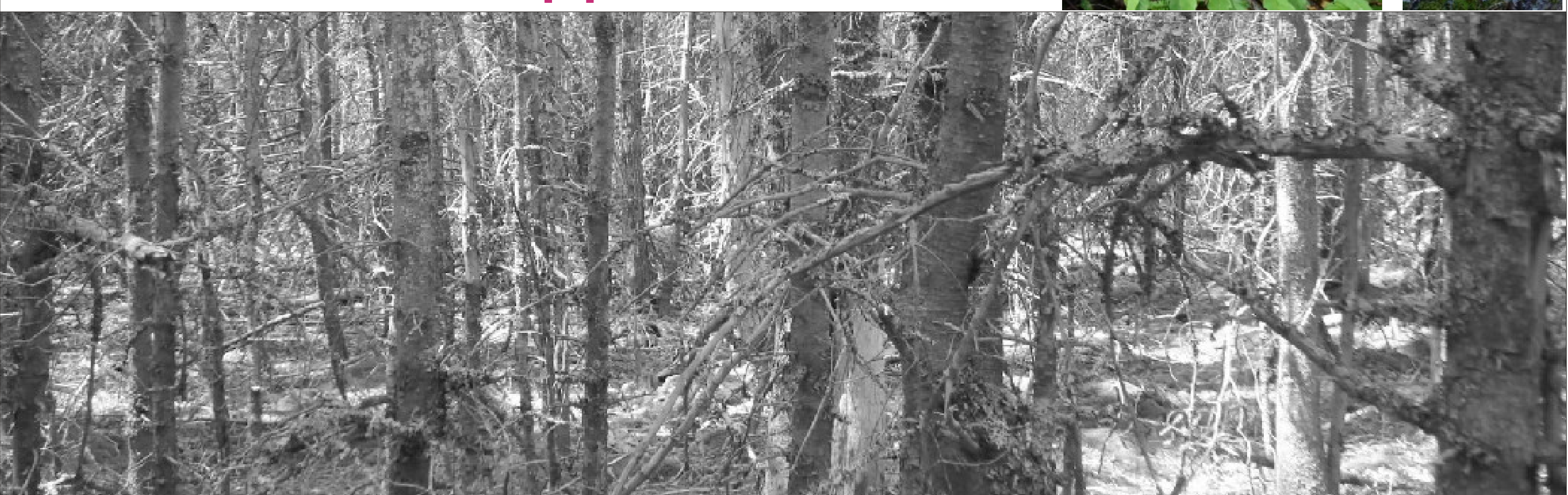
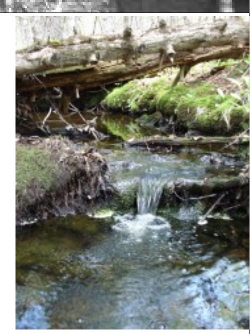
Environmental Assessment
Point Tupper Wind Farm





Prepared By:

CBCL LIMITED
Consulting Engineers

Prepared For:

RENEWABLE ENERGY SERVICES LTD.

AUGUST 2008

Project No.:
071240

Contents

List of Figures

List of Tables

Acronyms

ACCDC	Atlantic Canada Conservation Data Centre
AL	Aluminium
CANWEA	Canada Wind Energy Association
CCG	Canadian Coast Guard
CDC	Conservation Data Centres
CEPA	*Canadian Environmental Protection Plan*
CEAA	*Canadian Environmental Assessment Act*
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
dBs	decibels
DFO	Fisheries and Oceans Canada
DND	Department of National Defence
EC	Environment Canada
EMF	Electrical Magnetic Field
EMP	Environmental Management Plan
EPP	Environmental Protection Plan
FA	Federal Authority
FEAC	Federal Environmental Assessment Coordinator
ha	hectare
HADD	Harmful Alternation, Disruption and Destruction
IC	Industry Canada
IFC	Issue for Construction
km	kilometre
MW	Mega Watts
NRCan	Natural Resources Canada
NSBI	Nova Scotia Business Inc.
NSDE	Nova Scotia Department of Environment
NSDNR	Nova Scotia Department of Natural Resources
NSPI	Nova Scotia Power Inc.
NSTIR	Nova Scotia Department of Transportation and Infrastructural Renewal
NWPA	*Navigable Waters Protection Act*
PPA	Power Purchase Agreement
PID	Property Identification
RA	Responsible Authority
RABC	Radio Advisory Board of Canada
RESL	Renewable Energy Services Limited
RCMP	Royal Canadian Mounted Police
SARA	*Species at Risk Act*
TC	Transport Canada
The Agency	Canadian Environmental Assessment Agency
VEC	Valued Ecosystem Component
WEC	Wind Energy Convertor

Chapter 1 Introduction

1.1 Proponent Information

The following individuals may be contacted to provide additional information on the Project:

Project Name:	Point Tupper Wind Farm
Project Location:	Lands of NuStar, more commonly referred to as Statia Terminals, and of Nova Scotia Business Inc. (NSBI) at Point Tupper, on the Strait of Canso, Nova Scotia
Size of the Project:	Up to 24 Megawatts (MW)
Proponent Information:	Renewable Energy Services Limited (RESL) Attention: Peter Archibald 30 Memory Lane Lower Sackville, NS B4C 2J3 Tel: (902) 442-8196 Fax: (902) 471-7344
Applicant:	CBCL Limited 1489 Hollis Street Halifax, Nova Scotia B3J 2R7
Applicant Contact Person:	Ann Wilkie, VP Environment CBCL Limited Phone: (902) 492-6764 Fax: (902) 423-3938 Email: annw@cbcl.ca

The following documentation was prepared as required by the *Canadian Environmental Assessment Act (CEAA)* and the *Nova Scotia Environment Act* and associated regulations.

Peter Archibald
Proponent's Signature

Date: *August 19, 2008*

Ann Wilkie
Applicants Signature

Date: *August 19, 2008*

The proponent, RESL, is a Nova Scotia based, fully integrated renewable energy developer with seven exploration test wind turbines operating under long term Power Purchase Agreements (PPAs) with Nova Scotia Power Inc. (NSPI). With the exploration phase nearing completion on several sites, RESL is moving to the next phase of development using data collected from the established test turbines including the turbine on site at Point Tupper. RESL has been successful in its bid to NSPI and will be developing the Point Tupper site adjacent the Point Malcolm Road to supply the grid with a total installed capacity of 24 MW by November 2009.

1.2 Project Overview

The Point Tupper Wind Farm will consist of 12 wind turbines with a total capacity to generate a maximum of 24 MWh of electricity. As indicated above, all of the electricity generated will be sold to NSPI under a PPA to increase the supply of renewable energy available to Nova Scotians.

As depicted in Figure 1.1, the Point Tupper Wind Farm has 12 wind turbines located on approximately 1.22 km^2 of land to the east of the Port Malcolm Road in Point Tupper in the Municipality of the County of Richmond. The wind farm site is situated on two land parcels, one owned by NuStar and one owned by Nova Scotia Business Inc. (NSBI). The proponent has entered into lease agreements with the owners of the land parcels involved, i.e., PIDs 75006593 and 75035709. The distribution of the proposed turbines are depicted on Figure 1.2. Geographical coordinates of the turbine locations are provided in Table 1.1.

Table 1-1: Geographical Coordinates of Turbines

Turbine	*UTM*	
	Easting	*Northing*
1	631536	5048197
2	631770	5047951
3	632018	5047594
4	632363	5047359
5	632643	5047218
6	632964	5047071
7	631279	5048064
8	631019	5047924
9	631305	5047672
10	631590	5047456
11	631318	5047230
12	631665	5047673
MET	631358	5047777

Access to the sites will be attained from the Port Malcolm Road and to each of the 12 turbine locations from the access roads as depicted on Figure 1.2. In total, approximately 4.6 km of access road will be constructed to accommodate access for the construction and subsequent maintenance of the turbines.

1.3 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.

1.4 Regulatory Context

1.4.1 Requirement for Provincial Environmental Assessment

As a result of changes to the Nova Scotia Environmental Assessment Regulations that came into force in February of 2003, the proposed wind farm at Point Tupper will be subject to a Class I environmental assessment as defined in those regulations. This necessitates the registration of the Project with the Nova Scotia Department of Environment (NSDE). 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 50 days following the date of registration, the NSDE 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. Many of the matters that the Minister may wish to consider are the same, or similar to those to be addressed by the federal regulators. Therefore it is prudent to facilitate the exchange of information between the regulating parties and to the extent possible minimize duplication of effort by both the Proponent and the various agencies and departments with interests to be addressed.

1.4.2 Requirement for Federal Environmental Assessment

To enable the project to be carried out, the proponent has sought financial assistance in the form of an incentive under the ecoENERGY for Renewable Power Program administered by Natural Resources

Canada (NRCan). As such, the installation of a wind energy farm at Point Tupper as proposed by RESL will trigger an environmental assessment under the *Canadian Environmental Assessment Act (CEAA).* The *CEAA* is the legal basis by which the federal government outlines the responsibilities, requirements and procedures required for the environmental assessment of proposed projects. More specifically, federal departments and agencies must complete an environmental assessment whenever one or more of the following *CEAA* triggers apply:

- the federal department or agency carries out a project;
- the federal department or agency provides financial assistance to enable a project to be carried out;
- the federal department or agency sells, leases or otherwise transfers control or administration of land to enable a project to be undertaken; or
- the federal department or agency issues an authorization to enable a project to go forward.

Since federal financial assistance is being sought to enable the development of the wind farm at Point Tupper to proceed, the *CEAA* will be triggered.

Under the *CEAA*, the type of assessment required varies depending on the complexity, size, and the significance of the possible environmental effects of the project. Most inland wind farms are required to complete a screening style assessment. "A screening systematically documents the anticipated environmental effects of a proposed project and determines the need to modify the project plan or recommend further assessment to eliminate or minimize these effects" (*CEAA*, 2003). *CEAA* Section 16(1), stipulates that the environmental screening must provide the following information:

- The project's environmental effects, including the environmental impact of malfunctions or accidents that may occur in relation to the project, and any cumulative environmental effects that are likely to result from the project in combination with other projects or activities that have been or will be carried out;
- The significance of the effects listed in the previous statement;
- Comments from the public received in accordance with the *CEAA* and its regulations;
- Measures that are technically and economically feasible which would mitigate any significant environmental effects of the project; and
- Any other matters relevant to the screening, such as the need for the project and alternatives to the project.

NRCan has developed "*Environmental Impact Statement Guidelines for Screenings of Inland Wind Farms under the Canadian Environment Assessment Act*". These guidelines serve as a guide for the environmental screening required for the proposed project. Although the Responsible Authority (RA) will ultimately decide the necessary scope of the assessment, a typical screening document addresses the following:

- Construction, including reference to any pre-construction survey, site preparation, excavation, transportation of material, turbine erection, power connection, site remediation and demobilization of construction work;
- Operation and maintenance requirements; and
- Decommissioning of the wind turbine and site remediation.

These phases in the life of the wind farm are addressed in the analysis presented in Section 7.0.

The construction and subsequent operation of the proposed works is likely to involve the following federal regulatory authorities:

- NRCan who is responsible for the ecoENERGY program under which the proponent has applied for financial support;
- Transport Canada (TC) in connection with the marking and/or lighting of the proposed turbines to address the requirements of the *Aviation Regulations* pursuant to the *Aeronautics Act*;
- Health Canada who will take into account in their review of the documentation noise and other matters that may have a bearing on the health of those residents in closest proximity to the Project site;
- Environment Canada (EC) as an expert authority under the *Canadian Environmental Protection Act* (*CEPA*), the *Species at Risk Act* (*SARA*) and the *Migratory Birds Convention Act*; and
- Canadian Environmental Assessment Agency (the Agency) providing coordination for the federal environmental assessment process under *CEAA*.

1.4.3 Municipal Authorizations

The Municipality of the County of Richmond has been contacted regarding any setback or easement requirements for wind farms. Staff stated that the municipality does not have any by-laws relating to wind farms at this time.

1.5 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 in 2007 and 2008. The programs executed are described fully in Chapter 3. Table 1.2 identifies the team leads responsible for the research and field work undertaken.

Table 1-2: Team Leads

Name	***Topic***
Clinton Pinks, CBCL Limited	Determination of habitats including wetlands
Ian Bryson, CBCL Limited	Characterization of forest stands, plant species and Species at Risk
Leanda Delaney, CBCL Limited	Determination of fish habitat
Andrew Horne	Execution of avian field programs
Hugh Broders, St. Mary's University	Execution of bat field program
Steffen Käubler, CBCL Limited	Visibility analysis and land use investigations
Stephen Davis, David Archaeological Consultants Limited	Execution of archaeological field programs
Lea Barker, VIC Limited, Ottawa	Radar surveillance of shipping in the Strait of Canso

1.6 Structure of the Document

This report documents the environmental assessment of the environmental effects of the proposed construction, operation and decommissioning of the Point Tupper Wind Farm. This 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, 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 ENERCON E82 Technical Description
B ENERCON E82 Foundation Data Sheet
C ENERCON E82 Access Roads and Crane Platforms
D TC Aeronautical Obstruction Clearance
E ENERCON E82 Earth and Lightening Protection System
F Tabulated Results of Plant Inventory
G Archaeological Research Permits
H Open House Materials
I Letter from the Municipality of the County of Richmond
J Analysis of Effects on Eddy Point Radar
K Ice Detection

Chapter 2 Project Description

2.1 Project Background

2.1.1 Project History

In May 2006, RESL commissioned a test turbine on lands on NuStar's property near the Project site. Results from this turbine, an ENERCON E-48 800 KW machine, have demonstrated the feasibility of accessing the wind resource at Point Tupper. In August of 2007, therefore, RESL submitted a proposal to NSPI in response to its public call for wind energy supplies. In support of this bid the proponent had initiated the ecological field programs required by the environmental assessment process 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. At the same time steps were taken to engage representatives of the local municipalities and to disseminate information to them about the Project.

RESL was successful in its submission to NSPI and, as a result, entered into a long term PPA in January, 2008. The PPA requires that all energy from the Point Tupper wind farm be delivered and sold to NSPI at a fixed price over a defined term.

The proposed wind farm will be installed in a large industrial area and its development will not substantially change the ecology of the area. It will be located on lands zoned for heavy industrial use currently owned by NuStar Energy, formerly known as Statia Terminals, and NSBI. Other heavy industries in the immediate vicinity include the NSPI coal fired generating plant, the pulp mill, the natural gas fractionation plant and ideal concrete.

2.1.2 Political and Economic Context

Canadians are amoung 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 under the Kyoto Protocol, 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 Point Tupper will provide green renewable energy to the Nova Scotia grid.

More specifically, the federal and provincial governments have introduced strategies to facilitate the development of alternative energy sources to reduce the emission of "green house gases". The Province of Nova Scotia, for example, has enacted the *Environmental Goals and Sustainable Prosperity Act*, which identifies the long-term objectives of the province to be:

- To lower greenhouse gas emissions by 2020 by at least 10% below the 1990 emitted levels; and
- To obtain 18.5% of the total electricity needs of the province from renewable energy sources by 2013.

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

NSPI has established competitive bidding mechanisms by which they will buy from selected producers, including the proponent, "clean energy", i.e., wind power, in an effort to meet its emission targets.

The federal government also plays a leading role whereby it recognizes the need to financially encourage a change from existing sources of energy production to the use of more renewables, which, like wind, are often initially capital intensive. Accordingly, it administers an incentive program called "EcoENERGY for Renewable Power". This program provides one cent per kilowatt hour to qualified renewable power producers in respect to their electricity generation at newly constructed wind farms for the first 10 years of production. The program is administered by NRCan. To qualify, a wind farm must meet several criteria including having undergone a federal environmental assessment. The proponent is a registered applicant in the EcoEnergy program and anticipates the receipt of funding.

2.1.3 Project Justification and Purpose

The purpose of the proposed works, i.e., the construction of 12 – 2MW turbines, is to generate up to 24 MW of wind energy 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 green house 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 stated in Section 1.2, and depicted on Figure 1.2, the Point Tupper Wind Farm is located on two land parcels to the east of the Port Malcolm Road in Point Tupper. The lands involved are owned by NuStar and NSBI; lease agreements have been entered into with these companies.

2.2 Principal Project Components

Although the Project will be located in an area of approximately 1.22 km^2, its footprint will use about 8% of that land area. The principle project components associated with the proposed works are the wind turbine generators (consisting of towers, nacelles and blades), the concrete foundations and lay down areas, access roads, a cable collection system interconnecting the turbines, and the physical connection to the grid. No substation is required at the Project site as this wind farm will be connected directly to the existing substation located at the NSPI Point Tupper Generation Facility.

Module E-82

2.2.1 The Wind Energy Convertors (WECs)

As earlier stated, the Project, i.e., the development of the Point Tupper Wind Farm, will involve the development and operation of 12 – 2MW turbines capable of generating a maximum of 24 MWh. The turbines selected are manufactured by ENERCON. The model, the E82, generates a maximum of 2 MWh (in winds over 12-13 m/s). The rotor diameter of the E82 is 82 m and consists of three fiberglass blades equipped with an integrated lightning protection system. The tip speed of the blades varies between 25 and 80 m/s while the rotational speed ranges from 6 to 19.5 rpm. The turbine will start rotation in wind speeds of 2.5 m/s and cut out between 28 and 34 m/s (100 km/hr and 122 km/hr) for reasons of safety.

The height of the tower from ground level to the hub (centre of the rotor) will be 78.33 m. The tower will be anchored in a reinforced concrete base. Table 2.1 provides a summary of the technical specifications of the selected turbine. Appendix A provides additional technical information of the selected WEC.

Table 2-1: Turbine Technical Specifications

Rated capacity **(kW)**	**2,000**
Cut-in wind speed **(m/sec)**	**2.5**
Cut-out wind speed **(m/sec)**	**28-34**
Rated wind speed **(m/sec)**	**12**
Number of blades	**3**
Diameter **(m)**	**82**
Swept area **(m²)**	**5,281**
Rotor speed (variable) **(rpm)**	**6 – 19.5**
Tower (hub) height **(m)**	**78.33**
Gearbox	**N/A Gearless**
Generator **Synchronous DIRECT-DRIVE RINGGENERATOR (kW)**	**2,000**
Braking system (fail-safe) **AERODYNAMIC (3 Independent Pitch Systems)**	**YES**
Yaw system **Active (º/sec)**	**0.5**
Control system **(Microprocessor)**	**YES**

Noise reduction	**YES**
Storm Control	**YES**
Ice Detection	**YES**
Lightning protection system **(EXTERNAL/INTERNAL)**	**YES**
Tower design	**STEEL**

Although there will likely be small modifications as the detailed engineering is executed, the final layout and configuration of this phase of the proposed wind farm is based both on the environmental studies that have been done to date and the preliminary engineering of the access roads. The proposed layout is depicted on Figure 1.2. This configuration will involve the location of 12 WTGs and generate more than 63,252,000 kWh/hr of electricity annually which will be fed into the NSPI distribution grid.

The maximum installed capacity of each WEC is 2MW. Each WEC will have its own 2.3MVA Transformer / Switch Gear unit installed in the base section of the tower which will provide protection and isolation to the WEC. The collector system, i.e., 28 kV cables buried underground, will be connected to the switch gear that is installed in each WEC.

The proposed wind turbines will generate sufficient clean, renewable energy to supply 7,300 average Canadian homes displacing up to 57,000 tonnes of CO_2 (carbon dioxide) each year. This assumes average Canadian household electricity use, excluding home heating, of 8.666 kWh per household per year (Natural Resources Canada, 2005).

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 16.7 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 required dimensions of the service area required for the E82 are depicted on Figure 2.1. These areas will also be used for subsequent maintenance, component replacement, possible refit work and ultimate decommissioning. Additional foundation specifications required by ENERCON are provided in Appendix B.

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 access roads are depicted on Figure 1.2. The turbine components will arrive by ship at the wharf at Stora (New Page) approximately 5 km from the site. They will be trucked from the wharf to Industrial Park Road and hence to the Port Malcolm Road to the laydown/staging area on-site. Given the size and weight of some of the flatbed trucks that will be used, the Proponent and their engineers will work closely with the road authorities to ensure that the roads have the capacity to accommodate the loads involved. The distance

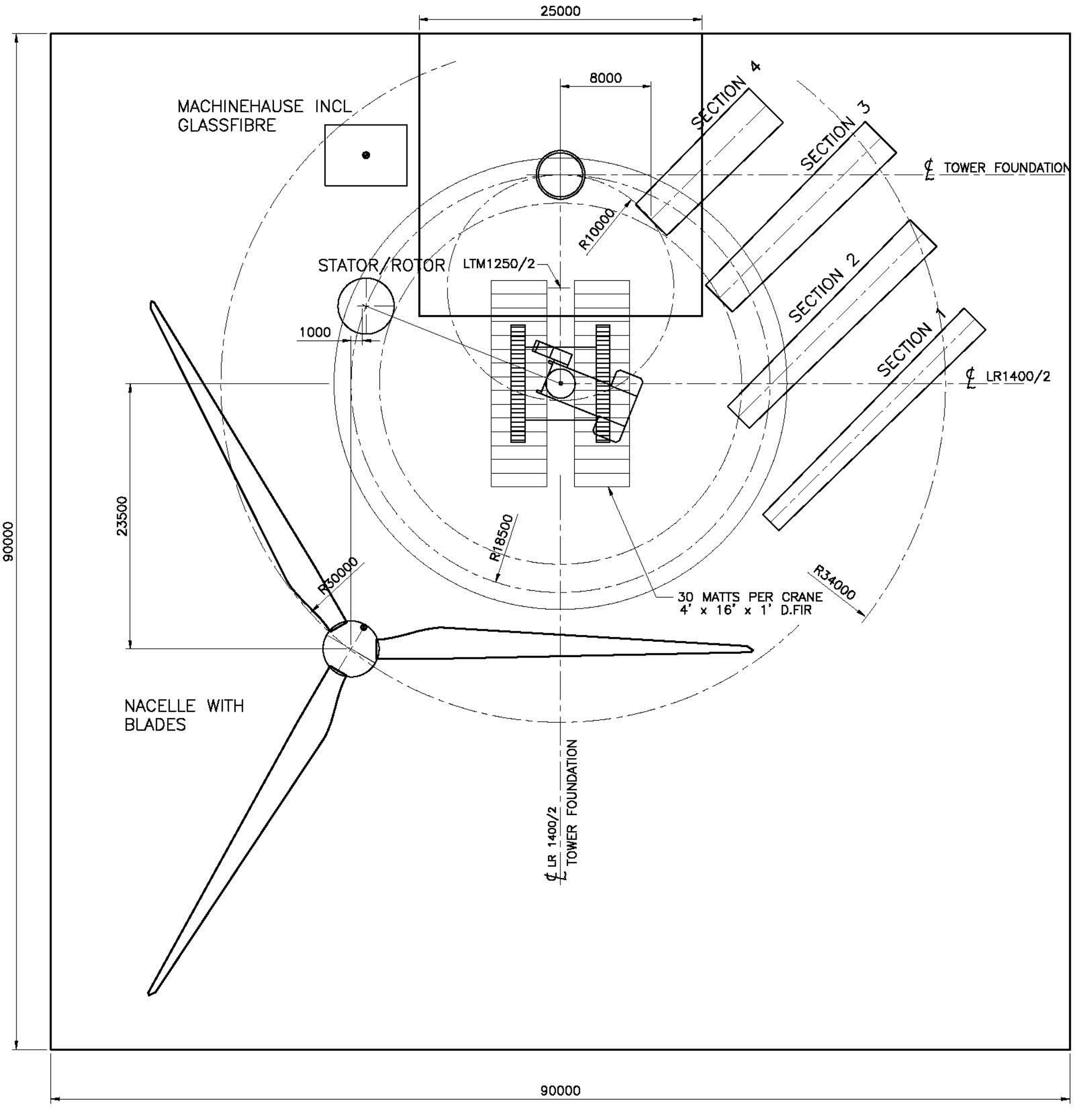


Figure 2.1: ASSEMBLY AREA REQUIREMENTS

SCALE NTS

from the wharf to the Project site is relatively short and is located entirely within the Point Tupper Industrial area. Nevertheless, the transportation of equipment with the dimensions of the tower sections and blades of a large turbine is a rare occurrence in the area and may generate interest. Discussions are ongoing with all the pertinent parties with respect to the transportation of the WECs including the Nova Scotia Department of Transportation and Infrastructure Renewal (NSTIR), TC and the Royal Canadian Mounted Police (RCMP). The intent is to work will all authorities to ensure safety for all involved including road users.

Access on site will be accommodated by the construction of new access roads. As indicated on Figure 1.2 there will be approximately 4.6 km of new access roads constructed. This figure depicts the proposed turbine locations, and the proposed new roads. Appendix C provides specifications from ENERCON in a document entitled “Access Roads and Crane Platforms”; this provides criteria with respect to access roads and the crane platform.

2.2.4 Connection to the Grid

The proposed site for the wind farm is located approximately 4.5 km from a substation, i.e., 1C – Point Tupper, at the NSPI Power Plant and will be connected to this substation by a 25 kV distribution system. In turn the substation is connected to the NSPI transmission system by two lines, i.e., L-6517 to substation 2C at Port Hastings and L-6523 to substation 47C at Stora.

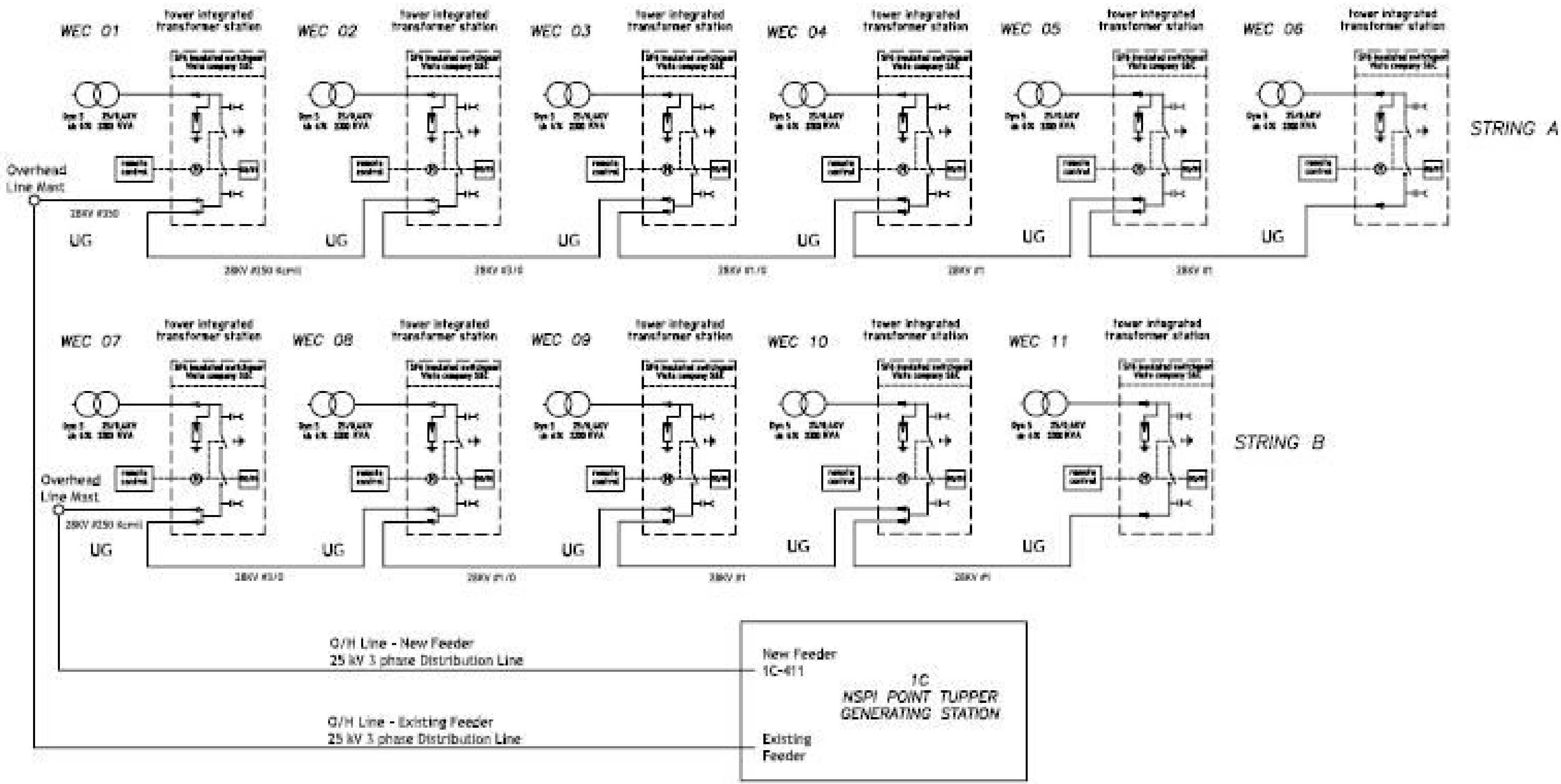
As the planned installed capacity of 24 MW exceeds the capacity of a single 25 kV distribution circuit, dual circuits are required from the wind farm site to the substation at the power plant. The existing distribution circuit, i.e., IC-411, is built with a 2/0 AASC conductor. It has been recommended by NSPI that the IC-411 distribution circuit be upgraded to a 336 AL conductor and that a second feeder also be constructed with a 336 AL conductor. Further study may determine that it would be cheaper to build the new circuit as a double circuit distribution structure across the road from the existing IC-411 and move the existing services to one of the circuits on the double circuit structures. To accommodate the upgrades to the distribution system will require the installation of a new 25 kV bay at the substation at the Point Tupper Power Plant, i.e., 1C-Point Tupper.

Six of the WECs (String A) will be connected to the extended existing three phase 25 kV overhead system; the balance of the other six WECs will be connected to the new three-phase 25 kV overhead system (Figure 2.2). The 25 kV distribution systems on-site can be run entirely underground or by a combination of a hybrid underground/overhead system. The system selected for this Project is:

- an underground duct bank from the turbine tower to a riser pole on the existing 25 kV overhead system; and
- buried underground cables between the wind turbines.

The E-82 turbine as illustrated in Figure 2.3 enables the transformer and the switch gear to be located within the tower thereby eliminating the need for external housing.

FIGURE 2.2: *RESL 22MW POINT TUPPER WIND GENERATION PROJECT SINGLE LINE DIAGRAM - 11 x E82*



RENEWABLE ENERGY SERVICES LTD.

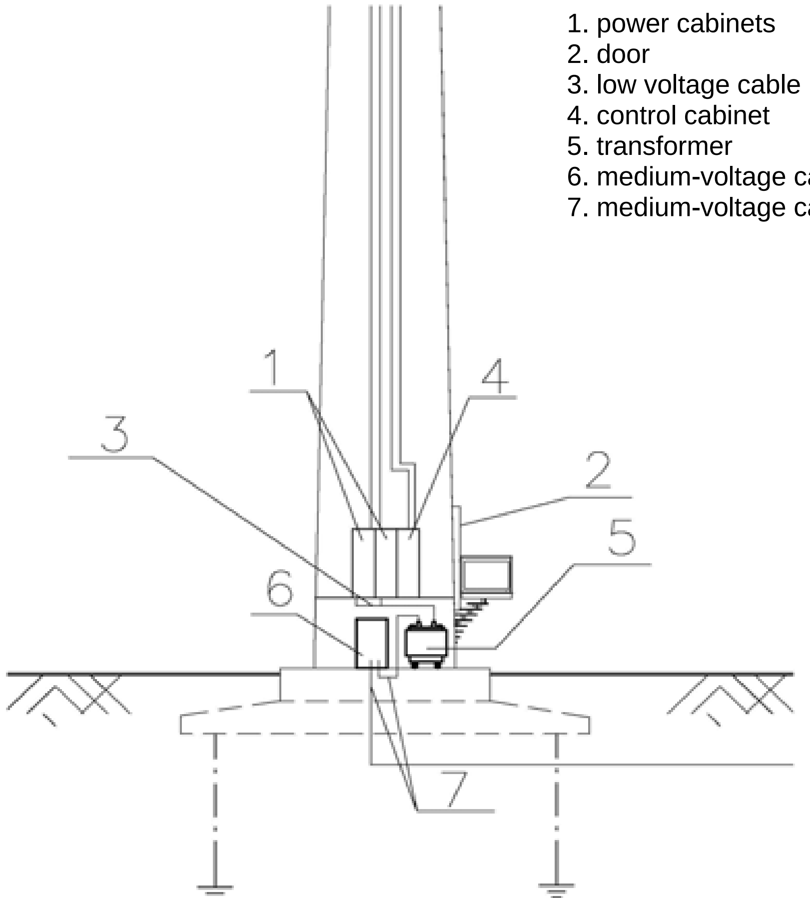


Figure 2.3: Arrangement of Electrical Component Equipment

The wind turbine transformer steps up the voltage from 400V to medium voltage 25kV. ENERCON installs three-phase hermetically sealed silicone oil transformers, and a special synthetic oil with a flash point of more than 300°C insulates and cools the transformer. Table 2.2 provides technical data for the 2,300 kVA transformers.

Table 2-2: Transformer: Technical Data

Type	3 phase-hermetic
Rated power (kVA)	2,300
Rated frequency (Hz)	60
Rated high voltage (kV)	25
Rated low voltage (V)	400
Tapping	+4 x 2.5%
Vector group	Dyn5 or YNyn0
Impedance	6%
No load loss (W)	< 3,100
Load loss at 115°C (W)	< 18,000
No-load current (%)	< 0.33

BIL between phase and earth (kV)	170
Temperature rise: Oil/windings (K)	50 / 55
Ambient temperature (°C)	40
Temperature monitoring-alarm level (C)	90
Temperature monitoring-trip level (C)	95
Cooling material	Silicone oil
Cooling type	KNAN
Installation height over sea level (m)	Max. 1,000
Noise level LwA dB(A)	60
Service	Continuous
External dimensions (approx.) (mm)	1,600 x 770, 2,040
Weight approx. (t)	2.6

In comparison to dry type transformers, oil transformers have the following advantages:

- compact and safe structure;
- lower iron losses;
- less sensitivity to overload and rapidly varying load;
- less sensitivity to overvoltage; and
- less sensitivity to mechanical stress.

The hermetically sealed and earthed housing, the safe medium-voltage bushings and the covers on the LV connections guarantee protection against indirect contact. A coating on the basis of zinc flakes protects the transformer housing against corrosion.

The Medium-voltage switchgear assembly depicted is a SF6 gas-insulated switchgear with a compact design, high operational safety and provides protection against harmful external influences. These switchgear assemblies are equipped with bursting discs and pressure channels. If an internal defect causes an electric arc, an expanded metal mesh cools leaking gases and gas pressure is reduced to a minimum. The remaining pressure escapes though the top of the pressure channel on the side turned away from the operator. Since the switchgear assembly is almost completely enclosed, the customer gets a safe and long-life product that only requires low maintenance. A remote control system located in the entrance area allows remote switching. This way, it is possible to turn the switchgear assembly off outside the medium-voltage area.

Medium Voltage Switchgear

The entire interconnection engineering and construction will follow the requirements laid out by NSPI pursuant to a system impact study, a facilities interconnection study and the governing generator interconnection agreement. These studies and agreement are required and defined by the generator interconnection procedures which form part of the Open Access Transmission Tariff regime as approved by the Nova Scotia Utility and Review Board and administered by NSPI.

2.2.5 Lighting of WECs

The wind turbines will be marked in accordance with TC'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 the TC standards it must also be mindful of the EC (through the Canada Wildlife Service) preference to have a flash with a distinct off period. Accordingly, the proponent is considering the use of a LED based technology pointed within the TC acceptable range with all lighting synchronized[1].

2.3 Project Activities

The four phases of the Project are described in the following subsections. These include:

- Planning and design;
- Construction and commissioning;
- Operation and maintenance;
- Decommissioning and abandonment.

2.3.1 Planning and Design

As part of preparing the bid to NSPI to secure a power purchase agreement for up to 24MW of wind power energy at Point Tupper, the project team created a preliminary plan which took the following factors into account:

- Physical characteristics of the site that will be developed;
- Land ownership and current and future uses of the area;
- Ecological relevance of the 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 ongoing design involves a multi-disciplinary team to determine location, capacity and configuration considering 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 *SARA* and the provincial *Endangered Species Act*;
- Bird studies, including assessment of migration routes;

[1] RESL has received notice from TC dated July 24, 2008, that their request to install lighting on turbines 1, 3, 6, 8 and 11 as per their submission of an Aeronautical Obstruction Clearance Form has been approved. A copy of this notice is attached in Appendix C.

- 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 NSPI.

2.3.2 Construction

In determining the scope of the Project for environmental assessment, RESL 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 that are necessary to accommodate the construction of the principal elements.

It is anticipated that construction activities will begin in the fall of 2008 after appropriate approvals and permits are in place. Table 2.3 summarizes the activities that will occur.

Table 2-3: Site Preparation and Construction

Surveying	Surveying includes gathering of location and elevation data required for the design of the system. Surveying requires 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, shrubs and grasses, very little clearing will be required for surveying.
Geotechnical	Previous experience in the area gained during the foundation construction of the test turbine and geological evidence indicate that the principle overburden strata are silt and clay tills. Geological mapping shows the area to be underlain by Cumberland Group bedrock (sandstone, conglomerate, shale and siltstone) as stated in Jacques Whitford Geotechnical Investigation Report Number SD19621.05 dated 24-October-2006. Site specific geotechnical investigations have confirmed the results of the earlier work (Report Number SD19621.11 dated 24-July-08).
Development of access roads	Approximately 4.6 km of access roads 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 previously 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 a site-by-site basis. Merchantable timber, if any, will be salvaged and the remaining debris disposed of in accordance with landowner agreements
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 if 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 distribution lines	The turbines will be connected by approximately 6.5 km of power cables buried approximately one meter below the surface. The power cabling trenches (Direct Buried Ducts) shall be prepared according to the requirements of NSPI.
Piling and Foundation excavation	The turbine foundation consists 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 dependant 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 need to stabilize the foundation and reducing the amount of material to stockpile and stabilize on site.
Pouring turbine foundation	The foundation is a circular raft footing design 16.7 m in diameter. This design is 2.53 m below grade when complete. The work required but not limited to: (a) Survey and Layout. Ensure the excavation is large enough to install the 16.7 m diameter mud slab (b) Excavation of foundation, level and prepare base as per the geotechnical report recommendations (c) Excavate trench for duct bank. (PVC Duct Bank supplied and installed by electrical contractor).

	(d) Install compressive layer (Styrophor PS30) (e) Compact base with plate tamper or vibratory roller (f) 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 The foundation excavation/base preparation to be inspected and approved by Geotechnical Engineer prior to mud slab installation. The next step is to place reinforcement steel and foundation section and install the electrical grounding system according to the issued for construction (IFC) Drawings. The reinforcement steel to be inspected and approved by the Structural Engineer and the electrical grounding system to be inspected by NSPI prior to concrete installation. Finally, Supply, place and finish concrete. Concrete quality: C 25/30. Concrete quantity: 311 m^3. No additives to be used. A minimum of two vibrators to 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. Concrete testing to be performed by Jacques Whitford. 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 Point Tupper at the wharf located at Stora (New Page). 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 substation equipment	E82s are shipped complete with internal transformers and switch gear (E-module) and are loop connected to the distribution lines.
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 2.4 provides further detail on access and inspection.

Table 2-4: 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 (Supervisory Control and Data Acquisition) 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 E - 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 had 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 2.5).

Table 2-5: 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 used for the site following decommissioning of the wind farm, 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 schedule is depicted on Figure 2.4. It can be summarized as follows:

2008
Fall Construction of Road, site & lay down areas
NOV-DEC Foundation Construction

2009
MAR-APR Turbine components arrive and are moved to site
MAY –JUN-JUL-AUG Equipment mobilization/turbine erection & electrical works
SEPT-OCT Grid connection, Commissioning and Start-up

2.5 Anticipated Emissions and Waste Streams

During Project operation the proposed wind farm will not generate air emissions, and 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

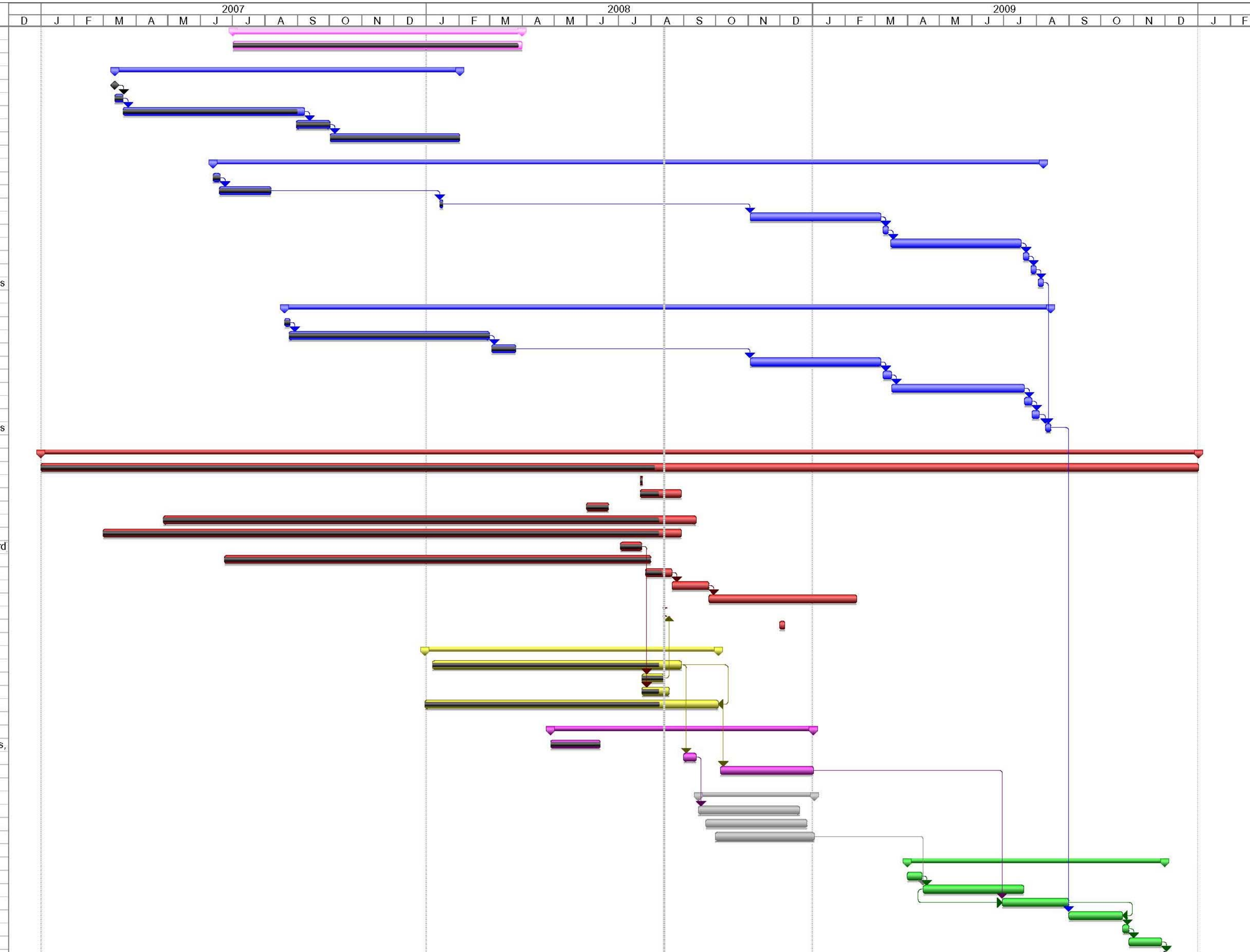
A limited number of hazardous materials will be required for the construction and operation of the proposed turbines. As referenced above, prior to commercial operation, an EMP will be developed and implemented to ensure that all staff working at the wind farm are appropriately trained to handle, store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

Figure 2.4: Project Schedule

ID	Task Name
1	**Land Leases Agreements**
2	Land Leases Agreements NuStar + NSBI
3	
4	**NSPI RFP and PPA AGREEMENTS**
5	RFP Issued
6	Notice of Intent to Submit
7	RFP Submission
8	NSP Review and Notification to Bidders
9	PPA Negotiation and Signed PPA Agreement
10	
11	**NSPI STUDIES IR#137**
12	Signing of Interconnection Feasibility Agreement IR#137
13	Interconnection Feasibility Study + Report GIP-137-FES-R2 Issued
14	Signing of Interconnection System Impact Study Agreement IR#137
15	Interconnection System Impact Study + Report
16	Signing of Facility Agreement
17	Interconnection Facility Study + Report
18	Signing of Engineering & Procurement Agreement
19	Signing of Standard generator Interconnection Agreement (SSGIA)
20	Schedule Construction of Interconnection facility and Network Upgrades
21	
22	**NSPI STUDIES IR#150**
23	Signing of Interconnection Feasibility Agreement IR#150
24	Interconnection Feasibility Study + Report GIP-150-FES-R2 Issued
25	Signing of Interconnection System Impact Study Agreement IR#150
26	Interconnection System Impact Study + Report
27	Signing of Facility Agreement
28	Interconnection Facility Study + Report
29	Signing of Engineering & Procurement Agreement
30	Signing of Standard generator Interconnection Agreement (SSGIA)
31	Schedule Construction of Interconnection facility and Network Upgrades
32	
33	**RESL STUDIES, CONSULTATION and APPROVALS/PERMITS**
34	Wind Data Collection - MET TOWER Statia
35	Transport Canada Approval
36	NavCAN Approval
37	Public Consultation (CBCL)
38	Analysis and Modeling (RESL - ENERCON - HELIMAX)
39	Micro-Siting + Optimization (RESL-HELIMAX-ENERCON)
40	Geotechnical Investigation/Grounding Study + Report (Jacques Withford
41	Environmental Study (CBCL)
42	EA Final Report (CBCL)
43	EA Approval Provincial
44	EA Approval Federal
45	Development & Building Permit
46	NSPI Electrical Wiring Permit
47	
48	**RESL & ENERCON Engineering**
49	Road design + tender documents (RESL)
50	Foundation design (ENERCON)
51	Grounding design per WEC (ENERCON)
52	Electrical Wind Farm Cabling design (RESL)
53	
54	**Procurement**
55	12 x E-82 Turbines, Inside Switch Gears / Transformers, Aviation Lights,
56	Finalize Road Construction Contract
57	Finalize Electrical Works Contract
58	
59	**Site Work**
60	Site preparation (Clearing)
61	Road Works (RESL)
62	Foundation Works + Grounding System WECs (ENERCON)
63	
64	**Installation**
65	WEC Arrival & Transport to Site (RESL - ENERCON)
66	Erection 12 x E-82 Wind Turbines (ENERCON)
67	Electrical Cable Works (RESL)
68	Grid Connections (NSPI)
69	Energization (NSPI)
70	Commissioning and Testing (ENERCON)
71	Handover to Operations In-Service Date 30-Nov-2009



Project: Project Schedule - Statia WEC
Date: Wed 13/08/08

Task | Progress | Milestone | Summary | Rolled Up Task | Rolled Up Milestone | Rolled Up Progress | Split | External Tasks | Project Summary | Group By Summary | Deadline

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 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 E82, 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 E82 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, 2004). 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. It is also noted that there have been no noise complaints from the existing test wind turbine that was commissioned in May, 2006.

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 some 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. RESL is committed to articulate and adhere to systems, procedures, practices and materials that will ensure the development and operation of the wind farm at Point Tupper 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 RESL 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 federal and provincial agencies including EC and NSDE, will be completed prior to construction and will outline specific environmental and engineering measures that must 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 finalized once the project design is finalized.

2.7 Malfunctions and Accidents

RESL 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:

i) minimize the risk to human health and safety during both construction and operation; and

ii) 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, though handling structural elements that are not yet common to this region, 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 an industrial area closed to public access; and
- since the ice reduces rotation, modern turbines are equipped with an ice detection system that will shut down the unit if ice is detected on the blades.

The E82 wind turbine will cease operation in winds exceeding between 28 m/s and 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 D provides detail of ENERCON's 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 assessment regulations of both the Nova Scotia *Environment Act* and the *CEAA*. 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 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 assessment process.

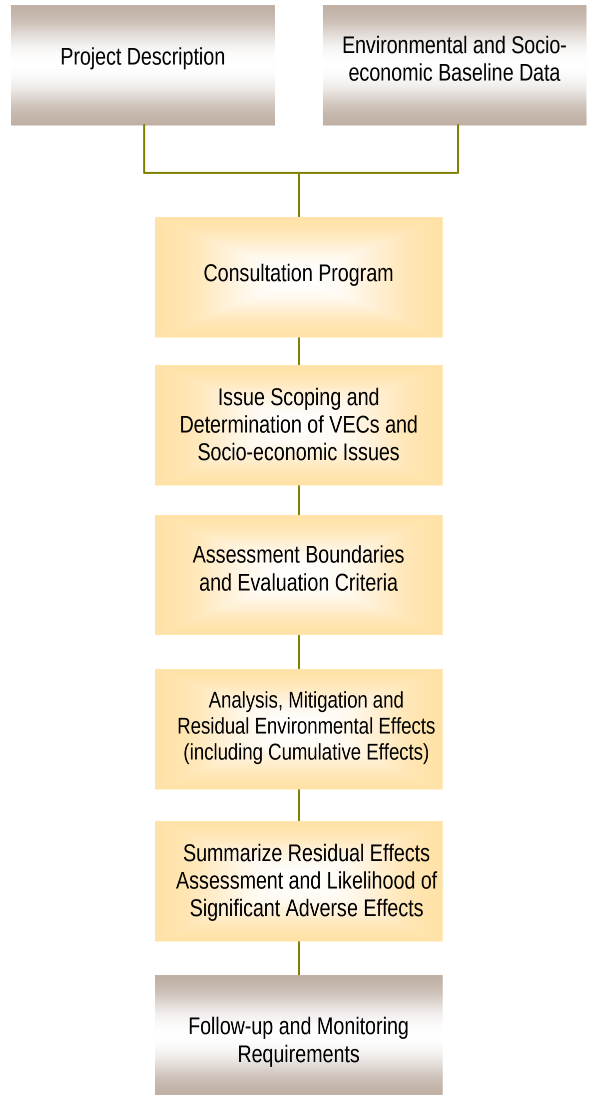


Figure 3.1: Environmental Assessment Process

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 often 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 Study Team has also executed a number of pertinent studies in Point Tupper and environs including environmental work for NuStar. The team is therefore familiar with the study area. Experience 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, that 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 environmental regulatory staff at the provincial and federal levels. Chapter 5 provides an account of the consultation undertaken.

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 works is a much disturbed site in an area designated for heavy industrial use. The lands owned by NuStar Energy and NSBI are not generally accessible to the public and are not used for recreational purposes. Based on the nature of the site, its location and previous environmental studies undertaken, it has been determined that no large mammals access the area on a regular basis. Further, given the land locked nature of the site, and the fact that the land is owned by NuStar Energy and NSBI and not readily accessible, a Mi'Kmaq ecological study was not executed for the lands associated with this Project. In support of this decision reference is made to the work done for the Mi'Kmaq Ecological Knowledge Study for the Environmental Assessment of the Bear Head LNG facility and the findings of the archaeological work done for this Project.

In addition to the research and the consultation program executed, environmental field programs were undertaken in 2007 and in 2008 to facilitate both the compilation of the environmental and socio-economic baseline and the determination of the VECs and socio-economic issues. Both biophysical and ecological field programs were conducted; these included, but were not limited to investigations and/or surveys to identify:

- ecological habitats and vegetation patterns to determine locations that were subsequently subject to further field examination as habitat for rare or endangered plants, or other species;
- breeding and migrating birds; and
- locations of archaeological value.

The above and other programs undertaken 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 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 Browne, 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.

The Agency has amended the definition of "environmental effect" in subsection 2(1) of the *CEAA* to clarify that under the *SARA*, an environmental assessment must always consider project impacts on listed wildlife species, their critical habitat or the residences of individuals of that species. 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., 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.

