NINE MILE RIVER

COMMUNITY WIND PROJECT

ENVIRONMENTAL ASSESSMENT REGISTRATION DOCUMENT

Proponent
Scotian Windfields Inc.
and
Scotian Wind Inc.
and
WEB Wind Energy North America Inc.

Document Prepared By:
Strum Consulting

October 2013

EXECUTIVE SUMMARY

Scotian WindFields Inc., Scotian Wind Inc., and WEB Wind Energy North America Inc. have proposed to develop a 4.0 MW wind project in the community of Renfrew, Nova Scotia. The proposed Project site is approximately 13 km northwest of Enfield, Nova Scotia in the Municipality of the District of East Hants (45°1'28"N, 63° 39'27"W).

The Nine Mile River Community Wind Project is proposed under the province of Nova Scotia's recently developed Community Feed-In-Tariff program, an incentive-based program introduced by the Nova Scotia Department of Energy, for which municipalities, First Nations, cooperatives, local non-profits, and small businesses, operating through Community Economic Development Investment Funds, are eligible to apply.

The Project is considered a Class 1 undertaking under the Nova Scotia Environmental Assessment Regulations and as such, requires a registered Environmental Assessment as identified under Schedule A of the Regulations. The Environmental Assessment and the registration document have been completed according to the methodologies and requirements outlined in the document "A Proponent's Guide to Wind Power Projects: Guide for Preparing an Environmental Assessment Registration Document", as well as accepted best practices for conducting environmental assessments. As the Project consists of two turbines, it is considered a small project. Based on the known existence of five bird species ranked 'red' by the Nova Scotia Department of Natural Resources, and the presence of a bat hibernacula less than 25 km from the Project site, the Project is classified as having a 'Very High' potential sensitivity. As such, the Project is determined to be a Category 4.

A number of environmental components were evaluated for this assessment. Based on field data and associated research, mitigation strategies and best management practices were identified to avoid or mitigate potential effects of the Project for the majority of the components. Following the preliminary assessment, the components identified for further assessment were: avifauna, bats, and species of conservation interest. The effects assessment for these components determined that residual effects are expected to be not significant. Cumulative effects were also considered to be not significant.

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ACCDC	Atlantic Canada Conservation Data Centre
ARD	Acid Rock Drainage
ARIA	Archaeological Resource Impact Assessment
ATV	All-terrain Vehicle
AQHI	Air Quality Health Index
BMP	Best Management Practice
CanWEA	Canadian Wind Energy Association
CCME	Canadian Council of Ministers of the Environment
CEDIF	Community Economic Development Investment Funds
CEAA	*Canadian Environmental Assessment Act*
COMFIT	Community Feed-In-Tariff
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CWS	Canadian Wildlife Service
CWFI	Community Wind Farms Inc.
dBA	Decibel
DFO	Fisheries and Oceans Canada
DND	Department of National Defense
EA	Environmental Assessment
EC	Environment Canada
EMI	Electromagnetic Interference
EMF	Electromagnetic Field
EPP	Environmental Protection Plan
ESCP	Erosion and Sediment Control Plan
GHG	Greenhouse Gas
IBAs	Important Bird Areas
IBoF	Inner Bay of Fundy
KMKNO	Kwilmu'kw Maw-klusuaqn Negotiation Office
LWT	Large Scale Wind Turbine
MBBA	Maritime Breeding Bird Atlas
MBCA	Migratory Birds Convention Act
MLA	Member of Legislative Assembly
MW	Megawatt
NRC	National Research Council
NRCan	Natural Resources Canada
NSDE	Nova Scotia Department of Energy
NSE	Nova Scotia Environment
NSEA	*Nova Scotia Environment Act*
NS *ESA*	*Nova Scotia Endangered Species Act*
NSPI	Nova Scotia Power Inc.
NSTIR	Nova Scotia Department of Transportation and Infrastructure Renewal
PID	Property Identification Number
RCMP	Royal Canadian Mounted Police
SARA	*Species at Risk Act*
SOCI	Species of Conservation Interest
SWFI	Scotian WindFields Inc.
SWI	Scotian Wind Inc.
TAFL	Technical and Administrative Frequency Lists
UTM	Universal Transverse Mercator
VEC	Valued Ecosystem Component
WAM	Wet Areas Mapping
WEB AG	WEB Windenergie AG
WEB N.A.	WEB Wind Energy North America Inc.
WHMIS	Workplace Hazardous Materials Information System

