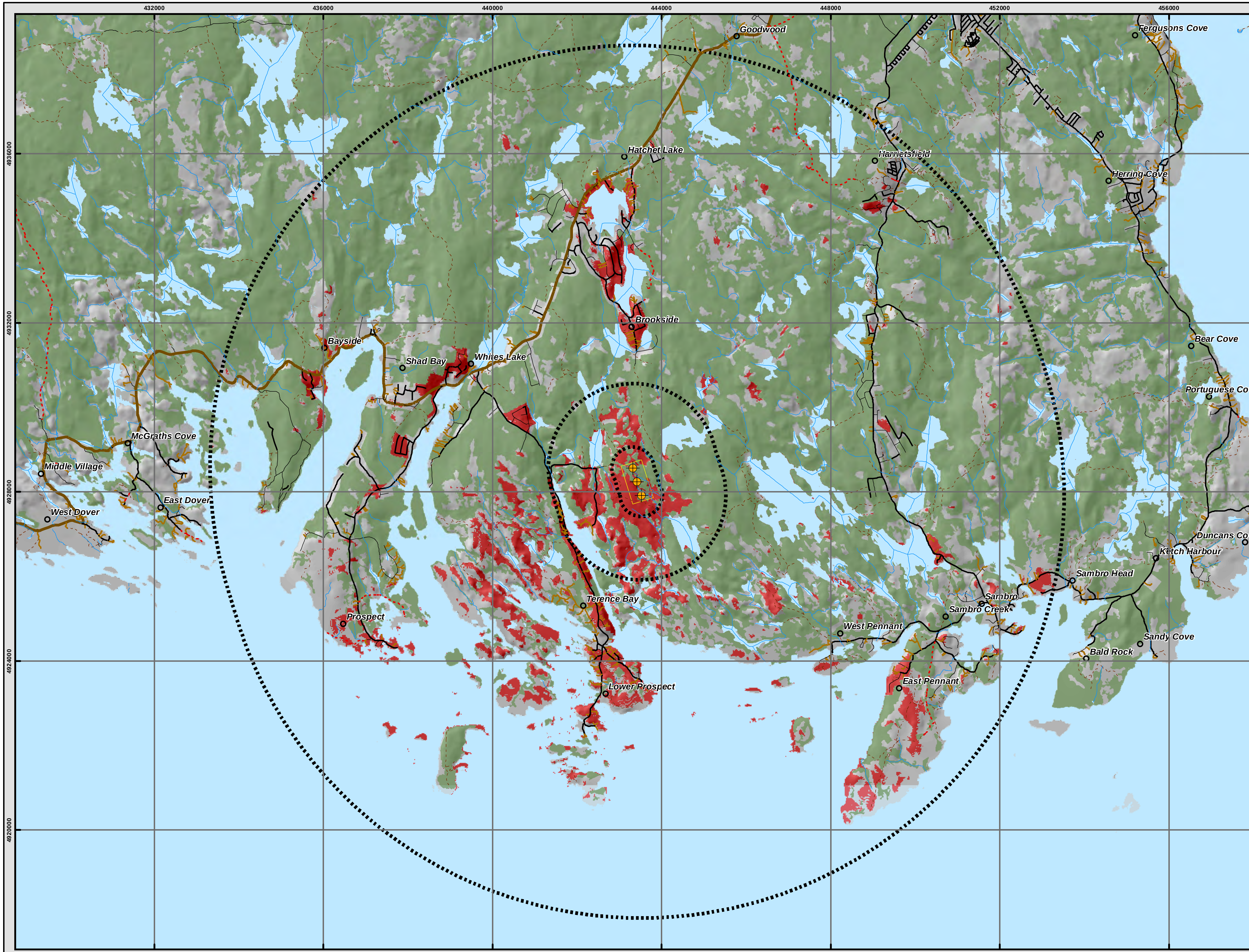
- Viewing Position 1 on River Road, 1.2 km away from the nearest turbine;
- Viewing Position 2 on River Road, 1 km away from the nearest turbine;
- Viewing Position 3 on Terence Bay Road, 1.9 km away from the nearest turbine;
- Viewing Position 4 at the Terence Bay Road Park and Terence Bay Boat Launch, 1.9 km away from the nearest turbine;
- Viewing Position 5 on Terence Bay Road, 2.4 km away from the nearest turbine; and
- Viewing Position 6 at a walking trail part of the SS Atlantic Heritage Interpretation Park and Interpretation Centre on Sandy Cove Road, 4.1 km away from the nearest turbine.