A list of the potential species of concern that may reside in, or migrate through, the study area was compiled from the legislated designated lists, the ACCDC and the NSDNR General Status Ranks.

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*. The 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 Project area. The observed distance of each species from the study area (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 Point Tupper was acquired from the ACCDC. Within this list, there were 341 Yellow and Red listed species under NSDNR's General Status List. By defining the habitat present on site, this list was refined to 19 species which have a habitat requirement consistent with those identified on site (see Table 4.3). This list of species was divided by taxon, i.e., birds, plants, etc.; this provided both guidance for the development of field methodologies and as a reference for the assessment.

Those species identified by COSEWIC, or by the NS *Endangered Species Act* as "Endangered", "Threatened" or of "Special Concern", and/or by NS DNR General Status as "Red" or "Yellow" and/or by ACCDC as "S1: or "S2" were identified. Table 3.1 provides a summary of definitions of rarity ranks associated with the referenced lists.

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.
Red	Known to be or is thought to be at risk.

Yellow	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.
Green	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
COSEWIC 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 execution of this analysis provided a framework of relevance to the definition of selected field programs, to the identification of VECs and to their evaluation.

In addition to the above, Dr. Andy Horn evaluated the recognized important bird areas within the region through a search of the important Bird Area database (http://www.ibacanada.com), EC's seabird colony database (courtesy of Carina Gjerdum, Wildlife Biologist, CWS Dartmouth, Nova Scotia), books on local birding sites (Murrant 1995, NSBS 1996, Maybank 2005), and interviews with local birders (Ian McLaren at Dalhousie University, David McCorguodale at Cape Breton University, Randy Lauff at St. Frances Xavier University and David Johnston of Port Hawkesbury). Species likely to breed at the site were identified from the Maritime Breeding Bird Atlas (Erskine, 1992 and http://www.mba-aom.ca/english/index.html) and the environmental assessment undertaken for the Liquid Natural Gas Project at Bear Head (Jacques Whitford Environment Limited, 2004). The Breeding Bird Survey database (http:www.pwr.usgs.gov/bbs/retrieval/menu.cfm) and the Christmas Bird Count database (http://www.audubon.org/bird/cbc/hr/index.html) were also consulted, although they provided no information beyond that obtained from the above referenced sources. Habitats were also assessed from aerial photographs and topographic maps.

Based on the review of the secondary databases and the initial mapping generated from the NSDNR forest GIS database, as well as the interpretation of recent aerial photography, the principal habitats in and adjacent to the Project site were identified. This database and mapping provided the reference material for the initial field reconnaissance and facilitated the design of the field programs.

3.2.2 Field Programs Executed

To augment the work referenced above, a number of specific field programs were undertaken. These are identified in Table 3.2 and outlined in the following sections.

Table 3-2: Field Programs Undertaken

Field Program	***Program Description***	***Lead Researcher***
General ecological field investigations	Ecological reconnaissance, including the identification of wetlands, habitat description and stream/stream crossing assessments	Clinton Pinks and Ian Bryson, CBCL Limited
Bird breeding and migratory programs	Field work to identify breeding and migratory bird populations	Andrew Horne, Dalhousie University
Botanical survey	Field investigations for priority plant species.	Clinton Pinks and Ian Bryson, CBCL Limited
Bat monitoring program*	Field investigation to determine the importance of the site for bats	Hugh Broders, Saint Mary's University
Archaeological program	An archeological desktop study and an archeological field program of the turbine sites and the access roads.	Davis Archaeological Consultants Limited
Land use investigations	Documentation of land use in and near the project site including the compilation of data for the visibility analysis.	Erica Chisholm-Keith and Steffen Käubler, CBCL Limited

* This program will be undertaken in the fall of 2008

3.2.2.1 General Ecological Field Investigations

There were a number of visits made to the site to confirm habitats and to execute field programs. These are referenced below.

Confirmation of Habitat Types

The initial mapping based on the secondary databases was ground truthed by CBCL Limited to confirm the habitat delineations identified. Where necessary, the mapped classifications were updated to reflect the on-the-ground conditions. The identified habitat types are:

- Mature mixed-wood forest;
- Young hardwood forest; this type of habitat arises from two separate conditions at different areas of the site:
  - Regenerating clearcut; and
  - Revegetated landfill;
- Mature coniferous forest;
- Non-forested areas including access roads and waste sites including asbestos dump sites;
- Deep Marsh: there are two deep marshes on the northern portion of the site, adjacent to the Port Malcolm road; and

- Treed Bog: there are two bogs on the central portion of the site, both of which are avoided by the proposed works.

Further information on these habitats is provided in Section 4.2.2.

Wetlands and Surface Water

A desktop GIS survey was conducted using the NSDNR Wetlands Inventory database to determine whether wetlands or waterbodies were located within the study area (Figure 3.2). A number of wetlands, i.e., treed bogs and deep marshes, were identified on site; as the preliminary engineering design avoids these features. No exhaustive field programs were undertaken to delineate or characterize the wetlands.

Within the area being developed adjacent the Port Malcolm Road, there is one stream, but it is given a wide berth by the proposed works. Most of the surface water movement appears to be via near-surface drainage. Where these drainage corridors were encountered, they were documented, geo-referenced and photographed. Culverts will be installed to ensure continued drainage (Figure 3.3). As stated, there are no streams on this site, and the WTGs are generally sited along the watershed crest. Water drains northwards towards Seacoal Cove and southwards to the Strait of Canso.

Land Use

Information on land use in and adjacent to the area was determined from observations in the field, through conversations with people at the open house and from consultations with those who own and use the properties involved. The observations made in the field were also used to identify viewpoints that could be used in the visual assessment (see Section 3.2.2.6); these viewpoints are depicted on Figure 3.4.

3.2.2.2 Avian Field Programs

The approach to the execution of the avian field programs was based upon a desktop survey undertaken by Dr. Horn in 2007, the determination that the site fits EC's Category 1 (EC, 2006b) level of concern and consultation with EC. As a result of the latter, field coverage was extended to ensure that sensitive elements at each season were not missed (J. Chardine, pers. comm.). Weather conditions and the focus of each site visit, i.e., breeding bird searches or migration searches, are detailed in Table 3.3. Three visits covered the morning hours (between 7:30 am and 12:30 pm) and four covered the late afternoon and evening (between 16:30 and 22:00) for a total of 20 hours on site.

These surveys, executed by Dr. Andy Horn from Dalhousie, followed the protocols advocated by EC in the text entitled "<u>Recommended Protocols for Monitoring Impacts of Wind Turbines on Birds</u>". The results of these programs are detailed in Section 4.3.1.2.

Table 3-3: List of Site Visits and Weather Conditions

Date	*Temperature (°C)*	*Wind Direction (°)*	*Wind Speed (km/h)*
April 19	2.4	340	19
May 13	3.4	10	20
May 19	9.9	160	17
June 3	17.5	350	4
June 16	11.1	360	7
June 18	12.2	140	17

i) Spring Migration

EC guidelines (2006a, b) are less specific about migration sampling than about breeding bird searches, and the desktop survey did not reveal any particularly sensitive elements related to migration. The purpose of sampling at this site, therefore, was to ensure that sensitive factors during migration were not missed. The four day sampling period, i.e., April 19, May 13 and 19 and June 3, was determined by combining the minimum migration sampling referenced by EC 2006a, i.e., weekly visits of stopover sites, with advice that migration monitoring be concentrated during the peak of migration, i.e., three to four weeks. These counts involved standardized area searches at six locations (see Figure 3.4) that were located in relation to the project area and were judged to be potential migrant traps, mainly because they were located in dense edge habitats that were more sheltered and richer in food and water than the surrounding habitat. At each site, five minutes of listening was followed by five minutes of "pishing" and/or playback of chickadee mobbing calls, during which all birds found from an area of approximately 1 ha (including birds outside that area) were listed.

ii) Breeding Bird Searches

Breeding bird searches consisted of both area searches and point counts. Area searches consisted of walking through the different habitats in the project area, noting all birds heard or seen. Unlike the migration searches, they were not standardized; this enabled flexibility in directing the searches preferentially toward habitats that might contain species of concern, although all habitat types were visited every day[2]. Breeding status was noted using standard breeding status codes (see Appendix 2 in EC 2006a), and playback was used to search for relatively secretive raptors and species of conservation concern where appropriate nesting habitat was found. These latter species were the Northern Goshawk, the Common Nighthawk, the Olive-sided Flycatcher and the Rusty Blackbird.

Originally, 20 point counts throughout the site were planned to:

> ... determine the consequences of the turbines to species diversity, to evaluate the predictions made during the EA process, to evaluate the cumulative effects of the industry on bird diversity and numbers, and to detect significant changes in numbers at single sites. (EC 2006a)

---

[2] This approach was legitimate and possible given the small area involved and the highly disturbed nature of much of the habitat.

It was apparent on the first visit, however, that ongoing clearing of forest remnants and other industrial works in the area would be such that point counts would not contribute to the above goals. Although some point counts were performed, the methods focused on area searches.

3.2.2.3 Bats

The best time to undertake field programs to determine the presence of bats is when movements of bats is expected to be highest, i.e., mid August until mid-late September. This work has not yet been undertaken. The proposed field program will involve the deployment of an Anabat II detection system to sample the echolocation calls of bats foraging or commuting. This system will consist of an ultrasonic Anabat II detector interfaced to a IF Storage ZCAIM (Titley Electronics Ltd., NSW Australia). Ultrasonic monitoring will be conducted for a period of 10 or more nights.

Species will be qualitatively identified from echolocation sequences by comparison with known echolocation sequences recorded in this and other geographic regions. In the case of species in the *genus Myotis* (northern long-eared and little brown bat), it will not be possible to identify sequences to the species level, as their calls are too similar to be reliably separated. Identifications will be accomplished using frequency time graphs in ANALOOK software (C.Corben, www.hoarybat.com). A bat pass, defined as a continuous series of greater than two calls, will be used as the unit of activity. The bat activity data will provide a record of activity by resident bat species throughout the study period. Ultrasonic monitoring will be scheduled to coincide with the timing of bat swarming at hibernacula, i.e., mid to late August. This is when most long distance movements are anticipated.

3.2.2.4 Plants

Ecological and botanical surveys were executed by the CBCL Limited team on May 9th, June 6th, June 25th, July 17th, and July 31st 2008. The intent of the multiple surveys was to capture both temporal changes in vegetation and maximum biodiversity. A list of rare and endangered plant species from the ACCDC was compiled prior to survey and was used to guide the survey. Based on the preliminary habitat assessment in fall 2007, species deemed as probable for existing on site were flagged. These species are listed in Table 4.3 and described in Section 4.3.2. A more exhaustive list of species deemed probable at the regional level is included in Appendix F.

The pedestrian surveys are depicted on Figure 3.2. The locations of the proposed turbine sites, assembly areas and road alignments were loaded into a Garmin Map76 GPS unit and each of these features was visited. At each turbine site, and at notable transitions along the road alignment, plant communities were photographed and described. Anecdotal information was also gathered at each of these sites, such as stand age, stand type and disturbance history. In addition to the footprint of the project, other areas were sampled in order to attain an understanding of the biodiversity of the area.

A full inventory of vascular plants and bryophytes was compiled based on the field work undertaken. The results are discussed in Section 4.3.2 and the detailed listings provided in Appendix F.

3.2.2.5 Archaeological Program

The archaeological work for this Project has been undertaken in two phases. In the fall of 2007, Davis Archaeological Consultants conducted a desktop archaeological resource impact assessment of the study area. The purpose was to determine the potential for archaeological resources within the development zone, which was referenced as that area of the Point Tupper Heavy Industrial Park between Lake Landrie and the Strait of Canso, and to provide recommendations, as warranted, for mitigation. The researchers noted that this area had been subject to several previous archaeological assessments both under their auspices (Licenses A200NS42, A2003NS73, A2005NS54, A2005NS70 and A2006NS69) and by *In Situ* Culture Heritage Research Group (Licenses A2005NS64 and A2005S89). In addition, there had been a Mi'kmaq Ecological Knowledge study conducted in the area by Mi'kmaq Environmental Services Limited in 2004 as part of the environmental work conducted for the proposed LNG Terminal at Bear Head. These reports were consulted and reviewed.

An integral part of the desk top work was the execution of predictive modeling to determine the likelihood of the area having an elevated potential for First Nations recourses. The Archaeological Potential Model: Musgrave Plateau Integrated Management data base is used to predict the archaeological potential of First Nations sites based on assigned values of stream order within the study area. The evaluation of stream order is based on a watercourse's hierarchal ranking within a network of streams and water bodies. The ranking of these water courses is based on their potential for supplying subsistence resources, both terrestrial and aquatic. The model, however, does not account for terrestrial topography; consideration of the latter is founded on experience and knowledge of the typical placement of First Nations sites.

In April and June the archaeological team conducted field work that involved the inspection of an area that encompassed a 100 m radius around each turbine location and along the identified access roads. Those involved were cognizant of positive as well as negative evidence of cultural activity including potential cultivation, stone piles, stone property boundaries, modern cultural and natural disturbance, shallow soil and rugged topography in the vicinity of the impact areas. Field notes and photographs were taken to record progress and the results of the survey.

The permits issued by the Nova Scotia Heritage Division to enable this work to proceed are provided in Appendix G. The results of the work undertaken are presented in Section 4.4.5.

3.2.2.6 Visual Assessment Methodology

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 Point Tupper Wind Farm is outlined in Figure 3.5.

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 3.4). 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 two locally important viewpoints with a 50 mm focal length lens (this most closely matches the human eye). The first of these viewpoints was looking south from Highway 104; the second was looking across the Strait of Canso from Route 344. Each of the viewing points was recorded by GPS (see Figure 3.4).

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 7.4.3.

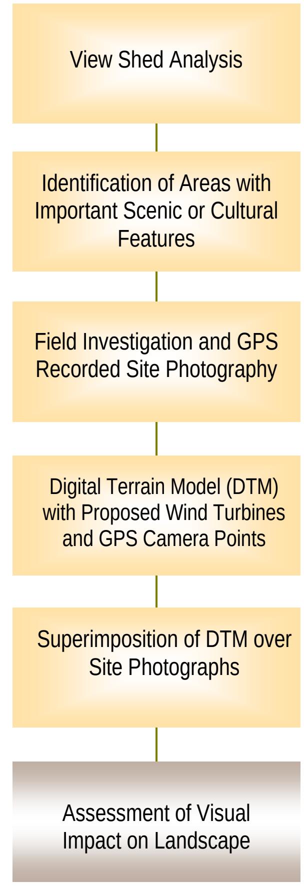


Figure 3.5: Visual Assessment Methodology

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 (some time in May), cool and cloudy. Summers are short in duration, warm and are characterized by less precipitation than in other seasons.

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.

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 Point Tupper site. The site is situated on the shore of the Strait of Canso within a cool, temperate climatic zone. Climate norms, i.e., 30-year averages, for the 1971 to 2000 period from the weather station located at the Port Hastings weather station are tabulated in the sections that follow. Extreme weather data are also provided for the period of record.

4.1.1.1 Precipitation

The recorded precipitation data is summarized in Table 4.1. The total annual precipitation (1,538.5 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 November and April. Monthly precipitation ranges from 90.8 mm (July) to 166.2 mm (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	99.4	48	147.4	111.3	41.9	111.3
FEB	61.1	46.7	107.2	127	48.3	132.1
MAR	103.1	29.3	132.3	88.2	30.5	88.2
APR	128.6	13.5	142.1	61.8	58.4	61.8
MAY	105.5	0.9	106.4	80.5	24.1	80.5

Month	*Mean Rainfall (mm)*	*Mean Snowfall (cm)*	*Total Precipitation (mm)*	*Extreme Daily Rainfall (mm)*	*Extreme Daily Snowfall (cm)*	*Extreme Daily Precipitation (mm)*
JUN	114.2	0	114.2	91.4	0	91.4
JUL	90.8	0	90.8	78.8	0	78.8
AUG	111.7	0	111.7	127.8	0	127.8
SEP	113.6	0	113.6	127	0	127
OCT	142.5	0.8	143.4	83.8	15.2	83.8
NOV	158.6	4.7	163.3	83.2	14	83.2
DEC	128	38.2	166.2	66	63.5	66
YEAR	1357	182.1	1538.5	127.8	6.5	132.1

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 -5.6°C in February to 18.5°C in August. The annual daily mean is 5.4°C. Daily maximums, minimums and extreme temperatures at the Port Hastings weather station are reported in Table 4.2.

Table 4-2: Temperature Norms and Extremes: Port Hastings Weather Station

Month	*Daily Maximum (°C)*	*Daily Minimum (°C)*	*Daily Mean (°C)*	*Extreme Maximum (°C)*	*Extreme Minimum (°C)*
JAN	-0.9	-9	-4.9	18.3	-26.7
FEB	-1.6	-9.6	-5.6	16.7	-26.1
MAR	2.1	-5.8	-1.9	17.8	-26.7
APR	7	-0.7	3.2	26.7	-13.3
MAY	13.4	4	8.7	31.7	-6.7
JUN	18.7	9	13.9	36.1	-2.2
JUL	23	13.4	18.2	37.2	-0.6
AUG	23	13.9	18.5	32.8	-17.8
SEP	18.8	10.1	14.5	31	-5.6
OCT	13.1	5.2	9.2	29.4	-7.2
NOV	7.3	0.8	4.1	30	-12.2
DEC	2.2	-5	-1.4	20.6	-22.8
YEAR	10.5	2.2	6.4	37.2	-26.7

Source: Environment Canada Climate Normals: 1971-2000.

4.1.1.3 Wind

The Strait of Canso area is dominated in summer by south, south-westerly and westerly winds. In winter winds shift to a north-westerly direction. These transitions in wind circulation patterns take place in April and November.

4.1.1.4 Air Quality

Because of the location of the Project site and the fact that the Project will not emit emissions to the atmosphere, no laboratory testing to determine air quality was undertaken. Due to the density of industrial activities in the area, however, the ambient air quality is poorer to that across much of coastal Nova Scotia.

4.1.2 Topography and Physical Setting

The project site, (see Figure 1.2) covers approximately 1.22 km^2 of land in size. The *Natural History of Nova Scotia* (Davis, and Browne, 1996) describes this area as being located in the Sedimentary Lowland District (District 860) of the Atlantic Coast Theme Region. The area is dominated by Chedabucto Bay, the largest bay on the Atlantic Coast. Although water temperatures here are typically warmer in the summer than other more exposed coastal areas along the Atlantic, the area is also more sheltered than other parts of the Atlantic Coast Region and is characterized by highly productive freshwater habitats.

4.1.3 Geology

The proposed site falls just east of the Horton sandstone Rolling Upland (District 570) of the Carboniferous Lowlands as described in the *Natural History of Nova Scotia*. The underlying bedrock is dominated by sedimentary rock, although other volcanic and conglomerate deposits are known to the area. Soft and relatively erodable deposits of salts (Windsor Group), reddish siltstones (Canso Group) and fine sandstones (Riversdale Group) have formed rolling lowlands which slope towards Chedabucto Bay and the Strait of Canso. Soil types in the vicinity of the Project area have developed from hard sandstones, slates and shales which range in texture from sandy loam to shale-clay loam.

4.1.4 Hydrology

The lands in Point Tupper and environs are moderately to highly permeable. There are small to medium sized lakes scattered throughout the region and the streams are often intermittent. The level of pH in the region fluctuates between slightly acidic to very alkaline due to the presence of high limestone and gypsum deposits. There are several small streams located in the area that extends from Point Tupper to Bear Head, but many are of low grade and some are not perennial (Oliver, pers. comm., 2006). Landrie Lake is the largest freshwater body near the project site; the associated watershed drainage area is approximately 16 km^2. This waterbody and its watershed supply the drinking water for the Town of Port Hawkesbury and water to industries in Point Tupper. Drainage from the Project site permeates northwards to Seacoal Cove and southwards towards the Strait of Canso (Figure 1.1).

4.2 Ecological Environment

4.2.1 Regional Context

The greater landscape surrounding Point Tupper is primarily forested, typical of what is found throughout the eastern portion of Cape Breton Island. The landscape is dominated by a matrix of coniferous and mixed forest, with patchy deciduous forest interspersed throughout (Figure 4.1). The majority of forests in the area are dominated by early seral pioneer species, due in part to the long history of industrial forestry and heavy industrial development in the area (Figure 4.2). Little in the way of late seral, i.e., climax or old-growth, forest exists south of Highway 104. Much of the region is poorly drained and is typically colonized by edaphic climax species including black spruce, red maple and tamarack. Mesic to dry sites tend to support mixed forest communities composed predominantly of black spruce, white pine, red maple, eastern hemlock, trembling aspen, balsam fir and yellow birch.

The coastal influence on vegetation can be clearly seen, with salt tolerant conifers, such as white and black spruce, dominating the shoreline. To the west of the project site, all the way to the Canso Causeway, much of the shoreline and adjacent lands are developed for industrial, residential and commercial purposes. To the east, the shoreline and adjacent lands are primarily wilderness and rural residential lands.

4.2.2 Terrestrial Habitats and Site Vegetation

The Project site is located in the midst of a heavy industrial landscape, and, as a result, the land has been rather seriously disturbed, particularly in the northwestern and southeastern portions. For example, to both the north and south of the proposed Project site, there are a number of dump sites (Figure 1.2). To the north a cleared area contains a number of asbestos burial sites, as well as the Bear Head bark landfill, which is currently being used by NewPage. The NSPI ash landfill is located on the south side.

The northwestern area of the site in the vicinity of WEC's 01, 02, 07, 08, & 09 is composed of unconsolidated fill material removed from the Statia terminals site during its construction (Figure 1.2). The central portion of the site, in the vicinity of WEC's 03, 04, 10 & 11 is relatively undisturbed, with intact climax forest in some locations. The southeastern portion of the site, in the vicinity of WEC's 05 & 06, shows evidence of recent (approximately 15 years) forestry practices.

Field work undertaken in spring and summer of 2008 identified eight main habitats:

1. Mature mixed forest
2. Mature, moist coniferous forest
3. Mature, dry coniferous forest
4. Young deciduous forest
5. Regenerating clear-cut
6. Treed bog
7. Deep marsh / Alder Swamp
8. Waste places and non-forested areas

Given the current distribution and siting of the proposed turbines and the alignment of the access roads, no wetlands will be impacted by the proposed development. A description of the general habitats, and associated plant communities, is provided below; these provide the context that the various ecological field programs build upon. The various habitats are delineated in Figure 4.3.

4.2.2.1 MATURE MIXED FOREST

This is one of the main forest type in the Point Tupper area, and the overstory is composed of predominantly Red Maple (*Acer rubrum*), White Pine (*Pinus strobus*), Black Spruce (*Picea mariana*), Yellow Birch (*Betula alleghaniensis*) and occasional Sugar Maple (*Acer saccharum*) and Eastern Hemlock (*Tsuga canadensis*). The understory is generally comprised of the same species as the overstory, indicating a climax forest community. Additional understory shrubs include Striped maple

(Acer pennsylvanicum), Red elderberry (*Sambucus pubens*), Red Raspberry (*Rubus idaeus*) and Blackberry (*Rubus allegheniensis*). This habitat inhabits a range of moisture regimes, from moist to very dry. Along this moisture gradient, *A. rubrum* and *P. mariana* tend to dominate on moist sites, whereas all other species tend to dominate on fresh to dry sites.


Mature, Moist Coniferous Forest

Herbaceous cover in this habitat is generally quite sparse. Common species include Bunchberry (*Cornus canadensis*), Wood Sorrel (*Oxalis montana*), Wild Lily-of-the-valley (*Maianthemum canadense*), Sarsaparilla (*Aralia nudicaulis*), White Violet (*Viola blanda*), Starflower (*Trientalis borealis*), and Blue-bead lily (*Clintonia bore*alis). The herbaceous layer also contained various ferns, of with Evergreen wood fern (*Dryopteris intermedia)*, Spinulose wood fern (*Drypoteris carthusiana*), Long Beech fern (*Phegopteris connectilis*) in mesic sites. Cinnamon fern (*Osumda cinnamonmea*) and Sensitive fern (*Onoclea sensibilis)* were most common in moist locations such as drainage corridors.


Mature Mixed Forest

Bryophytes (mosses, liverworts and clubmosses) are also a common component of the understory vegetation. Commonly encountered moss and liverwort species include Sphagum (*Sphagnum spp.*), Three-lobed Bazzania (*Bazzania trilobata*), Schreber's moss (*Pleurozium schreberii*), Hair-cap and Broom mosses (*Dicranum spp.*). Clubmosses encountered include Bristly clubmoss (*Lycopodium annotinum*), Ground pine (*Lycopodium obscurum*) and Running clubmoss (*Lycopodium clavatum*).

4.2.2.2 Mature, Moist Coniferous Forest

This forest type occurs at the periphery of the two main bogs sites. Overstory trees are primarily Black Spruce, with occasional Red Maple and Balsam Fir. Shrub species are similar to those in the overstory, with the addition of Sheep Laurel (*Kalmia angustifolia*), Rhodora (*Rhodora canadensis*), Labrador tea (*Ledum groenlandicum*), and False holly (*Nemopanthus muctolata*). The dominant ground vegetation is Sphagnum moss, combined with Bracken fern.

4.2.2.3 Mature, Dry Coniferous Forest

Overstory species found in this habitat are predominatly Black Spruce, White Spruce, White Pine, Balsam Fir (*Abies balsamea*) with occasional Larch (*Larix laricina*) and Eastern Hemlock. The shrub layer is minimal, and the ground vegetation typically consists of mosses such as Schrebers moss, Sphagnum moss and Hair-Cap moss.

Due to the year round shade that is cast by the needlebearing trees, there tends to be a much lower understory diversity than that found in the nearby deciduous or mixed forest stands. These areas also tend to have a thick duff (needle) layer which inhibits the growth of many understory species and acidifies the underlying soil. Overall this type of habitat is very nutrient poor, and this is reflected in its overall biodiversity.

Mature, Dry Coniferous Forest

4.2.2.4 Immature Deciduous Forest

The majority of this habitat results from the gradual revegetation of land that was infilled during the construction of the Statia terminal tank farm during the 1960s. At the time of construction, a large portion of the northern part of the site (see Figure 1.2) was used for stockpiling of topsoil, grubbings and other organic debris as this material was cleared from the Statia site. Today, the topography in the area is riddled with many pit-mound formations resulting from the settling of the dumped soil and decomposing woody debris. The result is a rather complex landscape with much microsite variation. Overall, the area is fairly well drained, and several distinct drainage channels have formed over time.

Pit-Mound micro topography characterizes the infilled land

The vegetation in this area is predominately even-aged pioneer species such as White Birch (*Betula papyrifera*), Trembling Aspen (*Populus tremuloides*), White Spruce (*Picea glauca*), Red maple, Speckled Alder (*Alnus rugosa*), Mountain ash (*Sorbus americana*) and Grey Birch (*Betula populifolia*). There is very little in the way of a shrub layer.

Regenerating Clear Cut

The understory herbaceous vegetation is composed of Evergreen wood fern, Sensitive fern, Bracken Fern, Reed Canary Grass (*Phalaris arundinacea*), goldenrods (*Solidago spp.*), and various mosses such as Sphagnum and Hair-Cap moss. At several locations, large patches of the invasive exotic Japanese Knotweed (*Polygonum cuspidatum*) dominate other species.

4.2.2.5 Regenerating Clearcut

In the southeast portion of the Project area, near turbine 5, there is an area of regenerating clearcut forest. There is an existing, although heavily degraded, logging road which accesses this area from the North, from the Bear Head bark dump. This forest was likely harvested approximately 15 years ago, based on the stature of the regeneration.

The dominant tree species in this habitat include Red Maple, Tamarack, Black Spruce and Balsam Fir. The habitat is very open in some spots, while in other areas it is very dense. The understory vegetation is comprised largely of Bunchberry, Sphagnum and Hair-Cap mosses, Wild Lily-of-the-Valley, Spinulose woodfern, and Bracken fern.

4.2.2.6 Treed Bog

Wetlands #3 and #4 are both classified as treed bogs. In this habitat, the dominant species is stunted Black spruce, Tamarack and Red Maple, with a substrate of Sphagnum moss. In both bogs, the Sphagnum / peat layer appears to be very deep, with minimal surface water visible. In more open areas, there is a shrub layer of Labrador Tea, Rhodora and False holly. Herbaceous vegetation include Small Cranberry (Vaccinium oxycoccus), Bracken Fern, Wild Lily-of-the-Valley and Round-Leaved Sundew (*Drosera rotundifolia*).

Treed Bog

4.2.2.7 Deep & Shallow Marsh / Alder Swamp

Along the Port Malcolm road, and near WEC #1, there are two wetlands, which are classified as a combination of marsh (deep and shallow) and alder swamp.

Deep marsh adjacent to Port Malcolm Road

Wetland #1 has a significant open water deep marsh in the center; there is a peripheral band of shallow marsh. Emergent vegetation in both these habitats is quite similar, and is dominated by Broad-Leaved Cat-tail (*Typha latifolia*). Occasional emergent species include Pickerel weed (*Pontederia cordata*). At the margins of this wetland, there are shrubby species that include Speckled alder, grading into upland species such as White Birch, Red Maple, Black Spruce and Balsam Fir.

Wetland #2 is predominantly alder swamp, with areas of shallow marsh. This wetland has much less open water and a greater incidence of other herbaceous species including Sphagnum moss and Soft rush (*Juncus effusus*).

4.2.2.8 Waste Places and Non-Forested Areas

In the Northwestern portions of the site, there are a number of waste places, which are presently not supporting any forest type vegetation. It appears that the topsoil may also have been removed from these sites which were used as staging areas during the construction of Statia terminals. The vegetation in these areas is characterized by shrubs such as Speckled Alder, Bebbs Willow, Serviceberry, Meadowsweet and Common Wild Rose. The herbaceous vegetation is characteristic of the weedy species found along many roadsides in Nova Scotia, and includes Queen-Annes Lace (*Daucus carota*), Yarrow (*Achillea millefolium*), various Hawkweeds (*Hieracium spp.*), Dandelion (*Taraxacum officianale*) Coltsfoot (*Tussilago farfara*) and Timothy (*Phleum pratense*). In the wetter areas, the exposed clay subsoil has been colonized by Sphagnum and Hair-Cap mosses. There are many areas where the exposed subsoil is colonized only by lichens.

In addition to the above, there are several cleared fields in the northern portion of the site that contain asbestos burial sites. These areas appear to have been seeded with a standard highway grass seed mix, and consist mainly of Timothy (*Phleum pratense*) and Red Clover (*Trifolium patens*).

Field containing asbestos burial sites

Typical location where waste has been deposited

4.2.3 Aquatic Environment

Although located in proximity to the marine environment to both the north and the south, and to several lakes, the site for the Point Tupper Wind Farm is notably free of running or standing bodies of water. The surrounding marine waters, however, provide rich habitat. Chedabucto Bay, the Canso Strait and the River Inhabitants region provide habitat for both resident and migrating (spawning or feeding) fish species. Freshwater and marine species in the area include pelagics such as gaspereau (*Alosa pseudoharengus*), shad (*Alosa sapidissima*), winter flounder (*Pseudopleuronectes americanus*), herring (*Clupea harengus harengus*) and mackerel (*scomber scombrus*). Key demersal species include cusk (*Brosme brosme*) Atlantic cod (*Gadus morhua*), pollock (*Pollachius virens*), American plaice (*Hippoglossoides platessoides*), white hake (*Urophycis tennuis*), Lobster (*Homarus americanus*), sea scallop (*Plactopecten magellanicus*), rock crab (*Cancer irroratus*) and haddock (*Lampris guttatus*). The

Project is some distance back from marine waters, and its development and operation will not impact these waters.

4.3 Species of Concern

As indicated in Section 3.2.1, Section 2(1) of the *CEAA* has amended the definition of "environmental effect" to clarify that under *SARA*, an environmental assessment must always consider project impacts on listed wildlife species, their critical habitat or the residences of individuals of that species. Environmental effect is defined as any effect on species of concern and their habitat resulting from project activities. Figure 4.3 shows the habitat associated with and surrounding the Project area including the wetlands. There are a number of small streams that drain northwards to Seacoal Cove and south to the Strait of Canso. The potential for effects resulting from the construction and operation of the proposed Point Tupper wind farm on these areas, on listed wildlife species, their critical habitat, or the residences of individuals of that species, provides the focus of this environmental assessment.

The screening of the ACCDC list acquired for areas within 100 km of Point Tupper yielded a list of 341 species that had been noted within 100 km of the site. Determination of habitats in and adjacent to the Project site enabled this list to be reduced to 19 species that might have a habitat requirement consistent with those in the area. These 19 are identified on Table 4.3; the field teams were vigilant in striving to identify these species on site.

Table 4-3: Conservation Status of Potential Species at Risk at Point Tupper

Common Name	***Scientific Name***	***COSEWIC***	***NSESA***	***NSDNR***	***ACCDC***
PLANTS					
Alderleaf Buckthorn	*Rhamnus alnifolia*			Yellow	S3
Climbing False-Buckwheat	*Polygonum scandens*			Yellow	S2
Disguised St. John's-Wort	*Hypericum dissimulatum*			Yellow	S2S3
Downy Willow-Herb	*Epilobium strictum*			Yellow	S3
Lesser Wintergreen	*Pyrola minor*			Yellow	S2
New Jersey Rush	*Juncus caesariensis*	SC	Vulnerable	Yellow	S2
Northern Bog Violet	*Viola nephrophylla*			Yellow	S2
Slender sedge	*Carex tenera*			Yellow	S1S2
Southern Twayblade	*Listera australis*			Red	S1
Stalked Bulrush	*Scirpus pedicellatus*			Undetermined	S1
Stout Wood Reed-Grass	*Cinna arundinacea*			Red	S1
BIRDS					
Bobolink	*Dolichonyx oryzivorus*			Yellow	S3B
Eastern Bluebird	*Sialia sialis*	NAR		Yellow	S2S3B
Long-eared Owl	*Asio otus*			Yellow	S1S2
Northern Goshawk	*Accipiter gentilis*	NAR		Yellow	S3B
Rusty Blackbird	*Euphagus carolinus*	SC		Yellow	S3B
Vesper Sparrow	*Pooecetes gramineus*			Yellow	S2S3B
ODONATA					
Harlequin Darner	*Gomphaeschna furcillata*			Yellow	S1
Zigzag Darner	*Aeshna sitchensis*			Yellow	S2

4.3.1 Birds

Marine and coastal birds, e.g., gannets, sea ducks and shorebirds, are known to migrate and move locally along the eastern shore of Cape Breton and northern Nova Scotia, and are thus seen in large numbers in Canso, Isle Madame and at the Important Bird Area nearest the site, the Basque Islands and Michaud Point, some 50 km to the northeast near Point Michaud. The Project site, however, is well to the west of this main travel corridor. The Canso Strait does provide an isolated route over water between the Atlantic Ocean, i.e., Chedabucto Bay, and the Northumberland Strait, and large concentrations of seabirds, mainly gulls, gannets and storm petrels, can be concentrated by strong winds at the north end of the Strait or, especially in the case of gannets, by concentrations of fish trapped at the Canso Causeway (Maybank, 2005, and personal communications with birders). While many of these birds necessarily pass the shoreline between Bear Head and Point Tupper, this shoreline is well south and east of the highest concentrations of these birds. Further, none of these species are likely to cross over land as they follow the Strait.

The colonial database showed no colonies (apart from one pair of the Great Black-backed gulls, an abundant species, at Flat Head) nearer than the eastside of Inhabitants Bay, some 15 km away; the latter include an apparently abandoned colony of 35 pairs of Great Blue Herons on Freeman Island and a colony of 59 pairs of Common and Arctic Terns on the Little Spirits Islands.

Breeding evidence exists for five species of raptor within the atlas squares that include the Project site; these are the Osprey, the Bald Eagle, the Northern Harrier, the Northern Goshawk and the American Kestral (Erskine, 1992).

The Canso Strait is a significant passage and feeding route for a variety of marine species, some of which, notably gannets and sea ducks, migrate in early and late winter. All of these species are likely to follow the water quite closely and are thus unlikely to cross the Project area (pers. comm. with birders identified in Section 3.2.1). Finally, there are no landscape features that would attract concentrations of birds at the site in winter, e.g., agricultural operations that might concentrate rodents for raptors.

Based on the work done and the ACCDC screening, six bird species were identified as having some potential for residing in or passing through the project area. By understanding the critical habitat for individual species, and through the execution of field programs, the likelihood of project impacts on the bird species at risk was examined. Section 4.3.1.1 provides information on the avian species of risk identified in Table 4.3. Section 4.3.1.2 provides information from the field programs executed by Dr. Andy Horne (Dalhousie University).

4.3.1.1 Bird Species at Risk

Bobolink (*Dolichonyx oryzivorus*)

This species is listed as a ‘Yellow’ species by NSDNR. Bobolink habitat includes hayfields, moist meadows and other areas that are dominated by a mixture of tall grasses. The numbers of this species have declined sharply both in Nova Scotia and throughout its eastern range in part because of more intensive agricultural haying practices. At the Point Tupper site, there are no agricultural areas; the only marginal habitat that might be potentially suitable is the roadside areas, and the cleared areas surrounding the asbestos burial sites. The likelihood of finding this species within the project area was considered low.

Eastern Bluebird (*Sialia sialis*)
Listed as a "Yellow" species by NSDNR, the eastern bluebird prefers habitat that consists primarily of a combination of interspersed deciduous forest and grassland. While the former habitat component is plentiful on site, the latter is not. The likelihood of finding this species within the project area was considered low.

Long-eared Owl *(Asio otus)*
The long-eared owl has been listed by NSDNR as Yellow, or thought to be at risk. The long-eared owl breeds in dense coniferous, mixed and riparian forests and areas with tall shrubs. It winters in woodlots, dense riparian woodlands and hedgerows, fields, cemeteries, farmyards or parks. The habitat characteristics of the project site are similar to the preferred breeding habitat of the long-eared owl. However during the breeding survey, conducted in the spring of 2008, no signs of this species were observed on site.

Northern Goshawk (*Accipiter gentilis*)
The NSDNR Yellow listed Northern Goshawk tolerates a wide range of habitats including mature deciduous, coniferous and mixed forest, particularly those with open understoreys. This species is primarily an interior forest hunter and generally avoids habitats with considerable amounts of edge, or those areas which are frequented by humans and traffic. Breeding sites for Northern Goshawk are typically located in isolated locales, generally in one of the largest trees in an area. While the greater Point Tupper area appears moderately suitable as Goshawk habitat, as it is relatively secluded and has a high proportion of mature forest, the immediate project area seems to offer more marginal habitat. Forest management has rendered most of the project footprint as immature forest. The likelihood of finding this species within the project area was considered low.

Rusty Blackbird (*Euphagus carolinus*)
Listed as a "Yellow" species by NSDNR and listed by COSEWIC as a Species of Concern, the Rusty Blackbird's favoured habitat is among wetlands, such as bogs, fens, meadows and swamps and along watercourses; it particularly favours a boreal forest setting. It is also known to feed extensively on aquatic invertebrates within the riparian zones of shallow, slow moving rivers. Consideration was given to the possibility of occurrence of this species within the project area, but none were encountered.

Vesper Sparrow (*Pooecetes gramineus*)
Listed as a "Yellow" species by NSDNR and listed by COSEWIC as Endangered, Vesper sparrows are characteristically found in areas with short grass or low shrubs, such as pastures, blueberry fields and clearings; scattered trees and taller shrubs are often used as sign posts. The species has been listed by NSDNR as yellow because over the last 50 years, changes in land use and increased farming intensity has had deleterious effects on the species' habitat and therefore populations. Because of the nature of the habitat on Point Tupper, the likelihood of finding this species within the project area was considered low.

4.3.1.2 RESULTS OF THE AVIAN FIELD PROGRAM

The avian species found as a result of the field programs described in Section 3.2.2.2 are listed in Table 4.4. With two exceptions, the spring migration searches did not locate any obvious migrants, i.e., birds following long flight paths in closely maintained groups, and/or outside their normal nesting habitat. The two exceptions occurred on April 19, when a flock of six American Robins were detected heading from east to west near the tanks along the Port Malcolm Road, and on May 13 when, at the same location, a mixed flock of likely migrants was seen; these consisted of five Yellow-rumped Warblers, one Ruby-crowned Kinglet, one Palm Warbler and one Black and White Warbler.

Table 4-4: Avian Species Found

Species	***Breeding Evidence***	***Comments (e.g., Listings or Rankings)***
American Black Duck	T	
Ring-necked Duck	T	
Ruffed Grouse	T	
Common Loon	T	
Osprey	FY	Seen along Landrie Lake; likely nests along Landrie Lake, but no nest found on project area
Bald Eagle	T	
Northern Harrier	H	
American Kestrel	H	
Broad-winged Hawk	T	
Killdeer	T	
Spotted Sandpiper	P	
Herring Gull	T	
Barred Owl	T	
Ruby-throated Hummingbird	T	
Belted Kingfisher	H	
Yellow-bellied Sapsucker	T	
Hairy Woodpecker	AE	
Northern Flicker	T	
Pileated Woodpecker	T	
Olive-sided Flycatcher	T	COSEWIC Special Concern, NS rank Yellow, S rank S4
Yellow-bellied Flycatcher	S	
Alder Flycatcher	T	
Least Flycatcher	T	
Blue-headed Vireo	T	
Red-eyed Vireo	T	
Blue Jay	T	
Gray Jay	P	NS rank Yellow
American Crow	FY	
Common Raven	FY	
Tree Swallow	T	
Black-capped Chickadee	P	

Species	*Breeding Evidence*	*Comments (e.g., Listings or Rankings)*
Red-breasted Nuthatch	T	
Brown Creeper	T	
Ruby-crowned Kinglet	T	
Swainson's Thrush	T	
Hermit Thrush	T	
American Robin	T	
European Starling	FY	
Cedar Waxwing	P	
Northern Parula	T	
Yellow Warbler	T	
Magnolia Warbler	T	
Yellow-rumped Warbler	T	
Black-throated Green Warbler	T	
Blackburnian Warbler	T	
Palm Warbler	T	
Black-and-white Warbler	T	
American Redstart	T	
Ovenbird	T	
Mourning Warbler	T	
Common Yellowthroat	A	
Wilson's Warbler	T	
Savannah Sparrow	S	
Song Sparrow	T	
Swamp Sparrow	T	
White-throated Sparrow	T	
Dark-eyed Junco	T	
Red-winged Blackbird	T	
Common Grackle	FY	
Purple Finch	T	
American Goldfinch	T	

Notes:
H = seen in appropriate breeding habitat
S = singing
T = territorial, i.e., seen in the same location at least one week apart
P = pair in suitable habitat
AE = adult entering presumed nest

During the breeding bird searches, the only species of conservation concern that was found was the Olive-sided Flycatcher; this was heard singing, and thus probably breeding, at the wetland areas mapped on Figure 3.1. Grey Jays were detected to the west of Landrie Lake; this species is yellow listed in Nova Scotia, although it is common throughout the province. Likely breeding raptors included a pair of Broad-winged Hawks, which were probably nesting on the ridge somewhere in the vicinity of Landrie Lake and a pair of Barred Owls, which were thought to be nesting to the south of the telemetry tower; these were not found during the June visits, and thus may have nested elsewhere. Four other species of raptors were seen in the project area, (Table 4.4), but showed no evidence of breeding in the Project site.

The desktop survey speculated that there was a possibility that marine or shoreline species might pass over the Project area, and that Common Nighthawks, Chimney Swifts or Rusty Blackbirds might breed there. The fieldwork offered no support for any of these possibilities. There is suitable habitat for Common Nighthawks near the project site, i.e., gravel areas and bogs for nesting, open light areas for foraging, but none were encountered, despite a particularly intensive search using playback during the still, warm dusk of June 16.

4.3.2 Plants

As indicated on Table 4.3, 11 species of plants, based on the ACCDC screening, were identified as possibly existing in the Project area, based on geographic proximity and overall habitat conditions. The list was further refined based on the actual habitats within the project footprint. While each of the species has been observed within 100 km of Point Tupper, many are limited in their range, and many obligate to much richer and wetter sites, i.e., intervale or floodplain forests, than are found on Point Tupper. The seasonally flooded intervales, where the combination of year round moisture and high nutrient soils lead to a higher overall biodiversity and incidence of rare taxa, are not found at this site.

None of the identified species were encountered during the botanical surveys, and a closer examination of their specific habitat requirements shed light as to why this is the case. While the theoretical habitat requirement for any given species is often satisfied, this is not a guarantee that that species exists in that habitat. Section 4.3.2.1 provides information on the plant species at risk identified in Table 4.3. Figure 3.2 indicates routes taken on the various surveys.

4.3.2.1 Plant Species at Risk

Based on the eight habitats present at the project site, the following plants species were identified as having potential for being present within the study area. The field programs were designed to sample each habitat representatively, and confirm or refute the presence of that species on site.

Alderleaf Buckthorn (*Rhamnus alnifolia*)
This species prefers rich, poorly drained areas. While there are poorly drained areas on site, these areas are moderate to poor in terms of nutrient availability. This species was not encountered during any of the plant surveys, and its likelihood of being encountered on site is considered low.

Climbing False-Buckwheat (*Polygonum scandens*)
Climbing False-buckwheat is a trailing vine which favors moist woods, thickets and riparian areas with rich loamy soils. This species generally thrives in disturbed areas. While the riverine habitat required to sustain Climbing False-buckwheat is not present on Point Tupper, there is a considerable amount of disturbed loamy soil in the northeastern portion of the site which could provide suitable habitat. After surveying this area, it was determined that the likelihood of encountering this species was low.

Disguised St. John's-Wort (*Hypericum dissimulatum*)
This species prefers wet sites. Upon surveying the drainage corridors and wetlands, there was no indication that this species was present. The likelihood of encountering this species at other locations on site was considered low.

Downy Willow-Herb (*Epilobium strictum*)
This species has a habitat preference for bogs and meadows. While bog habitat exists, the species is unlikely to be encountered, and was not encountered during any surveys.

Lesser Wintergreen (*Pyrola minor*)
This species is characteristic of mature coniferous woods in northern Cape Breton. While this type of habitat exists on site, the species is unlikely to be encountered, and was not encountered during any surveys.

New Jersey Rush (Juncus caesariensis)
This species is the only federally and provincially legislated species which might have been found on site. It is known to inhabit bogs and fens along the coastal plain of Cape Breton. Since all wetlands will be avoided, there would be no impact should the species in fact be present. Surveys completed in these habitats suggest that it is not present on site.

Northern Bog Violet (*Viola nephrophylla*)
This species is found primarily in bogs and damp woods, all of which are present at Point Tupper though not in abundance. The likelihood of encountering this species was considered unlikely, and since all wetlands are being avoided, there would be no impact on this species if in fact it was present.

Slender sedge (*Carex tenera*)
This species prefers meadows and moist openings in woods. There are some open areas which could be considered good habitat on the northwestern portion of the site, but the level of historical disturbance is likely too great for this species to have become established. This species is quite unlikely to be encountered based on the surveys performed.

Southern Twayblade (*Listera australis*)
This species is typically associated with spruce and tamarack in sphagnum bogs or damp woods. The two treed bogs on site are considered suitable habitat, but the species has not been encountered in these areas.

Stalked Bullrush (*Scirpus pedicellatus*)
This species prefers wet meadows and swamps. Meadows are not found anywhere on site, but the two wetlands on the northwestern portion of the site provide potential habitat. The species, however, has not been encountered on any surveys in these areas.

Stout Wood Reed-Grass (*Cinna arundinacea*)
This species prefers moist woods, such as the type found on site. Surveys of this type of habitat did not yield any occurrences of this species.

4.3.2.2 Results of the Plant Field Program

A total of 21.5 km of pedestrian surveys were conducted on five separate occasions, from early May to late July. The intent of the multiple surveys was to capture variability in the phenology of species, allowing for better representation of biodiversity. Figure 3.2 depicts the routes taken on these five plant surveys.

The relatively nutrient poor ground throughout most of the site in turn leads to a particularly uniform and species-poor understory in the forested areas, particularly in the mixed and coniferous stands. Deciduous stands tended to be more species rich. The waste places and non-forested areas were often very species rich, with roadside species predominating.

Plant Species and Communities

A total of 116 species of vascular plants were encountered and recorded, with an additional seven species of bryophytes. All species are ranked as S4 or S5 (ACCDC), and were determined to be relatively common.

A number of plant communities all typical of the Acadian Forest region were encountered during the surveys. Plant communities are summarized for each turbine site in Table 4.5. Section 4.2.1 contains descriptions of the typical plant communities present within each habitat.

No plants ranked S3, S2 or S1 (ACCDC) were encountered on site during any of the surveys. Furthermore, no provincially or federally legislated species were encountered at any of the turbine sites, nor at any points in between. Based on the habitat assessment, the areas of highest potential for rare plants were the various drainage corridors, wetlands and low areas. Surveys of these areas yielded no species of particular interest. The great majority of the species encountered are cosmopolitan throughout Nova Scotia, and many thrive on disturbed sites, which are in abundance at Point Tupper. A listing of all plant species found on site is provided in Appendix F.

Table 4-5: Plant Communities Encountered at Proposed Turbine Sites

Turbine Location	***Dominant Tree Species***	***Forest Age (years)***	***Dominant High Shrub***	***Dominant Herbaceous / Low Shrub***	***Habitat Notes***
01	*A. rubrum* *B. alleghaniensis*	30+	*S. racemosa*	*D. intermedia* *D. carthusiana* *Osmunda cinnamomea* *V. cuculata* *A. acuminatus*.	Mature deciduous forest, with abundant herbaceous understory.
02	N/A	N/A	N/A	*P. pratense* *T. pratens* *J. effusus* *C. scoparia* *Typha spp.*	Developed site. Open grassy area in midst of asbestos burial area. Probably hydroseeded at time of construction.
03	N/A	10-15	*A. rubrum* *B. papyrifera* *A. balsamea*	*C. canadensis* *A. rubrum* *M. canadense* *R. .idaeus*	Young regrowth from cutover area. Sparse understory due to shading/crowding of dense saplings.
04	*B. papyrifera* *P. mariana*	25+	*P. mariana*	*Dicranum spp.* *P. schreberii* *Sphagnum spp.*	Dry Black Spruce forest
05	*A. rubrum* *P. glauca* *P. mariana* *A. balsamea*	10-15	*A. rubrum* *P. glauca* *P. mariana* *A. balsamea* *B. populifolia*	N/A	Sparse understory due to shading/crowding of dense saplings.
06	*P. mariana* *A. balsamea* *A. rubrum* *B. papyrifera*	40+	N/A	*P. schreberii* *Sphagnum spp.*	Mature, dry mixed forest. Moss dominated understory.
07	*P. glauca* *B. papyrifera* *P. tremuloides* *A. rubrum*	30+	N/A	*D. intermedia* *D. carthusiana* *Osmunda cinnamomea* *V. cuculata* *A. acuminatus*	Young mixed forest, abundant herbaceous understory.

Turbine Location	*Dominant Tree Species*	*Forest Age (years)*	*Dominant High Shrub*	*Dominant Herbaceous / Low Shrub*	*Habitat Notes*
08	*B. papyrifera* *A. rubrum* *P. tremuloides*	15+	*A. rugosa* *B. papyrifera* *P. glauca*	*D. punctilobula* *T. noveboracensis* *Solidago spp.* *A. acuminatus* *A. umbellatus* *H. scabrum*	Young early successional deciduous forest. Abundant herbaceous understory consisting of many disturbance species.
09	*B. papyrifera* *A. rubrum*	20+	Speckled Alder, *A. rubrum*	*P. arundinacea* *D. carthusiana* *D. punctilobula*	Grassy deciduous forest, fairly moist. Drainage channels carved through infilled overburden material.
10	*P. mariana*, *A. balsamea*, *P. strobus*	40+	N/A	*P. schreberii*	Predominantly coniferous, with thick duff layer inhibiting most herbaceous growth. Mosses are dominant ground cover.
11	*A. rubrum*, *B. papyrifera*, *P. mariana*	60+	*A. balsamea*	*A. balsamea*	Deciduous forest, mostly dry with a few openings, which are dominated by balsam fir saplings.
12	*P. mariana*, *A. balsamea*, *P. strobus*, EH	40+	*A. rubrum*, *A. pensylvanicum*	*P. schreberii* *B. trilobata*	Predominantly conifer with some deciduous species. Thick leaf and needle litter with sparse understory vegetation. Dry site.