1.0 PROJECT INFORMATION

1.1 Project Introduction

Scotian WindFields Inc., Scotian Wind Inc., and WEB Wind Energy North America Inc. (WEB N.A.) have proposed to develop a 4.0 MW wind project in the community of Renfrew, Nova Scotia. The Nine Mile River Community Wind Project (the Project) has been developed in support of Nova Scotia's "Renewable Electricity Plan: A Path to Good Jobs, Stable Prices and a Cleaner Environment" (Renewable Electricity Plan) (NSDE 2010), which is a strategic plan designed to decrease the province's dependence on carbon-based energy sources (fossil fuels) and move towards greener, more affordable and more reliable sources of electricity. Nova Scotia recognizes the numerous benefits of supporting the development of renewable energy within the province, as currently 82% of the province's energy comes from non-renewable sources, mostly sourced from outside of the province (NSPI 2013). Dependence on fossil fuels increases the vulnerability of Nova Scotians to rising international energy prices, weakens energy security, and takes valuable revenue out of the province (NSDE 2010). Negative impacts to human health, particularly in developing countries, and the environment, mainly in the form of climate change, are among the widely cited problems associated with fossil fuel consumption around the world.

In its most recent assessment report, "Climate Change 2007 - Impacts, Adaptation and Vulnerability", the United Nations Intergovernmental Panel on Climate Change provides a detailed synopsis of the impacts associated with climate change on both global and regional scales. Evidence from all continents indicates that many biological systems and habitats are currently being affected by regional climate change. Ecological changes include: changes to the thermal dynamics and quality of aquatic habitats; shifts in migratory timing and ranges of fauna and flora; changes in fish abundance; and increased risk of extinction and loss of forest habitat (IPCC 2007).

Canadian climate experts acknowledge that the debate has largely evolved from questions about the reality and causes of climate change, to what actions can be taken to adapt to the realities of a changing climate. As the second most important and fastest growing (along with solar) renewable energy source in Canada (NRCan 2009), wind energy is a critical component of Canada's renewable energy strategy. Wind energy is emission-free with every megawatt of wind energy generated reducing greenhouse gas emissions by as much as 2,500 tons per year, and improving air quality (NSDE 2009).

The goal of Nova Scotia's Renewable Electricity Plan is to gradually transition the province to local, renewable energy sources, including wind, tidal and solar technologies. To reach this objective, the province has set a commitment of 25% renewable energy by 2015, and 40% by 2020 (NSDE 2010). The plan encourages the participation of community-based organizations in this opportunity, through the incorporation of the community-based feed-in tariff (COMFIT) program. Numerous benefits can be expected from the transition to renewable energy, and may include:

- Long term stability in energy prices;
- Long term security in locally-sourced energy supply, and decreased dependence on international markets;
- Creation of jobs and economic opportunities throughout the province;

- Community investment and economic return;
- Protection of human health and the environment;
- Retaining revenue within the province; and
- Educational opportunities for youth and the broader community about renewable energy technology, its benefits, and the role played in Nova Scotia's energy future.