*Digital Terrain Model*

Using the GIS data of the study area, a digital terrain model was created and the exact turbine locations and heights inserted into the model. Accurate digital images of the terrain were then created from the field points recorded. The views created resembled the same field of view, i.e., focal length, as used for the site photography. The images of the digital terrain model were then merged with the site photographs, and photographic images of the wind turbines are placed in the locations indicated by the digital terrain model. The results of this analysis are presented in Section 7.4.4.

#### 3.2.3.4 Noise

An independent sound analysis was undertaken using WindPro 2.9.207, which provides a comprehensive suite of wind farm design and modeling software. The sound model is based on the ISO 9613-2: Attenuation of Sound during Propagation Outdoors, Part 2. This international standard provides a conservative estimate of sound propagation and subsequent environmental attenuation as a result of ground porosity, atmospheric attenuation and geometric spreading. Ground attenuation was considered and used the alternative case described in the ISO-9613-2 standard. This method uses the surface shape of the terrain to determine the sound dampening characteristic between the turbine hub and the receiver. The earth is considered to be a bare earth model with no forest, vegetation or buildings. The terrain model was developed from 5 m contour data obtained from the Nova Scotia Geomatics Centre.





- Turbine Configuration
- Rivers and Streams
- CTB Property Boundary
- 500m, 2000m, 10000m Buffer
- Open Water
- Forest Cover > 2m

**Viewshed Analysis**

- Not Visible
- Visible Poles within 10km Radius
- Collector
- Paved Road
- TCH
- Unpaved Road
- Railroad
- Lanes / Driveways
- ROAD ruin/inactive/abandoned
- Cart Track / Footpath

CBCL LIMITED
Consulting Engineers

# Chebucto Terence Bay Wind Farm

Figure 3.6

Potential Turbine Visibility

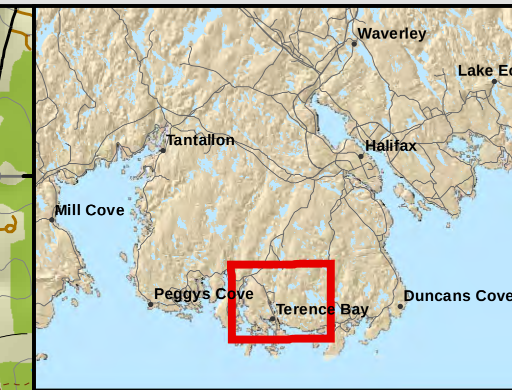
| | |
|---|---|
| Drawn: MD | Date: 20/06/2014 |
| Checked: | CBCL Project # 121216.00 |
| Approved: | Scale @ 11"x17" 1:85,000 |

0 850 1,700 3,400 m

**Data Sources:**
NSGC 1:10,000 Topo

**Map Parameters:**
Coordinate System: NAD 1983 UTM Zone 20N
Projection: Transverse Mercator
Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -63.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

L:\121216.00 RESL Terence Bay\GIS\LAYOUT\FINAL REPORT FIGURES\121216.00 FIG 3-6 Potential Turbine Visibility.mxd


Turbine Configuration
Photo Montage Locations
Rivers and Streams
Contours
500m, 2000m Buffer
Open Water
CTB Property Boundary (Approx)
Forest Cover
Collector
Paved Road
TCH
Unpaved Road
Railroad
Lanes / Driveways
ROAD ruin/inactive/abandoned
Cart Track / Footpath

**CBCL LIMITED**
Consulting Engineers

## Chebucto Terence Bay Wind Farm

Figure 3.7

Visibility Analysis: Viewing Points

| | |
|---|---|
| **Drawn:** MD | **Date:** 20/06/2014 |
| **Checked:** | **CBCL Project #** 121216.00 |
| **Approved:** | **Scale @ 11"x17"** 1:35,000 |

0 360 720 1,440 m

**Data Sources:**
NSGC 1:10,000 Topo

**Map Parameters:**
Coordinate System: NAD 1983 UTM Zone 20N
Projection: Transverse Mercator
Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -63.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

L:\121216.00 RESL Terrence Bay\GIS\LAYOUT\FINAL REPORT FIGURES\121216.00 FIG 3.7 Visibility Analysis - Viewing Points.mxd

The A-weighted sound pressure levels were modeled and represent the range of frequencies that are audible to the human ear. Noise emission data that summarize test results from field measurements for a variety of wind speeds were obtained from the turbine manufacturer. One third octave band data were provided and were used as model inputs. The highest sound pressure levels occur at a wind speed of 7 m/s; these were therefore used in the analysis. The turbine parameters used are summarized in Table 3.4.