4.3.3 Mammals

Nova Scotia provides habitat to 57 species of mammals (Davis and Brown, 1996), and most are relatively widespread in their distribution across the province. The Whitetail deer (*Odolcoileus Virginianus*), the coyote (*Canislatrans*), the American black bear (*Ursus americanus*), the raccoon (*Procyon lotor*) and the porcupine (*Erethizon dorsatum*) are amoung the mammals likely to frequent the lands in and around the Project area. Based on the ACCDC screening, however, no occurrences of legislated species had been reported within a 100 km of the Project site.

4.3.3.1 Mammal Species at Risk

No mammal species at risk have been identified.

4.3.3.2 Results of Research

There have been sparse sightings of moose within the Point Tupper and Port Hawkesbury area, but, unlike mainland moose populations, the resident population of Cape Breton is quite prevalent. It is likely that in the past, the peninsula provided habitat for moose, but increased access and extensive industrial development have diminished both habitat and the area's remoteness.

4.3.4 Odonata

4.3.4.1 Species at Risk

Two species of Odonata were initially flagged as potential inhabitants on site, based on general habitat requirements.

Harlequin Darner (*Gomphaeschna furcillata)*

This species is listed as Yellow by NSDNR, and is ranked S1 by ACCDC. Its primary habitat is sphagnum bogs and fens.

Zigzag Darner (*Aeshna sitchensis)*

This species is listed as Yellow by NSDNR, and is ranked S2 by ACCDC. This species generally prefers small bog pools, generally without emergent vegetation.

4.3.4.2 Results of Research

No occurrence of either species was noted during any of the surveys. While a partial habitat requirement for both species exists on site, it appears that overall, the habitat is marginal. The most significant bogs, i.e., wetlands #3 and 4, are dominated by woody vegetation and have no visible pooling of water that would serve as suitable breeding habitat for either species. Furthermore, the configuration of the proposed works avoids this habitat, so that any impact to these species, if present, is mitigated.

4.4 Socio-Economic Environment

The Project site is located in the Point Tupper Industrial Park in the Municipality of the County of Richmond just south of Port Hawkesbury; the industrial area is located on the Strait of Canso. Point Tupper itself is a small community with a long history. Today there are only about 40 people resident in the immediate area, while Port Hawkesbury has a population of 3,500 people. The area immediately surrounding the Project site is industrial.

4.4.1 Key Settlements and Local Population Trends

The key settlements in the vicinity of the proposed wind farm are Point Tupper and Port Hawkesbury. Guysborough County and the town of Mulgrave are situated across the Strait of Canso. Point Tupper is a small residential community, but with a large industrial presence; Port Hawkesbury is the nearest population and service centre. Guysborough County is a large, predominantly rural, municipality; Mulgrave is a community of approximately 900 people. It was once the location of the mainland rail terminal for Cape Breton; today it is a residential area, with a slowly diversifying commercial and industrial base.

Port Malcolm Looking Towards the Site

Historically, Point Tupper was an important coastal village with homes, a hotel, two churches, a railroad station and a few stores. In the late 1970s, much of the private land was purchased to make way for new industries wishing to locate in the area due to the potential of the Strait of Canso as an ice-free and deep water harbour. Today, there are only about 10 homes. One of the churches is used by the Point Tupper Heritage Association as a museum. The emergence of Port Hawkesbury as the principal urban centre coupled with the area's potential for industry and shipping lead to a decline in the Point Tupper population. Today, approximately 40 people reside in Point Tupper.

The closest wind turbine will be located approximately 4 km from residences in Point Tupper, 4.5 km from a residential area in Port Hawkesbury (Queen Street Extension), 2.5 km from the closest residence on Highway 344 across the Strait of Canso and approximately 4 km from the nearest occupied residence on the Port Malcolm Road.

Port Hawkesbury is the largest urban centre in the area. The town experienced its most significant population growth following the opening of the Canso Causeway in 1955 and the development of the Point Tupper Industrial Park in 1959. Between 1956 and 1976 the population nearly quadrupled from 1,078 to 4,008. Economic volatilities over the past three decades, however, have had a negative impact on growth. In 2006, the town's population was 3,517 which represents a 5% from 2001.

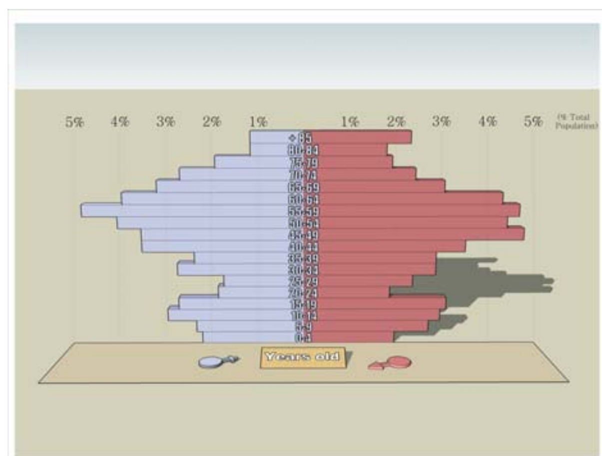


Figure 4.4: Population Structure

Despite this decline, as depicted on Figure 4.4, Port Hawkesbury has a relatively young and well balanced population. In 2006 only 13% of its citizens were 65 years and older compared to 15% in Nova Scotia and 13% nationwide. There are also more children under the age of 15 in the town (17.9%) than in either Canada (17.7%) or the province (16%). This trend is also reflected in the median age[3] distribution. The median age of the population in Port Hawkesbury is 39.0 years, in Nova Scotia 41.8 years, and in Canada 39.5 years.

4.4.2 Existing Land Use and Economic Activity


New Page Mill

Point Tupper is the industrial and employment centre of Richmond County. The deep, ice-free round harbour has been a draw for many of the industries that have established in the Point Tupper/Bear Head Industrial Park and other areas of the Strait. These industries include:

- ExxonMobil Canada - fractionation plant within the STCP site;
- Nova Scotia Power - power generation plant and terminal;
- NewPage - newsprint and calendar paper mill;
- Federal Gypsum - gypsum wallboard manufacturer and export facility;
- Georgia Pacific - gypsum export facility;
- Port Hawkesbury Pier - service vessel, fishing boat, tug boat, barge, patrol vessel, pleasure craft & cruise ship berthage;
- Martin Marietta - aggregate quarry & deep water terminal;
- Ideal Concrete;
- Point Tupper Properties Fabrication (former heavy water plant);
- Beaver Marine - marine construction and repair;
- AW Leil Crane Rental;
- Strait Supplies - industrial, marine and hydraulic equipment;
- Savage Coal Terminal - coal storage and rail loading;
- Bear Head LNG - liquefied natural gas storage facility (on hold); and
- Mulgrave Marine Terminal - deep water terminal.

Economic expansion in the Strait of Canso area has been steady. In 2003 EDS (Electronic Data System) set up a call centre in Port Hawkesbury. Stora Enso upgraded its plant to include a thermo mechanical pulp (TMP) operation, and NSPI built a new coal pier at its Point Tupper facility. The international Martin Marietta construction aggregate industry is located across the Canso Strait at Cape Porcupine, next to the Canso Causeway. In April of 2004, Ocean Nutrition Canada (ONC) expanded its facility across the Strait of Canso in the Town of Mulgrave, employing approximately 250 people. Though many of those working in these facilities stay in Port Hawkesbury, the area also attracts labour from a wide geographical including the Municipality of the County of Richmond, Guysborough County, Antigonish County and beyond.

As referenced in Section 4.2.2.8, there are several sites in and around the Project area that have been used as dump sites for asbestos, bark and top soil. These are located on Figure 4.3.

[3] The median age is an age 'x', such that exactly one half of the population is older than 'x' and the other half is younger than 'x'.

While much industrial activity takes place in Point Tupper, the Town of Port Hawkesbury is the major service centre in the area with shopping, recreational facilities and regional government offices. A number of educational institutions including the community college, serve the immediate area and the wider community.

Port Hawkesbury's position as a retail and service centre is reflected in the large portion of its inhabitants who are employed in wholesale and retail trade (29%); this is followed in importance by employment in manufacturing and the construction industries (22.8%) and in other services (21.6%). The majority of those resident in Subdivision A Richmond County work in the manufacturing and construction industries (27.1%) followed by other services (19.8%) and health and education (18.4%).

In addition to further industrial growth with the Point Tupper Industrial Park, there are opportunities for industrial development on adjacent lands in Port Hawkesbury, in the Town of Mulgrave, and across the Strait in the Melford Industrial Land Reserve in Guysborough County. The Melford Industrial area has been designated a petroleum products and deep-water related industrial reserve. The Strait of Canso is an important industrial location in the Province, and one that has the potential to contribute substantially to the economic well being of the Atlantic Region.

4.4.3 Communication and Radar Systems

The document entitled "Technical Information and Guidelines on the Assessment of the Potential Impact of Wind Turbines on Radio Communication, Radio Communication, Radar and Seismoacoustic Systems" produced by the Radio Advisory Board of Canada (RABC) in conjunction with the Canada Wind Energy Association (CANWEA) provides guidelines wherever there is a possibility that a wind farm may impact such systems. The crux of these guidelines is a "series of analytical methodologies and thresholds that help to indicate where a potential interference may occur, thereby acting as a voluntary (but highly recommended) trigger for the proponents to notify the applicable authority".[4]

The referenced document provides basic information on the manner in which interference may arise and its effects on systems. Radio communication systems include two main types: broadcast-type systems, including cellular type networks, and point-to-point (one way or two way) or point-to-multipoint systems. Radar systems are used for several purposes including:

- Predicting the weather;
- The Canadian Air Defence System; and
- Air traffic control systems.

Wind farms may also affect the functioning of the 52 Seismological Monitoring Stations located in Canada to detect and record ground motion signals related to distant earthquakes, etc.

To address these concerns a number of parties were consulted in regard to the proposed wind farm at Point Tupper. The results of this work are summarized in the sections below.

4.4.3.1 DND Air Defence and Air Traffic Control Radar Systems

The role of the Canadian Air Defence System is to provide aerospace surveillance, thereby contributing to the defence of North America, through radar systems located throughout Canada's arctic, coastal and inland

[4] Radio Advisory Board of Canada and Canada Wind Energy Association, "Technical Information on the Assessment of the Potential Impact of Wind Turbines on Radio Communication, Radar and Seismoacoustic Systems", April 2007, p4.

regions. DND was contacted and Mark Bartley (+ wind turbines@forces.gc.ca) replied on 27th June, 2008, as follows:

> *"I have analyzed the proposed Point Tupper Wind Farm, located in NS, with respect to the Department of National Defence, Air Traffic Control and Air Defence Radars. Our software modeling indicates no conflict with any current radar installations".*

4.4.3.2 NavCanada Air Traffic Control Radar

As detailed in Section 2.2.5 and Appendix C, the proponent has received notice from TC dated July 24, 2008 that their request to install lighting on turbines 1, 3, 6, 8 and 11 as per their submission of an Aeronautical Obstruction Clearance Form has been approved.

NavCanada Air Traffic Control Radar have not yet responded to enquiries, i.e., as of August 15, 2008.

4.4.3.3 Seismoacoustic Systems

The closest seismoacoustic monitoring station to the proposed wind farm is at Guysborough some 24 km away. A response received from David McCormack at NRCan on the 7th August, 2008 stated that the "proposed development does not pose a concern from a seismic or acoustic monitoring perspective".

4.4.3.4 Vessel Traffic Radar System

There is a radar station at Eddy Point some 7 km from the project site at Point Tupper that monitors all vessel traffic operating in the Strait of Canso and Chedabucto Bay. The Canadian Coast Guard (CCG) was asked to comment and has expressed concern that the proposed facility may compromise vessel safety. This subject is addressed further in Section 7.2.3.

Highway #4

4.4.4 Transportation Routes and Traffic Patterns

The Project site is accessed through the Point Tupper/ Bear Head Industrial Park from Port Malcolm Road. The street is four-lanes wide at the entrance to the Park, and two-lanes wide for the remainder of its length. The Port Malcolm Road is a local dirt access road.

The principle highway connecting the site to the national highway system is the Trans Canada Highway 104. As highway 104 passes though Port Hawkesbury, it converges on Highway 4, or Reeves Street. This busy four-lane roadway is the main commercial strip through the town and has unlimited access. Travel distances from Point Tupper to key settlements are: 1 km to Port Hawkesbury, 8 km to the Canso Causeway, 16 km to Mulgrave, 62 km to Antigonish and 53 km to St. Peters.

4.4.5 Archaeological Findings

Although the review of the existing historic documentation, previous archaeological assessments, predictive modeling and the Nova Scotia Heritage Divisions Maritime Resource Inventory had shown that the development area was of high archaeological potential for historic recourses, the field survey showed no archaeological resources present within the area to be developed. Furthermore, the absence of substantial watercourses, the lack of suitable topography, and previous disturbance on the site lend credence to the prediction that the study area is of low potential for First Nations resources. Table 4.4 summarizes the conditions at each of the turbine locations. The pertinent licenses under which the archaeological work was executed are provided in Appendix G.

Table 4-5: Findings at Each Turbine Location

Turbine	Archaeological Field Observations
Turbines 1 & 2	Land owned by NuStar Energy and used for asbestos burial – the land has been heavily modified and no archaeological resources were visible
Turbine 3	Located adjacent to a roadway in the Bear Head Landfill Facility – the land has been heavily modified and no archaeological resources were present
Turbines 4, 5 & 6	Located in areas that have been recently planted – area heavily modified and no archaeological resources present
Turbines 7 & 8	Located adjacent an area that has been quarried and therefore heavily modified – no archaeological resources present
Turbine 9	Located south west of the existing meteorological tower. Land disturbed during construction – no archaeological resources visible
Turbines 10 & 11	Located in young mixed wood forest – land disturbed. No archaeological features were present.

In summary, much of the land in the vicinity of the proposed locations for the turbines has been heavily modified by industrial use in the late 20th century. No visible signs of archaeological resources were encountered.

4.4.6 Mi'kmaq Ecological Knowledge

Predictive modeling for First Nations Resources, as summarized on Figure 4.5, indicates that the area to the south of Port Malcolm Road is of low archaeological potential for First Nations Resources; this conclusion is corroborated by the Mi'kmaq Ecological Knowledge Study which was conducted by Mi'kmaq Environmental Services Ltd. in 2004 and by the archaeological field work executed for this Project. Any elevated archaeological potential for First Nations resources in this vicinity would be along the shore of Seacoal Cove and the south end of Landrie Lake, both located outside the development area for this Project.

4.5 Environmental Factors Susceptible to Impact

Based on the expertise and experience of the Project team and the work undertaken to compile this environmental baseline, the following physical, ecological and socio-economic factors have been further evaluated:

- Surface Water Quality: because the Project area is located in proximity to surface waters, care must be taken throughout construction to prevent erosion and the transportation of silt to these areas;
- Species of Concern: a legislative requirement;
- Forest cover: although the forest cover across the Project site is already fragmented, some additional cover will be removed to facilitate the siting of the turbines;

- Migratory and Breeding Birds: given the nature of the Project, birds are susceptible to collision with the rotating blades of the turbines;
- Bats: given the nature of the Project, bats are susceptible to collision with the rotating blades of the turbines;
- Radar systems: in response to observations received from the CCG, this topic has been further examined with respect to shipping safety.

Chapter 5 Consultation

5.1 Community Consultation

Consultation is both an important part of the environmental assessment process and is also necessary to convey accurate, relevant and complete information to the local community. The study team and proponent have had many meetings with property owners and others in the area that may in one way or another have an interest in the construction and operation of the Project. They have also met with and kept municipality elected officials in both the Town of Port Hawkesbury and the Municipality of the County of Richmond fully informed about the Project and the various studies that have been undertaken. In addition to the informal meetings and communications that have taken place, a public open house was held in Point Tupper. Further details on this event and other key meetings are provided below.

5.2 Public Open House

To ensure that all interests in the local area had the opportunity to meet with the proponent and the environmental study team a public open house was held on June 16, 2008 at the Point Tupper Heritage Church, Henry Paint Street, Point Tupper. This event was advertised in the Port Hawkesbury Reporter and on local radio, i.e., Cape Breton Radio. In addition, approximately 150 landowners within approximately 1 km of the Project site and on Highway 344 (Guysborough County) were individually informed by mailed notice. The objectives of this event were:

- to provide information on the siting and development of the proposed wind farm;
- to provide interested individuals an opportunity to meet with the developers and the project team;
- to provide information on the environmental assessment process;
- to demonstrate an understanding of the area;
- to listen to concerns and provide information to mitigate those concerns; and
- to provide some indication of the timelines, constraints and requirements associated with the development of the Project.

Information about the Project (see Appendix H) was made available through a brief fact sheet that was distributed to attendees, a series of six storey boards and through one to one discussions. Nine people attended the Open House. Questionnaires were made available, but none were completed. The project team was able to discuss at length the concerns raised and questions posed and made note of these issues. Overall people wanted to know more about the turbines or wind energy generally, wanted to know where they were likely to be sited relative to their property and sought answers to a range of pragmatic questions including details of the construction schedule, noise, etc. The following specific topics were raised by those attending the Open House:

- turbine noise
- environmental regulatory process
- construction traffic
- jobs and local economic benefits
- operation characteristics of WTGs
- visual/landscape impact
- large mammals: especially deer
- birds and bats
- power market
- operational characteristics of WTGs

Overall, the feedback from those in attendance was supportive.

5.2.1 Other Consultation Undertaken

In the spring 2007 the proponent presented the Project to the Port Hawkesbury Chamber of Commerce, the membership of which represents a broad cross section of the business community in the Strait of Canso area. Considerable interest and support was expressed. In February 2008 the proponent and NSPI made a joint public announcement about the Project to elected officials, the business community and the public in Port Hawkesbury. Again the project was endorsed by the community at large.

Other meetings that have taken place include one with John Bain, Director of the Eastern District Planning Commission, to discuss the details of the project at length to ensure that the proposed Project complied with all local zoning regulations and municipal bylaws. A meeting also took place with Alan MacDonald, Senior Economic Development Officer for Richmond County to discuss the Project and the benefits that would accrue to the locality and to the Municipality. Benefits include the proposed alignment of the access road which could at some future date be used to access lands in the Point Tupper Industrial area which are currently inaccessible, and the taxes that will accrue to the local municipality. In February 2008, the Municipality of the County of Richmond passed unanimously the following resolution:

> "Moved by Councilor McNamara, seconded by Councilor Cotton that council write a letter to Mr. Larry LeBlanc, President/CEO of Renewable Energy Resources Limited, with a copy to Nova Scotia Power, welcoming their wind turbine project to the Point Tupper area, and commending them for their investment in a renewable energy project in Richmond County".

A copy of this letter is attached as Appendix I.

5.3 Regulatory Consultation

An integral and important part of the environmental assessment is to meet and/or communicate with the many regulatory departments that have expertise and guidance to contribute to the successful execution of the various field programs and studies. This has been done at various levels. After the submission of the Project Description to the Agency in August, 2007, the proponent and the environmental assessment manager met with representatives of the key regulatory agencies; this meeting took place on October 26, 2007 at the offices of the Agency.

The study team presented the Project as then envisaged and described the work that was underway. This in turn lead to a discussion of various topics including the following:

- the need for those conducting the field programs to have sufficient and substantive consultation with key leads in the Canadian Wildlife Service and NSDNR;
- the need to address EMF in the environmental assessment;
- the need to identify and categorize the forest types on the site; and
- the need to provide specific information on turbine lighting including the number and nature of the lights proposed.

Table 5.1 summarizes the role of the regulatory agencies participating in the meeting.

Table 5-1: Involved Federal and Provincial Departments

Agency/Organization	*Role*	*Observations*
Canadian Environmental Assessment Agency	Federal Environmental Assessment Coordinator (FEAC)	
Health Canada	Federal Authority (FA)	➢ human health concerns related to noise ➢ exposure to electric and magnetic fields (EMFs)
DFO	FA	➢ clarification of impact on stream crossings and fish habitat
Environment Canada	Expert Authority with mandates under several federal statutes	➢ recommended liaison with CWS with respect to the scope of avian baseline studies ➢ recommended lighting with short flash durations and the ability to emit no light during the "off phase" of the flash, e.g., strobes and modern LED lights ➢ detail/categorization of habitats ➢ proximity to weather radar
Natural Resources Canada	RA	➢ NPA approved under the ecoENERGY program
Transport Canada	Not a RA	➢ No navigable waters within the Project site

The above matters were discussed at some length and have been taken into account in the execution of the work programs described in Chapter 3 and in the determination and assessment of project impacts in Chapter 7.

In addition, to the specific meeting referenced above, the team at different times and for different purposes has been in contact with representatives of the following:

- Canadian Environmental Assessment Agency
- NRCan
- TC
- EC-Canadian Wildlife Service
- CCG
- NSDE
- NSTIR
- NSDNR
- DFO
- RABC
- DND

5.4 First Nations Notification

A letter providing information on the Proponent, the nature of the proposed Project, the consultant conducting the environmental assessment was sent to each of the following:

- Assembly of Nova Scotia Mi'kmaq Chiefs (the "Assembly");
- Union of Nova Scotia Indians;
- Confederacy of Mainland Mi'kmaq;
- Kwilmu'kw–klusuagn;
- the Native Council of Nova Scotia; and
- Nova Scotia Department of Aboriginal Affairs.

Chapter 6 Scope of the Assessment

6.1 Approach

The overall approach to this assessment and the fieldwork is detailed in Chapter 3. Figure 3.1 depicts the steps in the environmental assessment process. The following sections provide a further explanation of how the environmental evaluation was undertaken.

6.2 Scoping: VECs and Socio-Economic Issues

It is impractical, if not impossible, for an assessment to address all of the potential environmental effects that might be directly or indirectly associated with a proposed undertaking. An important part of the assessment process, therefore, is to identify those matters upon which the assessment may be focused to ensure a meaningful and effective evaluation. This process is often referred to as scoping, i.e., an activity designed to identify those components of the biophysical and socio-economic environment which may be impacted by the Project and for which there is public and professional concern (Sadar, 1994). This section references the steps that were taken to focus this assessment and to identify the VECs and socio-economic issues.

As detailed in Chapters 3 and 4, there was both extensive documentary research and the execution of a range of field programs. The resultant database, in conjunction with the consultation undertaken, including consultation with pertinent provincial and federal departments, and the study team's professional expertise and experience, has enabled the definition of the VECs and socio-economic issues. This process has involved internal team discussions to ensure that the requisite interdisciplinary rigor brought focus to the assessment. These discussions have included the participation of the specialists contracted to execute specific field programs and the engineers involved in the prefeasibility studies associated with the siting of the turbines and the access roads. The informed professional judgement of this team, particularly those who have executed the various field programs, and the local knowledge that the proponent team brought to the process, were important inputs to the determination of the VECs and socio-economic issues identified in Section 6.3. It is these factors that are subject to evaluation in Chapter 7.

6.3 Potential Pathway and the Definition of VECs and Socio-Economic

Once the scope of the Project was determined and the phases of the Project defined, it is possible to identify those facets that may cause consequences for the receiving environment. This is accomplished by identifying the linkages, or pathways, between the Project and the receiving environment. That is, those components and activities that will be carried out on the site during Project construction, operation and eventual decommissioning that may have the potential to interact with the physical, ecological and/or socio-economic environment. Such pathways will include, but will not be limited to, the generation of sedimentation and emissions, including noise and dust.

The study team has determined the VECs and socio-economic issues that will be subject to assessment based upon its collective knowledge and experience; input received from the Proponent; review of the regulatory requirements and feedback from the regulatory authorities, and others as part of the consultation program and selected field programs. The VECs and socio-economic issues that will be evaluated are identified in Table 6.1.

Table 6-1: Potential VECs and Socio-economic Issues

Physical Components	***Ecological Components***	***Socio-economic Issues***
Ground and surface water quality	Wetlands	Land use
Noise	Forest cover	Employment and the economy
CCG Radar	Species at Risk	Property values
	Migratory and breeding birds	Aboriginal use of lands
	Bats	Archaeological resources
		Visual impacts
		Traffic
		Health and safety

6.4 Analysis and Evaluation Criteria

The definition of "environment" in the *NS Environment Act* is as follows:

"Environment" means the components of the earth and includes

(i) air, land and water;

(ii) the layers of the atmosphere;

(iii) organic and inorganic matter and living organisms;

(iv) the interacting systems that include components referred to in sub clauses (i) to (iii); and

(v) for the purpose of Part IV, the socio-economic, environmental health, cultural and other items referred to in the definition of environmental effect."

In the provincial legislation *"environmental effect"* means in respect of an undertaking

a) any change, whether positive or negative, that the undertaking may cause in the environment, including any effect on socio-economic conditions, environmental health, physical and cultural heritage or on any structure, site or thing including those of historical, archaeological, paleontological or architectural significance, and

b) any change to the undertaking that may be caused by the environment, whether that change occurs inside or outside the Province.

This assessment focuses on the evaluation of potential interactions between the VECs and socio-economic issues and the various Project activities outlined in the Project description, i.e., in Chapter 2. A standard evaluation system has been developed to ensure that potential effects are clearly and completely evaluated. Residual environmental effects are those that remain after mitigation and control measures are applied. The prediction of residual environmental effects follows three general steps:

- determining whether an environmental effect is adverse;
- determining whether an adverse environmental effect is significant; and
- determining whether a significant adverse environmental effect is likely to occur.

Many, if not all potential adverse effects, can be avoided through the application of good engineering and construction practices, the careful timing of activities, and the adherence to appropriate environmental management techniques.

The effects evaluation for each VEC and socio-economic issue is conducted by Project phase, i.e., construction, operation, and decommissioning, as well as malfunctions and accidents. For each phase, the study team selects those Project activities that may result in a positive or negative effect on the VEC or socio-economic issue. To determine if there are adverse effects, the study team took the following factors into account:

- negative effects on the health of the biota;
- loss of rare and endangered species;
- loss of critical and/or productive habitat;
- fragmentation of habitat;
- transformation of natural landscapes;
- discharge of persistent and/or toxic chemicals;
- reductions in the capacity of renewable resources to meet the needs of present and future generations, including those lands and resources used by aboriginal peoples; and
- interference with the use and enjoyment of property.

The analysis evaluates the interactions between Project activities and the VEC or socio-economic issue and determines the significance of any residual adverse environmental effects, i.e., effects that may persist after all mitigation strategies have been implemented. To determine and appreciate the relevance of residual effects following mitigation, the following definitions of impact have been adhered to:

- *Significant*: Potential impact could threaten sustainability of the resource in the study area and should be considered a management concern - research, monitoring and/or recovery initiatives should be considered; and
- *Negligible*: Potential impact may result in a slight decline of the resource in the study area during the life of the project - research, monitoring and/or recovery initiatives would not normally be required.

As not all consequences of Project development and operation on the identified VECs and socio-economic issues are adverse, the above table has been supplemented by the following two definitions:

- no impact, i.e., where the consequences of the Project have no effects on the specific VEC or socio-economic issue; and
- beneficial impact, i.e., where the consequences of that phase of the Project enhance the specific VEC or socio-economic issue.

6.5 Cumulative Effects

A consideration in any environmental assessment process is how the proposed Project may interact with past, present or likely, i.e., approved, future projects or activities within the defined spatial and temporal timeframes identified. It is, in fact, a way of setting the Project into its broader ecological and regional development context, and it is the Project's interface with this context that is discussed further in the evaluation.

6.6 Effects of the Environment on the Project

Several naturally occurring environmental factors, including fire, extreme weather events and climate change, could to varying degrees have consequences for the development and operation of the Project. These are referenced as appropriate in the evaluation of specific VECs and socio-economic issues in Section 7.5.

7.1 VECs and Socio-Economic Issues

The VECS and socio-economic issues that form the basis for this environmental analysis were identified in Table 6.1. For an impact to occur, however, there has to be a link between the Project and the VEC or socio-economic issue, i.e., a pathway. Table 7.1 depicts where there is a potential pathway or linkage between the identified VEC or socio-economic issue through site preparation and construction, the operation and maintenance of the turbines and their decommissioning. This table graphically depicts potential interactions where there is a possibility for impact. Where there is no pathway, or linkage, there can be no impact on that VEC or socio-economic issue; a justification of this outcome is provided in the text.

Table 7-1: Potential Interactions Between Project Activities and VECs/Socio-Economic Issues

	Site Preparation and Construction					Operation and Maintenance				Reclamation & Decommissioning		
	Site preparation	Transportation of WECs	Assembly of WECs	Release of hazardous materials	Accidents and malfunctions	Movement of WEC blades	Release of hazardous materials	Presence of WECs	Accidents and malfunctions	Dismantling of WECs	Transportation of WECs	Accidents and malfunctions
Physical												
Ground and surface water quality	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓
Noise	✓	✓	✓	✓				✓		✓	✓	✓
CCG Radar						✓						
Biophysical												
Wetlands	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓
Forest cover	✓				✓				✓	✓		✓
Species at Risk												
Migratory and breeding birds	✓			✓	✓	✓	✓	✓	✓			✓
Bats	✓			✓	✓	✓	✓	✓	✓			✓
Socio-economic												
Land use	✓			✓	✓		✓		✓			✓
Employment and the economy	✓	✓	✓							✓	✓	

	Site Preparation and Construction					Operation and Maintenance				Reclamation & Decommissioning		
	Site preparation	Transportation of WECs	Assembly of WECs	Release of hazardous materials	Accidents and malfunctions	Movement of WEC blades	Release of hazardous materials	Presence of WECs	Accidents and malfunctions	Dismantling of WECs	Transportation of WECs	Accidents and malfunctions
Property values												
Aboriginal use of lands												
Archaeological resources												
Visual impacts								✓				
Traffic patterns	✓	✓									✓	
Health and safety	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓

The following sections present the environmental evaluation and identify the residual effects of the proposed Project on the above identified physical and biophysical VECs and socio-economic issues. Recommendations for mitigation are identified where applicable. The analysis also takes into account the consequence of the proposed Project interacting cumulatively with other activities taking place in the area.

7.2 Physical VECs

Examination of Table 7.1 indicates that various activities associated with the Project's development, operation and subsequent decommissioning may impact ground and surface water quality and may generate noise. On the other hand, only the movement of the WEC blades may cause interference with ships' radar. These factors and potential interactions are explored further in the sections that follow.

7.2.1 Ground and Surface Water Quality

The maintenance of the quality of the ground and surface waters on site is important to the maintenance of habitat quality particularly that associated with the wetlands that have been identified. Ground and surface water quality has therefore been identified as a VEC.

A significant environmental effect on ground and surface water quality would result if a substantive change attributable to the Project could be identified in ground and surface water quality in the immediate area of the site.

7.2.1.1 Boundaries

The physical boundaries encompass the lands that will be subject to the construction or upgrading of the access roads, laydown areas and WEC foundations. Construction will involve the use of heavy equipment and may involve some excavation of bedrock; during Project operation the focus will be upon maintenance activities while the eventual decommissioning of the WECs will again involve the use of heavy equipment. The temporal boundaries are primarily those associated with site preparation and Project construction, but the effects, if mitigative measures are not applied, could be more reaching both spatially and over time. In the broader sense the temporal boundaries relate to the anticipated life of the Project, i.e., perhaps 20 years or more.

7.2.1.2 Pathway Analysis

The pathways that may adversely affect ground and surface water quality include:

- the disturbance of sediments and the generation of dust during the construction of the WECs and the associated access roads;
- the disturbance of sediments and the generation of dust during the decommission of the WECs; and
- the accidental release of hazardous materials such as fuels, oils and lubricants.

7.2.1.3 Mitigative Measures

Construction activity will involve clearing and grubbing in addition to excavation, activities that have the potential to cause erosion and the transportation of sediment to adjacent areas, including existing ditches, wetlands and streams. The severity of erosion and sediment transport depends on several factors including precipitation, soil type, slope, vegetation cover and distance. Some portions of the area as referenced in Section 4.2.2 is composed of unconsolidated till material which is susceptible to erosion. Nevertheless the greater part of the site and the vegetation surrounding the wind turbine pad locations will remain largely untouched. In most areas erosion and associated sedimentation is not anticipated. This will be reinforced through the use of proven methods to control run-off, erosion and dust including:

- defined procedures for the storage and handling of excavated materials;
- timely re-vegetation, if necessary, of disturbed areas after construction;
- the installation of temporary erosion control measures, e.g., drainage barriers, sediment fences, plastic sheeting, straw or mulches, etc.; and
- watering of exposed areas in dry conditions to control dust.

As referenced in Section 3.2.2.1, the local flow of water from the site appears to be via near-surface drainage. Culverts will be installed in a manner to protect existing drainage patterns, and the necessary protective measures will be installed to ensure that there is no impact from the disturbance of soils etc. More specifically the following mitigative are proposed for the construction, operation and decommissioning phases.

Site Preparation and Construction

- Installation of erosion and sedimentation control measures and surface water control features, e.g., silt fencing, where appropriate, before land clearing and earth handling;
- Excavation for turbine footings and the storage, handling and disposal of excess materials in an environmentally appropriate manner;
- Installation of required culvert sections to specified grades and inspections to ensure tight joints;

- Placement of road gravels; and
- Covering exposed surfaces where applicable with straw mulch.

Operation and Maintenance
During the operation and maintenance of the site, storm drainage structures will be monitored and maintained to the extent applicable to prevent sediment migration from any runoff from the turbine pads.

Reclamation and Decommissioning
The mitigative actions during reclamation and decommissioning will be comparable to those executed during the construction phase, including the installation of site specific erosion and sedimentation control measures and the management of storm drainage from disturbed areas.

Accidental releases of hazardous materials could occur during any phase of the Project and might include petroleum products and possibly solvents and paints. Accidental releases of other chemicals could occur from storage facilities or vehicles. The severity of an accidental event would depend on the chemical characteristics and volume of the release. Relatively small amounts of fuel and hydraulic fluid spilled during the operation of construction equipment, or the servicing of the turbines, are the most likely types of accidental releases. Standard practices for the handling, storage and use of potentially hazardous materials will be enforced through all phases of the Project. The following mitigative measures will also be applied:

- all hazardous materials to be used at the site will be labeled according to WHMIS regulations;
- vehicle maintenance and refueling will be prohibited on site;
- frequent inspection and maintenance of all equipment used on the site will be undertaken to identify and repair fuel leaks;
- used oil, filters and other products associated with equipment maintenance shall be collected and disposed of in accordance with regulatory requirements; and
- all spills shall be immediately reported to the Environmental Emergency # 1-800-565-5733.

Given the use of proven sedimentation control measures, including those advocated in the “Erosion and Sedimentation Control Handbook for Construction Sites”, the distances from the WEC sites to streams, water bodies etc., and the further development of standard practices for the handling, storage and use of potentially hazardous materials as part of a comprehensive EMP program, it is highly unlikely that sedimentation will pose a hazard to ground and surface waters. In summary, through the use of standard and accepted industry procedures and mitigative measures, adherence to applicable regulations and guidelines, and waste management planning, the construction of the proposed Project will be undertaken in an environmentally responsible manner and is unlikely to result in a significant adverse effect on surface and ground water quality.

Project interactions with surface and ground water during Project operation are anticipated to be minimal. The most likely interface is an accidental release of a hazardous material during turbine maintenance or when machinery is necessary to facilitate repairs. In summary, by adhering to applicable regulations and guidelines, implementing mitigation measures and applying good management practices as referenced above, the operation of the proposed Project is unlikely to result in a significant adverse effect on surface and ground water quality.

The decommissioning of the Project would involve the dismantling and removal of the WECs and the reasonable rehabilitation of the Project site. There would be no excavation of bedrock involved, and, the concrete pads at the site would likely remain in place. In summary, the reclamation and decommissioning of the site is unlikely to result in a significant adverse impact on surface and groundwater quality.

Beyond the accidental release of a hazardous material, malfunctions could perhaps involve a need to replace components of one or more WECs, or other components of the wind farm. The measures adopted to minimize erosion or sedimentation during construction would be likewise adopted to address the consequences of any earth works required to resolve malfunctions in equipment.

7.2.1.4 Cumulative Effects

There are no known development activities that will take place in or in the vicinity of the site that might act cumulatively with the proposed Project to cause a significant adverse effect on the surface or ground water quality.

7.2.1.5 Residual Effects

The Project is not anticipated to have a significant residual environmental effect on the surface and ground waters of the area; the impact is predicted to be negligible.

7.2.2 Noise

Noise produced by wind turbines is a concern that is often raised by people when learning of the possible development of a wind farm in their community. It is not a concern, however, that has been raised with respect to the Point Tupper Wind Farm. Noise from a WEC is caused in part from the conversion of wind energy into sound when interacting with the blades and in part from other mechanical sources. Sound is measured in decibels (dBs). The audible range is from 0 dB, the threshold of hearing, to 140 dB, the threshold of pain.

The impact of noise depends on a range of factors that influence sound propagation including, but not limited to, the following:

- distance from the source, e.g., the bulldozer or WEC;
- height of the source;
- atmospheric conditions, including humidity;
- intervening topography or structures;
- vegetation; and
- background wind noise levels.

The proposed site is located in a heavy industrial area, some considerable distance from the nearest occupied residential unit, and, as detailed in section 4.4.1, the closest residence is located on Highway 334 on the other side of the Strait of Canso. There is heavy traffic on a daily basis throughout Point Tupper plus other industrial noise.

A significant environmental effect would arise is noise that could be attributed to the Project was demonstrated to cause harm to local residents.

7.2.2.1 Boundaries

The geographical area of interest is:

- the area within which wildlife, including birds, may be impacted; and
- the nearest residences, i.e., over 2 km distant.

The temporal boundary encompasses the construction and decommissioning phases and the operating life of the Project, i.e., perhaps 20 years or more.

7.2.2.2 Pathway Analysis

All phases of the proposed Project will generate noise, i.e., construction, operation and decommissioning. During the construction and decommissioning phases, the anticipated noise will be that generated by typical construction activity including the transportation of materials, site works including the building of the access roads, turbine pads, etc. The noise will be caused by the operation of heavy equipment such as back hoes, bulldozers, flatbeds trailers, cranes, dump trucks, ready mix trucks and the smaller vehicles used to transport workers to and from the site.

Typical dBA levels in an industrial environment are in excess of 55 dB. The nearest occupied residence is over 2 km distant. It is very unlikely that construction activity would be heard at that distance, but if it is, it will be intermittent and unlikely to be an ongoing nuisance. Such noise, however, may temporarily disrupt the activities of fauna and birds at, or in the vicinity of, the Project site.

It has been found easier in practice to calculate the potential sound emissions from wind farms than to measure them, because to obtain an accurate measurement the sound level has to be some 10 dBA above background noise. With typical ambient background levels frequently greater than 30 dBA, this can be difficult. Reliance is therefore placed on calculation. Given the minimum distance between the nearest WEC and an occupied residence, background noise from natural and anthropogenic sources will drown out the sounds associated with the WECs.

7.2.2.3 Mitigative Measures

To mitigate the impact of noise from construction activities, construction and decommissioning should be limited to day time working hours whenever reasonably possible, and all machinery should be fully serviced.

The distance between the wind farm and the nearest residence, i.e., over 2 km, will absorb the incremental noise generated by the wind farm.

7.2.2.4 Cumulative Effects

There are no known development activities that will take place in, or in the vicinity of, the Project site that might act cumulatively with the proposed Project to increase noise levels thereby causing a significant adverse effect; no cumulative effects are anticipated.

7.2.2.5 Residual Effects

The noise that will be generated by the Project is not predicted to have a significant residual effect on the wildlife, or on the occupants of the nearest residences. The impact is predicted to be negligible.

7.2.3 CCG Radar

CCG uses a standard radar system installed on a tower at Eddy Point to monitor traffic entering the Strait of Canso. It is estimated that approximately 1,100 vessels use the Strait in a typical year. Of these approximately 300 are tankers, 200 are dry cargo carriers and the balance are other cargo, government, fishing and pleasure vessels. In addition to the monitoring undertaken by the CCG, there are compulsory pilotage requirements enforced in the Strait of Canso for the following vessels:

- > 1,500 gross tonnage for Canadian vessels;
- all foreign registered vessels;
- oil rigs;
- any combination of tug and tow; and
- any pleasure craft greater than 500 gross tones.

Obviously these pilotage requirements go directly to ensuring the safety of vessel movements in the Strait of Canso and augment in a very real sense the radar surveillance that is provided from Eddy Point.

Marine safety, however, is a serious topic and the concerns raised by the CCG in their communication with respect to the wind farm were taken very seriously by the proponent. This is also a complex subject matter, and few have the experience and expertise to understand the issues involved. The CCG themselves recommended the services of Lea Barker, VIC Limited in Ottawa; his report is appended in Appendix J.

7.2.3.1 Boundaries

The area of interest with respect to this subject matter is the safety of shipping in the Strait of Canso and particularly in that area of the Strait between the wind farm and the CCG radar installation at Eddy Point, some 7 km distant.

The temporal boundaries are those associated with the operation of the wind farm, i.e., perhaps 20 years or more.

7.2.3.2 Pathway Analysis

This, as has been stated, is a complex issue, but concern has been expressed that the operation of the wind farm may interfere with the effectiveness of the current radar system operating at Eddy Point and may therefore, under certain circumstances, compromise shipping safety in the Strait. Barker's report addresses all possible interferences that the wind farm may cause and discounts many, if not all. The following concerns remain:

- multiple reflection effects where a false target is created via a double reflection off a tower, i.e., a ghost echo that looks like a ship target which can temporarily occur at certain ship orientations[5]; and
- effects seen on the radar on board transiting vessels – thought to be rare and could be mitigated via a Notice to Shipping to warn of the effect.

[5] This may occur every other day on average and could be distracting to VTS operators, but there would be no collision alarms from false targets as these are based on operators' calculations. Barker recommends one or two tests at Eddy Point to determine the potential consequences of these false targets on the work of the CCG.

As stated above, radar is but one tool that is used to ensure vessel safety. The compulsory pilotage of most vessels, and certainly all of the larger vessels, is perhaps the primary mechanism that is used to ensure vessel safety in the Strait of Canso.

7.2.3.3 Mitigative Measures

Based on the work done by Barker (Appendix J), CCG should be encouraged to issue a Notice to Shipping to warn of the possible reflection effects that may arise from the proposed wind farm. The CCG is also encouraged to act upon some of the additional recommendations referenced in Barker's report.

7.2.3.4 Cumulative Effects

The Strait of Canso is an ice free, deep water harbour and one that has the capacity to accommodate additional commercial shipping. Several other developments that may involve such traffic are in the design phases. In this context, all involved parties must work collaboratively with the CCG and TC to ensure the safety of vessel movement in the Strait through both the continual deployment of effective pilotage, implementing timely updates to Notices of Shipping and ensuring that the CCG has the necessary upgrades to its radar systems to address the needs of the area and to enable the area to accommodate the industrial and commercial development sought by the Province and by the municipalities serving the Strait region.

7.2.3.5 Residual Effects

Given the current requirements for pilotage and the deployment of the recommended Notice to Shipping, the operation of the proposed wind farm is unlikely to result in a significant adverse impact on the effectiveness of CCG radar in the area. The impact is predicted to be negligible.

7.3 Biophysical VECs

Examination of Table 7.1 indicates that the various activities associated with the Project's development, operation and subsequent decommissioning may impact the wetlands in the vicinity of the WECs, forest cover, migratory and breeding birds and bats. Based on the studies executed, including the field programs, no Species at Risk have been identified in the Project site. No further evaluation of this VEC has been undertaken.

7.3.1 Wetlands

Wetlands provide distinctive habitat and serve as an important link between freshwater and terrestrial ecosystems. RESL acknowledges the importance of the "Federal Program Wetland Conservation" and its objective to "promote the conservation of Canada's wetlands to sustain their ecological and socio-economic functions, now and in the future." As referenced in Sections 3.2.2.1, 4.2.2.6 and 4.2.2.7 and depicted on Figure 4.3, a limited number of wetlands have been identified on the lands to the east of the Port Malcolm Road. As a result of the field truthing and associated investigations carried out, the proponent has succeeded in siting both the WECs and the access roads that service them to avoid direct impact on any wetland. The intent of the proposed layout is to enable the retention of the existing wetlands and to ensure their protection.

A significant environmental effect on wetlands would result if there was a substantive change to the wetlands in the area that could be attributed to the Project.

7.3.1.1 Boundaries

The spatial boundaries are limited to the physical extent of the wetlands themselves and the physical relationships between these areas and the WECs and access roads. The temporal boundaries are primarily those associated with Project construction.

7.3.1.2 Pathway Analysis

The pathways that could have an adverse impact on the wetlands include the grubbing and clearing of land for the WECs and the access roads, the construction process itself and the associated disturbance of sediments and dust that may be associated with such activities. Other pathways include the accidental spilling of fuels, lubricants, or hydraulic fluids and pedestrian and vehicular access into the wetlands.

Construction activity can affect a wetland in several ways. The movement of heavy machinery, for example, can result in the physical disturbance of plant communities and substrates. Other activities such as clearing and grubbing, trenching and backfilling, if inappropriately undertaken, could result in the sedimentation of inundated portions of a wetland. Trenching could alter the hydrologic regime by changing groundwater flows. In dry weather, excessive dust could be blown into wetland areas. In turn, this could result in increased or decreased water levels depending on whether groundwater is directed into the wetland or drained from it. Wetland flora and wildlife species could also be affected by accidental spills of fuels, lubricants or hydraulic fluids.

7.3.1.3 Mitigative Measures

As referenced above, effective planning for the proposed wind farm has enabled the siting of both the WECs and the access roads to be undertaken to avoid direct impact on any wetland. Indirect impacts in the absence of effective mitigation could be associated with the consequences of construction on ground or surface waters. The latter are addressed in Section 7.3.1 above.

Since there will be no direct impact on any wetland from the construction of the WECs or the access roads associated with the development of the Point Tupper Wind Farm, it is not anticipated that the operation and maintenance of the proposed facilities will have any effect on the wetlands in the area. The most likely pathway for impact is an accidental release of a hazardous material during turbine maintenance or when machinery is necessary on site to facilitate repairs. Through the application of good management practices, the operation of the proposed Project is unlikely to result in a significant adverse effect on the wetlands identified.

The decommissioning of the Project would involve the dismantling and removal of the WECs and the reasonable rehabilitation of the Project site. There would be no excavation involved and the foundations of the WECs would likely be left in situ. In summary, the decommissioning of the site, though involving the transportation in heavy equipment of large structural components, would be less invasive than the construction program and would be conducted in accordance with all applicable regulatory requirements in an environmentally responsible manner.

Beyond the accidental release of a hazardous material, malfunctions could involve the need to replace components on one or more WECs, or other components of the wind farm. The measures advocated to address spills and minimize sedimentation would be applied as appropriate.

Malfunctions and accidents are not predicted to have a significant adverse effect on the wetlands.

7.3.1.4 Cumulative Effects

There are no known works that are proposed in the vicinity of the proposed wind farm that would interact cumulatively with the construction and operation of the wind farm to have an adverse impact on the wetlands in the area; no cumulative effects are anticipated.

7.3.1.5 Residual Effects

The Project is not anticipated to have a significant residual environmental effect on the wetland, i.e., the impact will be negligible.

7.3.2 Forest Cover

As detailed in Section 4.2.1 and depicted on Figures 4.1 and 4.2, the landscape is characterized by a matrix of coniferous and deciduous forest. Such forest cover does provide habitat for a range of wildlife including birds and has therefore been recognized as a VEC.

Field work undertaken has identified the following forest habitats:

- Mature mixed forests;
- Mature moist coniferous forest;
- Young deciduous forest;
- Regenerating clear cut;
- Treed bog; and
- Deep marsh/alter swamp

The dominant cover type over most of the area, under an undisturbed scenario, would be of mixed forest, interspersed with pure stands of coniferous species. Currently, this matrix is interspersed with both clear cuts, landfill areas and road cuts. In general, there is little in the way of ecologically significant or sensitive forest habitat south of Highway 104, and there is even less in the industrial landscape of Point Tupper. Interior forest conditions are generally absent, and there is no old-growth forest anywhere on site. The edge effects of the Port Malcolm Road and the NSPI and Bear Head landfills can be detected a great distance into the forested land base in terms of visibility, noise and species composition.

While the identified habitats are not particularly outstanding, their ecological role is nonetheless important. A significant environmental effect could result if there was a substantive loss of the existing cover that was attributable to the Project.

7.3.2.1 Boundaries

The areas of concern with respect to forest cover includes:

- those areas that will have to be cleared to accommodate the WECs that will not be located in existing open areas; and
- those areas that will have to be cleared to accommodate the new access roads.

These areas are all an integral part of the footprint of the Project. The temporal boundary is in the first instance the period associated with the construction of the Project when there will be clearing to enable the works to proceed. In the longer term the forest cover in some areas will regenerate, but the cover will continue to be modified through ongoing practices in the area.

7.3.2.2 Pathway Analysis

To enable the development of the Project it will be necessary that trees and associated vegetation in defined areas be cleared. The turbine sites and access roads will be areas of permanent non-forest, some of them new, and this will contribute to the fragmentation of the forest cover. The main effect of the clearing is to increase the amount of edge condition within the landscape. In addition to the activities associated with the development and operation of the Project, the area may be considered a 'working forest' and some areas may be subject to management in the years ahead. One example may be the harvesting of merchantable timber for sale to the forestry sector. Another practice may be the periodic management of vegetation adjacent to roadways. This would be achieved by mowing, or other mechanical means.

Connectivity of forest cover on and in proximity to the Project site is already compromised by past and present industrial activity. Due to the location of the various industrial installations, e.g., Statia Terminals and NewPage, as well as the Landrie Lake reservoir, there is currently limited forest connectivity between the Point Tupper peninsula and the rest of Cape Breton and the potential for the free movement of mammals between these areas is already compromised. The area is zoned for heavy industrial use, is used for such uses and will in the future accommodate further industrial use. The challenge is to develop such uses in an environmentally responsible manner.

7.3.2.3 Mitigative Measures

During construction, further fragmentation of the forest cover will be minimized by clearing only the area required for the construction of the required access roads, the turbine pads and the laydown areas.

Staff will be trained to respond appropriately to accidental events, including the occurrence of fire. The Contingency and Safety Plan will detail appropriate response measures.

7.3.2.4 Cumulative Effects

The forest cover on this site is fragmented and compromised by industrial activity. Although the clearing required to accommodate the WECs and 4.25 km of new access road will interact cumulatively with existing activities to further fragment the forest cover, there is at this time no known new developments proposed for these or adjacent lands. The entire area, however, including adjacent sites will likely be developed over time for industrial and commercial purposes.

7.3.2.5 Residual Effects

Over time, there will likely be some natural regeneration of some of the areas cleared for the construction of the Project. The level of fragmentation caused by the Project is minimal in comparison to the past and ongoing fragmentation due to other industrial initiatives. The Project is not anticipated to have a significant residual environmental effect on forest cover in the area.

7.3.3 Migratory and Breeding Birds

As indicated in section 4.3.1.2, many birds breed and visit the lands and waters that surround the Project site; migratory and breeding birds have therefore been identified as a VEC. As indicated in section 3.2.2.2, this included breeding bird searches and spring migration searches. This work resulted in the identification of 61 species of birds in the area (Table 4.4).

A significant environmental effect on migratory and breeding birds would result if a substantive change in their numbers and habits could be attributed to the Project.

7.3.3.1 Boundaries

The boundaries associated with the determination of breeding and migratory bird encompasses the entirety of the Project site and the immediately adjacent lands. The pertinent temporal boundary for the assessment of Project impacts on avian species is the duration of the Project, i.e., 20 years or more.

7.3.3.2 Pathway Analysis

The two primary pathways that may cause detrimental impacts to birds are:

- the destruction of habitat during Project construction; and
- the operation of the WECs throughout the operating life of the Project.