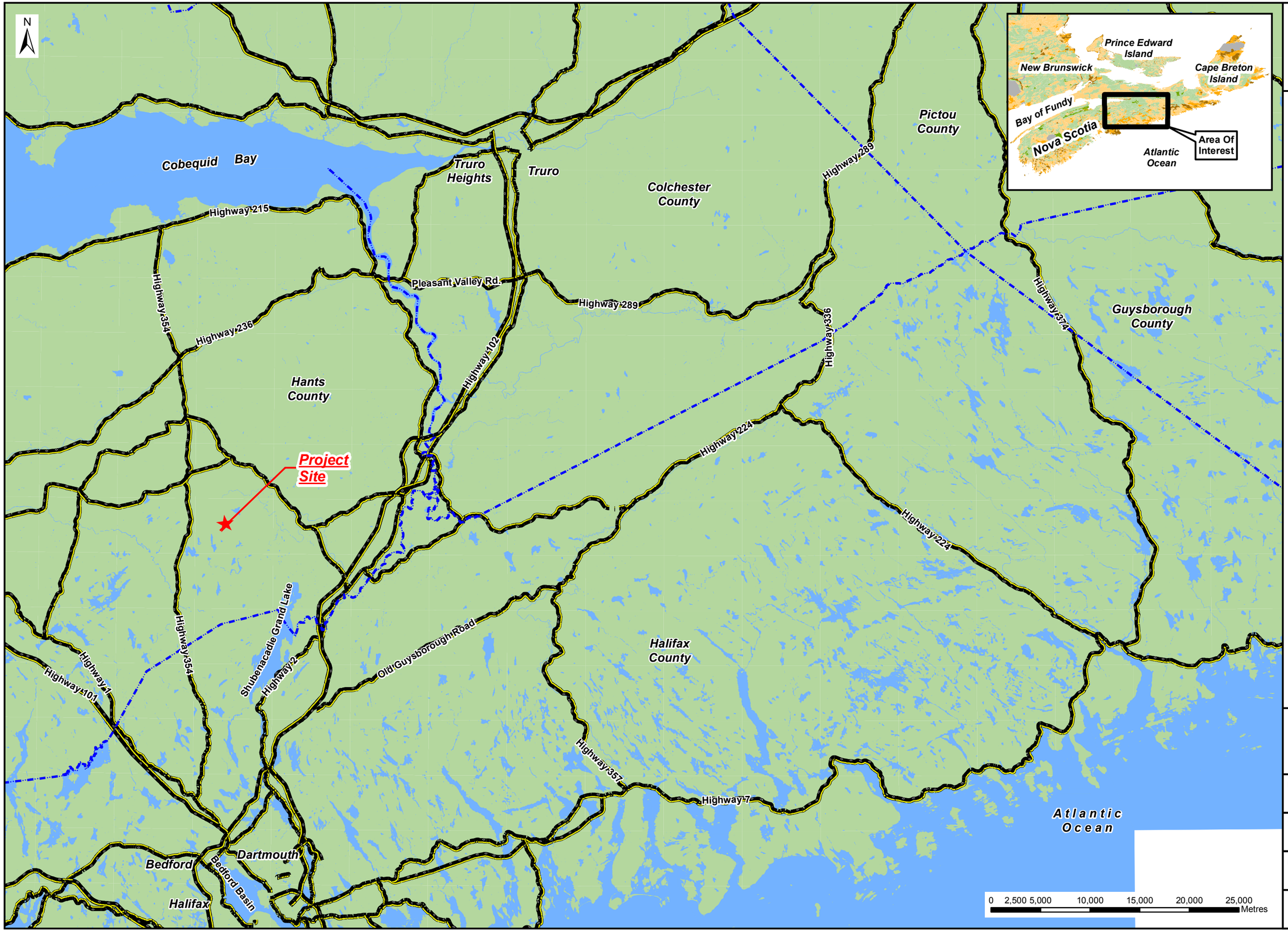
As part of this overall strategy, the Project will contribute to meeting Nova Scotia's renewable energy goals by producing enough green energy to provide 1,100 NS homes with stable, locally-produced renewable energy. The Project is committed to sharing economic opportunities with the local community, throughout the development and life-span of the Project via job creation, tax revenue, and the creation of a community dividend. No public funding is required for this Project.