**Table 3.4: Turbine Specifications Used in the Sound Modeling**

| ***Description*** | ***Specification*** |
|---|---|
| Manufacturer | Enercon |
| Model | E-92 |
| Hub Height | 85 m |
| Rotor Diameter | 92 m |
| Operation Mode | Full Power |
| Rated Power Output | 2,350 kW |
| Maximum Sound Level (7 m/s) | 105.4 dBA |

A conservative and standardized approach was incorporated into the analysis based on modelling sound pressure levels at all buildings located within 2 km of the proposed wind turbines. A total of 94 receptors were included in the analysis; the results are summarized in section 4.5.7 and additional data is provided in Appendix L.

### *3.2.4 Flicker*

An independent shadow flicker analysis was undertaken using WindPro 2.9.207 which provides a comprehensive suite of wind farm and modelling software. The analysis was based on a worst case scenario which assumed that:

- The sun shines 100% of the time when it is above the horizon;
- The turbine rotor is always perpendicular to the sun;
- Shadow flicker starts as the sun moves above 3° of the horizon;
- The shadows dissipate at a maximum distance from the blades as a result of atmospheric conditions and light diffusion; and
- The rotor blades are always spinning.

The total length of the shadow influence in the atmosphere is calculated from the physical dimensions of the blade. In this analysis, the maximum shadow distance from the E-92 was calculated to be 1,517 m. In most jurisdictions, a maximum of 30 hours of shadow flicker per year and a maximum of 30 minutes per day are the threshold parameters used to define the acceptable level of flicker from wind projects. A preliminary analysis was run to identify buildings that might be impacted by shadow flicker. All buildings that were potentially impacted were included as shadow receptors in the running of the model. All these buildings were considered to be habitable with one window that is perpendicular to the turbines. The results of the modelling undertaken are presented in section 4.5.8 and the detailed results provided in Appendix M.

# CHAPTER 4 ENVIRONMENTAL BASELINE

## 4.1 Geophysical Environment

### *4.1.1 Climatology and Meterology*

At the regional scale, Atlantic Canada lies within a zone of prevailing westerly winds that carry air from the interior of the North American continent. This zone experiences the passage of high and low pressure systems which are in turn influenced by ocean currents and continental topography. The low pressure systems moving through this area typically track across the continent, or up the seaboard, resulting in the onset of wind from an easterly direction, thickening cloud and a gradual drop in pressure. The frequent movement of such systems through Atlantic Canada brings significant precipitation. Winters are usually cold with frequent snowfall and freezing precipitation. Spring is typically late (sometime in May), cool and cloudy. Summers are short in duration, warm and are characterized by less precipitation than in other seasons (Davis and Brown, 1996; Environment Canada Climate Normals 1971-2000).

In recent years, extreme weather events have been occurring more frequently. The Province has been subjected to both drought and intense storms, including the landfall of Hurricane Juan in September 2003. Tropic weather events are expected to be both more intense and frequent as the effects of climate change influence ocean warming and coastal currents. Climate models predict an increase in extreme local events throughout this century (NSE, 2013).

This section provides a general description of the region's climate, i.e., climate norms, over a 30-year period and the meteorological conditions at the Terence Bay wind farm site. The site is situated in the Atlantic Coastal Climate Region, which is characterized by a strong coastal influence resulting in the coolest summer and the warmest winter temperatures in the province.

Climate norms, i.e., 30-year averages, for the 1971 to 2000 period are from the weather station located at Citadel Hill in Halifax for temperature and precipitation and the weather station located at Stanfield International Airport for Wind; these are tabulated in the sections that follow. Extreme weather data are also provided for the period of record.

#### 4.1.1.1 PRECIPITATION

Precipitation data recorded is summarized in Table 4.1. The total annual precipitation (1508 mm) is defined as the total rainfall plus water equivalent of snowfall and other forms of frozen precipitation. Rainfall is generally higher in the fall, with snow and freezing precipitation frequent between October and March. Monthly precipitation ranges from 98.3 mm in August to 160.2 mm in December.