Clearly there will be a footprint where the WECs are located and access roads are constructed, which will result in some minimal habitat loss to locally breeding species. The only species of conservation concern nesting in the Project area is the Olive – sided Flycatcher. Given their habitat preference in low boggy areas that are unsuitable for WEC placement, they are unlikely to be displaced by the proposed works particularly since the wetlands in and adjacent to the Project site will be avoided. With at most two pairs of these birds present in the area, if they were displaced, it would be difficult to attribute their disappearance to the Project given other activities taking place in and in proximity to the area. The effect on local populations would in any case be negligible.

The pair of Broad – winged Hawks and the pair of Barred Oils that may nest in the vicinity of the Project site are both deep wood species that may be disturbed by the proposed construction depending on their actual nesting location and the time of year when the clearing takes place.

The desk top work and the interviews with local birders suggested that the Project area is not located on a major migration route. The field program only identified two small migratory flocks.

In summary, the results of the field work undertaken support the conclusion of the desk top analysis that the site is one of low sensitivity. The project site appears to be located such that it should not have a significant impact on either migrant or nesting bird populations. With respect to Project lighting, the Proponent has struck a balance between the demands of aviation safety and the CWS preference for intermittent lighting with a distinct off period. Finally it is widely thought that birds that are resident in the vicinity of wind farms quickly become acclimatized to them (Kingsley and Whittam, 2001).

7.3.3.3 Mitigative Measures

Initial siting and WEC choice could be viewed as the primary mitigative measures. The Point Tupper Wind Farm has been responsibly sited in a heavy industrial area and away from known bird migratory routes, a fact that has been confirmed by research and the execution of field investigations. The WECs are in the range of

160 m to the tip of the extended blade and are therefore of a height less likely to interfere with bird passage[6]. Finally the towers are not of a lattice work design; birds will not be attracted to them for perching.

Although it is known that wind turbines will from time to time kill birds, it is also important to put such kills into perspective. The following paragraph addresses this issue:

> "One American study estimated that an average of 2.19 birds is killed annually at each wind turbine in the United States. Outside of California, the estimated fatality rate drops to 1.83 (there is no published study of the impacts of wind turbines on birds in Canada). Therefore, based on 15,000 American wind turbines in operation, approximately 33,000 birds are killed each year by wind turbines in the US including 26,000 in California alone. Although 33,000 is a lot of dead birds, the overall impact is small when compared to the millions of birds that travel over wind farms each year; not to mention the millions to hundreds of millions of birds that die due to collisions with transmission lines, vehicles, buildings and communication towers each year. Even if there were a million turbines in North America, they would likely not contribute to more than a few per cent of all bird collision deaths attributed to human structures" (Whittam and Hingsley, 2003).

7.3.3.4 Cumulative Effects

There are no known development activates that will take place in or in the vicinity of the site that may act cumulatively with the proposed Project to cause a significant adverse effect on migrating and breeding birds.

7.3.3.5 Residual effects

In summary, although there may be some minimum impact on birds, the construction, operation and decommissioning of the wind farm is unlikely to result in a significant adverse impact on this VEC. The impact will be negligible.

7.3.4 Bats

There are occurrence records for the following seven species of bats in Nova Scotia:

- *Lasiurus cinereus* – hoary bat
- *Lasionycteris noctivagans* – silver-haired bat
- *Lasurus borealis* – eastern red bat
- *Eptesicus fuscus* – big brown bat
- *Perimyotis subflavus* – eastern pipistrelle
- *Myotis septentrionalis* – northern long-eared bat
- *Myotis lucifugus* – little brown bat

With the exception of the northern long eared and the little brown bat, which are likely ubiquitous in Nova Scotia as their distributions extend into Newfoundland (Broders et al. 2003b), Nova Scotia is at the northern extent of the current known range for the other identified species (van Zyll de Jong, 1985). The northern long-eared bat, the little brown bat and the eastern pipistrelle appear to be the only bat species with significant

[6] It has been noted that the majority of migrating birds fly between 150 m and 450 m above ground level (Belrose, 1971). Radar studies have largely confirmed these visual observations with the majority of nocturnal bird migration appearing to occur between 500 m to 700 m above the ground (Able, 1970; Alerstam, 1990; Gauthreaux, 1991 and Cooper and Ritchie, 1995).

populations in the province. The eastern pipistrelle, however, is locally abundant only in the south west of the province (Broders et al. 2003a; Farrow, 2007; and Rockwell, 2005).

To date very little is known about the real implications of wind farm developments on populations of small non-migratory bat species. Although no bat species at risk were identified within 100 km of the Project site and no field work with respect to bats has yet been done at this site (Section 3.2.2.3), bats have been identified as a VEC.

It is likely that many factors influence bat fatalities at wind farms although such factors are poorly understood (Holland. 2007). For example, it is not known if bats actively echolocate when migrating (either locally or long distance) and the role of landmarks (natural or artificial) as visual cues for swarming and/or migration are also imperfectly understood (Cryan and Brown, 2007). Nor is it known if certain bat species routinely and predictably migrate at specific heights and routes, either regionally or locally, nor is it known if there is large variation in the number of migrants passing through an area from year to year (stemming from yearly differences in local bat populations – Barclay et al., 2007 and Johnston et al., 2003a). Stochastic weather factors that vary spatially (regionally from topography) and temporally (in frequency) may also contribute to bat fatality events in an unpredictable manner. In particular, low barometric pressure, low relative humidity and low wind velocities (conditions associated with the passing of storm fronts in an area) have been shown to be associated with high bat mortality events (Erikson et al., 2003 and Kerns et al., 2005). As a consequence, preconstruction surveys may be limited in their ability to detect and predict migrating bats moving through an area, and thus unexpected mortalities may be found once turbines have been installed and are on line.

A significant effect on bats would result if a substantive change in the numbers of bats or their habits, could be attributed to the operation of the Project.

7.3.4.1 Boundaries

The pertinent spatial boundary is that of the WECs; the pertinent temporal boundary is the duration of the wind farm's operation, i.e., perhaps 20 years or more.

7.3.4.2 Pathway Analysis

Bats can be impacted by the proposed works through the disturbance of habitat and through the motion of the turbine blades, i.e., as the result of collision.

Based on the research done by Dr, Broders, there is likely no significant, if any, migratory bat species, i.e., hoary, red, silver-haired or big brown bats, that pass through the Project area. As a result, the proposed WECs will likely not have a major impact on populations of migratory species in the region given their sporadic and patchy distribution. Similarly, since the eastern pipistrelle is abundant only in the south west of the province, the Project is unlikely to have a major impact on that species.

The more abundant myotis species, i.e., the little brown bat and the northern long eared bat, typically forage at heights below the level of the turbine blades. There may, however, be some minimal risk of mortality to these species, but it is not anticipated to be great.

7.3.4.3 Mitigative Measures
No specific mitigation measures are recommended.

7.3.4.4 Cumulative Effects
There are no known development activities that will take place in or in the vicinity of the Project site that may act cumulatively with the proposed Project to cause a significant impact on bats.

7.3.4.5 Residual Effects
Although there are many unknowns associated with the movement of bats, based on the research undertaken, the construction, operation and decommissioning of the proposed wind farm will not result in a significant adverse impact on this VEC. The impact, if any, is anticipated to be negligible.

7.4 Socio-Economic Issues
Examination of Table 7.1 indicates that the various activities associated with the Project's development, operation and subsequent decommissioning may impact land use, employment and the economy, visual impact, traffic patterns and health and safety. As the area is designated for industry purposes and is some distance removed from residential areas, there is no identified pathway between the Project and property values, i.e., residential property values. As detailed in 4.4.5, no visible signs of archaeological resources were found during the field work undertaken. Because of its land locked configuration and industrial usage there was no evidence to suggest that the Project site is of value to First Nations. No further evaluation is undertaken of these socio-economic VECs.

7.4.1 Land Use
The Project site is located in an area designated for heavy industrial use. Further, as indicated in Sections 4.2.2.8 and 4.4.2 and depicted on Figure 4.3, several areas in and adjacent to the Project site have been used for dumping of various materials including asbestos and ash. There is no commercial logging in the immediate area and the site is not used for recreational purposes.

A significant effect on land use would result if currently land uses in the area were irreversibly changed as a consequence of the development, operation or decommissioning of the Project.

7.4.1.1 Boundaries
The spatial area of greatest relevance includes those lands with 500 m of the WECs; the temporal boundary would extend over the life of the Project, i.e., 20 years or more.

7.4.1.2 Pathway Analysis
As has been stated, the primary land use in the immediate vicinity of the proposed wind farm is heavy industrial use. Not only will such uses continue, but there is likely to be further industrial development in the area over time. Apart from ensuring the safety of all who may access the lands for other purposes or development, including those who access and service the turbines, and ensuring the integrity of the turbines, other land uses could be accommodated on the site and in proximity to the site. Indeed, the access road may be used at some future time to provide access to areas of industrially zoned lands that have been to date inaccessible.

7.4.1.3 Mitigative Measures

Apart from minimizing the footprint of the proposed works, no specific mitigative measures are proposed to protect existing land use in the area.

7.4.1.4 Cumulative effects

There are no other known works that would act cumulatively with the proposed Project to adversely impact land use in the area; no cumulative impacts are anticipated.

7.4.1.5 Residual Effects

Based on the above analysis, the Project is not anticipated to have a significant residual effect on land use; indeed the impact over time may be beneficial.

7.4.2 Employment and the Economy

The development of the wind farm will not only generate taxes for the Municipality of the County of Richmond, its construction will generate some local employment for a limited period. Employment and the economy has therefore been identified as a socio-economic factor to be evaluated.

A significant effect on employment and the economy would result if a substantive change in either employment or the economy could be attributed to the Project.

7.4.2.1 Boundaries

The spatial area of interest is the acceptable commuting distance to the Project site and the municipality to which taxes will be paid, i.e., the Municipality of the County of Richmond. The temporal boundary is the life of the Project, i.e., perhaps 20 years or more.

7.4.2.2 Pathway Analysis

The development of the proposed Project will generate employment. Labour will be required both to clear the required new access roads, the WEC sites and laydown areas and also to build the wind farm. Although contractors have not yet been selected for this work, based on experience of comparable sites, it is estimated that up to 40 people could be employed during the peak times of the construction phase. Some of this labour will be drawn from the regional area.

After the WECs are up and operational, there will be a need for one to two skilled persons with applicable training to maintain the WECs and to assist with the management of the site. Throughout construction, those working on the Project will seek services and supplies for gas, accommodations and sandwiches to more sophisticated equipment and services both in the immediate and regional areas. These expenditures, large and small, will bring benefit to a range of suppliers.

Another important benefit is the tax benefit that will accrue to the Municipality of the County of Richmond. Legislation has been enacted as to how this amount is determined. As a result, over the life of the Project, the Municipality will be a substantial beneficiary of the Project.

7.4.2.3 Mitigative Measures

No mitigative measures are required.

7.4.2.4 Cumulative Effects

There are no known works in the vicinity of the Project site and surrounding communities that would act cumulatively with the Project to impact employment and the economy.

7.4.2.5 Residual Effects

Based on the evaluation undertaken the execution of the Project as detailed will create possible employment opportunities in the short term and will create an enduring tax base for the Municipality. The impact will be beneficial.

7.4.3 Visual Impact

Wind turbines are highly visible in most landscapes due to their size, and they can, therefore, be intrusive. As such, visual impact has been identified as a socio-economic factor to be evaluated. Adverse visual impacts can be defined as "unwelcome visual intrusion, or the creation of visual contrasts, that affect the quality of the landscape' (BLM, 2004). There are views in Nova Scotia and elsewhere that are highly valued as reflective of the locality and that attract visitors to an area, i.e., views can have an intrinsic economic value. In such circumstances, steps can be taken through bylaws to protect such scenic resources from unnecessary adverse effects. There are no such views in the vicinity of the proposed Project.

A significant visual impact would involve substantive intrusion into a view of provincial or national significance and having a recognized economic value in the local economy.

7.4.3.1 Boundaries

The visual impact of the proposed Project extends some distance from the site itself. Two factors come into play:

- distance and topography; and
- vegetation and man made structures that may block the line of sight to one or more of the turbines.

Figure 3.4 presents the viewshed analysis for an area of several kilometres around the proposed wind farm. The further away from the proposed turbines, the smaller they will appear and the less intrusive they will be on the line of sight, i.e., spatial boundaries encompass the area from which the turbines are visible. The temporal boundaries relate to the time period the turbines are in place, i.e., the operating life of the proposed Project.

7.4.3.2 Pathway Analysis

Two viewpoints were selected for detailed analysis:

- Viewpoint 2 on Highway 104; and
- Viewpoint 1 on Route 344.

View from Highway 104 (Figure 7.1)

Highway 104 is a popular travel route for tourists visiting Cape Breton. In 2004, 12% of all visiting parties to Nova Scotia travelled either a portion, or all of this route, between Port Hawkesbury and Sydney (Nova

Scotia Visitor Exit Study, 2004). The proposed Project is located about 3.5 km south of Highway 104. For travellers leaving Port Hawkesbury heading west on the highway, the proposed wind farm will hardly be visible due to the dense growth of deciduous trees along the roadway. Only a narrow tree clearance in a power line right-of-way about 2.5 km past Port Hawkesbury opens up a brief view of the wind turbines. The view is relatively narrow and framed by trees on both sides. Viewpoint 02 focuses on Landrie Lake of which only a small portion is visible due to the dense forestation in the foreground. Behind the lake rises a treed ridge on top of which a total of 12 turbines will be visible, but appear small in the overall context. To the right of the wind farm, blue oil storage tanks provide a visual clue to the industrial character of the neighbouring lands. The wind farm from this viewpoint would populate about 50% of the view.

View from Route 344 (Figure 7.2)

Route 344 is located across the Strait of Canso and runs along the shoreline from Mulgrave to Guysborough. The road passes through a series of small coastal communities from some of which the proposed wind farm will be visible from portions of this route. Depending on the tree coverage along the shore road, residents of Pirate Harbour, Steep Creek, Middle Melford and Sand Point could catch sight of the Project. For travellers heading east on Route 344, the project site is visible only on occasion due to the obstruction by tree growth along the road. Viewpoint #1 is located across from the oil refinery at Wright Point approximately 2.5 km from the closest wind turbine. A wide angled view opens towards the study area and the mouth of the Strait of Canso. The foreground is populated by the shoreline vegetation while the middle ground is dominated by the water surface of the Strait. In the background the lands of the study area rise from the opposite shore. To the left hand side, the current test turbine is visible followed to the right by an industrial wharf and the blue oil storage tanks of the refinery. Further to the right, 12 wind turbines populate the horizon, six of which will be fully visible with the remainder partially tucked behind the ridge. Because of the broad angle of the view, the Project only impacts on a quarter of the entire scene.

7.4.3.3 Mitigative Measures

The visual impact of the Project cannot be totally avoided. A number of mitigative measures, however, have been considered by the turbine manufacturers in the design of their products and by the proponent in the consideration of the layout of the wind farm. These include:

- Tubular towers presenting an aesthetic design balance;
- Off white, or essentially very light grey in colour, and non reflective, i.e., not shiny;
- All WECs will be ENERCON E-82s, i.e., the same model;
- Minimizing the lighting on the turbines to what is required for air safety;
- Minimizing the Project footprint and implementing erosion control measures;
- Maintaining the turbines on a regular basis; and
- Removing all construction debris and associated litter thereby maintaining a tidy and clean site.

7.4.3.4 Cumulative Effects

There are no known works in the vicinity of the project site, that would act cumulatively with the project to impact the visual frame of reference.

7.4.3.5 Residual Effects

Based on the above analysis, the implementation of the recommended mitigative measures including the maintenance of a tidy and clean site, the proposed project is anticipated to have a negligible visible impact.

Indeed, given the subjective nature of the topic, there may be many in the community that perceive the sight of the proposed turbines in the distance as attractive and as contributing positively to the environment and to the local and provincial economies.

7.4.4 Traffic

As indicated in Section 4.4.4, the Project site is accessed from the Port Malcolm Road. Although unsurfaced, this road carries trucks bringing timber to Nupage on a daily basis. The other routes serving the industrial area are surfaced and are designed to accommodate the industrial traffic that is using them.

7.4.4.1 Boundaries

The spatial boundaries are those roads that will be used through the construction and decommissioning phases of the Project. The temporal boundaries are primarily those associated with Project construction and eventual decommissioning.

7.4.4.2 Pathway Analysis

The transportation of the major WEC components will involve the use of numbers of very large flatbed trucks, but the road distance that will be involved, as detailed in Section 2.2.3, is small and is located totally within the Point Tupper industrial area. Any inconvenience caused to other users of these roads will be for a limited duration.

7.4.4.3 Mitigative Measures

The proponent will work closely with all involved parties to ensure the safety of those who use the roads. On the recommendations of the authorities, including the RCMP, the roads will be posted and flagged during key transportation events.

7.4.4.4 Cumulative Effects

There are no other known works proposed in the Point Tupper that would act cumulatively with the Project to acerbate construction traffic; no cumulative effects are anticipated.

7.4.4.5 Residual Effects

Based on the above analysis, the construction traffic necessary to facilitate the development of the wind farm will cause a modicum of inconvenience to other road users, primarily other industrial road users, for a limited period of time. There will be no impact on traffic patterns during the day to day operations of the Project.

7.4.5 Health and Safety

Regard for public health and safety and the occupational safety of workers is very important to the Proponent and to all associated with the development and operation of the proposed Project. Considerations discussed in this section include ice throw, EMFs, shadow flicker and occupational and site safety. Health and safety has been identified as a socio-economic issue to be addressed as it was raised by Health Canada.

A significant effect on health and safety would result if the health or safety of those involved in the construction and operation of the wind farm, those who access the lands at the Project site, or those who work at Point Tupper was appreciably compromised.

Ice Fall or Throw

Under certain atmospheric conditions, it is possible for ice to form on the wind turbine blades. Generally, icing occurs at temperatures below 0°C when there is humidity in the air. The type, amount and density of ice depend on both meteorological conditions and the dimensions and type of structure (moving/static). To the extent such icing may occur, it can break free in a warming of temperatures or by movement of the blades and fall or be thrown to the ground. As indicated in Section 2.7, the ENERCON E82 is equipped with an ice detection system; further information is provided in Appendix K.

Given the meteorological conditions in the area 15 to 25 freezing rain events may not be uncommon in an average year. However, it is not necessarily the case that ice accumulation on wind turbine blades will occur at this frequency. If ice does form on the blades on occasion or occasions throughout the winter period, the risks of any safety concern are then a function of proximity of the wind turbine to property and persons in the area and any mitigation measures undertaken by the proponent. It is noteworthy to consider the work done by Garrad Hassan Canada as described in the report entitled *Recommendations for Risk Assessment of Ice Throw and Blade Failure in Ontario*. In this work, it was found (in the Ontario context) that the risk of a fixed structure situated 250 m from a turbine being struck by ice fragments is equivalent to 1 in 300 years and the risk to an individual being struck in the vicinity of the dwelling is equivalent to 1 in 500,000 years. There are no fixed structures within 250 m of the proposed WECs.

Electric and Magnetic Fields

Power frequency electric and magnetic fields (EMFs) are present everywhere electricity flows. All electric wires and the lighting, appliances and other electrical devices they supply are sources of electric and magnetic fields. Although they are often referenced together as EMFs, electric fields and magnetic fields are actually distinct components of electricity. Most of the public interest regarding possible health effects is related to magnetic fields. So usually, when the term EMF level is used, it is the magnetic field strength that is being referred to. Both electric and magnetic fields, whether it is a power line or an appliance such as a hair dryer, dishwasher or microwave oven, are strongest at their sources; these fields, including those associated with the WECs, decrease rapidly as you move away from the sources and become indistinguishable from background levels.

Shadow Flicker

Shadow flicker is the visual impact that results when the blade of a wind turbine passes between the sun and a particular point of observation, i.e., the receptor, and interrupts the sun's rays causing a flicker effect. Whether such flicker occurs at all and to what extent it does is dependent on many factors including weather conditions, i.e., whether the sun is shining or not, geographical position, topography and time of day. The duration and severity of shadow flicker effects also varies depending on the time of the year and wind conditions. Finally the distance of the WEC from a receptor will also influence the impact, since light perception diminishes with distance. The primary impact of shadow flicker is annoyance. As detailed in Model Wind Turbines By-Laws and Best Practices, "shadow flicker from wind turbines usually has a frequency range of between 0.5 Hz to 1.25 Hz which is well below the level of concern for this health issue (Noble Environmental Power, Department of Business Enterprise and Regulatory Reform, UK)." The same British government ministry has indicated that at a distance of 10 rotor diameters, i.e., 800 – 900 m, a person should not experience shadow flicker.

Occupational and Site Safety

Occupational safety issues are primarily associated with the construction and decommissioning activities associated with the handling and operation of large machinery and WEC components. Nevertheless, safety issues must also be considered as they pertain to the operational phase.

7.4.5.1 Boundaries

The spatial area associated with the above safety issues is primarily an area in proximity to the WEC and their immediate surroundings; the exception is the larger area that should be taken into account when dealing with shadow flicker, i.e., an area up to 900 m from a WEC. The temporal boundary involves the construction, operational and decommissioning phases of the proposed Project.

7.4.5.2 Pathway Analysis

Ice Throw

Ice may accumulate on wind turbine blades under conditions of freezing rain, or melting snow, but the number of occasions that this is likely to occur in any year are small. Safety issues, however, can arise if anyone is in the vicinity of a turbine when ice slides, or is thrown off the blades.

Electric and Magnetic Fields

As referenced above, both electric and magnetic fields decrease rapidly as you move away from the source and become indistinguishable from background levels. The term “extremely low frequency” is used to describe any frequency below 300 Hz, and power frequency EMF (such as that from components of the proposed Project) has a frequency of 60 Hz, placing it in the extremely low frequency category. It is at the lower end of the spectrum near DC electricity and well below the microwave, or RF (radio frequency) radiation emitted by cellular phones and radio broadcast transmitters. Epidemiological studies have failed to establish a cause and effect relationship between electromagnetic energy and health concerns. As a consequence, there are no Canadian government guidelines for exposure to EMFs at extremely low frequencies. Health Canada does not consider guidelines necessary because the scientific evidence is not strong enough to conclude that typical exposures cause health problems. Based on the evidence there is no obvious pathway between the proposed Project and the articulated public concern with respect to EMFs.

Shadow Flicker

As referenced above shadow flicker can be an issue of concern within narrowly defined parameters. As the nearest residence to a WEC is over 2 km. There is unlikely to be a potential pathway. This is because the topography, the distance and the vegetated nature of the lands and the fact that light perception diminishes with distance, mitigate against the possibility of a shadow flicker effect.

Occupational and Site Safety

The assembly and maintenance of WECs pose the range of occupational health and safety issues associated with any major construction project that involves the use of heavy equipment and the assembly of large structures. Ensuring the safety of all parties on site is a priority of RESL and all associated with the proposed Project and, as will be referenced below, the Proponent will take steps to ensure site safety for all concerned.

7.4.5.3 Mitigative Measures

The mitigative measures proposed for the different phases of the Project in conjunction with the preparation of a comprehensive EMP will also ensure that the health and safety of the workforce, those accessing the lands at the Project site and those working in proximity to the site are protected. More specifically the following mitigative measures are proposed:

- training including training on the hazards associated with ice forming on tall structures;
- a flag placement protocol which will necessitate the posting of a falling ice warning if, and when, ice is identified as an issue. This necessitates that operational staff are trained to be aware of the conditions likely to lead to ice accumulation on the WECs and the risk of ice falling;
- establishment of a comprehensive EMP which will include a Contingency and Safety Plan; the latter will detail the training and the protective equipment required for all who access the site; and
- access to the site will be restricted to authorized personnel throughout the period of construction.

No specific mitigative measures are required or proposed with respect to either EMFs or shadow flicker, because neither is considered to pose a concern for health or safety.

7.4.5.4 Cumulative Effects

There are no other known works that will take place within the vicinity of the Project site that would act cumulatively with the proposed Project to impact upon health and safety; no cumulative effects are anticipated.

7.4.5.5 Residual Effects

Based on the analysis undertaken and the implementation of the recommended mitigative measures, the proposed project is unlikely to have a significant adverse effect on health and safety; the anticipated effect is considered to be negligible.

7.5 Effects of the Environment on the Project

Several environmental factors, e.g., fire, extreme weather, including climate change, could have an adverse effect on the Project. These factors have all influenced the design criteria for the turbines and the layout of the proposed wind farm.

7.5.1 Boundaries

The spatial boundaries for these effects are restricted to the area of the wind farm. Temporal boundaries include all Project phases: construction, operation and decommissioning. Fire and extreme weather events could adversely impact the Project schedule, but such events are likely to be of short duration. Fire in the area could be instigated by both natural events, e.g., a lightening strike, or by humans.

Extreme weather events, including such events as might be aggravated by global warming, including ice formation, high winds, hail or lightening strikes, could damage the turbines.

7.5.2 Pathway Analysis

Fire and extreme weather could conceivably damage the installed facilities, reduce productivity and/or cause the turbines to be shut down.

7.5.3 Mitigative Measures

The design and operation of the WECs, however, include measures to address the consequences of extreme weather events. For example, the turbines and transformers are equipped with temperature related alarms. In addition, there are fire watches maintained during the most sensitive dry summer months in the region. It is therefore likely that any fire would be quickly detected and a prompt emergency response instigated. The turbine towers are also sufficiently high that damage to the nacelle in the event of a fire is unlikely. Any damage to power transmission in such circumstances would be quickly repaired.

During high wind events, or ice formation, the design of the WECs is such that the wind turbines will cut out. These factors have been taken into consideration in the operational and commercial planning of the Project. As referenced in Section 2.2.5, the turbine towers will be equipped with lightening protection, and damage to WECs from such an event is considered very rare.

In conclusion, extreme weather events are unlikely to pose a significant adverse effect on project construction, operation or decommissioning.

7.5.4 Cumulative Effects

There are no known other works taking place in the area, or in the vicinity, that might act cumulatively with severe weather events to increase the likelihood of an adverse environmental effect on the Project.

7.5.5 Residual Effects

Extreme environmental events are not anticipated to have a significant residual environmental effect on the Project, i.e., the impact is predicted to be negligible.

7.6 Summary of Potential Environmental Impacts

Residual environmental effects are those predicted to remain after the proposed mitigative measures have been implemented. Table 7.2 summarizes those effects for the proposed Project for each VEC or socio-economic issue. The effect is presented in terms of nature of effect, magnitude, reversibility, duration, timing and aerial extent. These are defined as:

- nature of effect, i.e., positive (+) or negative (-);
- magnitude of effect on background levels, i.e., small, moderate or large;
- reversibility of the effect, i.e., reversible or irreversible;
- timing of the effect during construction or operation, i.e., long or short term; and
- aerial extent of the effect, e.g., immediate area of construction is considered local.

Table 7-2: Residual Effects Assessment

VEC or Issue	*Nature*	*Magnitude*	*Reversibility*	*Timing*	*Extent*
Ground and Surface Water Quality	-	Small	Reversible	Short	Local
Noise	NI	N/A	N/A	N/A	
Radar Interference	-	Moderate	N/A	Long	Local
Wetlands	-	Small	Reversible	Short	Local
Forest Cover	-	Small	Reversible	Long	Local

VEC or Issue	*Nature*	*Magnitude*	*Reversibility*	*Timing*	*Extent*
Species at Risk	-	Small	Reversible	Long	Local
Migratory and Breeding Birds	-	Small	Reversible	Long	Local
Bats	-	Small	Reversible	Long	Local
Land Use	-/+	Small	Reversible	Long/long	Local
Employment and the Economy	+	Moderate/small	N/A	Short/long	Regional
Aboriginal Use of Lands	NI	N/A	N/A	N/A	N/A
Archaeological Resources	NI	N/A	N/A	N/A	N/A
Visual Impacts	-	Small	Reversible	Long	Local
Traffic patters	-	Small	Reversible	Short	Local
Health and Safety	-	Small	Reversible	Long	Local

NI = No Impact
N/A = Not Applicable

This is an important Project. Given the nature of such an investment, numerous studies have been executed and detailed engineering and associate work is ongoing to ensure that all necessary issues are addressed and that both corporate and regulatory decision makers have the information that they require to make decisions in a timely manner. It is a progressive and iterative process. Environmental work continues to be executed and will be an integral work stream throughout detailed engineering, construction.

Because the adverse residual effects are primarily small to moderate in magnitude, reversible and local, it is concluded that the undertaking can be executed with negligible residual effects on VECs and socio-economic issues with the application of standard and accepted industry practices and procedures, adherence to applicable regulations and guidelines, and proactive environmental protection planning, including implementation of the mitigative measures as identified.

7.7 Environmental Management and Monitoring

While it is anticipated that the residual environmental effects of the proposed works will be negligible based on the work that has been conducted, the Proponent will prepare an EMP to address potential issues and concerns and to ensure that the necessary work through Project construction and decommissioning is undertaken with due regard to environmental considerations and safety. The proponent also undertakes to honour all commitments made in this environmental assessment and to comply with all applicable laws and regulations. As indicted in Table 7.2, most, if not all, potential adverse effects, can be avoided through the application of good engineering and construction practices, the careful timing of activities and the adherence to appropriate environmental management techniques. All work in and around the site will be undertaken in accordance with the standards and protocols set out in the *Erosion and Sedimentation Handbook for Construction Sites.*

The Environmental Protection Plan (EPP) is a key component of the EMP and will be developed for both the construction and operations phases of the Project. The underlying objective of the construction EPP is to reduce environmental impacts during this period and consists of routine activities including:

- contingency procedures in the event of an erosion control failure;
- procedures to address fuel and hazardous material spills;

- procedures to address fire; and
- procedures to address archaeological finds.

The EPP for construction will detail inspection and reporting requirements, include detail of the applicable permits, approvals and authorizations and incorporate a key contact list. The EPP for the operation of the wind farm will articulate guidelines for equipment maintenance activities, the storage, handling and disposal of petroleum, oils and lubricants and the safe storage and handling of hazardous materials.

A second component of the EMP is the Contingency and Safety Plan. This provides detail of the response system that will be implemented to respond to an accidental event including the release of petroleum, oils lubricants or any other hazardous material. It will reference the need for personnel training, preventative measures, the response plan and a spill clean-up recourse list. The Contingency and Safety Plan will also detail necessary responses to address fire.

Finally, to ensure that work is carried out with minimal consequences for the environment and as a check on the evaluation that has been undertaken, a number of specific environmental effects monitoring programs will be designed and undertaken. Such programs can include either a direct monitoring of specific VECs or the monitoring of the environmental parameters known to be important to the VECs. Such studies are normally undertaken to address the following objectives:

- to verify predictions and evaluate the effectiveness of mitigation measures;
- to detect undesirable changes in the environment; and
- to improve the understanding of environmental cause and effect relationships.

The following specific programs are proposed and will be further detailed subsequent to release from the environmental assessment process:

- The turbine locations should be monitored for bird species due to collision with the turbine blades for a period of two years subsequent to Project start up.

EC and CWS will be consulted in the development of the necessary protocols and the results will be provided to pertinent regulating agencies.

Chapter 8 Conclusions

This environmental assessment was conducted to determine the potential environmental effects of the construction, operation and decommissioning of a proposed wind farm at Point Tupper in the Municipality of the County of Richmond to satisfy the requirements of *CEAA* and the *Nova Scotia Environment Act.* Potential environmental effects from Project related malfunctions and accidents were also considered. The Proponent conducted an Open House in the Project area and consulted extensively both with and through the auspices of the local municipality and with local individuals. On October 26th 2007, the Proponent met with representatives of a number federal and provincial departments to discuss the Project and review the environmental work that was being undertaken. The Proponent has committed to keeping all interested parties informed of Project progress and to respond to all reasonable questions posed.

The proposed project is located on two parcels of industrially zoned land owned by NuStar and NSBI to the east of the Port Malcolm Road in Point Tupper and some 6 km to the east of Port Hawkesbury. The Proponent plans to construct 12 2 MW wind turbines to generate up to 24 MW of wind energy which will be fed into the NSPI transmission grid. To facilitate the development the Proponent has entered into lease agreements with the owners of the two land parcels involved. The land is zoned for industrial purposes; in the immediate vicinity of the turbines the land is still largely wooded, but has in the past accommodated the waste material from several of the industrial plants in the area.

Fieldwork has demonstrated that there will be negligible impacts on the identified physical and biophysical VECS and on the identified socio-economic factors evaluated. The nearest occupied residence that is occupied year round, for example, is more than 2,000 m distant form the closest wind turbine which is reflective of the suitability of the site. There will be negligible impacts attributable to noise, lighting or visibility, on the surrounding communities. Indeed, the introduction of an environmentally sound project to the area appears to have widespread local support. The site's attributes include its location within the Point Tupper industrial area, the wind regime and, as stated, its separation from the nearest occupied dwellings. From the technical and environmental evaluations that have been undertaken, it is an ideal location for a wind farm.

The environmental assessment considered biophysical and socio-economic factors. In addition to an extensive search of the literature and pertinent data bases, the study team consulted widely with regulatory agencies and acknowledged experts in pertinent disciplines. A number of specific field programs were executed; these included field work with respect to birds, vegetation, wetlands and archaeology. VIC Limited out of Ottawa conducted an analysis of the effects of the wind farm on the radar system operated at Eddy Point by the CCG after the latter had raised concerns; this report is provided in its entirety in Appendix K. Sixteen VECs or socio-economic issues were subject to analysis. The significance of the residual effects, i.e., after mitigation has been applied, is predicted for each of the identified VECs and socio-economic issues and the potential for the Project to interact cumulatively with other projects and activities taking place in the area was factored into the evaluation.

Subject to adherence to all pertinent regulations and the application of appropriate mitigative measures, the conclusion of this environmental assessment is that no significant adverse residual environmental effects are likely as a result of the Project. The generation of electricity from a renewable energy source in this fashion is in accordance with both Federal and Provincial government articulated strategies and would contribute to a reduction of greenhouse gases as required by Canada's ratification of the Kyoto Protocol.

Bibliography

Able, K.P. 1970. A radar study of the altitude of nocturnal passerine migration. Bird-Banding 41(4): 282-290.

Ahlén, I. 2003. Wind turbines and bats - a pilot study. Page 5p. Sveriges Lantbruks Universitetet, Uppsala, Sweden.

Alerstram, T. 1990. Bird Migration. Cambridge University Press, Cambridge, United Kingdom.

Alerstram, T. and A. Hederstrom. 1998. The development of bird migration theory. Journal of Avian Biology. 29:343-369.

Andersen, P. D., and P. H. Jensen. 2000. Wind energy today and in the 21st century. International Journal of Global Energy Issues **13**:145-158.

Anthony, E. L. P., and T. H. Kunz. 1977. Feeding strategies of the little brown bat, *Myotis lucifugus*, in southern New Hampshire. Ecology **58**:775-786.

Arnett, E., D. Redell, J. Hayes, and M. Huso. 2006. Patterns of pre-construction of bat activity at proposed wind energy facilities. Presentation and Abstract. 36th Annual North American Symposium on Bat Research, Wilmington, North Carolina.

Barclay, R. M. R. 1982. Night roosting behavior of little brown bat, *Myotis lucifugus*. Journal of Mammalogy **63**:464-474.

Barclay, R. M. R., E. F. Baerwald, and J. C. Gruver. 2007. Variation in bat and bird fatalities at wind energy facilities: assessing the effects of rotor size and tower height. Canadian Journal of Zoology **85**:381-387.

Bellrose, F.C. 1971. The distribution of nocturnal migration in the air space. Auk. 88: 397-424.

BLM (Bureau of Land Management). 2004. Draft Programmatic Environmental Impact Statement on Wind Energy Development on BLM – Administered Lands in the Western United States. US Department of the Interior, Bureau of Land Management. September 2004. (http://winders.anl.gov/ers.guide/index.cfm)

Broders, H., G. Quinn, and G. Forbes. 2003a. Species status, and the spatial and temporal patterns of activity of bats in southwest Nova Scotia, Canada. Northeastern Naturalist **10**:383-398.

Broders, H. G. 2003. Summer roosting and foraging behaviour of sympatric *Myotis septentrionalis* and *M. lucifugus*. Page 192. Ph.D Dissertation. University of New Brunswick, Fredericton, NB.

Broders, H. G., C. S. Findlay, and L. Zheng. 2004. Effects of clutter on echolocation call structure of *Myotis septentrionalis* and *M. lucifugus*. Journal of Mammalogy **85**:273-281.

Broders, H. G., G. J. Forbes, S. Woodley, and I. D. Thompson. 2006. Range extent and stand selection for forest-dwelling northern long-eared and little brown bats in New Brunswick. Journal of Wildlife Management **70**:1174-1184.

Broders, H. G., D. F. McAlpine, and G. Forbes. 2001. Status of the eastern pipistrelle (*Pipistrellus subflavus*) (Chiroptera:Vespertilionidae) in New Brunswick. Northeastern Naturalist **8**:331-336.

Broders, H. G., G. M. Quinn, and G. J. Forbes. 2003b. Species status, and the spatial and temporal patterns of activity of bats in southwest Nova Scotia, Canada. Northeastern Naturalist **10**:383-398.

Canadian Wind Energy Association. 2007. Position on Setbacks for Large Scale Wind Turbines in Rural Areas (MOE Class 3) in Ontario.

CanWEA. 2001. Wind Vision for Canada (10x10): Recommendations for achieving Canada's wind energy potential. Page 9p. The Canadian Wind Energy Association, Calgary, Alberta.

CanWEA. 2006. The Wind Energy Industry: The business of wind. Canadian Wind Energy Association Fact Sheets.

Church, Ambrose F. 1885. *Topographical Township Map of Richmond County*. A. F. Church & Co., Bedford.

Cooper, B.A. and R.J. Ritchie. 1995. The Altitude of Bird Migration in East Central Alaska: A Radar and Visual Study. Journal of Field Ornithology 66(4): 590-608.

Cryan, P. M., and A. C. Brown. 2007. Migration of bats past a remote island offers clues toward the problem of bat fatalities at wind turbines. Biological Conservation **139**:1-11.

Davis Archaeological Consultants Limited. 2000. *Archaeological Resource Impact Assessment: Statia Terminals Canada Inc. Pt. Richmond Underground Storage Project*. Heritage Research Permit A2000NS42. Manuscript on file, Nova Scotia Museum.

Davis Archaeological Consultants Limited. 2003. *Archaeological Resource Impact Assessment: Nova Scotia Power Incorporated Marine Coal Unloading Terminal, Point Tupper*. Heritage Research Permit A2003NS73. Manuscript on file, Nova Scotia Museum.

Davis Archaeological Consultants Limited. 2005a. *Phase I Port Richmond Underground Storage Facility: Archaeological Resource Impact Assessment*. Heritage Research Permit A2005NS54. Manuscript on file, Nova Scotia Museum.

Davis Archaeological Consultants Limited. 2005b. *Phase II Port Richmond Underground Storage Facility: Archaeological Resource Impact Assessment*. Heritage Research Permit A2005NS54. Manuscript on file, Nova Scotia Museum.

Davis Archaeological Consultants Limited. 2005c. *Port Hawkesbury NSP Transmission Line Expansion Project: Archaeological Resource Impact Assessment*. Heritage Research Permit A2005NS70. Manuscript on file, Nova Scotia Museum.

Davis Archaeological Consultants Limited. 2006. *Statia Terminals Canada Inc. Wharf Extension Project : Archaeological Resource Impact Assessment*. Heritage Research Permit A2006NS69. Manuscript on file, Nova Scotia Museum.

Davis, Derek and Sue Browne. 1996. *The Natural History of Nova Scotia, Volume Two: Theme Regions*. Nimbus Publishing Co. and Nova Scotia Museum, Halifax.

Davis, D. and S. Browne. 1996. *The Natural History of Nova Scotia.* Volumes I and II. Published by the Province of Nova Scotia and the Nova Scotia Museum.

Davis, W. H., and H. B. Hitchcock. 1965. Biology and migration of the bat, *Myotis lucifugus*, in New England. Journal of Mammalogy **46**:296-313.

Department of Lands and Forests. 1951. Crown Lands Index Sheet #111: Guysborough.
Fergusson, C. Bruce. 1958. *Uniacke's Sketches of Cape Breton. Halifax: Public Archives of Nova Scotia.*

Environment Canada. 2007(a). Recommended Protocols for Monitoring Impacts of Wind Turbines on Birds. Environment Canada - Canada Wildlife Services, Gatineau, Quebec. http://www.cws-scf.ec.gc.ca/publicatinos/eval/index_e.cfm.

Environment Canada. 2007(b). Wind Turbines and Birds: A Guidance Document for Environment Assessment. Environment Canada – Canadian Wildlife Services, Gatineau, Quebec. http://ww.cws-scf.ec.gc.ca/publications/eval/index_e.cfm.

Erskine, A.J. 1992. Atlas of the Breeding Bird of the Maritime Provinces. Co-published by Nimbus Publishing and the Nova Scotia Museum, Halifax, N.S.

Erickson, W. P., J. Jeffrey, K. Kronner, and K. Bay. 2003. Stateline Wind Project Wildlife Monitoring Annual Report, Results for the period July 2001- December 2002 Technical report submitted to FPL Energy, the Oregon Office of Energy, and the Stateline Technical Advisory Committee.

Farrow, L. J. 2007. Distribution of the eastern pipistrelle (*Perimyotis subflavus*) in southwest Nova Scotia relative to landscape factors. M.Sc. thesis. Saint Mary's University, Halifax, Nova Scotia.

Fenton, M. 2003. Eavesdropping on the echolocation and social calls of bats. Mammal Review **33**:193-204.

Fenton, M. 1997. Science and the conservation of bats. Journal of Mammalogy **78**:1-14.

Fenton, M., and G. Bell. 1981. Recognition of species of insectivorous bats by their echolocation calls. Journal of Mammalogy **62**:233-234.

Fenton, M. B. 1969. Summer activity of *Myotis lucifugus* (Chiroptera:Vespertilionidae) at hibernacula in Ontario and Quebec. Canadian Journal of Zoology **47**:597-602.

Fenton, M. B., and D. R. Griffin. 1997. High-altitude pursuit of insects by echolocating bats. Journal of Mammalogy **78**:247-250.

Fujita, M., and T. Kunz. 1984. *Pipistrellus subflavus*. Mammalian Species **228**:1-6.

Garroway, C. J. 2004. Inter- and intra-specific temporal variation in the activity of bats at two Nova Scotia hibernacula. Honours thesis, Department of Biology. Saint Mary's University, Halifax, Nova Scotia.

Gauthreaux, S.A., Jr. 1991. The flight behaviour of migrating birds in changing wind fields: radar and visual analyses. American Zoologist 31:187-204.

Geological and Natural History Survey of Canada. 1884. Province of Nova Scotia: Island of Cape Breton. Sheet #22 and 24.

Grindal, S. D., and R. M. Brigham. 1999. Impacts of forest harvesting on habitat use by foraging insectivorous bats at different spatial scales. Ecoscience **6**:25-34.

Henderson, L. E. 2007. The effects of forest fragmentation on the forest-dependent northern long-eared bat (*Myotis septentrionalis*). MSc thesis. Saint Mary's University, Halifax, Nova Scotia, Canada.

Holland, R. A. 2007. Orientation and navigation in bats: known unknowns or unknown unknowns? Behavioral Ecology and Sociobiology **61**:653-660.

Horn, A.G. 2007. Possible Risk to Birds by the Proposed Wind Farm at Point Tupper, Nova Scotia. Unpublished report for CBCL Limited.

Hornung, R. 2006. Status report on wind energy supply and demand in Atlantic Canada. Canadian Wind Energy Association, Calgary, AB.

In Situ Cultural Heritage Research Group. 2005a. A*rchaeological Resource Impact Assessment of a Proposed Transmission Line Corridor from Port Hastings to Bear Head LNG Terminal, Inverness and Richmond Counties, Cape Breton*. Heritage Research Permit A2005NS89. Manuscript on file, Nova Scotia Museum.

In Situ Cultural Heritage Research Group. 2005b. A*rchaeological Impact Assessment of a Proposed Water and Water/Gas Pipeline from Bear Head to Point Tupper, Richmond County, NS*. Heritage Research Permit A2005NS64. Manuscript on file, Nova Scotia Museum.

Jacques Whitford Environment Limited. 2004. Environmental Assessment for the Proposed Bear Head LNG Terminal Bear Head, Nova Scotia. Project No. NSD 17393, Access Northeast Energy Inc. and Jacques Whitford Environment Ltd. http://www.gov.ns.ca/enla/ea/bearheadLNGterminal.asp.

Jain, A., P. Kerlinger, R. Curry, and L. Slobodnik. 2007. Annual report for the Maple Ridge Wind Power Project Post-construction bird and bat fatality study - 2006. Curry and Kerlinger, LLC, Syracuse, NY.

Johnson, G., W. P. Erickson, J. White, and R. McKinney. 2003a. Avian and bat mortality during the first year of operations at the Klondike Phase I Wind Project, Sherman County, Oregon, Goldendale, WA, USA.

Johnson, G. D. 2005. A review of bat mortality at wind-energy developments in the United States. Bat Research News **46**:45-50.

Johnson, G. D., W. P. Erickson, M. D. Strickland, M. F. Shepherd, and D. A. Shepherd. 2003b. Mortality of bats at a large-scale wind power development at Buffalo Ridge, Minnesota. American Midland Naturalist **150**:332-342.

Johnson, G. D., M. K. Perlik, W. P. Erickson, and M. D. Strickland. 2004. Bat activity, composition, and collision mortality at a large wind plant in Minnesota. Wildlife Society Bulletin **32**:1278-1288.

Jung, T. S., I. D. Thompson, and R. D. Titman. 2004. Roost site selection by forest-dwelling male Myotis in central Ontario, Canada. Forest Ecology and Management **202**:325-335.

Jung, T. S., I. D. Thompson, R. D. Titman, and A. P. Applejohn. 1999. Habitat selection by forest bats in relation to mixed-wood stand types and structure in central Ontario. Journal of Wildlife Management **63**:1306-1319.

Kerns, J., W. P. Erickson, and E. B. Arnett. 2005. Bat and Bird Fatality at Wind Energy Facilities in Pennsylvania and West Virginia in E. B. Arnett, editor. Relationships between bats and wind turbines in Pennsylvania and West Virginia: an assessment of bat fatality search protocols, patterns of fatality, and behavioral interactions with wind turbines. A final report submitted to the Bats and Wind Energy Cooperative. Bat Conservation International, Austin, TX, USA.

Kerns, J., and P. Kerlinger. 2004. A study of bird and bat collision fatalities at the Mountaineer Wind Energy Center, Tucker County, West Virginia: Annual Report for 2003. Prepared by Curry & Kerlinger, LLC.

Kingsley, A. and B. Whittam. 2001. Potential Impacts of Wind Turbines on Birds at North Cape, Prince Edward Island. A Report for the Prince Edward Island Energy Corporation.

Kingsley, A. and B. Whittam. 2005. Wind Turbines and Birds: A Background Review for Environmental Assessment. Environment Canada – Canadian Wildlife Services, Gatineau, Quebec. http://ww.cws-scf.ec.gc.ca/publications/eval/index_e.cfm.

Lacki, M. J., and J. T. Hutchinson. 1999. Communities of bats (Chiroptera) in the Grayson Lake Region, Northeastern Kentucky. Journal of the Kentucky Academy of Science **60**:9-14.

Loucks, O.L. Feb. 1961. A forest classification for the Maritime Provinces. In *The Proceedings of the Nova Scotia Institute of Science.* Halifax, N.S. Vol. 25 Part 2 Pp: 86-167.

Maybank, B. 2005. Birding Sites of Nova Scotia. Kimbus Pres, Halifax.

McAlpine, D. F., F. Muldoon, G. Forbes, A. I. Wandeler, S. Makepeace, H. G. Broders, and J. P. Goltz. 2002. Over-wintering and reproduction by the big brown bat, *Eptesicus fuscus*, in New Brunswick. Canadian Field-Naturalist **116**:645-647.

Mi'kmaq Environmental Services Ltd. May 2004. *Interim Mi'kmaw Ecological Knowledge Study*. Prepared for Jacques Whitford Environment Limited For the Bear Head LNG Terminal Project, Bear Head, NS. Manuscript of file, Nova Scotia Department of Environment and Labour.

Moseley, M. 2007. Records of bats (Chiroptera) at caves and mines in Nova Scotia. Curatorial Report # 99, Nova Scotia Museum, Halifax, Canada.

Murrant, C.L. 1995. Birding Cape Breton's Historic East Cape Perce Nature Tours Ltd., Port Morien.

Natural Resources Canada. 2007. Environmental Impact Guidelines for Screenings of Inland Wind Farms under the *Canadian Environmental Assessment Act*.

Nova Scotia Bird Society. 1996. Birding Nova Scotia, 3rd edition.

Nova Scotia Department of Environment and Labour. 2007. Proponent's Guide to Wind Power Projects: Guide to Preparing an Environmental Assessment Registration Document. http://www.gov.ns.ca/enla/ea/docs/eaguidewindpower.pdf.

NSDNR. 2007. Standards and Processes Applied to Provincial Impact Assessment, Wild Species Priorities Inventory and Mitigation Standards for Reporting.

O'Farrell, M., and W. Gannon. 1999. A comparison of acoustic versus capture techniques for the inventory of bats. Journal of Mammalogy **80**:24-30.

O'Farrell, M., B. Miller, and W. Gannon. 1999. Qualitative identification of free-flying bats using the Anabat detector. Journal of Mammalogy **80**:11-23.

Ogden, L.J. 1996. Collision Course: The hazards of lighted structures and windows to migrating birds. A special report for the World Wildlife Fund Canada and the Fatal Lights Awareness Program. Published on the web at www.flap.org.

Osborn, R. G., K. F. Higgins, R. E. Usgaard, C. D. Dieter, and R. D. Neiger. 2000. Bird mortality associated with wind turbines at the Buffalo Ridge Wind Resource Area, Minnesota. American Midland Naturalist **143**:41-52.

Report Concerning Canadian Archives for the Year 1905. Vol. II. 1906. “Tour of Inspection made by the Sieur de la Roche (Isle Royale), 1752.

RG5 Series P Vol. 94A #95. Road Petition to House of Representatives from residents of Cariboo Cove, Bear Island, & Ship Harbour, 1830. PANS.

RG5 Series P Vol. 97 #86. Petition to House of Representatives from residents of Cariboo Cove, Bear Island, & Ship Harbour, 1832. PANS.

RG5 Series P Vol. 10 #6-7. Petition to House of Representatives from residents of Cariboo Cove, Strait of Canso, and other parts of Richmond Co. 1848. PANS.

Rockwell, L. 2005. Species diversity and geographic distribution of bats in Mainland Nova Scotia. Honours thesis. Saint Mary's University, Halifax.

Sadar, M.H. and Associates. 1994. Environment Impact Assessment. Carleton University Press.

Sasse, D. B., and P. J. Pekins. 1996. Summer roosting ecology of northern long-eared bats (*Myotis septentrionalis*) in the White Mountain National Forest. Pages 91-101 in R. Barclay, and R. Brigham, editors. Proceedings of the Bats and Forests Symposium of the British Columbia Ministry of Forests, Victoria, B.C., Canada.

Stone, Arthur J. 1991. J*ourney Through a Cape Breton County: Pioneer Roads in Richmond County*. University College of Cape Breton Press, Sydney.

Taylor, J. 1997. The development of a conservation strategy for hibernating bats of Nova Scotia. Honours thesis. Dalhousie University, Halifax, Nova Scotia.

Thomas, D. W., G. P. Bell, and M. B. Fenton. 1987. Variation in echolocation call frequencies recorded from North American Vespertilionid bats: A cautionary note. Journal of Mammalogy **68**:842-847.

Tutty, B. R. 2006. Temporal variation in bat activity at two hibernacula in Nova Scotia: Spring emergence, fall immergence and management concerns. Honours thesis. Saint Mary's University, Halifax, Nova Scotia.

Union of Nova Scotia Municipalities. 2008. Model Wind Turbine By-Laws and Best Practices for Nova Scotia Municipalities. Prepared by Jacques Whitford.

van Zyll de Jong, C. G. 1985. Handbook of Canadian Mammals. Vol 2 (Bats) National Museums of Canada, Ottawa, Ontario.