**Table 4.1: Precipitation Normals and Extremes**

| *Month* | *Mean Rainfall (mm)* | *Mean Snowfall (cm)* | *Total Precipitation (mm)* | *Extreme Daily Rainfall (mm)* | *Extreme Daily Snowfall (cm)* | *Extreme Daily Precipitation (mm)* |
|---|---|---|---|---|---|---|
| **JAN** | 112.3 | 38.4 | 150.7 | 88.6 | 39 | 93.7 |
| **FEB** | 76.2 | 37.7 | 113.8 | 59.2 | 41.2 | 59.2 |
| **MAR** | 106 | 28.4 | 134.4 | 82.6 | 31 | 82.6 |
| **APR** | 111.3 | 9.8 | 121.1 | 73.2 | 22.9 | 73.2 |
| **MAY** | 118.1 | 1.2 | 119.4 | 72.1 | 20.3 | 72.1 |
| **JUN** | 108 | 0 | 108 | 65.8 | 0 | 65.8 |
| **JUL** | 105.9 | 0 | 105.9 | 93.8 | 0 | 93.8 |
| **AUG** | 98.3 | 0 | 98.3 | 118.1 | 0 | 118.1 |
| **SEP** | 107.1 | 0 | 107.1 | 96.3 | 0 | 96.3 |
| **OCT** | 134.4 | 1 | 135.4 | 81.3 | 12.7 | 81.3 |
| **NOV** | 146.8 | 6.9 | 153.7 | 99.1 | 22 | 99.1 |
| **DEC** | 131.7 | 28.5 | 160.2 | 95.3 | 44 | 95.3 |
| **YEAR** | 1356.1 | 151.8 | 1508 | - | - | - |

Source: Environment Canada Climate Normals: 1971-2000

### 4.1.1.2 Temperature

The Atlantic Provinces tend to experience a large annual temperature variation. Daily mean temperatures range from -4.4°C in January to 18.9°C in August. The annual daily mean is 7.2°C. Daily maxima, minima and extreme temperatures at the Halifax weather station are reported in Table 4.2.

**Table 4.2: Temperature Normals and Extremes**

| *Month* | *Daily Maximum (°C)* | *Daily Minimum (°C)* | *Daily Mean (°C)* | *Extreme Maximum (°C)* | *Extreme Minimum (°C)* |
|---|---|---|---|---|---|
| **JAN** | -0.2 | -8.6 | -4.4 | 14 | -26.1 |
| **FEB** | -0.1 | -8.1 | -4.1 | 16 | -25 |
| **MAR** | 3.5 | -4.2 | -0.3 | 23.5 | -21 |
| **APR** | 8.4 | 0.8 | 4.6 | 26.1 | -12 |
| **MAY** | 14.1 | 5.5 | 9.8 | 33.3 | -2.8 |
| **JUN** | 19.4 | 10.5 | 15 | 34 | 1.7 |
| **JUL** | 22.9 | 14.2 | 18.6 | 33 | 7.2 |
| **AUG** | 23 | 14.8 | 18.9 | 33.9 | 6.1 |
| **SEP** | 19 | 11.4 | 15.2 | 32.2 | 1 |
| **OCT** | 13.1 | 5.9 | 9.6 | 24 | -5 |
| **NOV** | 7.9 | 1.2 | 4.5 | 20 | -13.9 |
| **DEC** | 2.6 | -5.1 | -1.3 | 16.7 | -23.3 |
| **YEAR** | 11.2 | 3.2 | 7.2 | - | - |

Source: Environment Canada Climate Normals: 1971-2000

4.1.1.3 WIND

Table 4.3 provides a summary of wind data at the Stanfield International Airport Weather Station. The average annual wind speed is 16.8 km/h. Maximum hourly speeds of 89 km/h were measured in February. A maximum gust speed of 132 km/h was recorded in December.

**Table 4.3: 30-Year normals wind data: Stanfield International Airport weather station**

| ***Wind*** | ***Average Per Month*** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ***J*** | ***F*** | ***M*** | ***A*** | ***M*** | ***J*** | ***J*** | ***A*** | ***S*** | ***O*** | ***N*** | ***D*** | ***Year*** |
| Speed (km/h) | 18.6 | 18.4 | 19 | 18.6 | 16.7 | 15.6 | 14.5 | 13.5 | 14.6 | 16.1 | 17.6 | 18.4 | 16.8 |
| Prevailing Direction | W | W | W | S | S | S | S | S | S | S | NW | W | S |
| Maximum hourly speed (km/h) | 80 | 89 | 77 | 71 | 64 | 64 | 79 | 56 | 85 | 68 | 74 | 85 | - |
| Maximum Gust Speed (km/h) | 117 | 127 | 126 | 115 | 92 | 97 | 130 | 89 | 93 | 109 | 111 | 132 | - |
| Direction of Maximum Gust | SE | SW | SW | SE | SE | N | SE | NW | S | SE | S | SE | SE |

Source: Environment Canada Climate Normals, 1971-2000.

4.1.1.4 AIR QUALITY

Because of the location of the Project site and the fact that the Project will not generate emissions, no laboratory testing to determine air quality was undertaken. It is expected that the area's air quality is comparable to that across most of rural Nova Scotia.

### *4.1.2 Topography and Physical Setting*

The Project site is located approximately 25 km southwest of downtown Halifax on the Chebucto Peninsula. This area is located in the Granite Barrens district of the Atlantic Coast theme region, as described in the *Natural History of Nova Scotia* (Davis and Brown, 1996). Much of the landscape is covered by coastal barrens, exposed rock and scrubby vegetation. The community of Terence Bay is home to 824 people (2006 census) and is part of HRM.

The Project site encompasses 45 hectares of land located approximately 8 km north of the Atlantic coast (Figure 1.1). This parcel of land sits between Fourth Lake (to the north-west), Lake Frederick (to the north-east) and Brophys Back Lake (to the south-east); the site is accessible from River Road. Elevation in the Project site ranges from 50 to 75 m above sea level. The Project site lies adjacent to the Terence Bay Provincial Wilderness Protected Area, which comprises 4,450 ha of coastal and near coastal land.

#### *4.1.3 Geology*

Terence Bay falls into the Pennant Barrens unit of the Granite Barrens theme region (district 850) as described in the *Natural History of Nova Scotia* (Davis and Brown, 1996). The geology in this region is dominated by granite with thin, rocky tills and acidic soils. Granite is an impermeable crystalline rock and water can only penetrate where joints exist. As a result, water often pools on the surface to form many streams, lakes and bogs. The bedrock is shallow and exposed in many places. Glacial erratics of varying sizes are found randomly across the landscape. The dominant soil found in this area are of the Gibraltar series (well-drained sandy loam), with lesser amounts of Aspotogan soils and peat.

The Project site falls within two separate ecodistricts; the Eastern Shore Ecodistict (820) of the Atlantic Coastal Ecoregion, and the St. Margaret's Bay Ecodistrict (780) of the Western Ecoregion, as defined by the NSDNR. Land classification is further broken down into ecosections based on landform/topography, soils and vegetation. Three different ecosections are found within the Project site:

- WCHO: well drained, coarse textured soil on hummocky terrain
- ICHO: Imperfectly drained, coarse textured soils on hummocky terrain
- WFDM: well drained, fine textured soil on drumlins or flutes (Neily et al., 2003).