Veilleux, J. P., J. O. Whitaker, Jr, and S. L. Veilleux. 2004. Reproductive stage influences roost use by tree roosting female eastern pipistrelles, *Pipistrellus subflavus*. Ecoscience **11**:249-256.

Whittam, Becky and Andrea Kingsley. 2003. Shades of Green: A Bird's Eye View of Wind Energy. Bird Watch Canada, Spring 2003 No. 3.

Woodlot Alternatives, Inc., Topsham, Maine. March 2006. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Mars Hill Wind Farm in Mars Hill, Maine.

Young, D. P. J., W. P. Erickson, R. E. Good, M. D. Strickland, and G. D. Johnson. 2003. Avian and bat mortality associated with the initial phase of the Foote Creek Rim Windpower Project, Carbon County, Wyoming. Western EcoSystems Technology, Inc. (WEST, Inc.).

Zinck. 1998. Roland's Flora of Nova Scotia.

Appendix A
ENERCON E82 Technical Description

Technical Description

E-82

Document information:		Translation Information	
Author/date:	S. Anlas / 21.10.05	Translated/date:	C.Carsted / 28.11.05
Department:	VI	Revised/date:	
Approved/date:	M.Kuhlmann / 04.11.05	Reference:	VI-Technical Description E-82-Rev004ger-eng
Revision	4/10.07.07		

Table of Contents

ENERCON reserves the right to make any technical changes and improvements at any time without prior notice.

1 Brief Description

The E-82 is a wind energy converter with a three bladed rotor, active pitch controls, variable operating speed and a rated power of 2000 kW. Its 82 m rotor diameter and 78 – 108 m hub heights enable the turbine to make efficient use of the prevailing wind conditions at the respective sites to produce electrical energy.

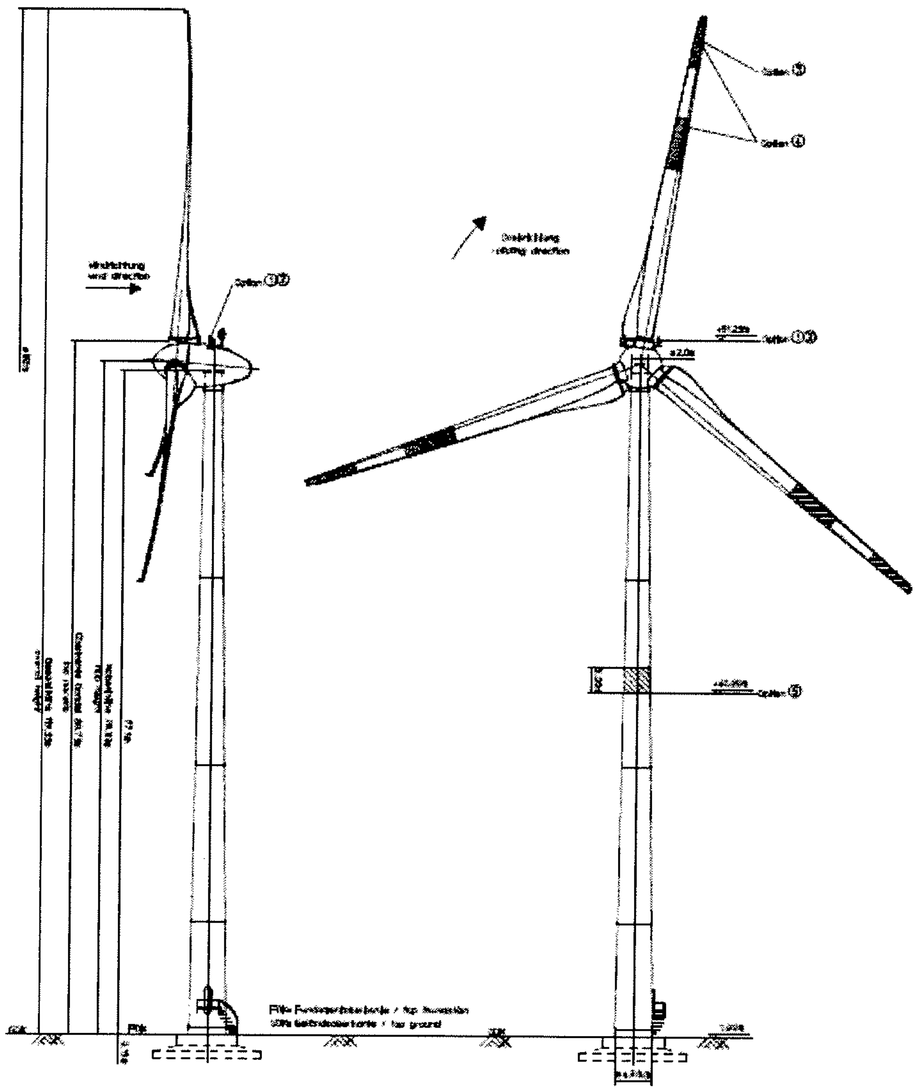


Figure 1: Illustration E-82

The main objective of ENERCON design and engineering is to minimise loads. All turbine components are developed and constructed accordingly. The result is a turbine which is, amongst other things, convincing due to its low load level and long service life.

Output controlled by variable speed allows the E-82 to attain maximum operation efficiency without increasing operating loads in the full and partial load ranges and at the same time prevents undesirable output peaks thus guaranteeing excellent yield and a high quality of power fed into the grid.

1.1 The ENERCON Concept

ENERCON wind energy converters are characterised by the following features:

The inner ring of the ENERCON annular generator and the rotor of the E-82 form one unit. These two components are flanged directly to the hub so that they both rotate at the same low speed. Since there are no gears or other fast-rotating parts, energy loss between generator and rotor, noise emissions, the use of gear oil and mechanical wear are considerably reduced.

The output produced by the E-82 generator is fed via the ENERCON grid connection system into the power supply company's grid. The ENERCON grid connection system comprises a rectifier/inverter unit (converter). This system ensures that high-quality electricity is fed into the power supply company's network.

Using the converter, this grid connection concept permits the E-82's rotor to operate at variable speeds. The rotor rotates slowly at low wind speeds and quickly at high wind speeds. This optimises wind flow on the rotor blades. Moreover, variable speed also reduces loads caused by gusts.

Each of the three rotor blades is equipped with an electrical pitch system. The pitch system limits the rotor speed and the use of the wind's power thus allowing the output of the E-82 to be reduced to rated power, even within a short period. By pitching the rotor blades into the feathered position, the rotor stops without mechanical brakes exerting load on the drive train.

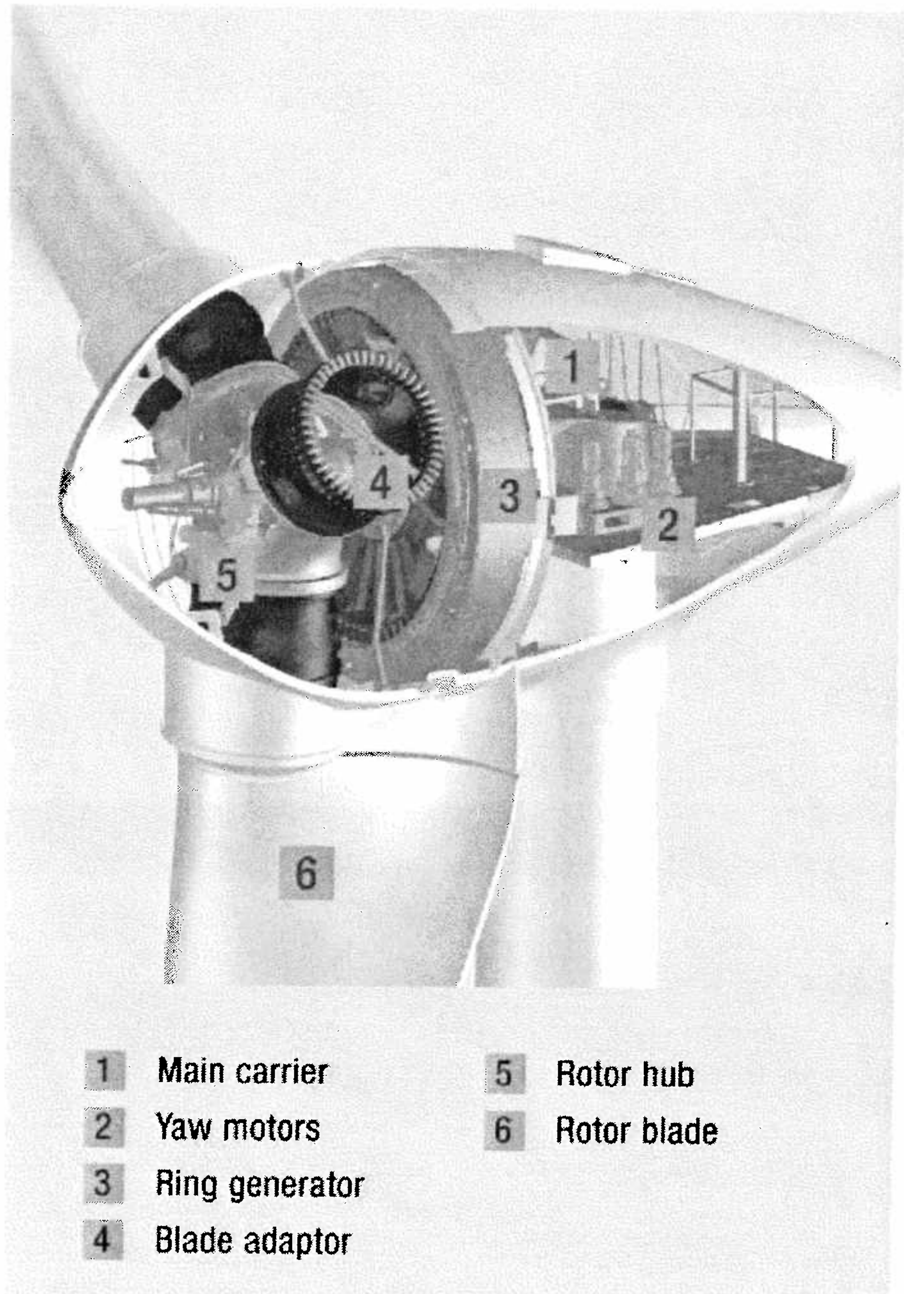


Figure 2: Illustration: Nacelle

1.2 Rotor

The E-82 rotor blades made of glass reinforced plastic (GRP) (epoxy resin) have a major influence on turbine output and its noise emission. Their shape and profile were developed according to the following criteria:

- high power coefficient
- long service life
- low noise emissions
- low loads and
- less material

One special feature to be pointed out is the new rotor blade profile which extends down to the nacelle. This innovative design eliminates the loss of the inner air flow experienced with conventional rotor blades. Together with the streamlined nacelle, the use of prevailing winds is considerably optimised.

The rotor blades of the E-82 were specially designed to operate with variable pitch control and variable speed. Due to this special profile, the blades are not sensitive to turbulence and dirt on the leading edge. On the outside, a top coat protects the rotor blades against environmental factors. The polyurethane-based material employed is highly resistant to abrasion, durable, and highly resistant to chemical factors and solar radiation.

Each of the three rotor blades is adjusted by independent microprocessor-controlled pitch systems. Angle encoders constantly monitor the set angle on each blade and ensure that the three blades are synchronised. This permits quick and accurate adjustment according to the prevailing wind conditions.

1.3 Generator

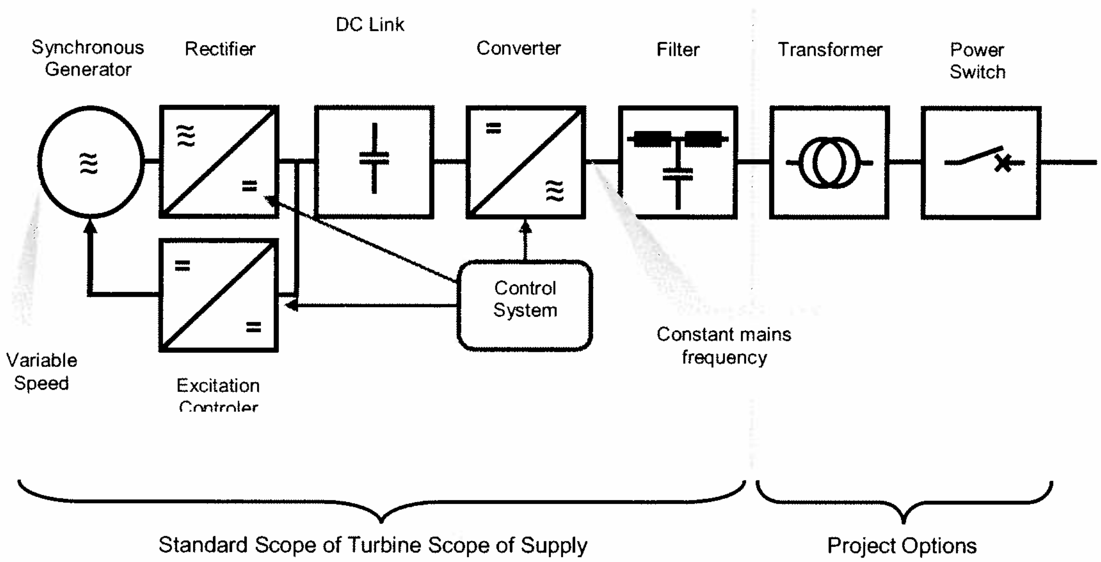
The air flow on the rotor blades drives the rotor which in turn is the direct drive for the E-82 annular generator. The multipole ENERCON generator is based on the direct drive synchronous machine principle.

Due to the low rotational speed and a large generator cross-section, temperature levels are comparatively low during operation and are only subject to minor fluctuations. Slight temperature fluctuations and comparatively few load changes during operation significantly decrease mechanical stress and the associated wear on generator material and insulation. Furthermore, variable speed and the connection to the electrical grid via converters contribute to reducing speed peaks.

1.4 Grid feed unit

The annular generator is coupled with the grid via the ENERCON grid connection unit. The main components in this system are a rectifier, a DC link and modular inverters.

The grid feed unit, generator and pitch unit are all controlled to achieve maximum output and excellent grid compatibility.



Flexible coupling between the annular generator and the grid guarantees ideal output transmission conditions while reducing undesirable reactions between the rotor and the grid in both directions. Sudden changes in wind speeds are controlled in order to maintain stable grid feed. Concurrently possible grid failures have very little effect on the mechanics. The power fed from the E-82 can be exactly regulated between 0 kW to 2000 kW.

Depending on the technical configuration, eight or nine identical converter modules are aligned. They feed three-phase current from output on the low voltage side into the grid. Generally, a transformer directly in or near the turbine converts 400V to the desired high voltage.

With this converter technology, the wind energy turbine can be considered as a regulated source of power As long as the voltage at the output terminals is within the permissible range, the converters feed symmetrical, sinusoidal current. The voltage at the output is affected by the feed but it is not actively controlled. If desired, a voltage regulator can be installed at the wind farm's point of common coupling.

Depending on the grid voltage phase angle and generator output, a target value for the current to be fed is generated. Three-phase current is then generated according to this target value with the power available in the DC link. This target value is compared to the actual current flow (actual value) every 100 µs and corrected in the event of deviations. The current fed is sinusoidal and largely free of disruptive harmonic oscillations. A high frequency filter further reduces harmonics. No significant flicker emissions occur. Momentary current peaks are excluded with this converter technology.

The range of operation parallel to the grid is limited by the minimum and maximum grid voltage. Both these values (undervoltage and overvoltage) can be set as the limit value for the E-82.

Furthermore, ENERCON provides turbines as "transmission" versions on request. This means that the wind turbine can ride though voltage dips (grid failures) from one to several seconds instead of immediately disconnecting from the grid. As soon as voltage is re-established maximum possible active power is fed into the grid. During a grid failure, active power is fed into the grid depending on the remaining voltage, the maximum converter current and the actual wind conditions. In addition, the wind turbine can support the grid by feeding reactive current in the event of a grid failure. With this feature ENERCON wind turbines are able to provide wind farms with power plant properties often demanded and at the same time contribute to maintaining stable network operation.

The E-82 is preset to a power factor of $\cos\varphi=1$. It does not require reactive power nor does it deliver reactive power to the grid within the entire power range from 0 to 2000 kW. Only active power is fed into the grid. Any equalization payments for reactive power demanded by some power supply network operators are not necessary.

However, if requested by the power supply network operators, it is also possible to run the turbine with an output factor of $\neq 1$. This enables the wind turbine to contribute to reactive power balance and to maintain the voltage in the grid. The maximum reactive power range varies depending on the turbine configuration. The active power being fed is not affected by reactive power being fed simultaneously.

The range of operation parallel to the grid is also determined by a lower and upper frequency limit value. The range between these frequency limits is much wider than in conventional energy production units thanks to ENERCON's flexible IGBT converter technology. ENERCON wind turbines can be used in grids with a rated frequency of 50 Hz or 60 Hz.

If these voltage or frequency limits cannot be maintained, the E-82 control unit switches off all grid contactors in the inverter. This allows the E-82 to immediately disconnect from the grid on all phases.

1.5 Yaw control

The yaw bearing is mounted directly at the top of the tower with an externally geared ring. The yaw bearing allows the nacelle to rotate, thus facilitating yaw control. Six adjustment drives (yaw gears) engage in the geared ring in order to adjust the nacelle to the wind direction. The yaw bearing also transmits the load of the nacelle to the tower. The main carrier is mounted directly on the yaw bearing.

1.6 Safety system

The safety system guarantees safe turbine operation in accordance with international standards and independent test institutes.

1.6.1 Brake System

Halting ENERCON turbine operation is done completely aerodynamically by pitching the rotor blades into the feathered position. The three independent pitch drives move the rotor blades into the feathered position within seconds (i.e. they are "driven out of the wind"). The speed of the turbine is diminished without applying additional load to the drive train. In order to reduce the rotor speed to a safe level, it would be sufficient to drive only one of the three rotor blades out of the wind.

The rotor is not locked in place even when the WEC is shut down. It idles freely at a very low speed. The rotor and drive train remain practically without load. While idling, fewer loads are placed on the bearings than when the rotor is locked.

The rotor is only completely locked in place for maintenance purposes or when the EMERGENCY STOP button is activated. In this case, an additional brake is employed. It does not engage until the rotor has already been partially braked with the pitch controls. The rotor lock is only used as a final safety mechanism for maintenance purposes.

In the event of an emergency (e.g. if the utility's mains fails), each rotor blade is safely brought into the feathered position via its own back-up pitch unit. The backup power units are monitored and automatically charged to guarantee availability. The backup pitch units, which are electromechanically linked, trigger simultaneous pitch control.

The pitch control system is equipped with parallel power supply in the case of emergencies (mains or backup power unit). Together with three fully independent pitch drives this safety concept more than fulfils the requirements for a fail safe braking system.

1.6.2 Lightning protection system

The ENERCON lightning conductor system in the E-82 efficiently diverts almost all possible lightning strikes with no damage caused to the turbine.

The leading and trailing edges of the rotor blade and the blade tip are equipped with aluminium profiles which are attached to an aluminium ring at the blade connection point. Strikes are safely absorbed by these profiles and the lightning current is conducted via a spark gap and cables into the ground surrounding the foundation.

The rear of the nacelle casing is also fitted with a lightning conductor which diverts the current into the ground.

In the event of a lightning strike or an abnormal increase in voltage (overvoltage), the entire electrical and electronic equipment is protected by built-in energy-absorbing components. All main conductive turbine components are connected to the equipotential busbar with an adequate wire cross-section. Furthermore, overvoltage surge arresters are installed with low impedance grounding at the mains connection point.

The turbine electronics located in metal housing are electrically isolated. The remote monitoring system is protected by a special protection module for data interfaces.

1.6.3 Sensor System

A comprehensive monitoring system guarantees turbine safety. All safety related functions (e.g. rotor speed, temperature, loads, oscillations) are monitored by electronic media. If the electronics fail, a mechanical safety function takes over. If one of the sensors registers a serious fault, the turbine shuts down immediately.

1.7 Control system

The E-82 control system is based on a microprocessor system developed by ENERCON. Sensors query all turbine components and data such as wind direction and wind speed and adjust the operating mode of the E-82 accordingly.

When wind speeds suitable for turbine operation are measured over three consecutive minutes, the automatic startup process is initiated. Once the lower speed range limit is reached, power output is fed to the grid. Elevated making current does not occur at start-up since the grid connection is performed through the DC Link and the converter.

During operation at partial load, speed and rotor blade angle are continuously adjusted to the changing wind conditions. Power is controlled through generator excitation. If rated wind speed is exceeded, the blade angle is adjusted to maintain rated speed.

When the storm control system (optional) is deactivated, the turbine stops as soon as an average wind speed of 25 m/s in the 10-mnute-mean or a peak value of 30 m/s is exceeded. The turbine restarts when the wind speed constantly remains below the shutdown wind speed. The rotor is permitted to idle freely at a very low speed even in the shutdown mode.

Yaw control begins even before the start-up speed has been reached. The wind vane constantly takes wind direction measurements. If the deviation between the direction of the rotor axis and the measured wind direction is too great, the yaw adjustment drives correct the nacelle position. The deviation angle and the time it takes for the nacelle position to be corrected vary depending on the wind speed.

Whether the turbine is stopped manually or via the turbine controls, the blade is pitched into the feathered position to reduce the actual contact surface of the wind flow on the blade. The turbine gradually slows down to idle mode.

2 Control System

2.1 Response to safety relevant sensor messages

Turbine response to messages received from individual sensors is explained in the following sections. If a safety relevant sensor responds, the turbine initiates an automatic shutdown. The nature of the shutdown and whether it is followed by a restart depends on the fault in question.

Turbine fault occurrences are displayed on the LCD. Minor faults can be reset by pressing the “Acknowledge fault” button once their cause has been established. Afterwards, the turbine automatically starts up again. Some faults may only be rectified by Service technicians and then deleted. The respective status text flashes on the LCD. These messages are also marked with an asterisk.

Furthermore, sensor reliability is constantly monitored by the control system. If the sensors respond, a fault message is sent via the remote monitoring system. Depending on the sensor, the turbine may continue to operate for a certain amount of time. If certain sensors respond, the turbine has to be stopped immediately and the fault rectified.

2.2 Starting the turbine

Unless expressly stated otherwise, these instructions apply to startup after an automatic shutdown and for operation start up with the start/stop switch.

When the turbine is switched on (main switch on control cabinet to “ON” and start/stop switch is set to start), "Turbine operational" appears on the LCD shortly afterwards (status 0:2), provided the E-82 control system has not detected any faults. Ninety seconds after start-up, the rotor blades are driven out of the feathered position (approx. 90°) and "idle mode" begins. The rotor starts turning slowly. The turbine begins the actual operations startup procedure when the average wind speed is greater than the required startup wind speed for three consecutive minutes.

2.3 Normal operation

Once the E-82 startup procedure is completed, the wind energy converter switches to normal operation. During operation, the wind conditions are continuously determined: rotor speed, generator excitation and output are optimised, the nacelle position is adjusted to the wind direction and all sensor messages are recorded. When outside temperatures are high and if the wind speeds are also elevated, the generator fan is switched on.

2.3.1 Operation at partial load

During operation at partial load, the speed and power output are continuously adjusted to the changing wind conditions. In the upper partial load range, the rotor blades are pitched a few degrees to avoid flow interruption (stall effect).

As wind speed increases, the rotor speed and power output increase.

2.3.2 Automatic control mode

When the wind speed exceeds the rated wind speed, the blade angle is adjusted to maintain the rotor speed at / or around its rated value and to limit the use of the wind's power ("automatic control mode"). The required blade angle adjustment is determined by evaluating speed and acceleration measurement data which is then transmitted to the pitch drives. This maintains power output at its rated value.

2.4 Idle mode

If the turbine is shut down (e.g. due to lack of wind or faults), the rotor blades are normally positioned at a 60° angle in relation to the operating position. The turbine then rotates at a slow speed. If this speed (approx. 3 U/min) is exceeded the rotor blades are pitched further into the feathered position (approx. 90°). This operating mode is called "idling". Idling reduces load and enables the turbine to be restarted in the shortest possible time. The reason for turbine shutdown or idle mode is indicated by the status message.

2.5 Stopping the turbine

The E-82 can be stopped by manually activating the start/stop switch and the EMERGENCY STOP button. The control system stops the turbine in the event of faults or unsuitable wind conditions (see Figure 3).

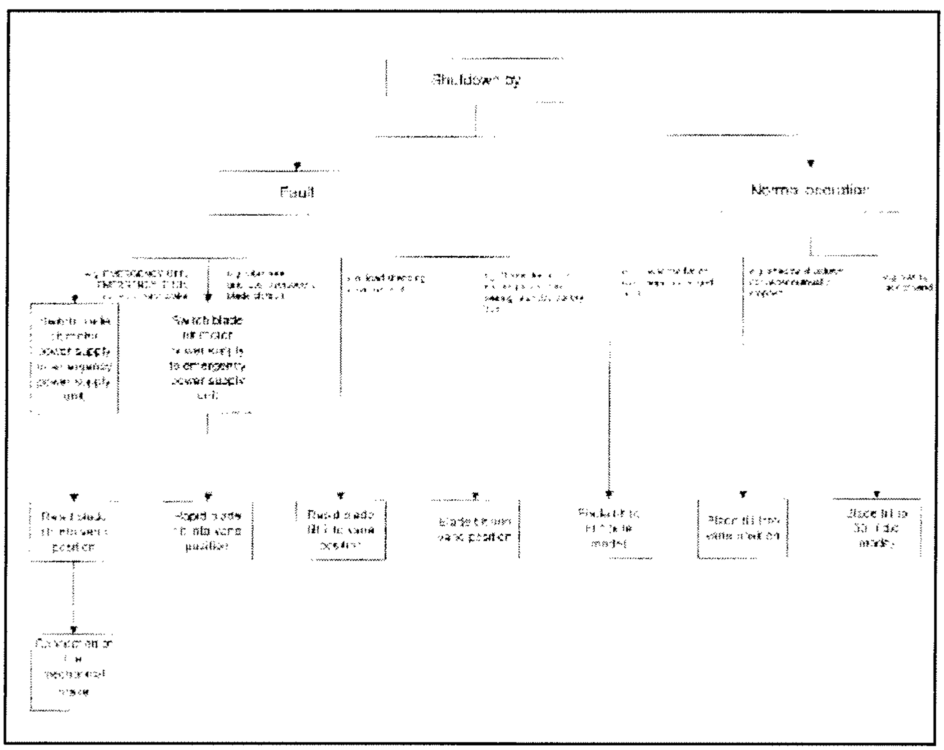


Figure 3: Shutdown procedures for the E-82

2.5.1 Automatic shutdown

In automatic mode, ENERCON wind energy converters are only brought to a standstill aerodynamically by pitching the rotor blades. Pitching the rotor blades reduces the aerodynamic lift force which slows the rotor down. The pitch control devices can drive the rotor blades out of the wind (i.e. into the feathered position) within seconds.

The turbine also stops automatically when certain faults or operating events occur or under certain wind conditions. Some faults cause rapid shutdown to occur. This happens via the rotor blades' backup power units. Other faults result in a normal shutdown.

Automatic restart may be possible depending on the type of fault. In each case the converters are electrically isolated from the grid during shutdown.

2.5.2 Manual stop

The E-82 can be stopped via the start/stop switch on the control cabinet. The control system then pitches the rotor blades out of the wind and the turbine slows to a halt. The brake is not activated and yaw control remains in operation so that the E-82 can continue to optimally adjust to the wind.

2.5.3 Manual shutdown in emergency situations

If individuals or turbine parts are at risk, the turbine can be stopped by pressing the EMERGENCY STOP button. An EMERGENCY STOP button is located on the control cabinet. Pressing it will induce immediate emergency braking on the rotor with rapid pitch control via the emergency pitch and brake units. At the same time the mechanical brakes are activated. All components continue to be supplied with power.

The buttons are latched and have to be pulled back to their original position once the emergency has passed and the turbine is to be restarted.

If the main switch on the control cabinet is set to the OFF position, all turbine components, except for tower and control cabinet lighting and individual light switches and sockets, are switched off. The turbine activates rapid pitch control via the emergency pitch devices. The mechanical brake is not activated when the main switch is used.

2.6 Lack of wind

If the turbine is in operation and the rotor speed drops too low due to lack of wind, the turbine is switched to idle mode by slowly pitching the rotor blades towards the 60° angle. The turbine then restarts automatically when the cut-in wind speed is reached.

If the anemometer freezes due to low temperatures (<3°C), the turbine attempts to start at hourly intervals to test whether the wind speed is sufficient for operation when the wind vane is functioning. If the turbine starts and produces power, it goes into normal operation. However, the correct wind speed does not appear on the display since the frozen sensor cannot provide accurate wind speed data.

2.7 Storm

From the standstill position or idle mode the turbine does not start up at wind speeds over 31 m/s. If an average wind speed of 31 m/s or a top value of 34 m/s is exceeded, the E-82 automatic control mode stops. The turbine also stops if the maximum permissible blade angle is exceeded. A frozen anemometer therefore does not represent a safety risk. In all cases the turbine switches to idle mode.

The E-82 components, such as rotor blades, nacelle, tower and foundations are designed to withstand considerably higher wind speeds.

The turbine starts automatically if the wind speed drops below cut-out wind speed (31 m/s) for 10 consecutive minutes.

When wind speeds surpass 28 m/s the ENERCON Storm Control System does not shut down the turbine abruptly, but rather reduces the power by continuously pitching the rotor blades. The output is only reduced to zero at wind speeds of approx. 34 m/s. This strategy improves electrical behaviour in the grid at the same time increases output.

2.8 Yaw control

The E-82 has a combination wind sensor, which is installed on the top of the nacelle. The combined wind sensor comprises a wind vane, which constantly determines the wind direction, and an anemometer, which measures wind speed.

E-82 yaw control already starts to operate below the cut-in wind speed of 2 m/s. Even if the system shuts down (e.g. due to excessive wind speed), it adjusts according to the wind conditions. The angle and the period of measurement depend on the wind speed and turbine performance.

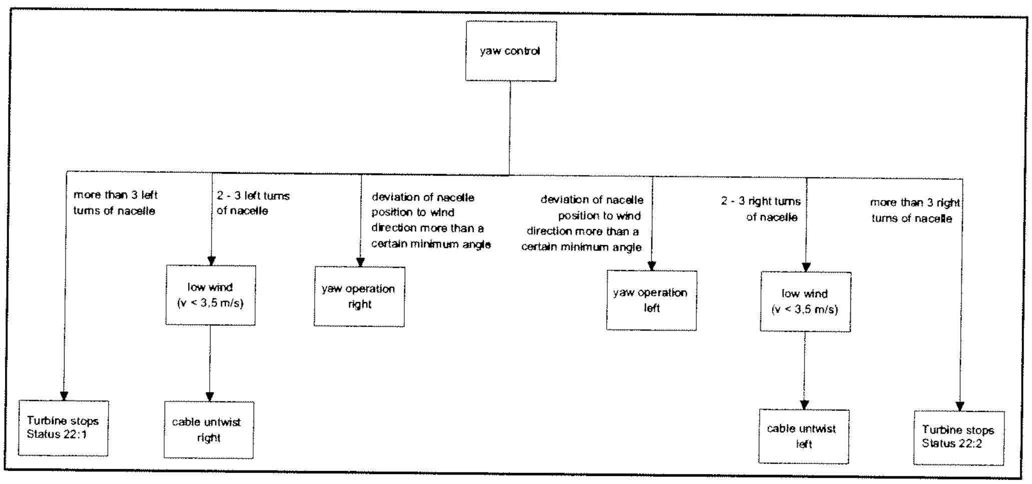


Figure 4: Illustration of yaw control

Yaw procedure is determined by counting the pitch motor rotations and the required pitch time is checked for plausibility. If the control system detects irregularities in yaw control or cable untwisting (See following), shutdown procedure is initiated.

2.8.1 Untwisting power and control cables

The E-82 power and control cables located in the tower pass from the nacelle over a deflection pad and are then fastened to the tower wall. The cables have enough freedom of movement to permit the nacelle to rotate several times in the same direction about its axis. The cables gradually twist. The E-82 control system ensures that the twisted cables are automatically unwound.

Once the cables have been twisted two and three times, the control system uses the next low-wind period to untwist the cables. If, however, high wind conditions continue and the cables have twisted more than 3 turns, the turbine stops and the cables untwist irrespective of wind speed. The cables take about half an hour to untwist. Once the cables have untwisted, the turbine automatically restarts.

The cable twist sensors can be found on the so-called cable twist switch, which in the E-82 is fitted near the access hatch. The sensor is connected via a gearwheel and gearbox to the yaw slewing ring. Changes in the nacelle direction are transmitted to the operation control system.

Furthermore, clockwise and anti-clockwise limit switches transmit whether the permissible limit has been exceeded in either direction (cable twist limit switch clockwise or anti-clockwise). This prevents the tower cables from twisting further. The turbine stops and cannot be restarted automatically.

3 TECHNICAL SPECIFICATIONS:

Turbine type:	**ENERCON E-82**
Rated power:	2000 kW
Rotor diameter:	82 m
Hub height:	78 – 108 m (tower and foundation options)
Turbine concept:	Gearless, variable speed, single blade pitch control
Rotor	
Type:	Upwind rotor with active pitch control
Rotational Direction:	Clockwise
No. of blades:	3
Swept area:	5281 m²
Blade material:	Fibreglass (epoxy resin); integrated lightning protection
Speed:	Variable, 6 – 19,5 rpm
Tip speed:	25 - 80 m/s
Pitch control:	ENERCON blade pitch system, one independent pitching system per rotor blade with allocated emergency supply
Drive train with generator	
Hub:	Rigid
Main bearing:	Dual row tapered / cylindrical roller bearings
Generator:	ENERCON direct-drive synchronous annular generator
Grid power feed:	ENERCON inverter

Braking system	- 3 independent pitch systems with emergency power supply - Rotor brake - Rotor lock
Yaw control:	Active via adjustment gear, load-dependent damping
Cut-in wind speed:	2.5 m/s
Rated wind speed:	12 m/s
Cut-out wind speed:	28 - 34 m/s
Remote monitoring:	ENERCON SCADA

Appendix B
ENERCON E82 Foundation Data Sheet

Fundamentdatenblatt
für geotechnische Nachweise
Foundation data sheet
for geotechnical calculations

Turmtyp: **E-82/S/77/4F/01**
tower type:

Typenklasse: Windzone 4 GK I (DIBt-Richtlinie)
type class: WTGS class II A (IEC-/ NVN-Richtlinie)

TYPENPRÜFUNG Geltungsdauer 5 Jahre/Wiedervorlage bis 30. Juni 2011

Fundamenttyp: **Flachgründung - Kreisfundament ohne Auftrieb - Ø 16,70m**

foundation type: ***shallow foundation – circular foundation without buoyancy - Ø 16,70m***

Statikdatum: 28.04.2006
static date:

In bautechnischer Hinsicht geprüft.
Siehe Prüfbericht vom ...
München ...
TÜV SÜD ... GmbH
Prüfamt für Baustatik ... Bauten und für Windenergieanlagen
Der Leiter: Der Bearbeiter:

Datum: 03.05.2006
date: Rev. 1.0

ENERCON GmbH
Dreekamp 5
D – 26605 Aurich / Germany
www.enercon.de

Author: Dipl.-Ing. (FH) M. Schacknies
Approved: Dipl.-Ing. S. Degenhardt

TÜV SÜD Industrie Service GmbH MÜNCHEN

- **Lasten an der Fundamentunterkante für geotechnische Nachweise**
  (inkl. Eigengewicht Fundament und Bodenauflast $\gamma = 18$ kN/m³)
  Loads at the bottom of foundation for geotechnical calculations
  (incl. dead weight foundation and soil weight $\gamma = 18$ kN/m³)

Lastfall *load case*	F_{xy} [kN]	F_z [kN]	M_{xy} [kNm]	M_z [kNm]
DLC 1.0	496	-15028	32868	-
DLC 6.1	627	-14873	49896	2570
DLC 6.2	774	-15003	61350	3028

alle Lasten mit Teilsicherheitsbeiwert $\gamma_F = 1{,}0$
all loads with partial safety factor $\gamma_F = 1{,}0$

- **Aufzunehmende Bodenpressung / *minimum required bearing pressure***
  Der anstehende Baugrund muss mindestens eine Bodenpressung von **σ = 234 kN/m²** aufnehmen können.
  Minimum required bearing pressure is σ = 234 kN/m².

- **Drehfedersteifigkeit / *rocking spring stiffness***
  Für die elastische Fundamenteinspannung zwischen Fundament und Baugrund ist eine Mindestdrehfedersteifigkeit von **k_φ = 40.000 MNm/rad (dynamische Bodenkennwerte)** einzuhalten.
  The minimum value of rocking spring stiffness for clamping between foundation and soil must be k_φ = 40.000 MNm/rad (dynamic soil parameters).

  Die erforderlichen dynamischen Steifemodule ($E_{oed,dyn}$) ergeben sich in Abhängigkeit von Fundamentgeometrie und Querdehnzahl.
  The minimum values of dynamic modulus of stiffness ($E_{oed,dyn}$) are calculated in dependence on foundation geometry and Poisson's ratio.

  Für Kreisfundamente gilt:
  For circular foundations:

$$k_\varphi = \frac{8 \cdot G \cdot r^3}{3 \cdot (1-v)}$$

  daraus folgt:
  resultant:

$$E_{oed,dyn} = k_\varphi \cdot \frac{3}{4} \cdot \frac{1}{r^3} \cdot \frac{(1+v)\cdot(1-v)^2}{1-v-2\cdot v^2}$$

  G = Schubmodul / shear modulus

  r = Radius / *radius*

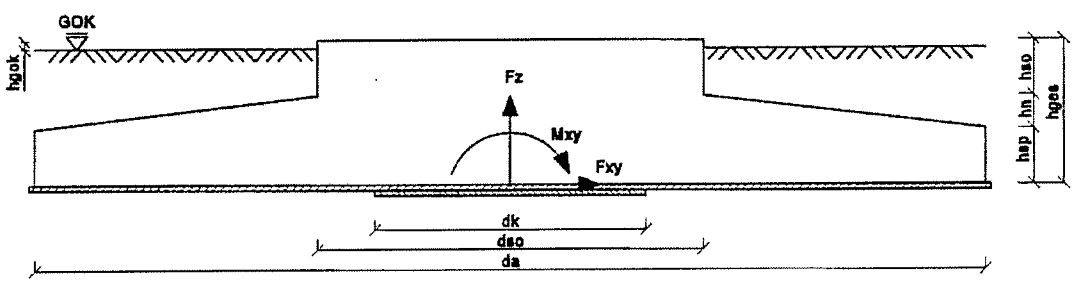
  v = Querdehnzahl / *Poisson's ratio*

- **Zulässige Schiefstellung / *permissible tilting***
  Maximal zulässige Schiefstellung infolge Baugrundsetzung in 20 Jahren.
  Maximum allowed tilting due to settlement of the foundation soil in 20 years.

  $\Delta s \leq 3{,}0$ mm/m

Fundamentgeometrie
geometry of foundation

Außendurchmesser *outer diameter*	da	16,70 m
Sockeldurchmesser *base diameter*	dso	6,60 m
Fundamenthöhe *foundation height*	hges	2,60 m
Sockelhöhe *base height*	hso	1,00 m
Höhe Spornneigung *inclination of plinth*	hn	0,70 m
Spornhöhe *height outside diameter*	hsp	0,90 m
Differenz Fundamentoberkante - GOK *difference top of foundation – top ground surface*	hgok	0,15 m
Durchmesser der kompressiblen Einlage *diameter of soft compressive layer*	dk	4,10 m
Betongüte und Volumen *concrete class and volume*	C 25/30	311 m³
Betonstahl und Gewicht *reinforcement steel and weight*	BSt 420 S (A)	36,6 t
Betonstahl und Gewicht *reinforcement steel and weight*	BSt 500 S (A)	32,8 t



Bemerkungen / *remarks*

- Die angegebenen Lasten sind ausschließlich für geotechnische Nachweise zu verwenden.
  The stated loads are only used for geotechnical calculations.
- Dieses Dokument wurde auf Anfrage bzw. für einen bestimmten Auftrag verschickt. Der Empfänger wurde nicht registriert! Der Empfänger wird bei Änderung nicht automatisch informiert!
  This document has been sent on request on a certain order. The receiver has not been registered! The receiver will not be informed automatically in case of alterations!
- Weitergabe und Kopien an Dritte sind nur mit schriftlicher Zustimmung der ENERCON-Konstruktionsabteilung erlaubt.
  Circulation of the data or copies are only enabled by written agreement from ENERCON design department.

Appendix C
ENERCON E82 Access Roads and Crane Platforms

Access Roads and Crane Platforms

E-82

77m steel tower

Document information:			
Author/date:	Heiko Krey/10.05.06	Translator/date:	-
Department:	Project Management	Revisor/date:	-
Approved/date:	Gunda Hinderlich/31.05.07	Reference:	PM-CW-SP023-E82-77m Zuwegung und Kranstellfläche-Rev004ger-eng

CONTENTS

Page

1. Assembling the tower and wind energy converter

The tower and wind energy converter are installed in two stages (work steps):

Step 1
Bolting the tower flanges to assemble the supplied tower sections. The 77m steel tower consists of four tower sections.

Step 2
Preassembly of the supplied converter components and subsequent assembly of the wind energy converter.

2. Crane technology

2.1. Details of crane technology

The following crane technology is required for the work steps described above:

	77m steel tower
Crane type	800t lattice tower crane
Length/basic unit	20 m
Width/basic unit	3 m
Track width	3 m
Supporting base	13 m x 13 m
Working radius	28 m

2.2. Supporting base and working radius

The **supporting base** describes the distance between the four support cylinders arranged in a square (in metres).

The **working radius** is the minimum distance between the crane hook and the crane's live ring.
Example: With a working radius of 28 m, the distance from the live ring to the centre of the foundation would be at least 28 m (see 6.2.).

2.3. Installing the lattice tower crane

The following work steps need to be performed:

- Drive crane into position
- Align the crane with the centre of the WEC (taking into account the working radius)
- Use approx. 20 trucks to transport the crane accessories to the crane
- Support the crane on the crane platform using load distribution plates and
- Assemble jib

2.4. Assembling the jib

The individual jib (lattice tower) components should be assembled across a span of 95 m with the aid of an auxiliary crane. It should then be installed. During this process, the auxiliary crane must be positioned to the side of the jib of the main crane.
In order to facilitate consecutive assembly of the individual jib components, a paved roadway will be required for the auxiliary crane to travel along. You are advised to make use of the existing access road for the wind energy converter. If the existing access road is not suitable, a temporary roadway has to be constructed for the purpose of assembling the jib; this roadway has to be agreed with the competent ENERCON Project Manager on a case-by-case basis.

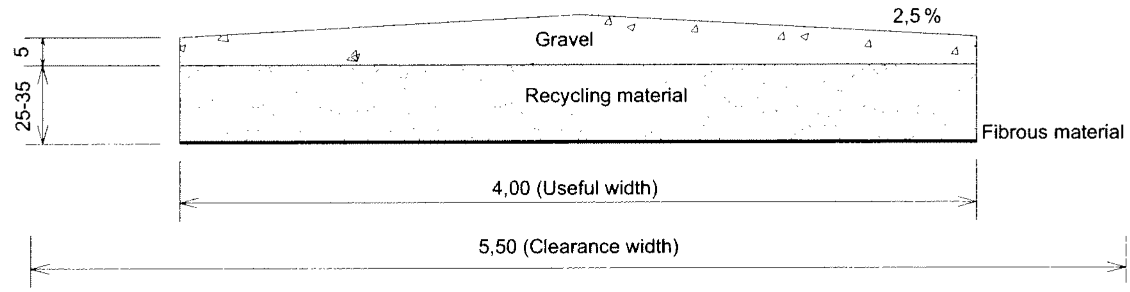
3. Access roads

Any roadways, bridges or access roads have to be able to withstand the transportation of heavy loads up to a maximum axle load of 12t and a maximum overall weight of 120t. Access has to be kept clear at all times. The responsible ENERCON Project Manager has to be informed of any failure to meet these requirements.

3.1. Minimum requirements of access roads

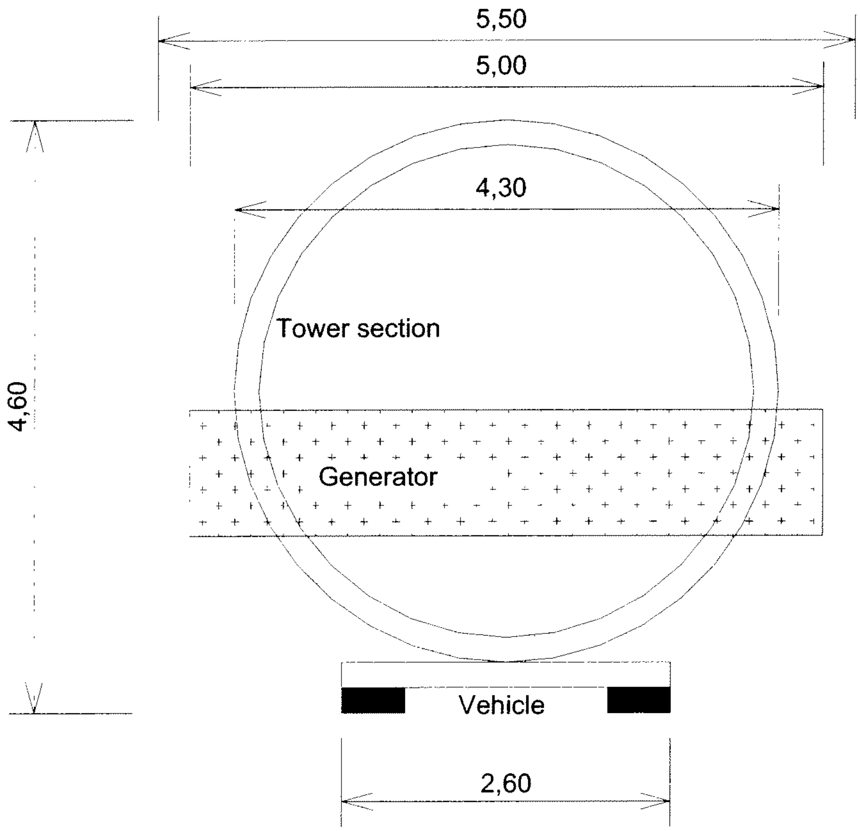
Useful width of carriageway	4 m
Clearance width	5.5 m
Clearance height	4.6 m
Radius of curve, external	28 m
Incline with loose surface	7%
Incline with fixed surface	12%
Ground clearance of transport vehicles	0.15 m

3.2. Example of access road construction



Caution:
The structure illustrated above is merely an example of average bearing soil. If the subsoil is soft (boggy soil, etc.), it may be necessary to use more backfill, install a geogrid and make use of gravel. ENERCON has always to be consulted prior to any construction work.

3.3. Transport structure clearance



3.4 Access road bearing capacity

In the case of cohesive soils, the use of a geotextile or geogrid is recommended, as this makes for better distribution of the load across the access road's subgrade. It will also increase the access road's service life and durability.
During construction, plate load bearing tests should be carried out to ensure that the necessary bearing capacity is achieved.

Data for soil experts:

Subsoil	$E_{v2} \geq 45$ MN/m²
Base course	$E_{v2} \geq 100$ MN/m²
Maximum axle load of transport vehicles	10t
Maximum axle load of crane	12t
Maximum vehicle weight	120t

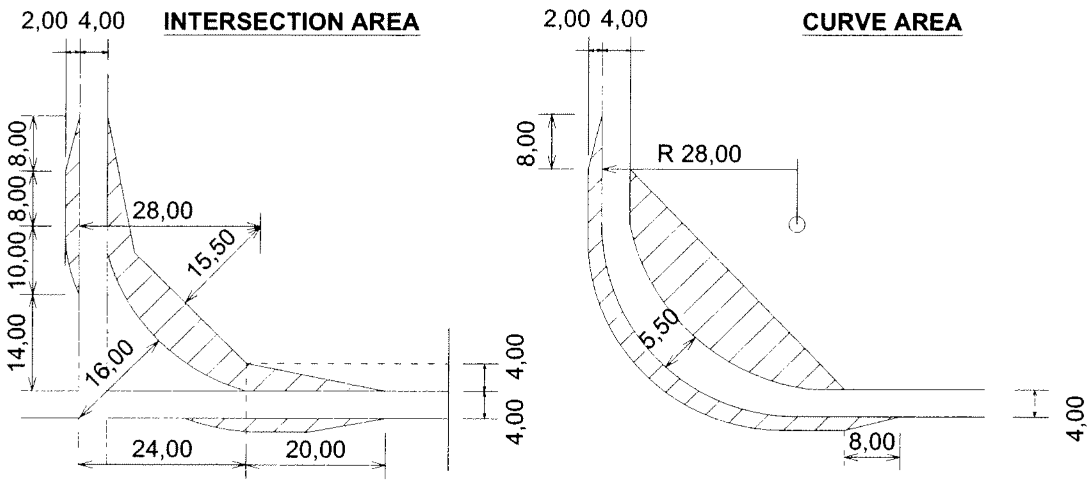
3.5. Basic principles of access road construction

- Useful carriageway width of 4 m
- Able to withstand an axle load of up to 12t
- Able to withstand an overall weight of up to 120t
- Carriageway width of 5.5 m on curves
- No obstacles on inside/outside of curves
- Clearance width of 5 m
- Clearance height of 4.6 m
- Checking of bridge bearing capacity
- Checking of outlets and pipework
- Checking of distances from graves, hollows and watercourses
- Checking of distances from high voltage/electrical/telephone cables and
- Inspection of inclines

4. Radii of curves

4.1. Minimum requirements of intersections and curves

In contrast to intersections, areas involving curves do not require the same degree of paving, as the squinch does not need to be constructed.



Intersections

The construction method for intersection areas as illustrated above should be used for existing intersections. The area indicated by the dotted line should already be paved; if not, it has to be paved.

The hatched areas have to be free of obstacles, as the load that is being transported may protrude into these areas (for example, rotor blades may protrude from the rear of the vehicle by 7 m during transport).

Curves

The construction method for curve areas as illustrated above should be used for new access roads within the context of any curves.

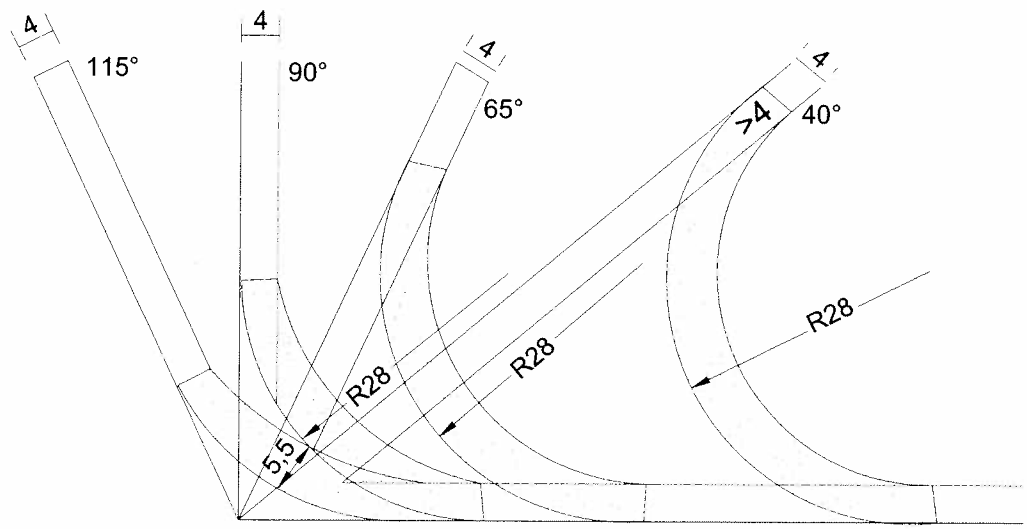
The hatched areas have to be free of obstacles, as the load that is being transported may protrude into these areas.