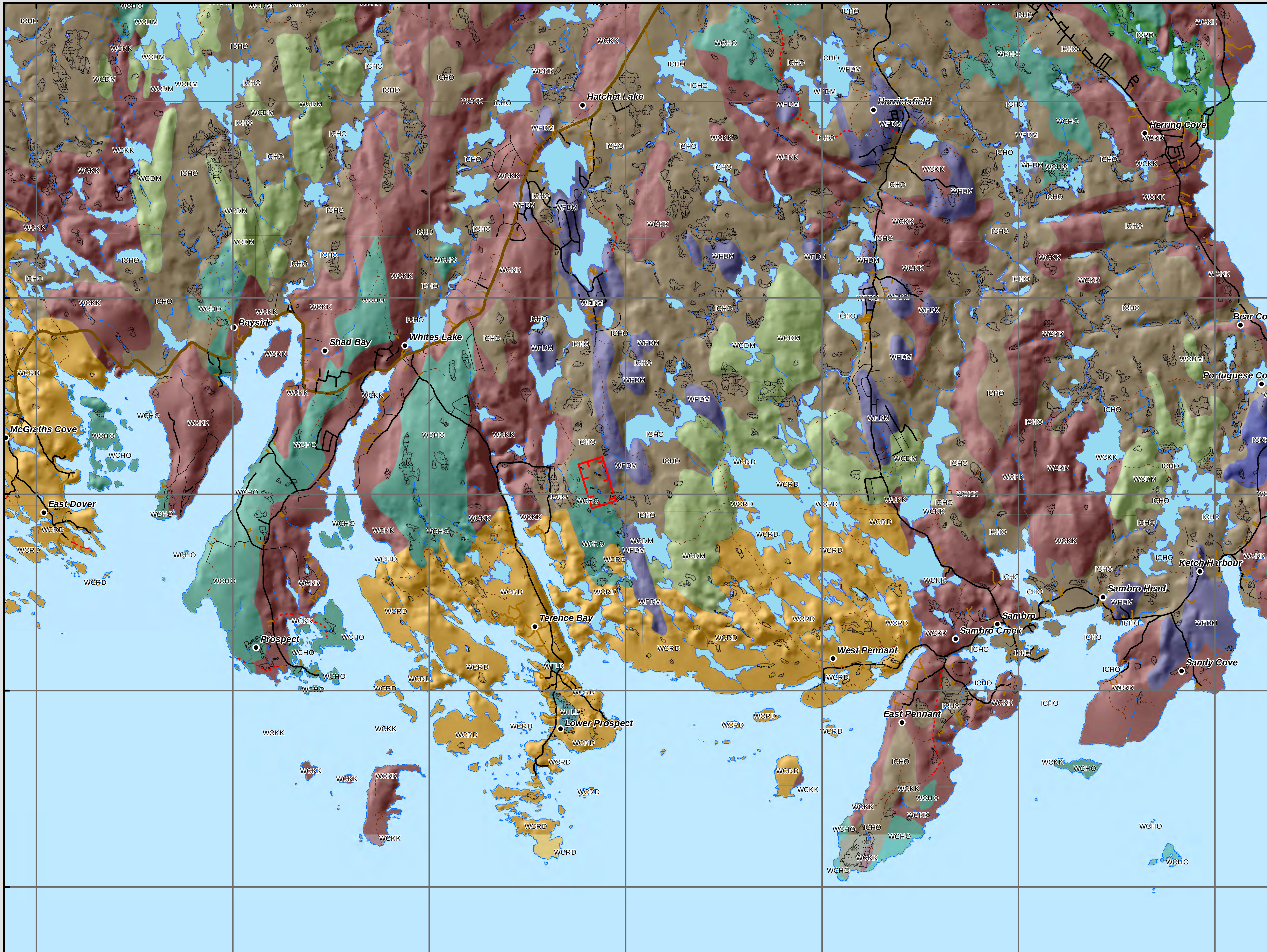
Ecosection mapping is presented in Figure 4.1.

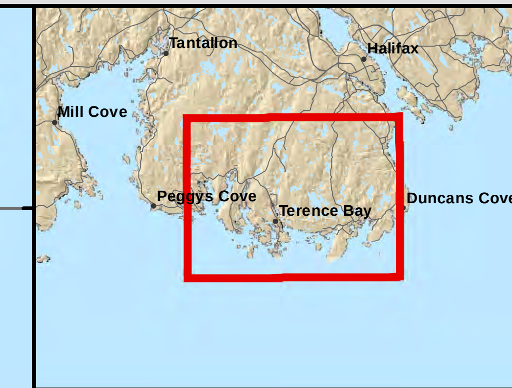
#### *4.1.4 Hydrology*

Many freshwater lakes exist in the Terence Bay region. These lakes are generally connected by meandering streams and are often associated with wetlands. Wetlands also exist in isolation from other surface-water features, as they often form in depressions across the landscape. Fresh water in this region tends to be slightly acidic with a pH ranging between 5.0 and 6.5 (Davis and Brown, 1996).

There are eight distinct wetlands located within the Project site; these are discussed in greater detail in section 4.4.3. The only significant body of open water is a brook located in the south-east corner of the Project boundary. This brook is surrounded by a large wetland complex. It runs southward before branching off and flowing into both Brophys Back Lake and Brophys Front Lake. Other more ephemeral water movement in the Project site tends to flow from north to south across the landscape. The Project site is located within the Sackville primary watershed; it is, however, split between two smaller sub-watersheds. Most of the Project site drains southwards directly into the Atlantic; the north-west corner is located in a separate secondary watershed that is defined by Partridge River. Hydrology mapping is presented in Figure 4.2.

All residential properties in the vicinity of the Project site attain their domestic water from drilled wells.




CTB Property Boundary (Approx)
Open Water
Rivers and Streams
Wetlands

**Roads**

- Divide Highway
- Arterial
- Collector
- Paved Road
- TCH
- Unpaved Road
- Railroad
- Lanes / Driveways
- Road: Inactive
- Cart Track / Footpath
- Ferry
- Misc

ECOSECTION Codes

Soil Drainage
I = Imperfectly Drained
W = Well Drained

Soil Texture
C = Coares Textured Soils
M = Medium Textured Soils
F = Fine Textured Soils

Topography
HO = Hummocky
KK = Knobs and Knolls
RD = Ridge
DM = Drumlins and Flutes
SM = Smooth

CBCL LIMITED
Consulting Engineers

# Chebucto Terence Bay Wind Farm

## Figure 4.1

Ecological Land Classification Ecosections

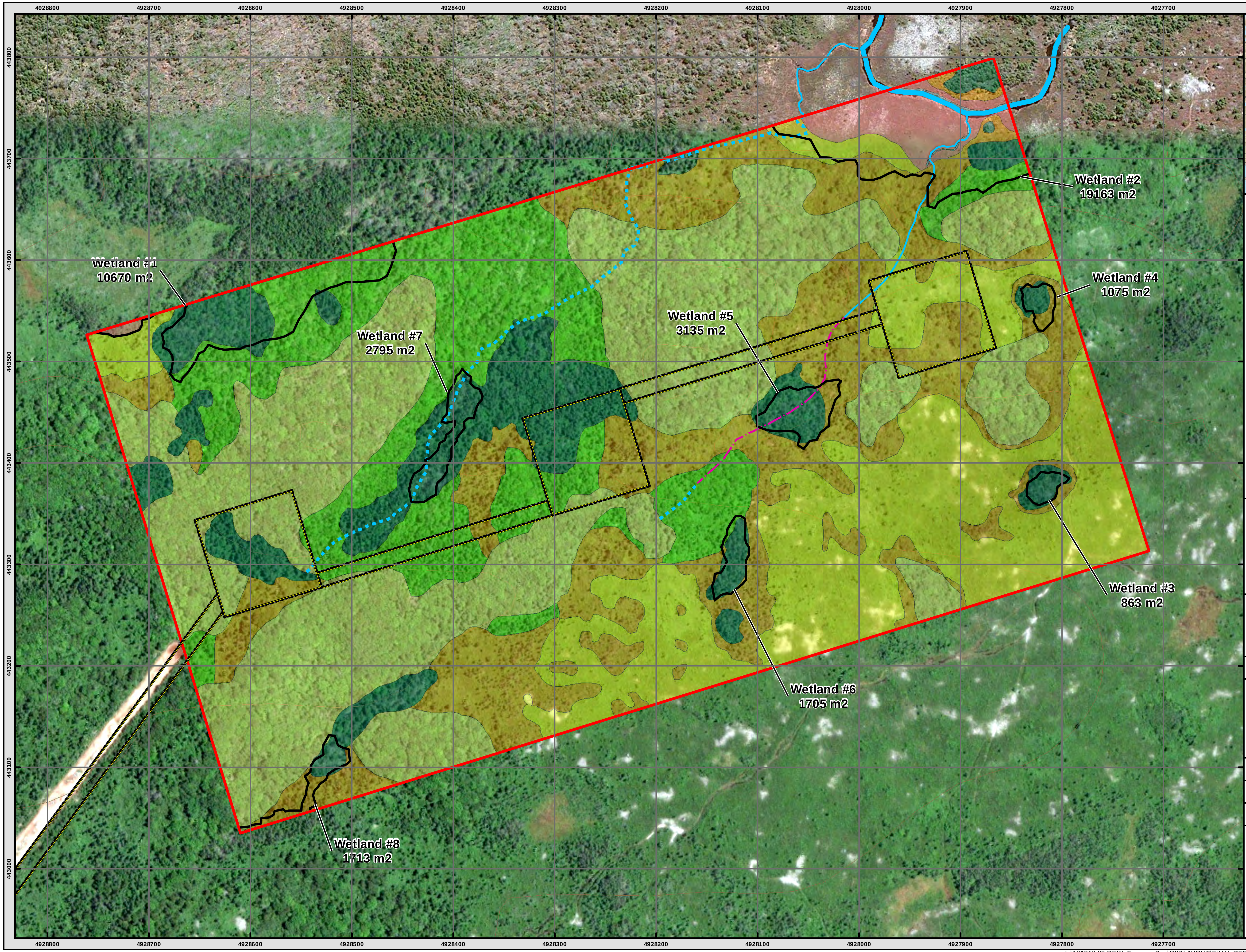
| | |
|---|---|
| Drawn: IB | Date: 20/06/2014 |
| Checked: | CBCL Project # 121216.00 |
| Approved: | Scale @ 11"x17" 1:75,000 |