Document information:

Author/date:	Heiko Krey/10.05.06	Translator/date:	-
Department:	Project Management	Revisor/date:	-
Approved/date:	Gunda Hinderlich/31.05.07	Reference:	PM-CW-SP023-E82-77m Zuwegung und Kranstellfläche-Rev004ger-eng

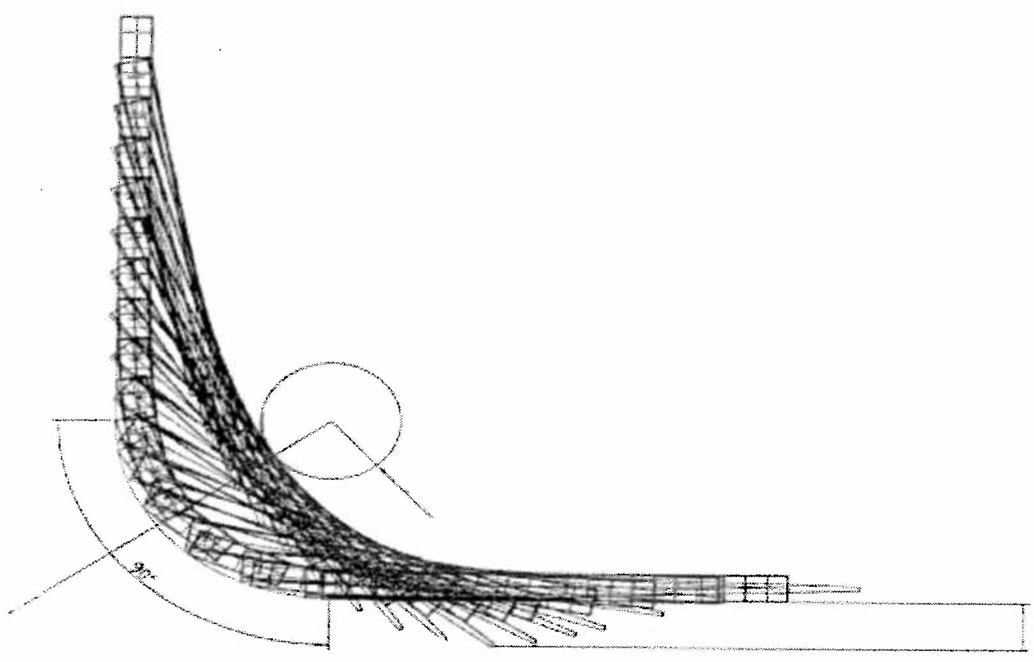
4.2. Radius of curve < 90 degrees

If the angle of the curve under construction is < 90 degrees, the curve moves outwards and the area associated with the necessary carriageway width of 5.5 m has to be enlarged accordingly (see marking). The load again protrudes into the inside and outside areas of the curve (see 4.1).



4.3. Road performance of vehicles in curves

The figure bellow illustrates the movement of blades as they are transported round a curve.



5. Transport and logistics

5.1. Basic principles of transport

It is a basic principle that transport vehicles should not exceed the maximum axle load of 10t. Thus, a transport vehicle with an actual overall weight of 100t has to have at least 10 axles.

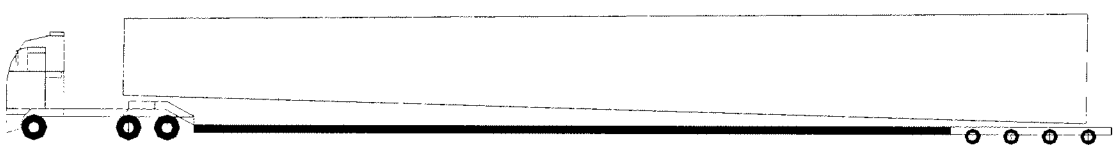
The following vehicles are used on ENERCON construction sites:

- Lowloader trailers
- Drop base vehicles
- Semi trailers and
- Adapter vehicles

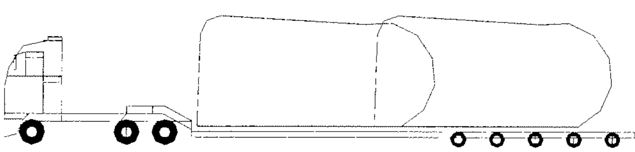
The vehicles vary to some extent in terms of length and width and can be shortened (pushed in) by several metres once they have been unloaded.

5.2. Overview of transport vehicles

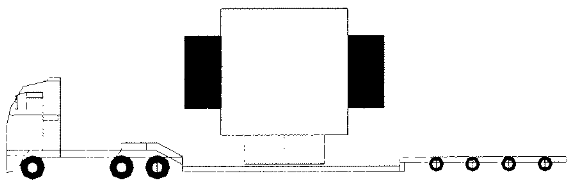
Semi trailer, steel section



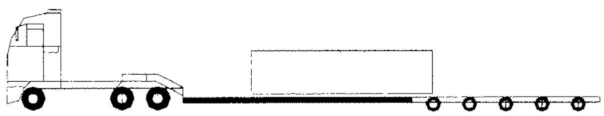
Telescopic semi, machine house components



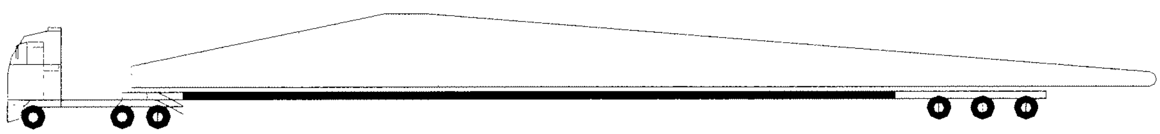
Flatbed trailer, hub



8-axled semi, generator



Semi trailer, rotor blade



6. Crane platforms

6.1. Minimum requirements of crane platforms

The crane platform is the key to ensuring that everything runs smoothly and safely during the construction phase.
It should take the form of a coarse, level surface with a top surface made from recycled materials or mixed minerals with a grain size of 0 – 32 mm.
The crane platform should be located above ground level to ensure that surface water is properly dispersed.
During construction, plate load bearing tests should be carried out to ensure that the necessary bearing capacity is achieved.

Any cranes used have a maximum support pressure of 200t and are supported on the crane platform by means of load distribution plates. Pressures of up to 18.5t/m² may act on the platform as a result of this and the maximum surface pressure is therefore **185 kN/m²**.

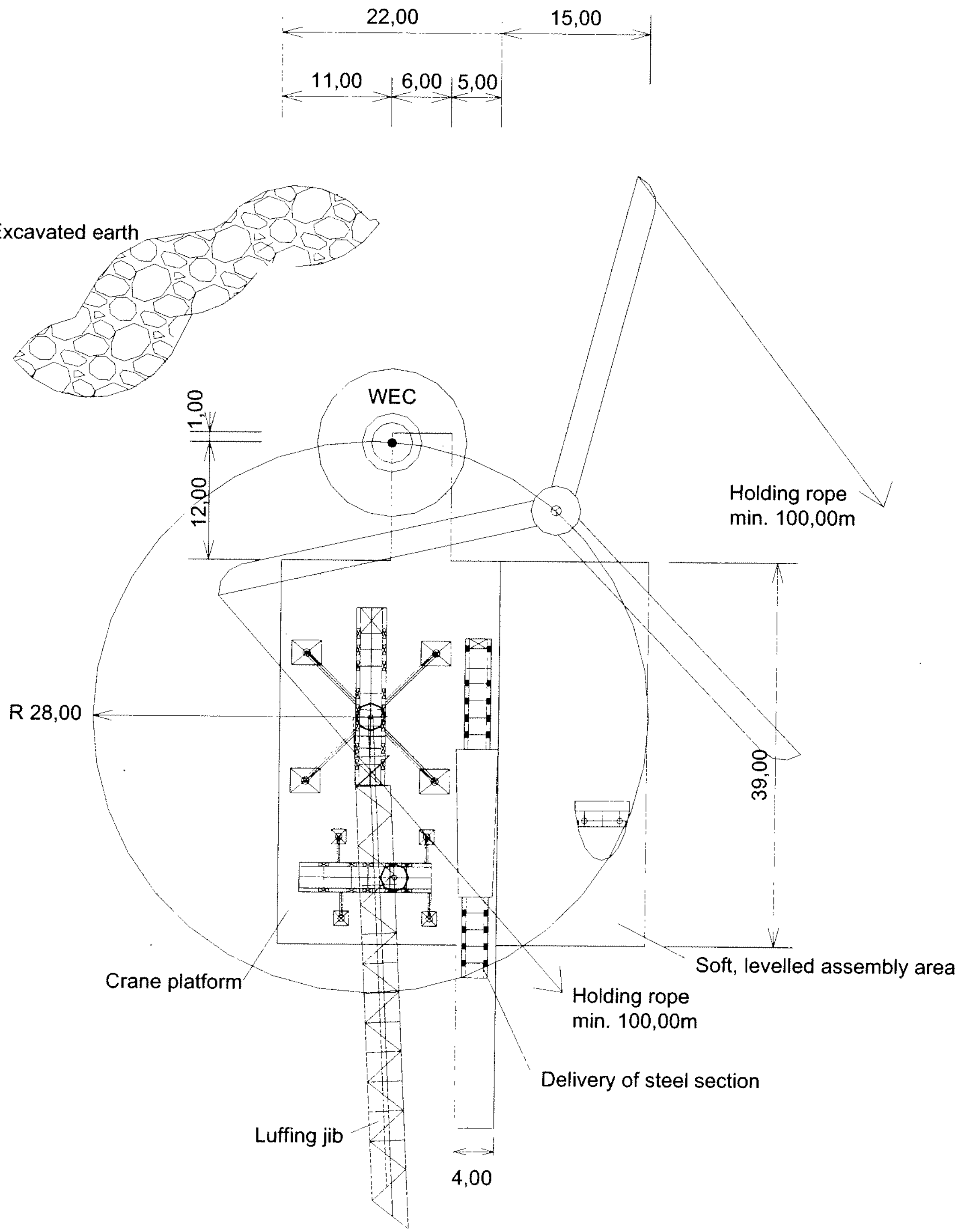
The dimensions of the crane platform should be calculated so that all the work necessary for installing the wind energy converter (including tower) can be carried out in the optimum manner. The example given in 6.2 provides a basic standard. This can be adapted to local conditions in consultation with the competent ENERCON Project Manager.
The soft, levelled assembly area can be located either to the left or to the right of the crane platform.

To ensure that any components inside the tower can subsequently be replaced and to protect the wind energy converter against ingress of dirt, a 6 m wide, paved access has to be constructed between the crane platform and the tower once the foundation has been backfilled.

During foundation construction, the crane platform also serves as a storage area for material (e.g. reinforced steel) and machinery.

Any excess earth excavated during the construction phase should always be stored behind the foundation (see 6.2).

6.2. Standard crane platform



Appendix D
TC Aeronautical Obstruction Clearance

Transport Canada / Transports Canada

July 24, 2008

Your file Votre référence

Our File Notre référence

M5105-6 (MAM)

Peter Archibald
Renewable Energy Services Limited
30 Memory Lanes
Sackville, NS
B4C 2J3

Dear Mr Archibald

RE: AERONAUTICAL OBSTRUCTION CLEARANCE FORM

Based on the information which you have provided on the Aeronautical Obstruction Clearance Form attached and listed below, Transport Canada, Aerodromes and Air Navigation, Atlantic Region has no objection to your proposal subject to the conditions noted on the form

Transport Canada #	Location / Coordinates
2008-119	Port Hawkesbury, NS (see spreadsheet)

We ask that you also coordinate your proposal with Nav Canada to ensure they have no objections The Land Use Department at Nav Canada, Ottawa can be contacted by

Phone 1-866-577-0247 *or* E-mail landuse@navcanada ca

Please keep in mind that this does not constitute approvals from other Federal Government departments or other local land use authorities Furthermore, it is the responsibility of the operator to ensure that the appropriate NOTAM (Notice to Airmen) is issued when any condition on this application cannot be met or maintained

Lighting and painting standards can be found in CAR 621 19 (Canadian Aviation Regulations)

Please inform this office if this project is cancelled If you have further questions, feel free to contact us

Yours truly,

S T Cripps
Regional Manager
Aerodromes & Air Navigation
Transport Canada, Civil Aviation, Atlantic Region

P O Box 42
Moncton, NB Ph (506) 851-3342
E1C 8K6 Fax (506) 851-3022 Attach c c Land Use Department (Nav Canada, Ottawa)

Canada

Transport Canada / Transports Canada

APPENDIX C TO CAR 621 19 - ANNEXE C RAC 621 19

AERONAUTICAL OBSTRUCTION CLEARANCE FORM
FORMULAIRE D'AUTORISATION D'OBSTACLE AERIEN

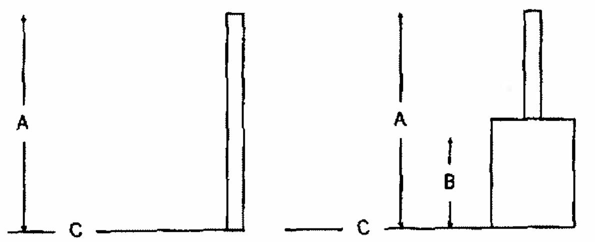
TC File No / Ref No - TC ...

RECEIVED / REÇU
JUL 23 2008
TC # 2008-119
MAM

TO BE COMPLETED BY APPLICANT – À REMPLIR PAR LE REQUÉRANT

Operator's Name – Nom de l'opérateur	RENEWABLE ENERGY SERVICES LIMITED
Operator's Address – Adresse de l'opérateur	30 MEMORY LANE, SACKVILLE, NOVA SCOTIA B4C2J3
Operator's Contact – Agent de liaison de l'opérateur	PETER ARCHIBALD
Contact's Telephone No – N° de téléphone de liaison	(902) 471-7344
Contact's FAX No – N° de télécopieur de liaison	(902) 484-7424
Contact's Email Address – Adresse électronique de liaison	parchibald@resl ca
Applicant's Name – Nom du requérant	PETER ARCHIBALD
Address – Adresse	30 MEMORY LANE
City – Ville	SACKVILLE
Province/Territory Province/Territoire	NOVA SCOTIA
Postal – Code – postal	B4C2J3
Applicant's Telephone No – N° de téléphone du requérant	(902) 471-7344
Applicant's FAX No – N° de télécopieur du requérant	(902) 484-7424
Applicant's Email Address – Adresse électronique du requérant	parchibald@resl ca
Nearest city / town to proposed facility – Ville la plus proche de la structure proposée	PORT HAWKESBURY, NS
Geographic coordinates of structure – coordonnées géographiques de la structure	° ' " N Latitude / Latitude N; ° ' " W Longitude / Longitude O; [ ] NAD27 [ ] NAD83 [✓] WGS84

TOWERS / ANTENNAS – TOURS / ANTENNES   BUILDING OR OTHER STRUCTURE – BÂTIMENT OU AUTRE STRUCTURE



		Feet – Pieds	Meters – Metres
A	Height above ground – Hauteur au-dessus du sol	see attached	
B	Building height – Hauteur du bâtiment	see attached	
C	Ground elevation above sea level – Hauteur du sol au-dessus du niveau de la mer	see attached	

List any tall adjacent buildings and structures which may shield the proposed structure (Attach sketch)

Faire une liste indiquant les structures et bâtiments avoisinants plus haut que le bâtiment projeté (Inclure un diagramme)

New struc – Nouv struc	Add to exist struc incl total hght – Ajout à un bâti exis incl hauteur total	Proposed Construction – Date – de construction proposée
[✓] Yes / Oui [ ] No / Non	NO	2009-04-01

TYPE OF STRUCTURE (narrative description and function) – GENRE DE STRUCTURE (description narrative et fonction)

The Wind Farm consists of 12 ENERCON E82 WEC's consisting of a tubular steel tower, nacelle and rotor with fiberglass blades Please refer to attachments for turbine description, coordinates and proposed lighting arrangement of the Wind Farm

Signature (of applicant) (du requérant) ▶ Peter Archibald   Date (Y/A M D/J) 2008-07-22

TRANSPORT CANADA USE ONLY – À L USAGE DE TRANSPORTS CANADA

AERONAUTICAL ASSESSMENT – EVALUATION AÉRONAUTIQUE

Site acceptable – Emplacement acceptable
[X] Yes / Oui [ ] No / Non (if no reason) (si non pourquoi)

Lighting as per (TP382) required – Balisage lumineux tel que demandé au (TP382)
[X] Yes / Oui [ ] No / Non or / ou As per proposal (Turbines 1, 3, 6, 8, 11)

Painting as per (TP382) required – Balisage peint tel que demandé au (TP382)
[ ] Yes / Oui [X] No / Non or / ou

Temporary lighting required – Nécessité d'un balisage lumineux temporaire
[ ] Yes / Oui [X] No / Non (if yes type) (si oui de quel genre)

Advise Transport Canada in writing 90 days before construction – Avertir Transports Canada par écrit 90 jours avant la construction ▶ [ ] when construction starts / au commencement de la construction [ ] and on completion / et à la fin des travaux [X] Valid to / Valide jusqu'au 2009-07-3

Civil Aviation Inspector (as required) – Inspecteur Aviation Civile (si nécessaire)
Comments – Commentaires

Signature: [signature]   Date (Y/A M D/J): 2008-07-23

Regional Manager Aerodrome Safety – Gestionnaire Régional Sécurité des aérodromes ▶ Signature: [signature]   Date (Y/A M D/J): 2008-07-24

26 0427 (0005 01)

Canada

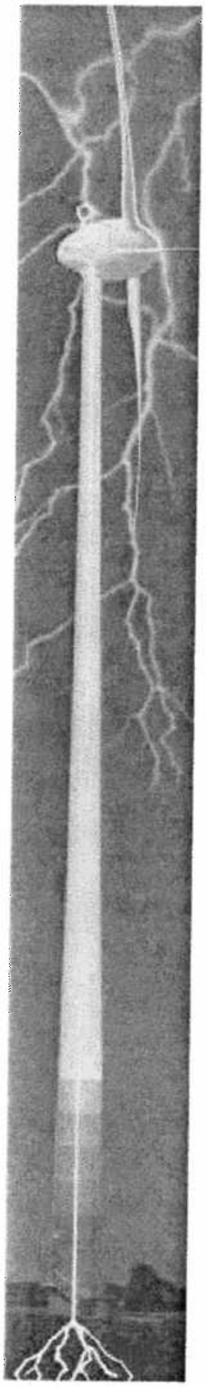
Appendix E
ENERCON E82 Earth and Lightning

Earth and lightning protection system for ENERCON WECs

Document information: This document is a translation. In case of conflict or doubt, the original document shall prevail.			
Author/date:	W. Fellensiek / A. Böhm / 04.06.07	Translator/date:	S.Kinne/2007-07-03-
Department:	Project Management	Revisor/date:	
Approved/date:	W. Fellensiek / 23.07.07	Reference:	PE-EW-DC010-Erdung und Blitzschutz-Rev003 ger-eng

Table of contents

1 Introduction



Like any other electrical system a wind turbine (WEC) can be exposed to internal and external electrical faults. These include on the one hand internal failures, such as short circuits or earth faults in the electrical components, and on the other hand external faults e.g. overvoltage caused by atmospheric discharges or switching overvoltage.

These factors can result in the destruction of the electrical devices and at worst can put lives at risk. To minimise the potential danger from electrical overvoltage, all ENERCON WECs are equipped with a comprehensive lightning protection and earth system.

The "external lightning protection" comprises, in particular, the measures for lightning protection on the rotor blade and the defined dissipation of the lightning current to the ground. The electrical WEC components are also protected against interfering fields and interference voltage.

The protection of electrical and electronic devices in the WEC itself is referred to as "internal lightning protection".

2 External lightning protection system

2.1 Rotor blade

The rotor blade tip is the highest point of the WEC and therefore is at the highest risk during thunderstorms. A lightning strike on the rotor blade can destroy the blade and other WEC components, as well as endanger any personnel inside the wind turbine.

The whole WEC is fitted with an integrated lightning protection system from the rotor blade tip right through to the foundation, so that lightning strikes are dissipated without causing damage to the rotor blade or other WEC components.

The rotor blade tip is made from moulded aluminium. A lightning conductor links the blade tip with the aluminium ring around the blade root (see figure 2). The aluminium ring is fitted at a sufficient distance from the metal parts in the blade connection area. This prevents unwanted flashover in the event of a lightning strike, and the lightning current is properly dissipated. The rotor bearings are protected from any consequential damage because lightning dissipation takes place on the blade root and not through the hub and the rotor bearings.

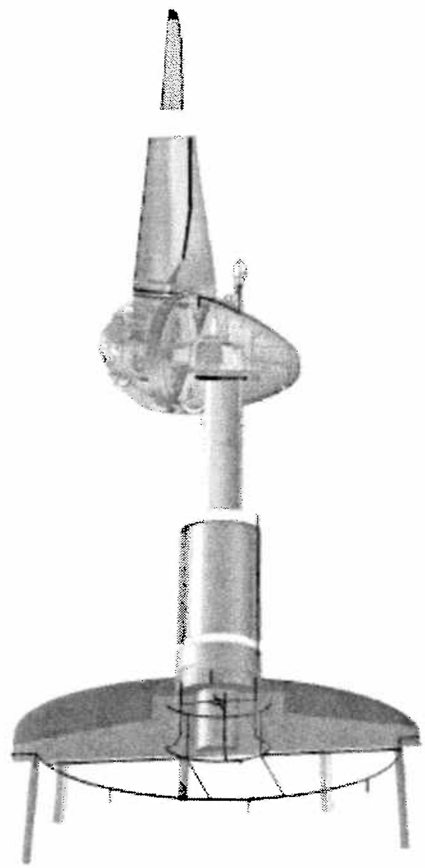


Fig. 1: External lightning protection design

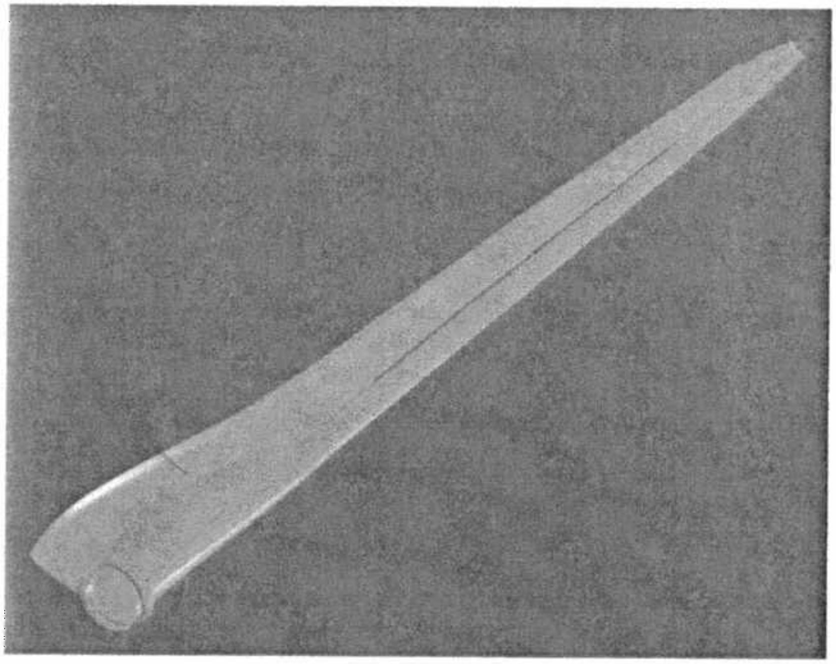


Fig. 2: Rotor blade lightning protection design

2.2 Nacelle

The dissipation of the lightning current from the rotating part (rotor blades) to the fixed part of the WEC (nacelle) takes place for each rotor blade through a spark gap, which is formed with lightning rods on the nacelle and an aluminium ring on the rotor blade. The lightning rods are on the rotor casing (each attached to one of the three blades) and on the back part of the nacelle casing. Each lightning rod has a conical tip in order to establish as large an electrical field as possible at this point in comparison to the surroundings.

The lightning current is conducted from the rotor casing via another ring and another spark gap to the nacelle.

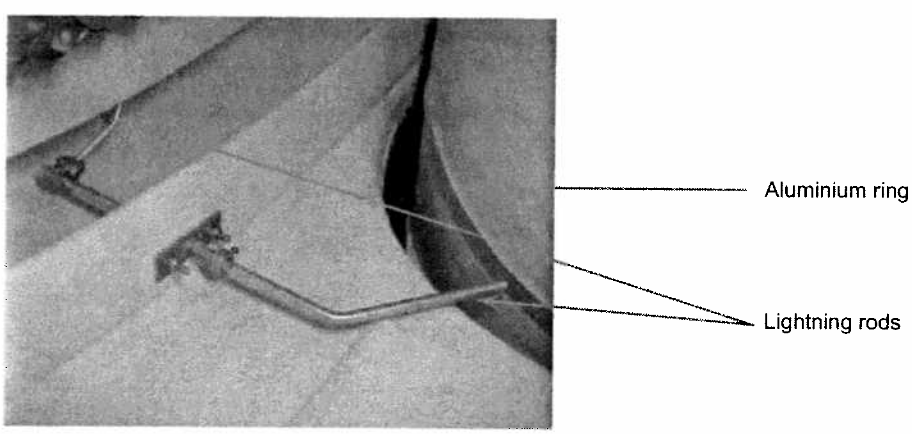


Fig. 3: Lightning rods

This arrangement allows a lightning strike to be conducted to the load-bearing structure regardless of the current position of the rotor and the current rotor blade angle.

On the back part of the nacelle casing there is also a lightning rod to protect the nacelle and the measuring equipment (anemometer and wind vane).
Within the machine house, the lightning current is conducted from the main carrier to the tower via a slip ring system on the yaw gear rim. In addition, the machine house is connected with a flexible copper cable to the bonding bar inside the tower basement.

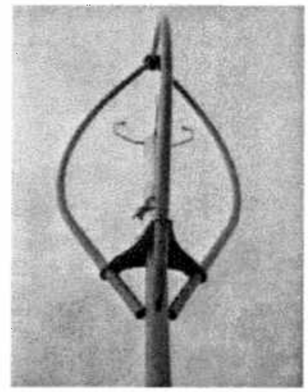


Fig. 4: Nacelle anemometer

2.3 Tower

Steel tower:
In steel towers the lightning current is dissipated from the nacelle to the earth electrode through the conducting tower itself. In order to ensure this, the flange joints on the tower sections are spray-galvanised. Two brackets welded to the tower are used to connect the foundation earth electrode.

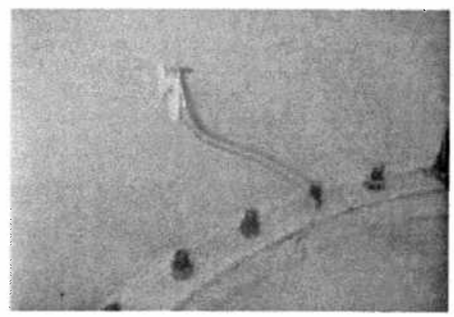


Fig. 5: Connection between steel tower and foundation earth electrode

Precast concrete tower:
To ensure lightning protection in precast concrete towers, four steel strips ($3.5 * 30\ mm^2$) are installed inside the towers and interconnected from the foundation to the steel tower section.

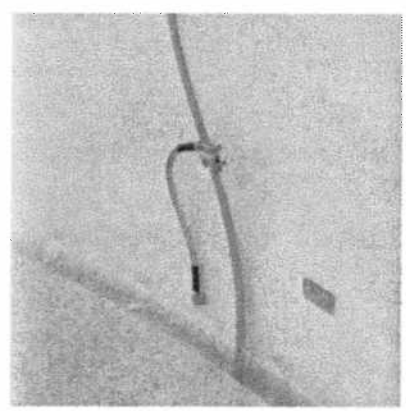


Fig. 6: Connection between concrete tower and foundation earth electrode

2.4 Bonding bar

The bonding bar is the central connection point for all usually non-conducting metal parts such as control cabinet housing, oil pan, fixings, etc. These components are connected directly to the bonding bar via appropriate cable cross-sections. This central connection point provides equipotential bonding within the WEC and prevents excessive touch voltage. The bonding bar is connected directly with the neutral point of the wind turbine transformer and, depending on the WEC type, is positioned either within the low-voltage distribution system or on the oil pan.

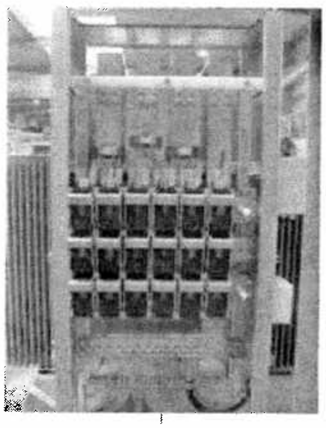


Fig. 7: Bonding bar in LV distribution system (E-70)

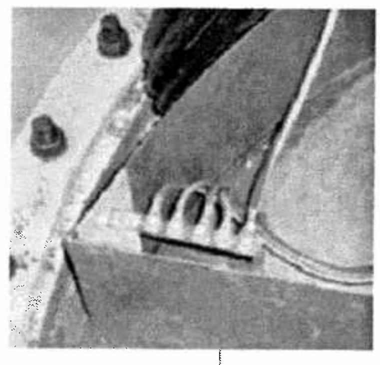


Fig. 8: Bonding bar on oil pan (E-48)

2.5 Foundation earth electrode

2.5.1 Foundation earth electrode – General information

Earth systems generally have the following tasks:

Protection of lives and property in the event of
- faults such as short circuits and earth faults
- transient events such as lightning strikes and switching operations

Each electrical system must be earthed in order to create a low-resistance connection between the electrical device and the general mass of the ground. The earth system should ensure effective operation of protective devices, provision of a reference potential for electrical devices and prevent excessive voltage peaks and potential differences.

A lightning strike e.g. on the wind turbine's rotor blade, produces electricity, which is dissipated into the ground through the rotor blade, the nacelle, the tower and the foundation earth electrode. Depending on the form and the dimensions of the foundation earth electrode and the earth system outside the foundation, the potential in and around the WEC foundation will increase. It is very important that the official step and touch voltages caused by the fault current/lightning current are not exceeded, in order to minimise the potential danger to any people in the vicinity of the WEC.

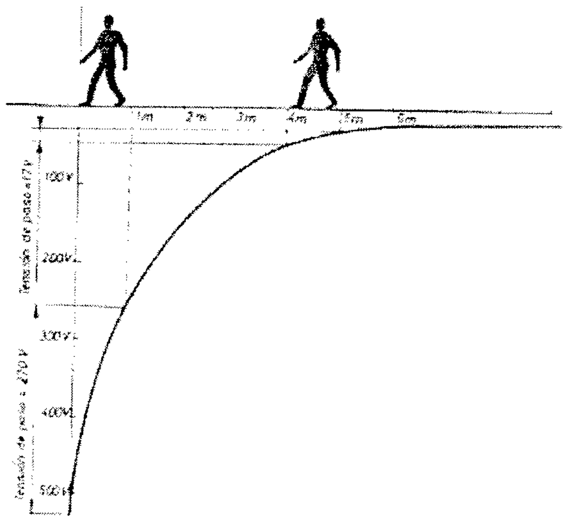


Fig. 9: Ground potential curve

2.5.2 Foundation earth electrode design

Four ring earth electrodes are laid at different positions in the foundation. They consist of hot-dip galvanised steel strips with a minimum cross-section of 100 mm² (3.5 x 30mm²) and are interconnected through foundation earth electrode connectors. If, in addition to hot-dip galvanised flat steel electrodes, country-specific standards require the installation of copper conductors, consult with the electrical project manager in charge.

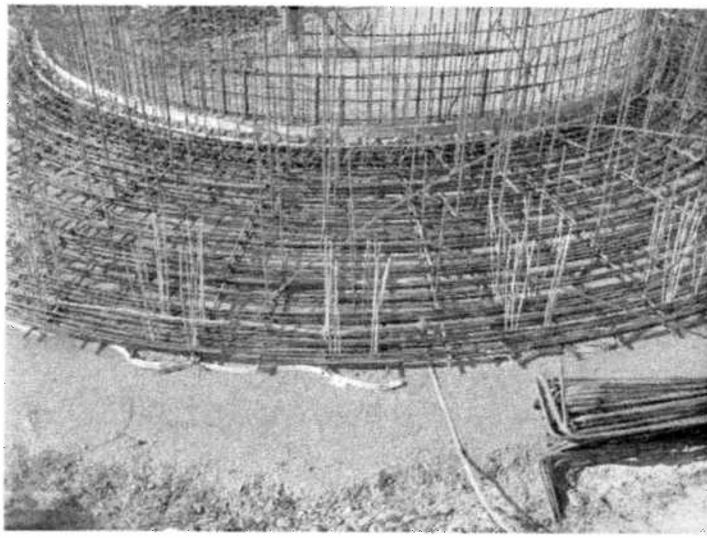


Fig. 10: Foundation earth electrode installation

Stainless steel (V4A) with a minimum cross-section of 100 mm² is used at the transition from foundation to ground. V4A steel strips or bare or tin-coated copper conductors can be installed in the ground itself.

To optimise dissipation of the lightning current into the ground and to reduce touch voltage, a maximum earth resistance of $\leq 2\,\Omega$ is required, which is achieved either through foundation earth electrode alone or with additional surface or deep earth electrodes.

Earth systems for installations electrically connected to the WEC, such as transformer stations, substations or communications shelters, are directly connected to the WEC earth system.

After completion of the earth system, an authorised specialist company should measure and record the earth resistance (2 Ω) and forward the earthing report to the ENERCON project manager in charge before WEC assembly.

3 Internal lightning protection/protection of electronic components

The electronic components on the wind turbines are galvanically isolated and located in earthed metal housings. In the event of a lightning strike or even in the event of an unusual increase in voltage (overvoltage) all the electrical and electronic parts are protected by fixed energy-absorbing components.
Further measures to protect against overvoltage:
Control cabinet and generator are protected with surge arrestors.
All PCBs with their own power supply units are fitted with high attenuation filters. Analogue and digital signal inputs and outputs are protected by RC elements and suppressor diodes.
Open-loop and closed-loop electronic systems are galvanically decoupled by optocouplers, isolation amplifiers and relays. Signals are transmitted via fibre optic cables inside the WEC.
The data communication module (modem) for remote monitoring is protected with a special protection module for data interfaces, to prevent external interferences through cabling and wires.

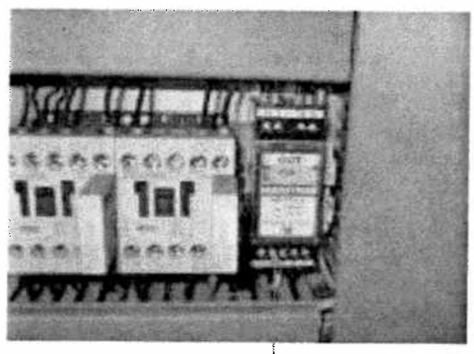


Fig. 11: Overvoltage protection data cable

4 Standards and guidelines for the construction of earth and lightning protection systems

- DIN 18014:1994-02
  Fundamentererrichtung (Foundation earth electrode installation)

- DIN VDE 0151 (VDE 0151):1986-06
  Werkstoffe und Mindestmaße von Erdern bezüglich der Korrosion (Materials and minimum dimensions of earth electrodes concerning corrosion)

- DIN EN 62305 (VDE 0185-305):2006-10
  Nationale Normenreihe – Blitzschutz (National series of standards – Lightning protection)

- DIN EN 50164-2 (VDE 0185 Part 202):2007-05
  Blitzschutzbauteile - Teil 2: Anforderungen an Leitungen und Erder (Lightning protection components – Part 2: Requirements for conductors and earth electrodes)

- DIN EN 50308 (VDE 0127 Part 100):2005-03
  Windenergieanlagen – Schutzmaßnahmen; Anforderungen für Konstruktion, Betrieb und Wartung (Wind turbines – Protective measures; Requirements for design, operation and maintenance)

- European harmonisation document HD 637 S1:1999
  National version in DIN VDE 0101 (VDE 0101):2000-01
  Starkstromanlagen mit Nennwechselspannungen über 1 kV (Power installations exceeding 1 kV)

- IEC 61936-1:2002
  INTERNATIONAL STANDARD – Power installations exceeding 1 kV a.c.;

- IEC 62305:2006-01
  INTERNATIONAL STANDARD – Blitzschutz (Lightning protection)

- IEC 61400-1:2005, German version DIN EN 61400-1 (VDE 0127-1):2006-07
  INTERNATIONAL STANDARD - Wind turbines - Part 1: Design requirements;

- IEC 60364-5-54:2002-06 - INTERNATIONAL STANDARD - Electrical installations of buildings, German versions DIN V VDE V 0800-2-548:1999-10 and DIN VDE 0100 Part 540:1991-11;

- IEEE Std 80-2000
  IEEE Guide for Safety in AC Substation Grounding

Appendix F
Tabulated Results of Plant Inventory

Appendix F
Plant Species Encountered On Site

Category	***Species Name***	***Common Name***	***NSDNR Status***
Clubmoss	*Lycopodium annotinum*	Stiff Clubmoss	GREEN
Clubmoss	*Lycopodium clavatum*	Running Pine	GREEN
Clubmoss	*Lycopodium obscurum*	Tree Clubmoss	GREEN
Herb	*Achillea millefolium*	Common Yarrow	GREEN
Herb	*Aralia nudicaulis*	Wild Sarsaparilla	GREEN
Herb	*Aster acuminatus*	Wood Aster	N/A
Herb	*Aster umbellatus*	Tall white aster	N/A
Herb	*Athyrium filix-femina*	Lady-Fern	GREEN
Herb	*Carex echinata*	Little Prickly Sedge	GREEN
Herb	*Carex scoparia*	Pointed Broom Sedge	GREEN
Herb	*Centaurea nigra*	Knapweed	N/A
Herb	*Chrysanthemum leucanthemum*	Oxeye Daisy	N/A
Herb	*Clintonia borealis*	Clinton Lily	GREEN
Herb	*Coptis trifolia*	Goldthread	GREEN
Herb	*Cornus canadensis*	Dwarf Dogwood	GREEN
Herb	*Cypripedium acaule*	Pink Lady's-Slipper	GREEN
Herb	*Daucus carota*	Queen-Annes Lace	N/A
Herb	*Dennstaedtia punctilobula*	Eastern Hay-Scented Fern	GREEN
Herb	*Dianthus armeria*	Deptford Pink	N/A
Herb	*Dryopteris carthusiana*	Spinulose Shield Fern	GREEN
Herb	*Dryopteris intermedia*	Evergreen Woodfern	GREEN
Herb	*Epigaea repens*	Trailing Arbutus	GREEN
Herb	*Epilobium ciliatum*	Hairy Willow-Herb	GREEN
Herb	*Equisetum arvense*	Field Horsetail	GREEN
Herb	*Equisetum sylvaticum*	Woodland Horsetail	GREEN
Herb	*Erigeron annuus*	Daisy Fleabane	GREEN
Herb	*Eupatorium maculatum*	Spotted Joe-Pye Weed	GREEN
Herb	*Eupatorium perfoliatum*	Common Boneset	GREEN
Herb	*Fragaria virginiana*	Virginia Strawberry	GREEN
Herb	*Galium palustre*	Marsh Bedstraw	GREEN
Herb	*Gaultheria hispidula*	Creeping Snowberry	GREEN
Herb	*Hieracium aurantiacum*	Devils Paintbrush	N/A
Herb	*Hieracium pilosella*	Mouse-eared Hawkweed	N/A
Herb	*Hieracium scabrum*	Rough Hawkweed	GREEN

Category	*Species Name*	*Common Name*	*NSDNR Status*
Herb	*Impatiens capensis*	Spotted Jewel-Weed	GREEN
Herb	*Iris versicolor*	Blueflag	GREEN
Herb	*Juncus effusus*	Soft Rush	GREEN
Herb	*Linnaea borealis*	Twinflower	GREEN
Herb	*Maianthemum canadense*	Wild Lily-of-The-Valley	GREEN
Herb	*Matricaria matricarioides*	Pineapple Weed	GREEN
Herb	*Medeola virginiana*	Indian Cucumber-Root	GREEN
Herb	*Onoclea sensibilis*	Sensitive Fern	GREEN
Herb	*Osmunda cinnamomea*	Cinnamon Fern	GREEN
Herb	*Osmunda claytoniana*	Interrupted Fern	GREEN
Herb	*Osmunda regalis*	Royal Fern	GREEN
Herb	*Oxalis montana*	White Wood-Sorrel	GREEN
Herb	*Phalaris arundinacea*	Reed Canary Grass	GREEN
Herb	*Phegopteris connectilis*	Northern Beech Fern	GREEN
Herb	*Phleum pratense*	Timothy	N/A
Herb	*Plantago major*	Common Plantain	N/A
Herb	*Platanthera psycodes*	Small Purple-Fringe Orchis	GREEN
Herb	*Polygonum cuspidatum*	Japanese Knotweed	N/A
Herb	*Pontederia cordata*	Pickerel Weed	GREEN
Herb	*Prunella vulgaris*	Self-Heal	GREEN
Herb	*Pteridium aquilinum*	Bracken Fern	GREEN
Herb	*Ranunculus acris*	Tall Buttercup	N/A
Herb	*Ranunculus repens*	Creeping Buttercup	N/A
Herb	*Scirpus microcarpus*	Small-Fruit Bulrush	GREEN
Herb	*Senecio jacobaea*	Tansy Ragwort	N/A
Herb	*Solanum dulcamara*	Evening Nightshade	N/A
Herb	*Taraxacum officianale*	Dandelion	N/A
Herb	*Thalictrum pubescens*	Tall Meadow-Rue	GREEN
Herb	*Thelypteris noveboracensis*	New York Fern	GREEN
Herb	*Thelypteris simulata*	Bog Fern	GREEN
Herb	*Trientalis borealis*	Northern Starflower	GREEN
Herb	*Trifolium pratens*	Red Clover	GREEN
Herb	*Trifolium repens*	Creeping White Clover	GREEN
Herb	*Trillium undulatum*	Painted Trillium	GREEN
Herb	*Tussilago farfara*	Coltsfoot	N/A
Herb	*Typha angustifolia*	Narrow-Leaved Cattail	GREEN
Herb	*Typha latifolia*	Broad-Leaf Cattail	GREEN
Herb	*Vaccinium oxycoccos*	Small Cranberry	GREEN
Herb	*Vicia cracca*	Tufted Vetch	N/A
Herb	*Viola blanda*	Smooth White Violet	GREEN

Category	*Species Name*	*Common Name*	*NSDNR Status*
Herb	*Viola pubescens*	Downy Yellow Violet	GREEN
Moss	*Bazzania trilobata*	Three-lobed Bazzania	N/A
Moss	*Dicranum spp*	Hair-Cap Moss	N/A
Moss	*Dicranum spp.*	Broom Moss	N/A
Moss	*Mnium sp.*	Mnium	N/A
Moss	*Pleurozium schreberii*	Schrebers Moss	N/A
Moss	*Ptilium crista-castrensis*	Plume moss	N/A
Moss	*Sphagnum spp.*	Sphagnum	N/A
Shrub	*Alnus incana*	Speckled Alder	GREEN
Shrub	*Amelanchier canadensis*	Oblong-Leaf Serviceberry	GREEN
Shrub	*Andromeda polifolia*	Bog Rosemary	GREEN
Shrub	*Chamaedaphne calyculata*	Leatherleaf	GREEN
Shrub	*Comptonia peregrina*	Sweet Fern	GREEN
Shrub	*Corylus cornuta*	Beaked Hazelnut	GREEN
Shrub	*Ilex verticillata*	Black Holly	GREEN
Shrub	*Juniperus communis*	Ground Juniper	GREEN
Shrub	*Kalmia angustifolia*	Sheep-Laurel	GREEN
Shrub	*Kalmia angustifolia*	Sheep-Laurel	GREEN
Shrub	*Ledum groenlandicum*	Common Labrador Tea	GREEN
Shrub	*Myrica gale*	Sweet Bayberry	GREEN
Shrub	*Myrica pensylvanica*	Bayberry	N/A
Shrub	*Nemopanthus mucronatus*	Mountain Holly	GREEN
Shrub	*Prunus pensylvanica*	Fire Cherry	GREEN
Shrub	*Prunus virginiana*	Choke Cherry	GREEN
Shrub	*Rhododendron canadense*	Rhodora	GREEN
Shrub	*Rosa virginiana*	Virginia Rose	GREEN
Shrub	*Rubus allegheniensis*	Allegheny Blackberry	GREEN
Shrub	*Rubus hispidus*	Bristly Dewberry	GREEN
Shrub	*Rubus idaeus*	Red Raspberry	GREEN
Shrub	*Salix bebbiana*	Bebb's Willow	GREEN
Shrub	*Salix discolor*	Pussy Willow	GREEN
Shrub	*Sambucus racemosa*	Red Elderberry	GREEN
Shrub	*Spiraea tomentosa*	Hardhack Spiraea	GREEN
Shrub	*Vaccinium angustifolium*	Late Lowbush Blueberry	GREEN
Shrub	*Viburnum nudum*	Possum-Haw Viburnum	GREEN
Tree	*Abies balsamea*	Balsam Fir	GREEN
Tree	*Acer pensylvanicum*	Striped Maple	GREEN
Tree	*Acer rubrum*	Red Maple	GREEN
Tree	*Betula alleghaniensis*	Yellow Birch	GREEN
Tree	*Betula papyrifera*	Paper Birch	GREEN

Category	***Species Name***	***Common Name***	***NSDNR Status***
Tree	*Betula populifolia*	Gray Birch	GREEN
Tree	*Larix laricina*	American Larch	GREEN
Tree	*Picea glauca*	White Spruce	GREEN
Tree	*Picea mariana*	Black Spruce	GREEN
Tree	*Pinus strobus*	Eastern White Pine	GREEN

Appendix F - Tabulated Results of Plant Inventory - ACCDC List

Scientific Name	Common Name	National Ranking	SubNational Ranking	NSESA Ranking	Min Dist to Observation
Accipiter gentilis	Northern Goshawk	NAR	S3B		26
Aeshna canadensis	Canada Darner		S3		100
Aeshna clepsydra	Mottled Darner		S2		11
Aeshna eremita	Lake Darner		S3		11
Aeshna sitchensis	Zigzag Darner		S2		21
Aeshna subarctica	Subarctic Darner		S3		100
Aeshna tuberculifera	Black-Tipped Darner		S3		100
Aeshna verticalis	Green-Striped Darner		S2		59
Ageratina altissima	White Snakeroot		S1		47
Aglais milberti	Milbert's Tortoiseshell		S2		73
Alasmidonta undulata	Triangle Floater		S2S3		25
Alasmidonta varicosa	Brook Floater		S1S2		29
Alca torda	Razorbill		S1B,SZN		86
Alces americanus	Moose		S1	Endangered	53
Allium schoenoprasum var. sibiricum	Wild Chives	S2			92
Allium schoenoprasum var. sibiricum	Wild Chives	S2			92
Alopecurus aequalis	Short-Awn Foxtail		S2S3		63
Amelanchier fernaldii	Fernald Serviceberry		S2?		39
Ammodramus nelsoni	Nelson's Sharp-tailed Sparrow	NAR	S3B		39
Amphiagrion saucium	Eastern Red Damsel		S2		36
Anax junius	Common Green Darner		S3		26
Anemone canadensis	Canada Anemone		S2		22
Anemone quinquefolia	Wood Anemone		S2		69
Anemone virginiana var. alba	River Anemone		S1S2		49
Arabis drummondii	Drummond Rockcress		S2		101
Argia fumipennis violacea	Variable Dancer		S3		100
Argia moesta	Powdered Dancer		S3		65
Arnica lonchophylla	Northern Arnica		S1		24
Asclepias incarnata	Swamp Milkweed		S3		29
Asclepias incarnata ssp. pulchra	Swamp Milkweed		S2S3		45
Asio otus	Long-eared Owl		S1S2		35
Asplenium trichomanes	Maidenhair Spleenwort		S2		100
Asplenium trichomanes-ramosum	Green Spleenwort	S2			100
Asplenium trichomanes-ramosum	Green Spleenwort	S2			100

Scientific Name	Common Name	National Ranking	SubNational Ranking	NSESA Ranking	Min Dist to Observation
Asplenium trichomanes-ramosum	Green Spleenwort	S2			100
Asplenium trichomanes-ramosum	Green Spleenwort	S2			100
Asplenium trichomanes-ramosum	Green Spleenwort	S2			100
Asplenium trichomanes-ramosum	Green Spleenwort	S2			100
Asplenium trichomanes-ramosum	Green Spleenwort	S2			100
Atriplex acadiensis	Maritime Saltbush		S1?		87
Atriplex franktonii	Frankton's Saltbush		S2		100
Bartonia virginica	Yellow Screwstem		S3		36
Basiaeschna janata	Springtime Darner		S3		27
Betula borealis	Northern Birch		S2		56
Betula pumila	Swamp Birch		S2S3		64
Bidens connata	Purple-Stem Swamp Beggar-Ticks		S3?		78
Bidens hyperborea	Estuary Beggar-Ticks		S1		47
Boloria chariclea	Arctic Fritillary		S2		66
Botrychium dissectum	Cutleaf Grape-Fern		S3		68
Botrychium lanceolatum var. angustisegmentum	Lance-Leaf Grape-Fern	S2			97
Botrychium lanceolatum var. angustisegmentum	Lance-Leaf Grape-Fern	S2			97
Botrychium simplex	Least Grape-Fern		S2S3		61
Boyeria grafiana	Ocellated Darner		S2		101
Boyeria vinosa	Fawn Darner		S3		11
Bromus latiglumis	Broad-Glumed Brome		S1		12
Bucephala clangula	Common Goldeneye		S2B,S4N		35
Calamagrostis stricta ssp. stricta	Northern Reedgrass	S1S2			12
Calidris bairdii	Baird's Sandpiper		S2M		49
Calidris canutus	Red Knot	E	S3M		34
Calidris maritima	Purple Sandpiper		S2N		2
Callophrys polios	Hoary Elfin		S3S4		39
Calopteryx aequabilis	River Jewelwing		S3		100
Calopteryx amata	Superb Jewelwing		S3		101
Caltha palustris	Marsh Marigold		S2		73
Campanula aparinoides	Marsh Bellflower		S3?		46
Caprimulgus vociferus	Whip-Poor-Will		S1?B		48
Cardamine pratensis var. angustifolia	Cuckooflower	S1?			101
Carex adusta	Crowded Sedge		S2S3		88
Carex albicans var. emmonsii	Emmons Sedge		S3S4		27

Scientific Name	Common Name	National Ranking	SubNational Ranking	NSESA Ranking	Min Dist to Observation
Carex alopecoidea	Foxtail Sedge		S1		37
Carex atlantica ssp. capillacea	Howe Sedge		S2		100
Carex atratiformis	Black Sedge		S2		48
Carex bebbii	Bebb's Sedge		S1S2		47
Carex bromoides	Brome-Like Sedge		S3		13
Carex castanea	Chestnut-Colored Sedge		S2		100
Carex eburnea	Ebony Sedge		S3		47
Carex gynocrates	Northern Bog Sedge		S1		64
Carex haydenii	Cloud Sedge		S1		70
Carex hirtifolia	Pubescent Sedge		S2S3		101
Carex hystericina	Porcupine Sedge		S1S2		51
Carex livida var. radicaulis	Livid Sedge		S1		37
Carex scirpoidea	Bulrush Sedge		S2		101
Carex tenera	Slender Sedge		S1S2		22
Carex tenuiflora	Sparse-Flowered Sedge		S1		45
Carex tincta	Tinged Sedge		S1		34
Carex vacillans	Estuarine Sedge		S1S3		37
Carex viridula var. elatior	A Sedge		S1		64
Catharus bicknelli	Bicknell's Thrush	SC	S1S2B	Vulnerable	95
Caulophyllum thalictroides	Blue Cohosh		S2		32
Cepphus grylle	Black Guillemot		S3		101
Charadrius melodus	Piping Plover	E	S1B	Endangered	26
Chenopodium rubrum	Coast-Blite Goosefoot		S1?		49
Chromagrion conditum	Aurora Damsel		S3		11
Cinna arundinacea	Stout Wood Reed-Grass		S1		12
Coccyzus erythropthalmus	Black-billed Cuckoo		S3B		33
Cochlearia tridactylites	Limestone Scurvy-grass		S1		100
Coenagrion interrogatum	Subarctic Bluet		S1		94
Comandra umbellata	Umbellate Bastard Toad-Flax		S2		40
Corallorhiza trifida	Early Coralroot		S3		39
Cordulegaster diastatops	Delta-Spotted Spiketail		S3		11
Cordulegaster maculata	Twin-Spotted Spiketail		S3		10
Cordulia shurtleffii	American Emerald		S3		11
Cornus suecica	Swedish Dwarf Dogwood		S1S2		4
Crassula aquatica	Water Pigmy-Weed		S2		34