0 750 1,500 3,000 m

**Data Sources:**
NSGC 1:10,000 Topo

**Map Parameters:**
Coordinate System: NAD 1983 UTM Zone 20N
Projection: Transverse Mercator
Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -63.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

L:\121216.00 RESL Terence Bay\GIS\LAYOUT\FINAL REPORT FIGURES\121216.00 FIG 4.1 Ecosection Mapping.mxd





- Road and Pad Layout
- Contour Line (5m Interval)
- CBCL Delineated Wetlands
- CTB Property Boundary (Approx)

**Watercourse Type**

- Ephemeral
- Ephemeral with Intermittent Characteristics
- Small Permanent
- Large Permanent

**Cover Type**

- Bog
- Coniferous
- Mixed Wood
- Deciduous
- High Shrub
- Low Shrub
- Water

**CBCL LIMITED**
Consulting Engineers

## Chebucto Terence Bay Wind Farm

**Figure 4.2**

Hydrology and Wetlands on the Project Site

| Drawn: IB | Date: 20/06/2014 |
| --- | --- |
| Checked: | CBCL Project # 121216.00 |
| Approved: | Scale @ 11"x17" 1:3,500 |

0 35 70 140 m

**Data Sources:**
NSGC 1:10,000 Topo
Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

**Map Parameters:**
Coordinate System: NAD 1983 UTM Zone 20N
Projection: Transverse Mercator
Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -63.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

L:\121216.00 RESL Terrence Bay\GIS\LAYOUT\FINAL REPORT FIGURES\121216.00 FIG 4.2 Wetland and Watercourse Field Results.mxd

## 4.2 Regional Ecological Environment

### *4.2.1 Land Cover*

Terence Bay and surrounding areas are primarily forested, with interspersed regions of barrens and urban/suburban land cover. The predominant forest cover is softwood; these stands are composed primarily of balsam fir and black spruce. In mixedwood regions, white birch and red maple grow among the conifers. Deciduous stands are less common. The coastal influence can be clearly seen on the vegetation communities in Terence Bay and across the Chebucto Peninsula (Figure 4.3). Barrens are abundant in this region and are generally made up of shrubby species and lack an over-story. In the coastal rock barrens, the granitic bedrock is exposed to form dramatic landscapes. Wetlands exist throughout the region, both in association with water courses and in areas where water becomes trapped on the shallow, impermeable bedrock.

There are several rural communities in the areas surrounding the Project site. The nearest communities to the Project site are Terence Bay, Lower Prospect, Brookside, Whites Lake and Shad Bay (Figure 4.4).

### *4.2.2 Protected Areas*

There are several designated protected areas on the Chebucto Peninsula (Figure 4.4), falling under three main designations: wilderness areas, provincial parks and wilderness reserves. Wilderness areas are designated under Nova Scotia's *Wilderness Areas Protection Act* (1998, c. 27, s.1). These areas are used for research, education and recreation, including hunting and fishing. Nova Scotia's provincial parks are designated under the *Provincial Parks Act* (R.S., c. 367, S. 1) and have greater focus on recreation. These parks often accommodate developed camping sites and recreation facilities. Nature reserves provide the highest level of protection and are used primarily for education and research. Nature reserves are designated under the *Special Places Protection Act* (*R.S., c. 438, s. 1).*

The Terence Bay Wilderness Area, established in 1998 (*Wilderness Areas Protection Act* c. 27, s.1), is located immediately adjacent to the Project site and covers 4,450 ha of land comprising barrens, granite headlands, softwood and mixed wood forests. Hiking, kayaking, hunting and fishing are all popular recreation activities that occur in this area. In this area the wilderness area designation protects this area from development and ensures that the habitat remains available for the resident deer, black bears, raptors, migratory birds and other wildlife.

The recently established Five Bridges Lake Wilderness Area is located approximately 4.5 km to the north-east of the Project boundary. Established in 2011, this wilderness area protects approximately 8,600 ha of land (NSE, 2011a). This land base includes the Bluff Wilderness Hiking trail and a small population of endangered mainland moose. Approximately 7 km north-east of the Project boundary is Long Lake Provincial Park, which is a popular destination for hikers due to its close proximity to Halifax. Together, the Long Lake Provincial Park and the Terence Bay Wilderness Area form a nearly 20 km natural corridor between Spryfield and the Atlantic Ocean. Another popular provincial park, Crystal Crescent Beach, is located along the coast south-east of the Terence Bay Wind Project site.