Scientific Name	Common Name	National Ranking	SubNational Ranking	NSESA Ranking	Min Dist to Observation
Crataegus robinsonii	A Hawthorn		S1?		97
Crataegus submollis	A Hawthorn		S1?		67
Cryptogramma stelleri	Fragile Rockbrake		S1		46
Cuscuta cephalanthi	Button-Bush Dodder		S1		37
Cyperus lupulinus ssp. macilentus	Slender Flatsedge	SH			37
Cyperus lupulinus ssp. macilentus	Slender Flatsedge	SH			37
Cyperus lupulinus ssp. macilentus	Slender Flatsedge	SH			37
Cypripedium parviflorum	Small Yellow Lady's-Slipper		S2S3		57
Cypripedium parviflorum var. makasin	Small Yellow Lady's-Slipper	S2			99
Cypripedium parviflorum var. pubescens	Large Yellow Lady's-Slipper	S2			99
Cypripedium reginae	Showy Lady's-Slipper		S2		39
Cystopteris bulbifera	Bulblet Fern		S3S4		100
Cystopteris laurentiana	Laurentian Bladder Fern		S1?		48
Cystopteris tenuis	A Bladderfern		S3?		31
Danaus plexippus	Monarch Butterfly	SC	S2B		42
Decodon verticillatus	Hairy Swamp Loosestrife		S2S3		34
Dichanthelium acuminatum var. lindheimeri	Panic Grass	S1?			12
Dichanthelium clandestinum	Deer-Tongue Witchgrass		S3		69
Didymops transversa	Stream Cruiser		S3		11
Dolichonyx oryzivorus	Bobolink		S3B		100
Dorocordulia lepida	Petite Emerald		S3		12
Dorocordulia libera	Racket-Tailed Emerald		S2		11
Draba arabisans	Rock Whitlow-Grass		S2		50
Dryopteris filix-mas	Male Fern		S3		100
Dryopteris fragrans var. remotiuscula	Fragrant Fern	S2			100
Dryopteris fragrans var. remotiuscula	Fragrant Fern	S2			100
Eleocharis olivacea	Capitate Spikerush		S2		52
Eleocharis quinqueflora	Few-Flower Spikerush		S2		64
Elymus hystrix var. bigeloviana	Bottlebrush Grass		S1		101
Elymus wiegandii	Wiegand's Wild Rye		S1		87
Enallagma aspersum	Azure Bluet		S2		75
Enallagma boreale	Boreal Bluet		S3		21
Enallagma carunculatum	Tule Bluet		S1		64
Enallagma civile	Familiar Bluet		S3		100
Enallagma cyathigerum vernale	Springtime Bluet		S2		21

Scientific Name	Common Name	National Ranking	SubNational Ranking	NSESA Ranking	Min Dist to Observation
Enallagma ebrium	Marsh Bluet		S3		11
Enallagma hageni	Hagen's Bluet		S3		100
Epilobium coloratum	Purple-Leaf Willow-Herb		S2?		101
Epilobium hornemannii	Hornemann Willow-Herb		S2S3		101
Epilobium strictum	Downy Willow-Herb		S3		28
Epitheca canis	Beaverpond Baskettail		S3		21
Epitheca cynosura	Common Baskettail		S3		8
Epitheca spinigera	Spiny Baskettail		S3		17
Equisetum scirpoides	Dwarf Scouring Rush		S3S4		49
Erigeron hyssopifolius	Daisy Fleabane		S2S3		57
Erigeron philadelphicus	Philadelphia Fleabane		S2		43
Eriophorum gracile	Slender Cotton-Grass		S2		52
Erynnis juvenalis	Juvenal's Duskywing		S2S3		50
Euphagus carolinus	Rusty Blackbird	SC	S3B		101
Euphydryas phaeton	Baltimore Checkerspot		S3		21
Floerkea proserpinacoides	False Mermaid-Weed	NAR	S2S3		101
Fraxinus nigra	Black Ash		S3		40
Galium kamtschaticum	Boreal Bedstraw		S3		52
Galium labradoricum	Bog Bedstraw		S2		64
Glyptemys insculpta	Wood Turtle	SC	S3	Vulnerable	17
Gomphaeschna furcillata	Harlequin Darner		S1		12
Gomphus adelphus	Moustached Clubtail		S2		32
Gomphus borealis	Beaverpond Clubtail		S2		21
Gomphus descriptus	Harpoon Clubtail		S2		22
Gomphus exilis	Lancet Clubtail		S3		100
Gomphus spicatus	Dusky Clubtail		S2		11
Goodyera oblongifolia	Giant Rattlesnake-Plantain		S2S3		76
Goodyera repens	Dwarf Rattlesnake-Plantain		S2S3		32
Goodyera tesselata	Checkered Rattlesnake-Plantain		S3		71
Hagenius brevistylus	Dragonhunter		S3		11
Halenia deflexa	Spurred Gentian		S2S3		25
Hedeoma pulegioides	American Pennyroyal		S2S3		64
Helocordulia uhleri	Uhler's Sundragon		S3		11
Hemidactylium scutatum	Four-toed Salamander	NAR	S3		11
Hesperia comma	Common Branded Skipper		S3		59

Scientific Name	Common Name	National Ranking	SubNational Ranking	NSESA Ranking	Min Dist to Observation
Hesperia comma laurentina	Laurentian Skipper		S3		59
Hieracium robinsonii	Robinson's Hawkweed		S2		96
Hieracium umbellatum	Umbellate Hawkweed		S2?		99
Hudsonia tomentosa	Sand-Heather		S1		87
Huperzia selago	Fir Clubmoss		S1S3		100
Hylocichla mustelina	Wood Thrush		S2B		53
Hypericum dissimulatum	Disguised St. John's-Wort		S2S3		29
Hypericum majus	Larger Canadian St. John's Wort		S1		58
Icterus galbula	Baltimore Oriole		S3B		5
Impatiens pallida	Pale Jewel-Weed		S2		17
Iris prismatica	Slender Blue Flag		S1		66
Ischnura posita	Fragile Forktail		S3		11
Isoetes acadiensis	Acadian Quillwort		S3		29
Isoetes lacustris	Lake Quillwort		S3?		12
Juncus alpinoarticulatus ssp. nodulosus	Richardson's Rush	S1S2			87
Juncus alpinoarticulatus ssp. nodulosus	Richardson's Rush	S1S2			87
Juncus alpinoarticulatus ssp. nodulosus	Richardson's Rush	S1S2			87
Juncus caesariensis	New Jersey Rush	SC	S2	Vulnerable	44
Juncus dudleyi	Dudley's Rush		S2?		63
Juncus greenei	Greene's Rush		S1S2		39
Juncus stygius ssp. americanus	Moor Rush		S1		42
Juncus trifidus	Highland Rush		S2		80
Ladona exusta	White Corporal		S3		63
Lampsilis cariosa	Yellow Lampmussel	SC	S1	Threatened	94
Lampsilis radiata	Eastern Lampmussel		S2		22
Lanthus parvulus	Northern Pygmy Clubtail		S2		54
Laportea canadensis	Wood Nettle		S3		12
Leptodea ochracea	Tidewater Mucket		S1		97
Lestes congener	Spotted Spreadwing		S3		11
Lestes dryas	Emerald Spreadwing		S3		11
Lestes eurinus	Amber-Winged Spreadwing		S2		78
Lestes forcipatus	Sweetflag Spreadwing		S2		27
Lestes rectangularis	Slender Spreadwing		S3		21
Lestes unguiculatus	Lyre-Tipped Spreadwing		S2		59
Leucorrhinia frigida	Frosted Whiteface		S3		11

Scientific Name	Common Name	National Ranking	SubNational Ranking	NSESA Ranking	Min Dist to Observation
Leucorrhinia glacialis	Crimson-Ringed Whiteface		S3		26
Leucorrhinia hudsonica	Hudsonian Whiteface		S3		100
Leucorrhinia intacta	Dot-Tailed Whiteface		S3		40
Leucorrhinia proxima	Red-Waisted Whiteface		S3		11
Libellula julia	Chalk-Fronted Corporal		S3		100
Lilium canadense	Canada Lily		S2S3		32
Limosa haemastica	Hudsonian Godwit		S2S3M		47
Limosella australis	Mudwort		S2S3		43
Liparis loeselii	Loesel's Twayblade		S3S4		25
Listera australis	Southern Twayblade		S1		48
Listera convallarioides	Broad-Leaved Twayblade		S3		46
Lobelia kalmii	Kalm's Lobelia		S1S2		40
Loxia curvirostra	Red Crossbill		S3S4		59
Luzula parviflora	Small-Flowered Wood-Rush		S3		75
Lycopodiella appressa	Southern Bog Clubmoss		S3		55
Lycopodium complanatum	Trailing Clubmoss		S3?		34
Lycopodium sabinifolium	Ground-Fir		S3?		51
Lycopodium sitchense	Alaskan Clubmoss		S3?		61
Lynx canadensis	Canada Lynx	NAR	S1	Endangered	19
Lysimachia thyrsiflora	Water Loosestrife		S3S4		12
Macromia illinoiensis	Illinois River Cruiser		S3		100
Malaxis brachypoda	White Adder's-Mouth		S1		17
Martes americana	American Marten		S1	Endangered	74
Megalodonta beckii	Beck Water-Marigold		S3		52
Mergus serrator	Red-breasted Merganser		S3B		13
Microtus chrotorrhinus	Rock Vole		S2		52
Milium effusum var. cisatlanticum	Tall Millet-Grass	S3			101
Mimus polyglottos	Northern Mockingbird		S3B		21
Montia fontana	Fountain Miner's-Lettuce		S1		5
Myriophyllum farwellii	Farwell's Water-Milfoil		S2		17
Myriophyllum sibiricum	Common Water-Milfoil		S3S4		64
Nannothemis bella	Elfin Skimmer		S2		12
Nehalennia gracilis	Sphagnum Sprite		S2		12
Nehalennia irene	Sedge Sprite		S3		17
Numenius phaeopus	Whimbrel		S3M		47

Scientific Name	Common Name	National Ranking	SubNational Ranking	NSESA Ranking	Min Dist to Observation
Nycticorax nycticorax	Black-crowned Night-heron		S1B		48
Nymphalis vaualbum	Compton Tortoiseshell		S1S2		42
Ophioglossum pusillum	Adder's Tongue		S2S3		97
Ophiogomphus aspersus	Brook Snaketail		S1		22
Ophiogomphus carolus	Riffle Snaketail		S3		16
Ophiogomphus mainensis	Maine Snaketail		S1		65
Osmorhiza longistylis	Smoother Sweet-Cicely		S2		101
Packera paupercula	Balsam Groundsel		S3		57
Paludella squarrosa	a Moss		S1		74
Papilio brevicauda	Short-Tailed Swallowtail		S1S2		73
Parnassia palustris var. parviflora	a Marsh Grass-of-Parnassus		S2		55
Passerculus sandwichensis princeps	""Ipswich"" Savannah Sparrow	SC	S1B		63
Picoides dorsalis	American Three-toed Woodpecker		S2		65
Pieris oleracea	Mustard White		S2		42
Pilea pumila	Canada Clearweed		S1		87
Piranga olivacea	Scarlet Tanager		S2B		96
Platanthera grandiflora	Large Purple-Fringe Orchis		S3		21
Platanthera hookeri	Hooker Orchis		S3		6
Platanthera orbiculata	Large Roundleaf Orchid		S3		34
Plathemis lydia	Common Whitetail		S3		21
Pluvialis dominica	American Golden-Plover		S3S4M		47
Poa glauca	White Bluegrass		S2S3		50
Polygonia faunus	Green Comma		S3		42
Polygonia gracilis	Hoary Comma		S1		73
Polygonia interrogationis	Question Mark		S3B		42
Polygonia progne	Gray Comma		S3S4		101
Polygonum buxiforme	Small's Knotweed		S2S3SE		97
Polygonum pensylvanicum	Pennsylvania Smartweed		S3		12
Polygonum raii	Pondshore Knotweed		S2S3SE		27
Polygonum scandens	Climbing False-Buckwheat		S2		12
Polygonum viviparum	Viviparous Knotweed		S1		34
Polystichum braunii	Braun's Holly-Fern		S3S4		100
Polystichum lonchitis	Northern Holly-Fern		S2		30
Pooecetes gramineus	Vesper Sparrow		S2S3B		100
Potamogeton friesii	Fries' Pondweed		S2		57

Scientific Name	Common Name	National Ranking	SubNational Ranking	NSESA Ranking	Min Dist to Observation
Potamogeton nodosus	Longleaf Pondweed		S1		84
Potamogeton obtusifolius	Blunt-Leaf Pondweed		S2		32
Potamogeton praelongus	White-Stem Pondweed		S3?		25
Potamogeton richardsonii	Redhead Grass		S3?		21
Potamogeton zosteriformis	Flatstem Pondweed		S2S3		58
Primula laurentiana	Bird's-Eye Primrose		S3		92
Proserpinaca palustris var. crebra	Marsh Mermaid-Weed	S3S4			64
Pyrola minor	Lesser Wintergreen		S2		49
Rallus limicola	Virginia Rail		S2B		85
Ranunculus flammula var. flammula	Greater Creeping Spearwort	S2			92
Ranunculus sceleratus	Cursed Crowfoot		S1S2		77
Rhamnus alnifolia	Alderleaf Buckthorn		S3		12
Rhynchospora capillacea	Horned Beakrush		S1		54
Rissa tridactyla	Black-legged Kittiwake		S2B,SZN		101
Rubus flagellaris	Northern Dewberry		S1?		37
Rudbeckia laciniata var. gaspereauensis	Cut-Leaved Coneflower	S2S3			93
Rumex salicifolius var. mexicanus	Willow Dock	S2			63
Rumex salicifolius var. mexicanus	Willow Dock	S2			63
Rumex salicifolius var. mexicanus	Willow Dock	S2			63
Rumex salicifolius var. mexicanus	Willow Dock	S2			63
Salix candida	Hoary Willow		S1		64
Salix pedicellaris	Bog Willow		S2		64
Salix pellita	Satiny Willow		S3?		4
Salmo salar	Atlantic Salmon	E	S2		100
Samolus valerandi ssp. parviflorus	Water Pimpernel	S2			92
Sanicula odorata	Black Snake-Root		S1		57
Saxifraga paniculata ssp. neogaea	a White Mountain Saxifrage	S2			77
Saxifraga paniculata ssp. neogaea	a White Mountain Saxifrage	S2			77
Saxifraga paniculata ssp. neogaea	a White Mountain Saxifrage	S2			77
Sayornis phoebe	Eastern Phoebe		S2S3B		35
Schizaea pusilla	Curly-Grass Fern		S3		27
Schoenoplectus robustus	Saltmarsh Bulrush		S1?		72
Scirpus pedicellatus	Stalked Bulrush		S1		13
Sclerophora peronella	frosted glass-whiskers	SC	S1?		100
Selaginella selaginoides	Low Spike-Moss		S2		42

Scientific Name	Common Name	National Ranking	SubNational Ranking	NSESA Ranking	Min Dist to Observation
Senecio pseudoarnica	Seabeach Groundsel		S2		100
Shepherdia canadensis	Canada Buffalo-Berry		S2		55
Sialia sialis	Eastern Bluebird	NAR	S2S3B		20
Solidago simplex var. randii	Mountain Goldenrod		SH		26
Somatochlora cingulata	Lake Emerald		S2		37
Somatochlora elongata	Ski-Tailed Emerald		S3		11
Somatochlora forcipata	Forcipate Emerald		S2		72
Somatochlora incurvata	Incurvate Emerald		S3		100
Somatochlora minor	Ocellated Emerald		S2		11
Somatochlora septentrionalis	Muskeg Emerald		S1		76
Somatochlora tenebrosa	Clamp-Tipped Emerald		S2		88
Somatochlora walshii	Brush-Tipped Emerald		S3		100
Somatochlora williamsoni	Williamson's Emerald		S1		79
Sorex gaspensis	Gaspé Shrew	SC	S2		52
Sparganium fluctuans	Floating Bur-Reed		S3?		16
Sparganium hyperboreum	Northern Bur-Reed		S1S2		47
Sparganium natans	Small Bur-Reed		S3		48
Speyeria aphrodite	Aphrodite Fritillary		S3S4		47
Sphenopholis intermedia	Slender Wedge Grass		S3S4		52
Spiranthes lucida	Shining Ladies'-Tresses		S2		62
Spiranthes romanzoffiana	Hooded Ladies'-Tresses		S3S4		25
Stellaria humifusa	Creeping Sandwort		S2		83
Sterna dougallii	Roseate Tern	E	S1B	Endangered	100
Sterna hirundo	Common Tern	NAR	S3B		100
Sterna paradisaea	Arctic Tern		S3B		20
Stuckenia filiformis ssp. alpina	Northern Slender Pondweed		S2S3		33
Stuckenia vaginata	Sheathed Pondweed		S1		72
Stylogomphus albistylus	Least Clubtail		S3		24
Suaeda calceoliformis	American Sea-Blite		S2S3		89
Suaeda maritima ssp. richii	Rich's Sea-blite		S1		41
Sympetrum costiferum	Saffron-Winged Meadowhawk		S3		11
Sympetrum danae	Black Meadowhawk		S2		19
Sympetrum obtrusum	White-Faced Meadowhawk		S3		39
Sympetrum rubicundulum	Ruby Meadowhawk		S2		21
Sympetrum semicinctum	Band-Winged Meadowhawk		S3		100

Scientific Name	Common Name	National Ranking	SubNational Ranking	NSESA Ranking	Min Dist to Observation
Sympetrum vicinum	Yellow-Legged Meadowhawk		S3		100
Symphyotrichum boreale	Boreal American-Aster		S2?		82
Symphyotrichum ciliolatum	Lindley's Aster		S2S3		61
Synaptomys cooperi	Southern Bog Lemming		S3S4		52
Teucrium canadense	American Germander		S2S3		19
Triantha glutinosa	Sticky False-Asphodel		S1		64
Triglochin gaspensis	Gaspe Peninsula Arrow-Grass		S1?		26
Tringa melanoleuca	Greater Yellowlegs		S2B,S5M		101
Tringa solitaria	Solitary Sandpiper		S1B		47
Triosteum aurantiacum	Coffee Tinker's-Weed		S2		101
Trisetum spicatum	Narrow False Oats		S3		97
Utricularia gibba	Humped Bladderwort		S2		48
Utricularia resupinata	Northeastern Bladderwort		S1		58
Vaccinium boreale	Northern Blueberry		S2		39
Vaccinium caespitosum	Dwarf Blueberry		S2		75
Vaccinium ovalifolium	Oval-Leaf Huckleberry		S1		34
Vaccinium uliginosum	Alpine Blueberry		S2		75
Verbena hastata	Blue Vervain		S3		46
Veronica serpyllifolia ssp. humifusa	Thyme-Leaved Speedwell	S2S3			97
Veronica serpyllifolia ssp. humifusa	Thyme-Leaved Speedwell	S2S3			97
Viburnum edule	Squashberry		S2		99
Viola canadensis	Canada Violet		S1		55
Viola nephrophylla	Northern Bog Violet		S2		101
Vireo gilvus	Warbling Vireo		S1?B		17
Vireo philadelphicus	Philadelphia Vireo		S1?B		53
Woodsia alpina	Northern Woodsia		S1S2		90
Woodsia glabella	Smooth Woodsia		S2		48
Zizia aurea	Common Alexanders		S1S2		40

Appendix G
Archaeological Research Permits

Permit No. A2007NS71

NOVA SCOTIA
Tourism, Culture and Heritage

Heritage Division

Special Places Protection Act, R.S.N.S. 1989

Application for
Heritage Research Permit
(Archaeology)

(Original becomes Permit when approved by the Executive Director of the Heritage Division)

The undersigned April MacIntyre

of c/o 6519 Oak Street, Halifax, NS B3L 1H6

representing (institution) Davis Archaeological Consultants Limited

hereby applies for a permit under Section 8 of the Special Places Protection Act to carry out archaeological investigations during the period:

from 17 September 2007 to 30 November 2007

at Point Tupper Wind Farm

general location Richmond County

specific location(s) (cite Borden numbers and UTM designations where appropriate

and as described separately in accordance with the attached Project Description. Please refer to the appropriate Archaeological Heritage Research Permit Guidelines for the appropriate Project Description format.

I certify that I am familiar with the provisions of the Special Places Protection Act of Nova Scotia, and that I will abide by the terms and conditions listed in the Heritage Research Permit Guidelines for the category (check one).

- ○ Category A - Archaeological Reconnaissance
- ○ Category B - Archaeological Research
- ⊙ Category C - Archaeological Resource Impact Assessment

Signature of applicant A MacIntyre **Date** 06 September 2007

Approved:
Executive Director [signature] **Date** Sept [illegible]/07

NOVA SCOTIA
Tourism, Culture and Heritage
Heritage Division

1747 Summer Street
Halifax, Nova Scotia
B3H 3A6

www.gov.ns.ca

071240
AW

October 11, 2007

In Reply Please Quote Our File Number:

Ms. April MacIntyre
Davis Archaeological Consultants
6519 Oak Street
Halifax, NS B3L 1H6

COPY

Dear Ms. MacIntyre:

RE: Heritage Research Permit Report
A2007NS71 – Point Tupper Wind Farm

We have received and reviewed your report on work conducted under the terms of Heritage Research Permit (A2007NS71) for an Archaeological Resource Impact Assessment of the Point Tupper Wind Farm.

The report details a desktop study of the proposed Point Tupper Wind Farm project area. Several previous archaeological assessment reports, records, as well as a Mi'kmaq Ecological Knowledge (MEK) study were consulted. It was determined that the area is of low potential for First Nations archaeological resources but of high potential for historic archaeological resources.

The report is acceptable as submitted, although please note an error on page 2 in the Introduction. The permit number is written as A2007NS72, whereas it should read A2007NS71. I would ask that any subsequent reports under this permit be titled differently than the one submitted.

The report recommends that the area be subjected to an archaeological survey by qualified archaeologists prior to any construction-related ground disturbance. We agree with this recommendation.

As per your request, I will copy Ms. Ann Wilkie of CBCL by copy of this letter.

If you have any questions, please let me know.

Sincerely,

Robert Ogilvie
Manager, Special Places

c. A. Wilkie, CBCL
C. Cottreau-Robins, Nova Scotia Museum

Permit No. A2008NS10

NOVA SCOTIA
Tourism, Culture and Heritage

Heritage Division

Special Places Protection Act, R.S.N.S. 1989

Application for
Heritage Research Permit
(Archaeology)

(Original becomes Permit when approved by the Executive Director of the Heritage Division)

The undersigned April MacIntyre

of c/o 6519 Oak Street, Halifax, NS B3L 1H6

representing (institution) Davis Archaeological Consultants Limited

hereby applies for a permit under Section 8 of the Special Places Protection Act to carry out archaeological investigations during the period:

from 11 February 2008 to 30 April 2008

at Point Tupper Wind Farm

general location Richmond County

specific location(s) (cite Borden numbers and UTM designations where appropriate

and as described separately in accordance with the attached Project Description. Please refer to the appropriate Archaeological Heritage Research Permit Guidelines for the appropriate Project Description format.

I certify that I am familiar with the provisions of the Special Places Protection Act of Nova Scotia, and that I will abide by the terms and conditions listed in the Heritage Research Permit Guidelines for the category (check one).

- ○ Category A - Archaeological Reconnaissance
- ○ Category B - Archaeological Research
- ⊙ Category C - Archaeological Resource Impact Assessment

Signature of applicant April MacIntyre Date 29 January 2008

Approved:
Executive Director Bill Greenlaw Date Jan 7/08

NOVA SCOTIA
Tourism, Culture and Heritage
Heritage Division

1747 Summer Street
Halifax, Nova Scotia
B3H 3A6

www.gov.ns.ca

In Reply Please Quote Our File Number:

June 17, 2008

Ms. April MacIntyre
Davis Archaeological Consultants
6519 Oak Street
Halifax, NS B3L 1H6

COPY

Dear Ms. MacIntyre:

RE: Heritage Research Permit Report
A2008NS10 – Point Tupper Wind Farm

We have received and reviewed your report on work conducted under the terms of Heritage Research Permit (A2008NS10) for an Archaeological Resource Impact Assessment of the Point Tupper Wind Farm.

The report is acceptable and outlines the results of a Phase II archaeological impact assessment of the proposed Point Tupper Wind Farm. The field survey indicated that much of the development area has been heavily modified by industrial use in the late twentieth century and, therefore, no visible archaeological resources were found. The development area was determined, through predictive modeling, to have low archaeological potential for First Nations resources.

Staff concur with your recommendation that no further archaeological assessment is necessary for the proposed development. The report further recommends that, should development plans change so that disturbance is expected in areas not surveyed during this assessment, a subsequent archaeological assessment be conducted. Finally, in the event that archaeological resources are encountered during ground disturbance, the report recommends that all activity cease and the Manager of Special Places, Mr. Robert Ogilvie (902-424-6475) be contacted. We concur with all of the stated recommendations.

I will notify Ann Wilkie, CBCL, by copy of this letter. If you have any questions, please let me know.

Sincerely,

Robert Ogilvie
Manager, Special Places

c. A. Wilkie, CBCL

Appendix H
Open House Materials

Proposed Point Tupper Wind Farm

Wind Energy

- Wind systems capture energy using large blades mounted on tall towers called turbines. The wind turns the blades and the blades rotate a generator which produces electricity.
- Harnessing the wind for energy is key to reducing our production of greenhouse gases (GHGs), as well as other air pollutants.
- In Canada, it is estimated that every 1,000 MW of installed wind energy capacity will reduce annual emissions of carbon dioxide by a minimum of 1.2 million tonnes.
- Achieving the stated government goal of 10,000 MW of installed wind energy capacity in Canada by 2015 would mean that an equivalent of about 3 million homes would be powered by wind energy.
- Global capacity for wind power is expected to exceed 150,000 MW by 2010. Current estimates of installed wind power projects account for about 50% of this total.

Proposed Wind Farm

- The wind farm is a phased development. Currently under assessment is phase one, which includes 11 800kW turbines.
- Estimated production of approximately 25.36 GWh annually.
- Turbine total height approximately 126 m (78.3 m from ground to centre of rotor and rotor diameter of 48 m).
- Additional infrastructure includes access roads and buried transmission line to connection point to NSPI grid.
- Many field studies are completed, underway or planned, including those for birds, bats, plants/ forest, fish habitat and cultural resources.
- Environmental approvals and permits are required before project commences, including a provincial environmental assessment process.

Anticipated Benefits

- 100MW of “green energy” could power up to 30,000 homes or have the same positive impact as planting 1.3 million trees.
- Substantial economic benefits through investment and local job creation in project development, operations and maintenance, and a new tax base for municipal governments.
- Complimentary land use as most of site consists of actively harvested forestry lands

Issues of Potential Concern

- Questions raised about other wind farms include potential impact to the community, such as noise, aesthetic impact, shadow flicker, land use, and property value.
- Key environmental issues include wetlands, birds, bats, rare and sensitive species, flora and fauna.

Community Input

- Consultation is a key input into the design of the wind farm.
- Your input will be included in next stages of planning and design.
- For further information, please contact:

Erica Chisholm-Keith, CBCL Limited
(902) 421-7241
ericack@cbcl.ca

Proposed Point Tupper Wind Farm
Open House June 16, 2008
Questionnaire

Thank you for taking the time to attend this Open House. It would be helpful if you could take a few minutes to answer the following questions. Your observations and input are important and will be taken into account in the ongoing design work.

1. Name:____

   Address:____

2. Do you think the proposed wind power site is visible from your home?

   Yes ___ No ___ Approximate Distance?_______

3. Do you have comments on the use of wind energy generally?

   ____

   ____

   ____

4. Are you in favour of the Point Tupper wind farm?

   ____

   ____

   ____

5. Please provide any concerns you might have regarding the proposed wind farm.

   ____

   ____

   ____

   ____

   ____

If you require additional information or wish to talk with the project team, please contact:

Peter Archibald
Renewable Energy Services Ltd.
(902) 422-8196

Ann Wilkie
CBCL Limited
(902) 421-7241
annw@cbcl.ca

Please complete and leave the questionnaire, or mail to the following address:

CBCL Limited
1489 Hollis Street
PO Box 606
Halifax, Nova Scotia B3J 2R7
Attention: Ann Wilkie

CBCL LIMITED
Consulting Engineers

Attendance Registrar

Point Tupper Wind Farm Open House – June 16, 2008

Name	Place of Residence
Allen MacDonald	
Adam Cooke	Port Hawkesbury, N.S. The Reporter
L. Forbrigger	Point Tupper
Daniel MacDonell	Port Hawkesbury, N.S.
Lindsay Anderson	Port Hawkesbury
Jessica MacMaster	" "
Russell MacNeil	Port Hastings
Jean MacNeil	Port Hastings
Joyce Oliver Shaw	Port Hawkesbury, NS

Appendix I

Letter from the Municipality of the County of Richmond

Municipality of the County of Richmond
P.O. Box 120, Arichat, N.S., B0E 1A0
Phone : (902) 226-3971 Fax: (902) 226-1510
E-Mail: kdoyle@richmondcounty.ca

February 14, 2008

Renewable Energy Resources Limited
30 Memory Lane
Lower Sackville, Nova Scotia
B4C 2J3

Attention: Larry LeBlanc, President, CEO

Dear Mr. LeBlanc:

Richmond Municipal Council discussed your Point Tupper project at their February 11, 2008 Meeting. The following resolution was unanimously adopted by our Council:

> "Moved by Councillor McNamara, seconded by Councillor Cotton that Council write a letter to Mr. Larry LeBlanc, President/CEO of Renewable Energy Resources Limited, with a copy to Nova Scotia Power, welcoming their wind turbine project to the Point Tupper area, and commending them for their investment in a renewable energy project in Richmond County. Motion carried."

We wish you success with your project.

Sincerely yours,

Karen Doyle

Karen Doyle
COUNCIL RECORDER

c.c. Mr. Ken Paruch, Nova Scotia Power

Appendix J
Analysis of Effects on Eddy Point Radar

Analysis of Effects on Eddy Point Radar

Date of this report: July 28, 2008

Prepared for

CBCL Limited, 1489 Hollis Street, PO Box 606, Halifax, NS B3J 2R7 Canada.
By Mr. Lea Barker, VIC Ltd., Ottawa

Purpose

To determine whether the location of a wind turbine farm at Point Tupper could have any serious negative effect on radar surveillance of shipping in the Strait of Canso, this latter surveillance originating from a radar at Eddy Point. A secondary effect could be on ships' radars.

Background:

1. Renewable Energy Services Ltd. (RESL) Wind Farm Project:

RESL proposes to install a wind turbine farm at Point Tupper, Nova Scotia, adjacent to Ship Point on the Strait of Canso, about 1 km inland from the Strait. CBCL Limited is the primary contractor on the environmental impact assessment.

- There will be 12 wind generator towers and turbines in the array.
- Each tower is about 78 m tall, to the hub of the turbine. A completely vertical blade of the rotor will extend this height to about 119 m in total.
- Each tower is 4.3 m in diameter at the base, and tapers to 3.71 m diameter at the top.
- The towers are for the most part constructed of steel, but with a concrete base.
- The centre of the wind farm is located about 7 km from the Canadian Coast Guard (CCG) Vessel Traffic Services (VTS) radar at Eddy Point.
- The wind farm is about 1 km southwest of a large oil storage tank facility, the several tanks being major reflectors of radar energy from Eddy Point.

2. CCG VTS Radar:

There CCG has a rather standard marine radar installed on a tower at Eddy Point; a second one originally located at Canso at the entrance to Chedabucto Bay has reportedly been decommissioned.

The radar was installed to monitor ship traffic, particularly petroleum tankers that enter Chedabucto Bay bound for the bulk storage facility near Ship Point. There are also various cargo ships that enter and leave the Strait, carrying stone aggregate and gypsum, thus posing a need for close monitoring to avoid oil spills of the type that occurred in the early 1970's with the Arrow incident.

It is estimated that somewhat over 1,100 vessels use the strait in a typical year, the major ones of interest being tankers (about 300 per year), and dry cargo carriers (about 200 per year).
These radars are of the X-band, pulsed, non-Doppler type (Decca Bridgemaster), much as is used on board large ocean-going ships.

The radar has good range resolution, being able to use pulse widths as low as 50 nanoseconds (equivalent to a range resolution of 25 ft, discounting display limitations) and moderately good azimuth resolution provided by and 8 ft slotted waveguide antenna having an azimuth beam-width of about 0.75 degrees.

The vertical beam-width is 15 degrees. Horizontal polarization is used. The radar video is processed using a variety of fairly common algorithms to extract bona-fide marine targets (via a Norcontrol type 5060 extractor), for transmission for remote display at the Sydney VTS Centre on Cape Breton.

3. Vessel Traffic Statistics

The following traffic data was provided by Ms. Janis Rod:

Based on data provided by the Harbours and Ports Directorate of TC in 2006 for another project, the average traffic is approximately one thousand vessels annually in the Strait of Canso, based on 1,061 vessels in 2003, 915 vessels in 2004 and 1158 vessels in 2005. Of these, about one third is tankers, one sixth is dry bulk vessels and the remainder is general cargo, government, fishing and pleasure vessels.

Thus about 300 tankers and 200 bulk cargo carriers transit the strait each year. This data, though somewhat dated, is sufficient to give a sense of the importance placed by the CCG on the current radar surveillance in place at Eddy Point.

Analysis

1. Review of Previous Studies of Wind Farm-to-Radar Interaction:

Most available studies on the effect of wind farms on radar relate to Air Traffic control (ATC) or various types of military radars, which rely extensively on Doppler processing or so-called Large Time-Bandwidth signals to detect moving targets in background clutter. Thus much of what they report is not applicable to simple radars of the VTS type.

1.1 BWEA REPORT

The one study that clearly addresses the simple type of pulse radar in use at Eddy Point, is the one by the British Wind Energy Association (BWEA), and dated April, 2007.

In this particular case, the wind farm is completely located on off-shore structures and is therefore in the midst of a variety of shipping traffic. In this respect it is different from Pt. Tupper where the towers are on land.

The effects noted in the BWEA study were as follows:

(from "Investigation of Technical and Operational Effects on Marine Radar Close to Kentish Flats Offshore Wind Farm, BWEA, April, 2007.)

- Reflections off obstructions on board the vessels can create linear or small sector interfering echoes;
- Reflections off plane (flat) surfaces on board the vessels can create "mirror" images on the radar display;
- Reflections between the two categories above from larger diameter curved surfaces on board can create a distorted "mirror" image on the display;
- Reflections from plane surface external influences, such as "slab sided" vessels can create "mirror" images on the display when the surfaces were in the correct alignment;

- Initial analysis indicates that in about 1/3 of trials vessels did not experience any obvious effects that could be considered significant;
- Linear, small and large sector reflections from side lobes, pulse extensions and multiple reflections from wind turbine towers can be manifested when close to the observing vessel;
- Extension of targets on the radar display is possible when aligning with recognizable formations such as the wind farm;
- Strong echoes are possible from wind farm turbines;
- Possible correlation with heights of scanners was identifiable in certain circumstances;
- A small number of pilots reported that they had observed interfering echoes displayed on the radar screen that, because they were in fog at the time, gave cause for concern. However, this type of effect was not seen during the trials by the MARICO observers. Pilots and other mariners should be requested to report and photograph if possible any occurrence in detail, to enable further analysis to be carried out;
- Limited and selective shadowing of targets was observed within the wind farm; and
- Multiple echoes from reflections off the wind turbine towers in the vicinity of the static London VTS radar scanner at the wind turbine.

The question is, how much of this is really applicable for comparison to the Pt. Tupper case? Much of what was investigated concerns the effects of the offshore turbine towers on the radars of vessels passing close by or through the tower array, something that will not be the primary case at Point Tupper.

As for effects seen by the Port of London Authority's VTS radars at Gravesend and beyond (including one mounted on a wind turbine tower), the major transitory effect seemed to be spurious displaced images of the wind farm when reflected from large slab-sided vessels that passed near the farm and in such an orientation that multiple reflections were possible.

1.2 Report for Méteo France: Impact of Wind Turbines on Weather Radars
Although this report deals with weather radars, to the extent it discusses non-Doppler effects it is possibly useful.

The radar in question operates in the C-band, or between 4 and 8 GHz, a somewhat longer wavelength than the Eddy Point radar (hence the towers, turbines and rotors would show a smaller radar cross-section).

The main conclusion is that significant clutter (signals that compete with the desired weather returns) is generated by the wind turbines, even at relatively large distances (out to 20 km in one case cited, though that seems an extreme case). The clutter during the tests was apparently generated both by the main radar beam and by side-lobes of the antenna.
(See section 12 herein for a short description of antenna side-lobes, for those who are unfamiliar with the term.)

Much of this report deals with Doppler radar effects and so most of it is not applicable to the simple pulsed-radar configuration at Eddy Point. But to the extent the report applies, it agrees with many others in revealing spurious returns from wind turbine towers.

1.3 Report for the Department of Trade and Industry (DTI) of the UK Government:
Wind Farms Impact on Radar Aviation Interests, Sept. 2003. FES W/14/00614/00/REP DTI PUB URN 03/1294

This report deals almost exclusively with radar modeling of the wind turbine nacelle and blades, and purposely deletes the radar cross-section of the tower itself from the study. A specialized computer program was developed to aid in the analysis, to resolve a feeling that aviation interests had no hard evidence that wind farms would be deleterious to the operation of ATC radars.
In spite of the lack of direct applicability to the Eddy Point situation, some quotations are noteworthy:

> **“**The electromagnetic interactions between a wind turbine and a radar signal are complex and there is currently limited understanding in this area and no accepted method for quantifying this potential impact.”
> “…Against this background there was little hard evidence to decide if sites could be developed for wind energy or (if) development should be denied to protect radar. This was a highly contentious issue.”
> “It is anticipated that this study will provide input into the revision of the “Wind Energy and Aviation Interests interim guidelines” ref. ETSU W/14/00626/REP for the siting of wind farms.”

1.4 IEEE Radar Conference paper: Radar Performance Degradation due to the Presence of Wind Turbines
This paper was instigated by the Royal Netherlands Air Force (RNAF) due to concerns about effects on their primary air surveillance radars. The first part of the paper deals with radar shadowing, which cannot be a problem at Point Tupper due to the positioning of the wind farm with respect to the Strait of Canso. A short section does deal with ghost echoes (false targets) generated by reflections from wind farms, noting that the effect is very likely to occur due to the large reflective area of wind turbine towers, but no quantitative data is given.

Both this and the other papers cited here serve mainly to highlight the rather general concern about likely effects of both primary and secondary radar types.

1.5 IEEE Radar Conference paper: Wind Farm Clutter mitigation in Air Surveillance Radar.
As expected, this paper deals with radar having some type of Moving Target Indicator (MTI), a type of processing not presently used by the Coast Guard due to complexity, expense, and the slow speed of most marine traffic. The paper describes a series of tests carried out in South Wales where four wind farms are located. Several aircraft were flown over the wind farms and instances of false targets were recorded. The company presenting the paper, Sensis Corporation, was developing a specific target tracker as a mitigative measure. Almost all of the paper is devoted to Doppler radar effects and hence is of little use in this present study. The paper does indicate that they measured the radar cross-section (RCS) of a “wind turbine” as 1,000 m^2. Unfortunately, as in so many papers, it’s not clear if this is for the whole tower/turbine/rotor assembly or just the rotors, which are the elements of interest in terms of Doppler processing.
2. Comparison to Proposed Wind Farm Installation at Point Tupper
The BWEA report’s main applicability to the Pt. Tupper case is that it confirms that the wind farm can cause mirror images of itself to appear on transiting ships’ radars and on the VTS radar if certain transient geometric conditions are favourable at any given time. At Point Tupper, the

wind farm is on land to the east of the Strait. This eliminates several possibilities for "ghost echoes" from the towers, as many of those that might occur will be in the area of land clutter masked by the radar processor.

The Méteo France study merely confirms that wind farms can be a significant source of clutter. The DTI report emphasizes the widespread conflicts that occur between wind farm proponents and operators of radars, be they Defense, ATC, or VTS. It emphasizes the need for computational tools to make siting decisions easier and grounded in hard calculations.

The other three papers, by DTI, the RNAF and the Sensis corporation, all deal largely with radar having Doppler processing or the equivalent, which makes them susceptible to the moving blades of the turbine rotor, a problem not applicable to the Eddy Point radar. Taken as a whole, the various papers exhibit a wide-spread concern about the potential effects of wind farms on radar performance, and as such many cases have been subjected to active tests with cooperating targets and either stationary or mobile radars. They do confirm the likelihood of false targets being generated by means of secondary reflections from towers (or from ships to towers and back again) and the possibility of antenna side-lobes also contributing to the false target problem. The papers give a clear indication of the difficulty of modeling wind farm-to-radar interaction, and some rather costly computer programs have been written to attempt to give more precision.

In almost all cases, authorities have taken recourse in active tests to provide better information on what is likely to be seen when wind farms and radars operate in close proximity.
This seems a prudent approach, very applicable to the Point Tupper situation.

3. Approximate Radar Cross-sections of Wind Turbine Towers and Blades
This calculation is done primarily to assess the radar cross-section of a turbine tower in comparison to the large reflectors that are already present, in the form of the many large oil storage tanks operated by Statia Terminals, and which are adjacent to the proposed wind farm.

To calculate roughly the radar cross-section (RCS) of each wind tower, I use the classical formula for the RCS of a cylinder:

$\sigma = 2\pi ab^2/\lambda$ where a = tower section radius and b = tower section height.
And λ = radar wavelength = 3 cm.

This formula can also be used to calculate, for comparison, the RCS for the adjacent oil storage tanks. The formula gives an absolute maximum for the RCS (in m^2) but this decreases rapidly as the angle of incidence of the radar beam differs from the perpendicular.

The formula assumes pure specular reflection at the optimal orientation of the incident beam. It thus gives RCS values than in my opinion are far above those seen in actual situations.
I therefore take the RCS to be only half that calculated, because of non-specular reflection, effects of paint and surface irregularities, and non-perpendicularity to the radar beam.

There are 4 tower sections, but I calculate the RCS for a tower of maximum radius (2.15m) and for minimum radius (1.35 m) and 77 m. high, and use a median value between the two as the

RCS of the whole. From these calculations the following results are obtained, with the 50% reduction noted above:
RCS of one tower: about 1,000,000 m^2
RCS of one oil tank: about 530,000 m^2 (assumed to be 30m. in diameter, 14 m. high.)
(for comparison:)
RCS of large crude carrier: 500,000 m^2 to over 1,000,000 m^2 depending on orientation.
(The RABC report states that a wind turbine & tower could have a "maximum possible RCS equal to that of a 747 aircraft;" this would depend on the radar wavelength in use, of course.
On the other hand, the Méteo France report gives a figure of 1000m^2, for turbine and rotor alone.)

To the extent these results correspond to reality, each wind tower has about twice the radar cross-section of one of the oil storage tanks. Initially, this seems odd, but one must realize that the towers are so tall that they occupy a substantial portion of the 15^o vertical beam-width of the radar antenna, at a distance of 7 km from the radar. In fact, the towers occupy 4.2% of the beam-width while the oil tanks occupy just 0.76%. The essential result is that the towers do form a very strong reflector of radar signals, and so in the right circumstances could contribute to false radar returns. Therefore it's necessary to check possible reflections from several turbine towers to ships that pass up the Strait of Canso, and that could lead to false target generation.

4. CCG verification of Radar Equipment Characteristics
From documents obtained from the CCG for a previous study, it was confirmed that the Eddy Point radar has these characteristics:
- Type: simple pulsed radar
- Pulse widths: 0.75 microseconds normally, but 0.25 and 0.05 microseconds are available
- Output power: 25 kilowatts, peak (usually somewhat lower)
- Noise figure (a measure of sensitivity): 5.5 dB (dB is a logarithmic measure of a ratio such as power, gain, etc.)
- Antenna: 8-foot slotted waveguide with 0.75^o azimuth beam-width.

The use of a 0.75 μsec. Pulse-width provides a range discrimination of about 370 feet or 112m. This is equivalent to saying that the radar will not resolve as two targets any wind tower (or oil tanks) that are less than 112 metres apart. They will be seen from the radar point of view as one extended reflector.

Since the beam-width is 0.75 degree, the arc covered by the beam when it reaches the wind farm that is 7 km distant, will be

$$A = (\Theta/360) \times 2\pi R$$
$$= (0.75/360) \times 2 \times 3.14 \times 7000$$
$$= 91 \text{ m}$$

This is an arc that could encompass two oil storage tanks if close together, but will individually illuminate the turbine towers due to their relative separation. This means that there could be multiple reflections from the farm if the location of a large tanker relative to the farm provided the correct geometry.

5. Radar Shadow-Zone Analysis

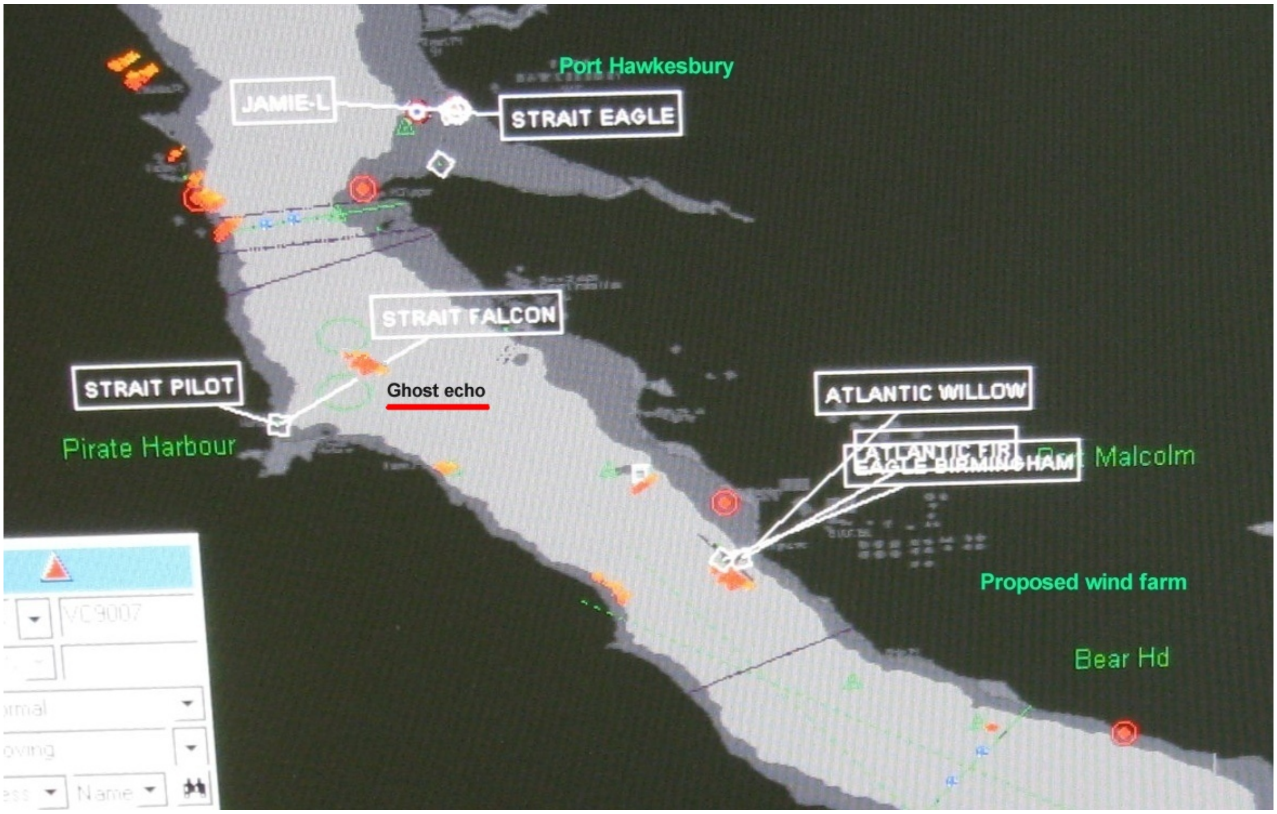
Because the wind turbine towers are now all to be land-based, there will be no radar shadow effects to be considered. It's worth noting here also, that land clutter is removed from the radar signal by a clutter mask, so returns from the towers themselves will not be seen.

6. Radar Diffraction Effects
Similarly, there are no diffraction effects to be considered because of the towers being land-based.

7. Multiple Reflection Effects
As mentioned, there are already several very large oil storage tanks located at Pt. Tupper.
In addition, a wind turbine of the type proposed for the major wind farm has been installed near the Statia Terminals unloading pier for some time. If there were going to be problems of ghost echoes, one would expect them in this area because of the large reflectors posed by the afore-mentioned structures.

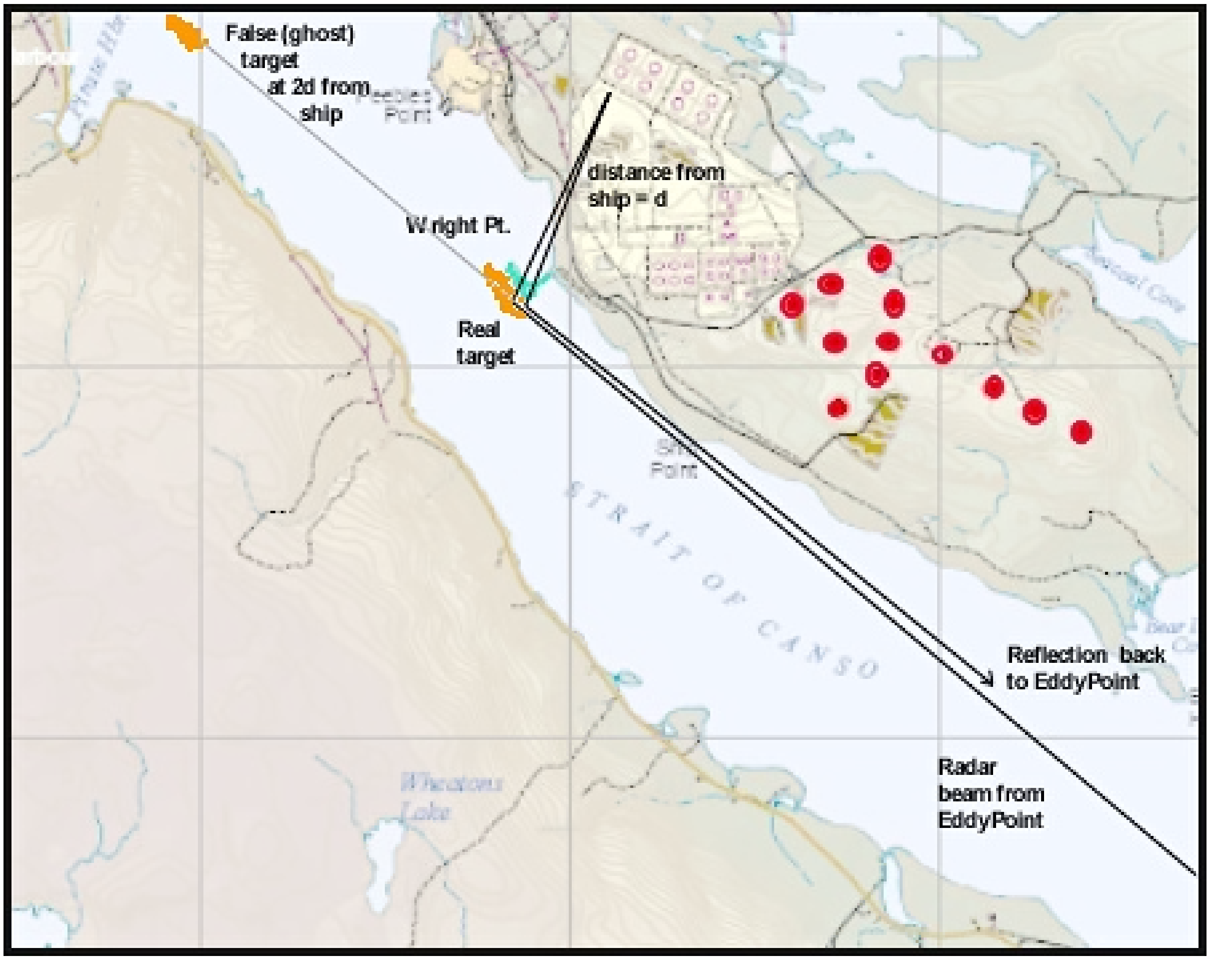
I interviewed two of the VTS operators at Sydney VTS (where the Eddy Point radar data is displayed), with a view to determining whether these existing large reflectors give rise to ghost targets. According to these operators, the only time this effect is observed in the area between Eddy Point and Pt. Tupper is when a very large tanker ties up at the unloading dock, and then a static ghost echo appears across the Strait near Pirate Harbour quite near the two designated anchorages. When this happens, the ghost echo (as extracted by the radar processor) appears very much like a bona-fide ship target. The operators know, because of their local knowledge, that the target is a false one and it can therefore be ignored. The extractor does not automatically apply a target tag (this is done by the operators as required) so there is no danger of tagging this particular false echo.

The following figure shows the appearance of the extracted video on the Eddy point screen at the Sydney VTS centre. Note that land clutter (and thus the returns from the oil tanks and existing wind turbine tower) are masked and not transmitted. The few targets (orange) that appear along the shore are deemed to be unmasked points of land revealed briefly by the outgoing tide.
The existing ghost target appears as an orange-coloured irregular shape some distance off Pirate Harbour. The figure below is a photograph of the Eddy Point screen with a typical ghost echo artificially added in the anchorage area by way of illustrating what the VTS operator currently sometimes sees. The 2 green circles are anchorage points.



For purposes of this study, it is instructive to see how this particular ghost target is generated. Assuming that the ghost target is not caused by an antenna side-lobe (not likely given that the ghost echo is not at the same range as the tanker) then as shown in the following figure the most likely cause (pending a much deeper analysis) is a double reflection off one of the large oil tanks to the east of the docked ship. While the geometry in the sketch is not precise, it's clear that at a certain orientation of the ship, such a reflection could occur. In making this sketch, I noted that the radar beam when directed at a docked tanker just grazes the land at Ship Point, according to the topographical chart 11F/11.

Note that ghost echoes (more properly termed "false targets") must occur on the radial (bearing) that the antenna beam is sweeping at any one instant. Because of the double reflection, the ghost echo occurs in front of the real target and at twice the distance from the ship to the offending oil tank. (This effect could also be caused by the large rectangular metal structure north of the dock.) Reflections could also occur from the more southerly tank farm, which would again place a ghost echo to the north of the real ship, though not so near to Pirate Harbour.

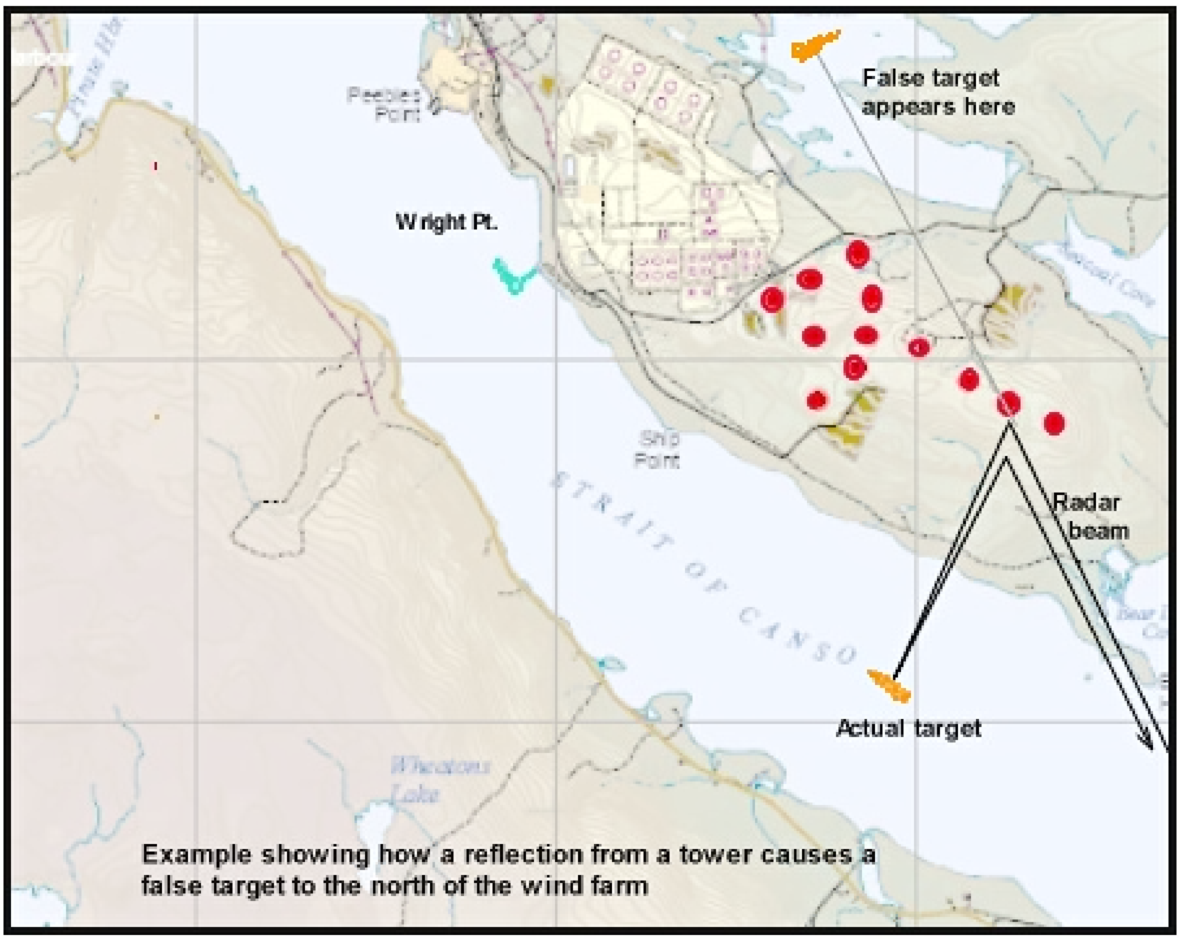


As to whether the existing wind turbine tower could be a factor in generating the single case of a ghost echo, the geometry of the positions of the ship and the tower seems to argue against this being a cause. The mechanism would be radar “splash” from the side of the ship, directed at the tower. The tower appears to be at most 600 meters from the docked ship, thus any anomalous reflection from the tower would appear about 1.2 km in front of the ship, near Peebles Pond. This is not where the ghost echo appears.

In the photos on this page are shown the location of the existing wind turbine and tower, an enlarged view of the turbine and tower, and at the bottom, a partial view of the Eddy point radar screen with a large tanker at the dock. Clearly in this case there is no false target generated by the tower. Any such target would be expected to appear within twice the separation distance between the tower and the ship. The radar target farther north of the tanker is another boat.

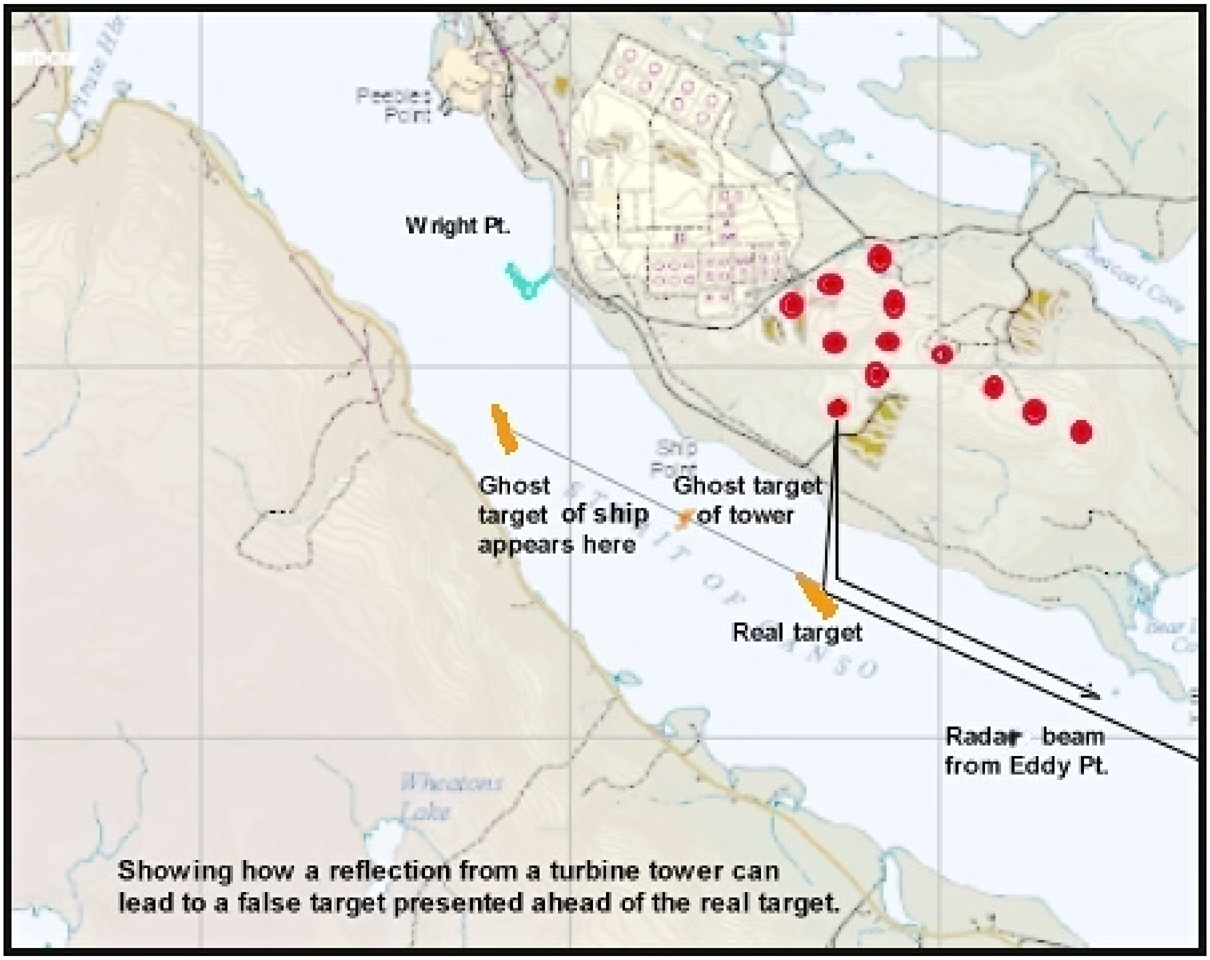
One must now consider other reflection possibilities arising from the twelve proposed turbine towers. There are far too many such possibilities to calculate without a specialized computer program. However, some facts do limit the scope of the problem.

Firstly, any reflections from a tower to a ship in the Strait, and back again, will appear as a false target within the land clutter roughly to the north of the towers as the beam sweeps through the array, and will in any event be eliminated by the land clutter mask in the radar processor. Within the roughly 6^{o} arc that encompasses the towers within the sweep of the radar beam, there is no geometric disposition of ships vis-à-vis the towers that can cause a false target to be painted within the Strait. This is illustrated in the accompanying figure.



Therefore the reciprocal situation is the one that must apply; that is, a reflection from the ship to a tower, then back to the radar by a second reflection to the ship, or via a side-lobe of the antenna (this latter presenting a much weaker target, if at all). The following illustration shows how a reflection could occur such that it generates a false target within the Strait as a large ship travels toward the Statia Terminals dock.

By the usual simple laws of reflection, if the broadside of the ship is oriented so that the angle of incidence of the radar beam is equal to the angle of reflection (from the perpendicular to the side of the ship) and if this reflected beam intercepts a turbine tower, then there is a good possibility of a false target being generated within the VTS surveillance area. Obviously this is very dependent on the orientation of the ship as it travels up the Strait, and a small deviation in course could cause the false target to quickly disappear.



Showing how a reflection from a turbine tower can lead to a false target presented ahead of the real target.

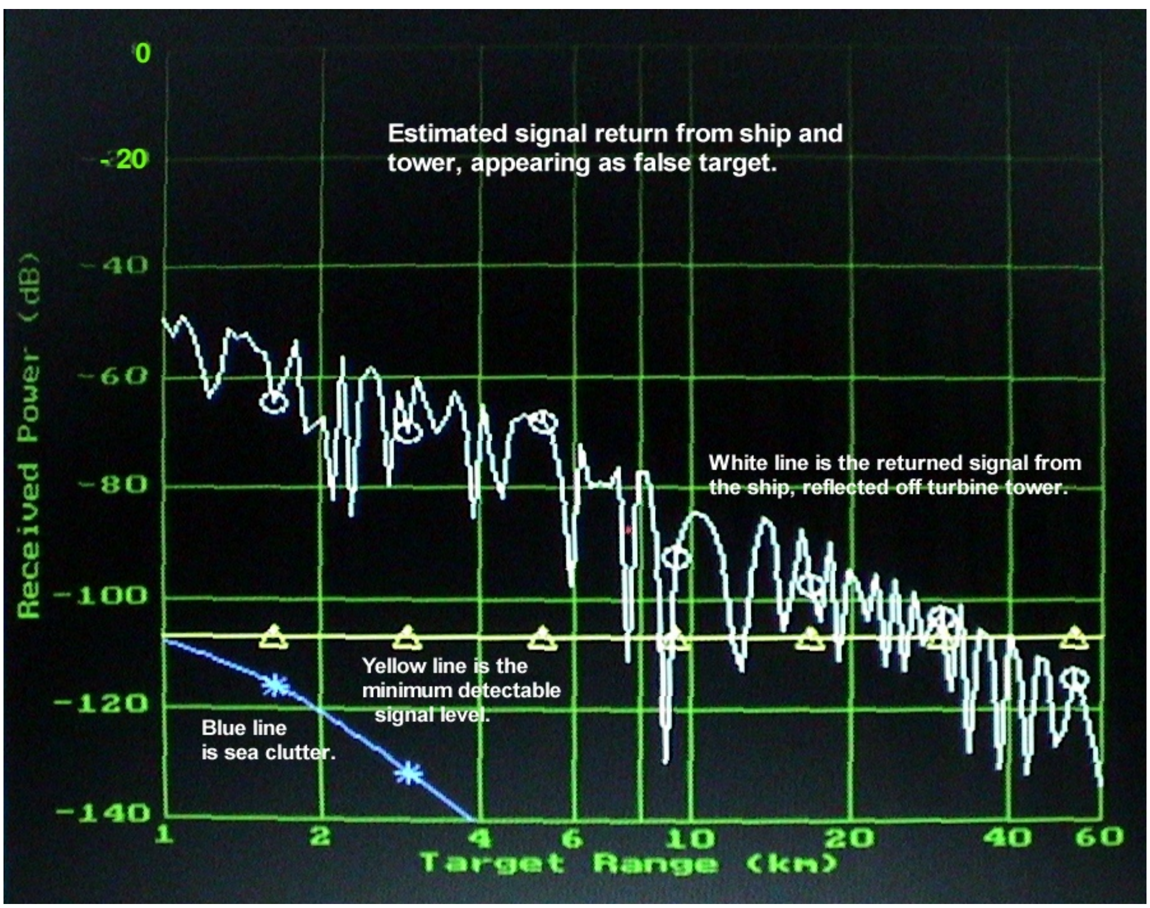
It is easily seen from this example that there are many opportunities for such reflections as a ship moves up or down this area of the Strait. Just where the ship must be when the false targets begin to be generated, can be determined by successive plots of the appropriate geometry. Generally speaking, the false targets will no longer be generated when the ship is so far south in the Strait that the necessary grazing angle on the ship cannot be achieved in a way to allow any significant double reflection from the southern-most tower.

One might question whether the current radar has the performance required to detect false targets generated in this way.
By way of an indicator, this radar can (in calm weather) detect a buoy equipped with a small corner reflector of RCS = 10 m^2 at a distance of up to 12 nautical miles. Even allowing for a significant reduction in radar power reflecting off the ship in question, the calculated RCS of

each tower is so large that at a distance of 7 km there no doubt that a signal will be returned to the radar that is more than adequate for clearly displaying on the VTS console.
I have tested this hypothesis using the radar computer program "CARPET", modifying some parameters to account for the double reflection by ship and tower. This is a very rough method at best; a sophisticated computer program would be needed for a more accurate analysis.
Parameters used were as follows:

Radar power: 25 kw (*but de-rated to only 250W. to account for losses in reflection from ship)*
Receiver losses: 20 dB *(i.e., 100x) to account for losses in reflection from the turbine tower, which acts much like a lossy microwave passive repeater*)
Noise figure: 5 dB
Antenna gain: 31 dB
Horizontal beam-width: 0.75 deg.
Vertical beam-width: 15 deg.
Pulse width: 0.75 microseconds
Pulse repetition rate: 785 Hz

The CARPET program only allows as a maximum radar target RCS a figure of 10,000 m^2. Therefore I have used this even though most industrial RCS measurements show a much larger RCS for a typical tanker. The calculation is therefore perhaps not quite worst-case.
The following figure shows the result of the calculation, with the white curve showing how high above the radar electrical noise "floor" is the echo from the ship as doubly reflected via a wind turbine tower. The received signal at 7 km from Eddy Point is about 20 dB above the minimum required signal – a large amount in radar terms.



What this graph also means is that even if the estimate of the power reflected from the ship is high by a factor of (say) 20, or 14 dB, the signal returned via the tower reflection will still be sufficient to display a false target on the radar screen, albeit at reduced intensity.

As mentioned previously, such an effect (double reflection off a tower causing a false target) will be quite transitory and *very dependant* on the aspect of the ship relative to the radar beam as it travels through this part of the Strait. If the ship is so oriented with respect to the radar beam that only its stern (or bow) and superstructure are illuminated (which could be most of the time during its transit), there might well be no false target generation.

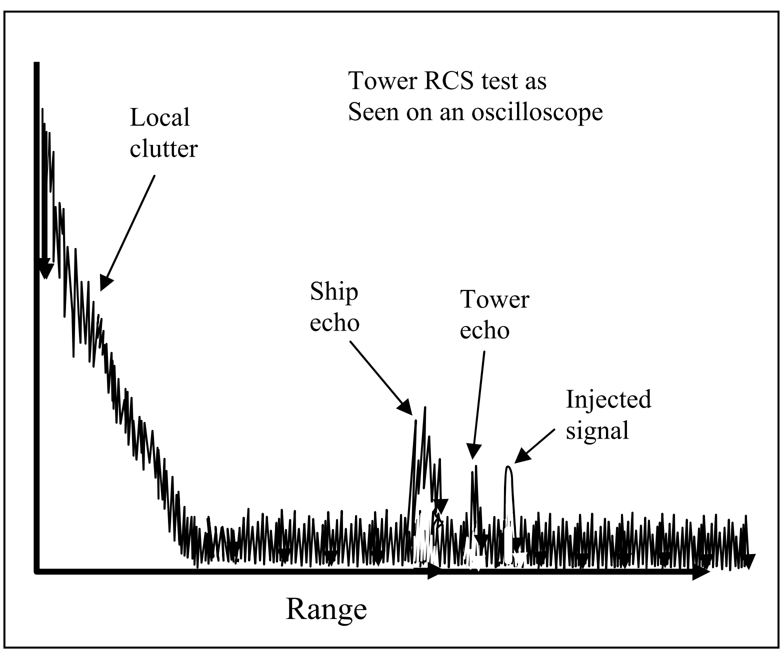
At this point some questions naturally arise:

1. Are the wind turbine towers really of such large electrical size as indicated by calculations, in microwave energy terms? That is, are they really going to act as very large passive repeaters of the radar beam? This is a very legitimate question in view of the relative difficulty in modeling such structures in the radar environment.

2. If the tower is not as large electrically as calculated, can it still generate false targets?

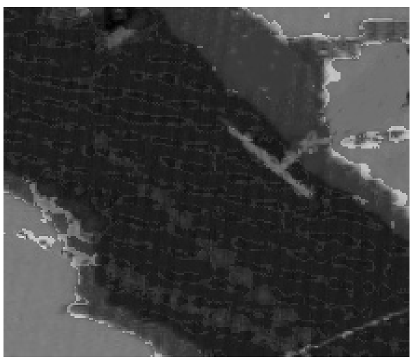
3. Would such a potential stream of false targets be problematic for VTS operators, or could they become acclimatized to them?

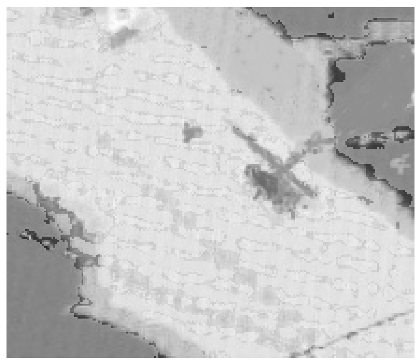
The first question is best answered by an active test, carried out *at the Eddy Point radar site*. The process would be to feed a signal from an X-band test set into the active radar at a waveguide coupler already available in the system, and with an oscilloscope view this signal alongside the radar return from the existing wind turbine tower (Note this would require the antenna to be stopped and pointing at the tower). The artificial signal is increased until it matches the return from the tower. This test will provide a quantitative measure of the received signal from the turbine tower, which can be converted to a RCS figure using the standard radar equation. The figure below illustrates the test output.

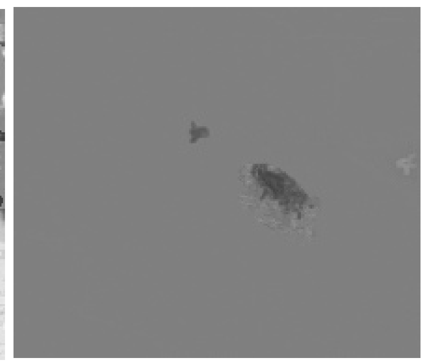


The second question might be answered, again at the Eddy Point site, by viewing the maintenance display (which shows unprocessed radar signals with no masking) when there is a large tanker at the dock. The radar screen, set to show about a 1 nautical mile area around the docked ship, would be examined and photographed for false targets nearby (the tower is only about 600 m from the dock). The screen would be photographed again after the tanker leaves. Visual examination of the 2 photos or a subtraction of the two photos in suitable software should indicate where there were false targets, and these could be correlated to the tower (if that was the cause) by distance measurements. This procedure eliminates problems in remembering the difference between the two situations, perhaps days apart.

The process is shown by the figures below:







Negative of display image with no ship present

Positive of display image with ship and a false echo

Composite of two images showing ship and false echo.

If no false targets are detected, even in the surrounding ground clutter, then that would be a reasonable indicator that the tower is not as large a reflector as are the nearby oil tanks.

As for the third question, my conversations with operators at the Sydney VTS centre indicate that while they can become used to a certain number of known and rather static anomalies, it’s likely that a series of moving false targets in the strait would be more than they would deem to constitute a safe situation. Naturally, their prime motivation is the safety of marine traffic and protection of the local environment.

8. Polarization Effects
Since this radar exclusively uses horizontal polarization from the radar antenna, there is no effect from a polarization point of view that would affect false targets, either in terms of generation or mitigation. (The horizontally polarized electric field is not rotated upon reflection, except in a corner reflector.)

9. Radar Target Extractor Affects
In conversation with the VTS operators at the Sydney VTS centre, as already mentioned, the radar extractor at Eddy Point provides a land-clutter masking function, and through various algorithms extracts radar targets for transmission to Sydney. It does NOT apply identification tags to extracted targets.

This function is carried out manually by VTS operators, as shown here for two small boats at Pirate Harbour.

It would (and does) extract false targets though, however they are generated. But, because of the fact that collision alarms are only generated by calculations as requested by VTS operators, there seems to be no danger of large-scale operator distraction due to false collision alarms. If we assume that of the roughly 1200 ships per year that use the Strait, 500 are tankers and dry bulk carriers, only 33% are large enough or have the hull shapes necessary to cause reflections to and from turbine towers, then roughly 165 vessels, or perhaps one every two days, will cause spurious and intermittent display of false targets as they transit the northern areas of the Strait. This could very well be a distraction for operators, however well-intentioned they are in terms of using “local knowledge” as it is termed, to ignore such false echoes.

This would be especially true if other bona-fide traffic was mixed in with the false targets emanating from the towers. Much radio communication would have to be carried out to separate real from false targets, until such time as tags could be attached to the real targets.

This result would be problematic, both for VTS operators and for the proponent of the wind farm, both of whom would want a clear indication that there will be no tower-related effects on the VTS radar. Ideally, one or two tests would be carried out to either expose the real threat of false targets, or to show that the situation would be benign or remediable.

10. Possible reaction of ship data processors at Sydney VTS centre

INNAV is a quasi-national system of ship data management and dissemination, operated by the Canadian Coast Guard in several of their Regions. Since data is entered into the INNAV ship data information management system at the discretion of the VTS operators, and only for vessels that they choose to identify with a tag, there should be no effect on this system because of false targets arising from reflections from the wind farm towers. The situation would be quite different if the data entry was an automatic function.

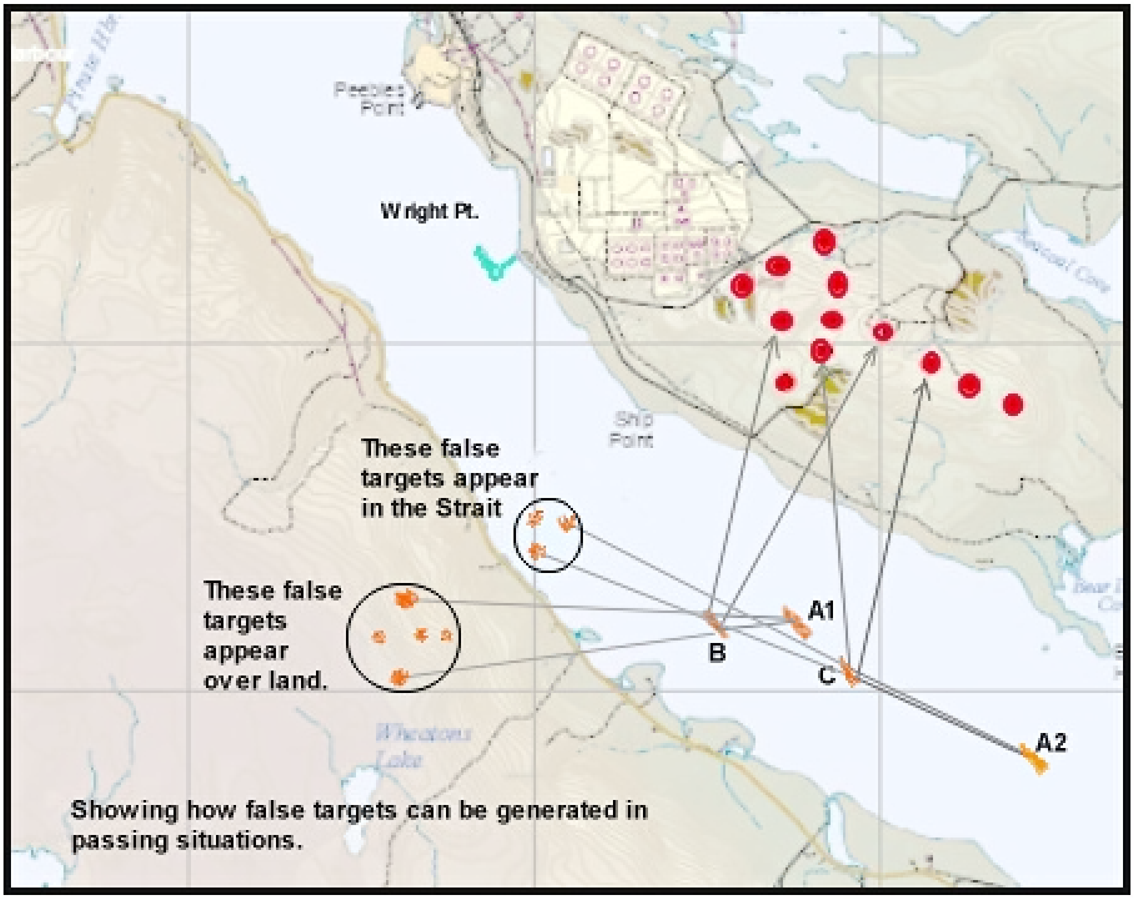
11. Possible effects on board transiting vessel’s radars

The BWEA report, noted in section 1 above, deals extensively with effects seen on the radars on board transiting vessels, albeit in a situation where the wind turbine towers are offshore. Several effects were noted that caused false targets as spurious displaced images of the wind farm:

- reflections from mast structures to the wind farm and back
- reflections of the ship’s radar from nearby ships to the wind farm and back
- responses from antenna side-lobes due to the close range and large size of the towers.

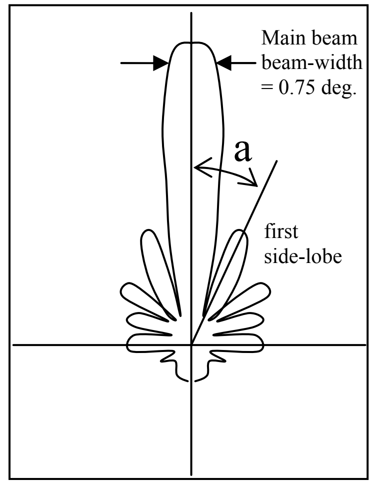
Given the proximity of the very large towers to the water in the Strait of Canso, one can expect similar effects here. As an example, the following figure shows two cases where a ship, shown in two positions:

at A1 and then at A2, is in close proximity to another large ship shown at positions B and C. As the ship's antenna scans from bow to stern (or vice-versa) of the other ship, reflections occur which can, depending on the geometry at the moment, overlie land or part of the Strait. Such passing situations would be relatively rare, but can occur, as the only passing restriction is near the Calling-In Point off Eddy Point.



12. The Effect of Radar Antenna Side-Lobes

Thus far, the effect of radar antenna side-lobes has been disregarded. As seen in the diagram on the right, which shows a stylized antenna horizontal radiation pattern, the side-lobe that might have to be considered is the first one, which is nominally about 27 dB* less in gain than the main beam and separated by some angle "a". What this means is that at a sufficiently close range and a very large target, the side-lobe can transmit and receive a signal strong enough to be displayed on the radar screen; but this side-lobe echo will be displayed at the bearing of the main beam, since that is what controls the radar display.



*dB = 10 x logarithm of gain ratio.

There will be two cases.

12.1 Side-lobes of the Eddy Point radar

There is no present evidence that the antenna side-lobes for the Eddy Point radar generate any false targets, at least within the unmasked surveillance area. If there had been such a possibility, it would appear as (for example) an extended echo from a large tanker at the Statia Terminals dock. This effect is illustrated in the diagram shown on the right. Sidelobes can also generate ghost echoes on very large ships, towers, etc.

Since these effects are *not* seen, even on very large tankers, it seems likely that the Eddy Point radar antenna side-lobes are sufficiently attenuated that there will be no such problems because of the turbine towers. In any event, any such side-lobe responses would be mostly over the masked land area.

12.2 Side-lobes on the radar antennas of ships.

This will be (for transiting ships) a more likely occurrence.

Ships will be so close to the wind farm that it is almost inevitable that the side-lobes of their antennas will cause extended images of the towers to occur. For a ship going northward, such side-lobe responses occurring to the starboard side of the radar display will for the most part be displayed as part of the land clutter. When the scanner is pointing toward the south-east, side-lobe responses could paint false echoes of the wind farm in the eastern part of the Strait. There is really no mitigative measure that can be taken here, so again, a Notice to Shipping warning of the effect might be something that the Coast Guard would consider.

13. Possible Field Test

There are 17 wind turbines already installed near Pubnico Nova Scotia, about 40 km south of Yarmouth. These turbine towers are also located on land and thus potentially are part of the land clutter for any radar viewing them. There are, however, no large oil tanks near the turbine towers as there are at Point Tupper.

To confirm the results of this short study, an active test could be mounted using two separate boats, such as a Coast Guard cutter with a medium-power radar on board, and perhaps other ships of opportunity that come into Yarmouth Harbour.
The test would proceed roughly as follows:

- station the observing vessel about 4 km south of the Pubnico wind farm
- observe the radar returns from another vessel such as a large fishing trawler as it transits from south of the wind farm into Yarmouth Harbour
- observe the test radar for anomalous effects, particularly ghost targets that are generated by reflections from the wind farm towers; these "ghosts" will be characterized by appearing spuriously and not persisting once the large vessel has passed the farm.

It might also be possible to carry out a meaningful test using the Eddy Point radar and the existing turbine tower just east of the Statia terminals offloading dock.
For example:

- One such test, by viewing and photographing the Eddy Point maintenance display with and without a tanker at dock, has already been described (section 7). If this test fails because of excessive radar clutter in the vicinity of the tower then one could:
- set the test boat, which would need to be large, such as a major tug, so that the side of the boat presents a good reflecting surface both to the Eddy Point radar and to the existing tower. Slowly maneouvre the boat while looking on the Eddy Point maintenance display for false targets, which should appear to the north of the test vessel; or
- obtain a radar-equipped boat and from somewhere north of Peebles Pond, orient the boat so that as closely as possible it bisects the distance between a docked tanker and the existing turbine tower. Adjust the position of the boat laterally while looking for false echoes of the tower on the boat's radar; these would appear to the south of the docked tanker.

The test at Pubnico would be preferable, if it can be determined that there will be sizeable vessels transiting the area enroute to Yarmouth.

14. Radar-Based Mitigation Measure

Pending the results of tests, if they are thought to be warranted to truly assess the risk of anomalous radar effects, and deleterious effects are confirmed, then one mitigative measure would be to set up a second (but low-power) radar at a location which will have a different view of the Strait in the at-risk area), and calculated to avoid reflective views of the towers, such that the two radars' signals can be correlated and false echoes thus eliminated. In very general talks with a Coast Guard representative, it is thought that the Coast Guard would require the proponent of the wind farm to pay for this second radar and its ancillary extractor/correlator. From experience in past years with a temporary radar during the building of the Confederation bridge, this need not be an extremely expensive undertaking.

15. Possible Future CCG Equipment Renewals

While the current radars used at all CCG VTS sites are of the pulsed, non-Doppler type, there is a new radar on the market, by Kelvin Hughes, that targets among other applications, the VTS market. This is the so-called "SharpEye™" radar, recently given type approval, and which has the advantages of being totally solid-state, with attendant reliability (no magnetrons). The CCG has expressed some interest in viewing and perhaps testing this new radar.

The Kelvin-Hughes announcement states that:

> "The SharpEye™ Coastal Surveillance/VTS radar features greatly improved target detection due to the use of Pulse-Doppler for rain and sea clutter rejection and mixed clutter suppression using coherent Moving Target Detection (MTD) processing."

This means that the new radar would be sensitive to the moving blades of a wind turbine rotor, depending on their orientation vis-à-vis the Eddy Point radar beam. Replacement of the current generation of pulse radars with this new variety would not occur in the near suture, according to current thinking. However, at such time that such a radar might be installed near any existing wind generator farm, mitigative measures would have to be taken. When dealing with pulse-Doppler radars, it might be possible to adjust the radar processor to reject returns from a turbine rotor, if the usual blade speed would be greater than anything encountered in normal marine traffic in the Strait of Canso (with the possible exception of the pilot boats). This is a matter for further study. It is mentioned here only as a cautionary note for the future.

16. Other considerations (AIS)

The International Maritime Organization through the Safety of Life at Sea convention, has mandated the carriage of Automatic Identification Systems (AIS) as follows:

"All ships of 300 gross tonnage and upwards engaged on international voyages and cargo ships of 500 gross tonnage and upwards not engaged on international voyages, and passenger ships irrespective of size shall be fitted with Automatic Identification System (AIS), as follows:

- Ships constructed on or after 1 July 2002;
- Ships engaged on international voyages constructed before 1 July 2002;
  - in the case of passenger vessels not later than 1 July 2003; in the case of tankers, not later than the first survey (survey for equipment) after 1 July 2003;
  - in the case of ships, other than passengers ships and tankers, of 50,000 gross tonnage and upward, not later than 1 July 2004;
  - in the case of ships, other than passenger ships and tankers, of 300 gross tonnage and upwards, but less than 50,000 gross tonnage, not later than the first (survey for safety equipment) after 1 July 2004 or by 31 December, 2004, whichever occurs earlier; and
- Ships not engaged on international voyages constructed before 1 July 2002, not later than 1 July 2008."

AIS is a radio-based system that transmits an identification signal, together with other pertinent information such as position and dangerous cargo, to suitably equipped ships, and by extension to shore-based VTS centres. The AIS is automatically interrogated by shore-based equipment. Although the CCG is somewhat behind their planned schedule for installation of shore-based receivers for AIS data, nevertheless this system would ultimately provide a measure of mitigation if the wind farm should happen to generate any spurious (ghost) targets. Correlation of extracted radar targets with AIS-generated data would be the required process.

17. Comparison to False-Target (Multiple Reflection) Case at Sarnia VTS

I recall that at the Sarnia (Ontario) VTS centre, there are two radars feeding data: one north of the international bridge, and one south of the bridge on the roof of the Federal Building.

Across the St. Clair River there is a vast oil refinery, petrochemicals industry and many product tanks. There is also marine traffic exiting and entering a river that flows out of Port Huron on the west river-bank. When certain large ships transit this area, ghost radar echoes are generated within the St. Clair River, and are usually (as I recall) displayed moving to the north of the transiting vessel, as seen on the local VTS operator's display. A call to Sarnia VTS generally confirmed my recollection. The ghost/false targets are caused by multiple reflections off the many refining towers and storage tanks on the west side of the river. They seem to be generated only when the transiting ship is quite close, perhaps within less than a mile, of the refinery. This case is in some ways analogous to a wind farm at Point Tupper, though certainly there are many more reflectors at Sarnia than would be posed by the wind farm.

18. Risks in Building the Wind Farm and Waiting to See if There are Indeed Radar Problems
Given the economic opportunity for the wind farm proponent and the great interest of Provincial authorities in seeing this project proceed, it might be decided that the farm should be built, with residual radar problems to be dealt with once they are definitively identified by actual operation. The risk in this approach is that if problems do occur, there could be a lengthy delay of more than one year while a mitigative measure is developed and put in place. In the meantime, VTS operators would have to deal with the distractions posed by the various false targets. This might well be unacceptable to the Canadian Coast Guard, given the importance attached to surveillance of tanker traffic in this strait. The alternative is to undertake such tests as will give a clear indication that either there will be no problem (or so minimal as to be acceptable) or that a mitigative measure is required.

It should be noted that if there are multiple false-target effects on the radars of transiting ships, there are really no easy corrective measures that can be applied to those cases. Perhaps a Notice to Shipping by the Coast Guard, for that area, would be in order.

Conclusions

1. In cases where a tanker or large cargo carrier is transiting the Strait, there could be sporadic cases, depending on the orientation of the ship, where false targets will be generated. Many of these would likely fall over the masked land area, though effects within the Strait are possible if the ship is appropriately oriented. No such effects are noted with the existing turbine tower near the tanker unloading dock.

2. In cases where ships pass in the Strait, near the turbine towers, the situation is such that several possibilities for false targets exist on the ship-borne radars. Some of these false targets could fall on land areas where they would merge with land clutter. There is no ready mitigative measure for this. Such passing situations are only operationally controlled near Eddy Point at a local Calling In Point, so it cannot be said that passing situations are rare. A *Notice to Shipping* might be required.

3. There should be no false targets generated from the Eddy Point radar side-lobes as a result of the wind towers. Ships, however, will likely see side-lobe effects on their own radar displays.

4. Since it's not possible to definitively rule out false target effects, one or more tests should be carried out to provide experimental evidence and confidence in any future actions.

5. There are relatively inexpensive mitigative measures available for the Eddy Point radar signal if tests confirm that the towers will cause false targets for the Eddy Point radar. The first would be incorporation of an AIS system with target correlation processing. The other (perhaps less desirable) solution would be a second low-power radar sited so that it views the Strait around the critical area, but in a way that ensures it will not display any false echoes of the towers except over land areas. This signal would then be correlated with the Eddy Point signals to delete any false targets.

Recommendation

Talks should now be undertaken with the Coast Guard authorities in the Maritimes Region to assess the VTS-related risk and determine what would be an equitable sharing of the cost of mitigative measures, starting with the potential AIS solution, which should be the most economical. Since the wind farm is seen as a very positive development for Nova Scotia and the Cape Breton region in particular, these talks should explore:

- how seriously the VTS (actually designated Marine Communications and Traffic Services, or MCTS) would view sporadic false targets in the Strait near Point Tupper
- what assistance by way of cooperating vessels the Coast Guard can offer for active tests
- what technical and operational assistance can be had for the active tests
- why this case can be granted an exemption from the 60 km separation guideline
- under what conditions the Coast Guard would *not* object to further work on the wind farm going ahead while the tests are going forward and the preferred mitigative measure is being designed
- what cost sharing could be agreed upon for the mitigative measure (involving AIS as a first choice, since the Coast Guard intends to install AIS receivers in any case).

Data Sources

1. Report by the British Wind Energy Association (BWEA): Investigation of Technical and Operational Effects on Marine Radar Close to Kentish Flats Offshore Wind Farm. April, 2007.

2. Radio Advisory Board of Canada (RABC) and Canadian Wind Energy Association (CANWEA) - Technical Information On Assessment of the Potential Impact Of Wind Turbines On Radio Communication, Radar And Seismoacoustic Systems, April, 2007.

3. Report of Méteo France: "Impact of Wind Turbines on Weather Radars", Opera II WP 1.8, Dec. 2006. (Deemed applicable in the non-Doppler mode.)

4. Report for the Department of Trade and Industry (DTI) of the UK Government: Wind Farms Impact on Radar Aviation Interests, Sept. 2003. FES W/14/00614/00/REP DTI PUB URN 03/1294.

5. IEEE Radar Conference paper: Radar Performance Degradation due to the Presence of Wind Turbines. TNO Defence, Security and Safety, The Hague, Netherlands

6. IEEE Radar Conference paper: Wind Farm Clutter mitigation in Air Surveillance Radar. Sensis Corporation, E. Syracuse, New York.

7. Interview with VTS operators at the Sydney VTS Centre.

8. Interview with the OIC of the Sarnia VTS Centre.

9. Photographs of the proposed site, and site plans, provided by CBCL Limited.

10. Photographs of the Eddy Point radar display (at Sydney) provided by the Engineering Services group within the Canadian Coast Guard.

11. Topographic map, Port Hawkesbury area, # 11 F/11, Natural resources Canada.

12. Brochure for SharpEye™ Coastal Surveillance/VTS Radar from Kelvin Hughes.

13. Eddy Point radar specifications from a previous study for the Canadian Coast Guard.

14. Photo of Pubnico wind farm from Flickr ™ web-site.

Appendix K
Ice Detection

1. General information

Under certain weather conditions, ice, hoar frost or snow can build up on the rotor blades. This usually occurs when the moisture level in the air is elevated or if it rains or snows at temperatures around 0°C. Ice formation also occurs when water droplets freeze on the blade surface. Hoar frost build-up appears when the moisture particles in the air are frozen. The rotor blades pick up these particles which stick to the blade surface. Ice build-up most frequently occurs at temperatures between -1°C and -4°C. It does usually not occur at temperatures above +1°C and below -7°C, as the moisture level is too low at lower temperatures.

While ice and hoar frost build-up can reach levels that might present a danger for persons and objects if they were to fall, snow build-up usually accumulates in areas which are not crucial for the aerodynamics of the rotor blades (e.g. the flange) and does normally not present any danger.

All types of ice build-up on the surface of the rotor blades, such as ice, hoar frost or snow have one thing in common: An impairment of the aerodynamic rotor blade characteristics and the associated reduction of turbine performance. The subsequently described ice detection procedure is based on this fact.

2. Ice detection operating mode

High-grade aerodynamic profiles are used for the rotor blades, resulting in high lift with low resistance. The aerodynamic characteristics of these profiles are very sensitive to contour and roughness changes caused by ice build-up.

The resulting significant change in the turbine's operating characteristics (interrelation of wind/rotating speed/power output/blade angle) is used to detect ice build-up.

For this purpose, interlinked turbine-specific values (wind / power output / blade angle) are recorded as long-term mean values at temperatures above +2°C on the nacelle. At temperatures below +2°C (ice conditions) the current operating data is compared to the long-term mean values and the turbine is then stopped if their is a significant deviation.

Main status on display: *14 : Formation of ice*

2.1 Temperature measurement

Using two independent temperature sensors, one at the top of the nacelle and the other at the tower base, the turbine control system measures the outside temperature. The temperature at the tower base is measured to check plausibility.

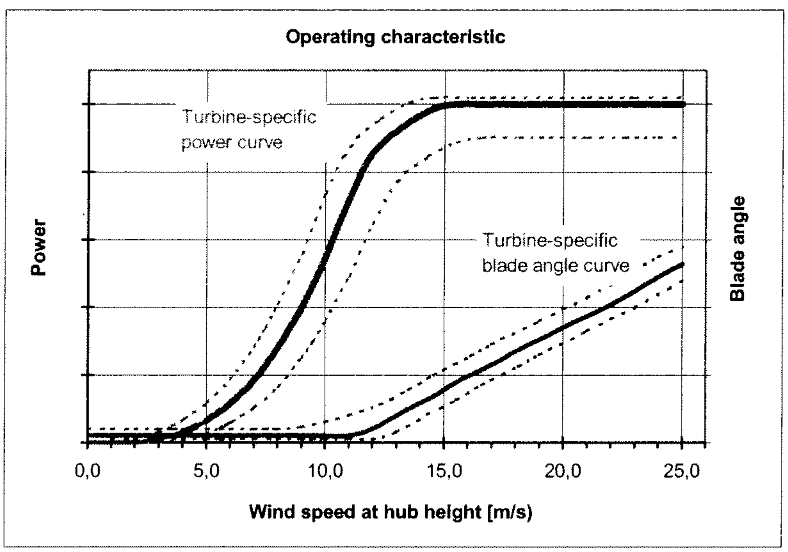
2.2 Determining the operating characteristics

Because of the normal component and construction tolerances (in particular for the anemometer) and location-dependent factors (air density and wind turbulences), it is not practical to compare the turbine-specific values directly to an idealized operating characteristic for the turbine type.

Therefore a characteristic wind/power curve and wind/blade angle curve for the particular turbine type are initially used at commissioning. As soon as the turbine enters regular operation and the outside temperature measured at the nacelle is above +2.0°C, these curves are corrected in a sliding manner with the current mean values. Thus a reproducible turbine-specific operating characteristic is determined after a short operating time. The influence of the temperature-dependent air density on the curve is adjusted via the measured outside temperature. This increases the reaction accuracy of the system.

2.3 Comparison with the operating characteristic

If the outside temperature measured on the nacelle drops below +2.0° C, the control system assumes that ice formation on the rotor blades is possible due to low temperatures. The turbine-specific operating map is now no longer corrected but compared to the current operating data.
An empirically determined tolerance range is applied to the wind/power and wind/blade angle curve. This is based on simulations, tests, and several years of experience with numerous turbines of the different types. If the operating data of power or blade angle determined as a sliding average is outside the tolerance range, the turbine is stopped with main status 14, “Formation of ice”.
Because of the narrow tolerance range, the turbine is usually stopped within 30 minutes, before the ice layer becomes a threat to the surrounding area. Some operating points will be outside of tolerances even without ice formation, but because of the sliding average this does usually not cause the turbine to stop.



Example of an operating map with tolerance range (schematised)

Depending on the frequency of operating data position in reference to the operating characteristic tolerance range, further differentiation marked by an additional status is possible.

A measured power average below the power tolerance range indicates ice formation on the rotor. The turbine stops with Status 14:11 "Formation of ice : rotor (power measurement)".

The turbine's anemometer is heated. In the event of an anemometer heating failure or ice build-up even though the anemometer heating is intact, the measured mean power may rise above the power tolerance range. In this case, the turbine stops with Status 14:12, "Formation of ice : Anemometer (power measurement)" because the control system assumes that not only the anemometer has ice build-up but also the rotor blades.

The adjustment blade angle at rated power is smaller when there is ice build-up than when the blades are free of ice formation. A measured blade angle average below the blade angle tolerance range indicates ice formation on the rotor. The turbine stops with Status 14:13 "Formation of ice : rotor (blade angle)".

As with the power measurement, a measured blade angle average above the blade angle tolerance range indicates ice formation on the rotor. In this case, the turbine stops with Status 14:14 "Formation of ice: anemometer (blade angle)" since the ice formation cannot be determined exactly.

Thus, ice formation detection for the entire wind speed range is ensured.

3. Restart

Automatic turbine restart is not possible until the ice has melted due to an outside temperature above +2°C for a sufficient time or by means of the optional blade heating. The time required to defrost the blades is determined depending on the outside temperature. During this period the turbine will not start up automatically.

Manual restart is only possible directly at the turbine once a visual check has been carried out. In doing so, the operator is liable for any resulting danger.

It can be assumed that without the optional blade heating, the ice will only melt at outside temperatures above +2°C. The time required for the ice to melt is determined depending on the outside temperature and based on empirical values. Several hours may pass until the restart of the turbine.

Turbines equipped with blade heating will restart after the heating period, which usually takes several hours.

If regulations demand that the turbine remains shut down once ice has been detected, the control system can be set accordingly. In this case, the turbine can only be restarted manually.

4. Summary

Developed entirely by ENERCON, this ice detection system is a highly efficient and reliable tool to detect ice formation on rotor blades. Compared to external ice detectors, which only detect possible ice formation according to the weather conditions without ever giving an indication of the actual condition of the rotor blades, this system monitors ice build-up directly at the source of the danger. For locations with low to moderate ice formation risk, it offers a perfect compromise between maximum safety and protection and maximum turbine availability for the operators.

In addition to the ice detection, ENERCON wind turbines are equipped with tower vibration sensors capable of detecting vibrations caused by imbalance.

The standard values used for ice detection and restart have been defined according to several years of experience with ice build-up situations and tests with a number of turbines of different types. An appropriate safety margin has then been added. The experience results from operating turbines in northern Scandinavia, the German low mountain ranges and the European Alps.

If required, the preset standard values can be adjusted to the location by ENERCON service personnel through a service code.

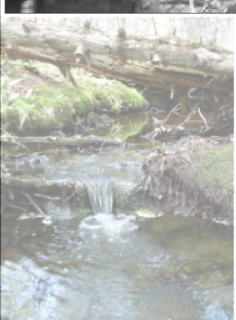
5. Safety

The ice detection system is extremely secure. The temperature sensor on the nacelle is backed up by a second sensor at the tower base.

The control system does not consider any other measurements with tolerances, such as wind speed, power and blade angle as absolute values, but only takes the changes in these values into consideration to detect ice formation. Even though all relevant turbine measurement values are constantly checked by the control system for plausibility, a change in value which is not based on ice formation would still be interpreted as ice formation and would lead to a turbine shutdown. Ice detection would not fail due to tolerances in transmitted measurement values or due to a transmission failure.

6. Validity

The ice detection system is currently available for ENERCON WEC types E-30/3.30, E-40/6.44, E-58/10.58, E-66/18.70 and 20.70 as well as for the new turbine generations E-33, E-48, E-53, E-70, E-82 and E-112. Ice detection is independent of rated power and hub height.



CBCL LIMITED
Consulting Engineers

1489 Hollis Street, Halifax, NS B3J 3M5
Phone: 902.421.7241 Fax: 902.423.3938 Website: www.cbcl.ca