1.2 Project Summary

This section of the Environmental Assessment (EA) report provides a summary of the Project, description of the proponent, and regulatory requirements. The structure of the overall document and the investigators and authors involved are also provided.

Table 1.1: Project Summary

General Project Information	Scotian WindFields Inc. (SWFI), Scotian Wind Inc. (SWI), and WEB N.A. intend to construct and operate a 4 MW wind project (the Project) at a site in the community of Renfrew, Nova Scotia.
Project Name	Nine Mile River Community Wind Project
Proponent Name	SWFI, SWI, and WEB N.A.
Proponent Contact Information	Scotian WindFields Inc. and Scotian Wind Inc. Dan Roscoe 108F Trider Crescent Dartmouth, NS B3B 1R6 Phone: 902.468.3132 Fax: 902.468.3002 Email: droscoe@scotianwindfields.ca WEB Wind Energy North America Inc. Detlef Krollpfeiffer 480 University Ave, Suite 1500 Toronto, ON M5G 1V2 Phone: 647.367.0930 Email: dk@webwindenergy.com
Project Location	• The Project site is located in the community of Renfrew, approximately 13 km northwest of Enfield, Nova Scotia in the Municipality of the District of East Hants (Drawing 1.1). • The approximate center of the Project site is located at 45°1'28"N, 63° 39'27"W. • Project study area includes Property Identification Numbers (PID) 45151719, 45164233, and 45392701.
Landowner(s)	Elmsdale Lumber Company Ltd.
Closest distance from a turbine to a permanent/seasonal structure	>1,300 m (Turbine 2)
Expected rated capacity of proposed project in MW	4 MW



Notes:

1. Reference: Digital Topographic Mapping By Nova Scotia Geomatics Centre.
2. Projection: NAD83(CSRS), UTM Zone 20 North.

Legend:

- County Boundary
- Major Roads and Highways

Site Location

Strum CONSULTING

Date: October 2013	Project #: 12-4550
Scale: 1:350,000	Drawing #: 1.1
Drawn By: H. Serhan	
Checked By: M. Henley	

1.3 Proponent Description

SWFI is a Nova Scotia based, owned and operated company whose primary mandate is to develop investment opportunities in renewable energy from funds raised within Nova Scotia. Approximately 36% of the shares in SWFI are held by community Wind Fields, community-owned investment funds covering the entire geographical region of the province. These Community Economic Development Investment Funds (CEDIF) provide the opportunity for Nova Scotia citizens to invest in and provide renewable energy to the province.

WEB N.A. is a wholly owned subsidiary of WEB Windenergie AG (WEB AG). WEB AG is a publicly traded Austrian-based renewable energy company with experience in complete life cycle wind energy development and operation. The company has been involved in planning, developing, financing, constructing and operating renewable energy projects in Austria, Germany, France, Italy, Czech Republic and Canada. WEB AG operates, and has 100% ownership, of over 153 wind energy plants, some of which have been in operation for 17 years. Comprising a total capacity of more than 260 MW, WEB AG is seeking to grow its core business within Europe and North America. WEB AG adds significant value to the Project team through their exceptional experience in the wind energy industry, as well as their financial capabilities with their group of more than 3,300 shareholders and access to financing.

SWI was formed to be the COMFIT eligible entity, to raise local investment in community-based wind energy projects, and to assist in the community engagement part of the development process. SWI will obtain CEDIF status as part of this process. SWI is currently owned by a broadly distributed group of locally based shareholders, which includes four other CEDIF entities.

1.4 Regulatory Framework

1.4.1 Federal

A federal EA is not required for the Project as it is not located on federal land or listed as a physical activity that constitutes a "designated project" as listed under the Regulations Designating Physical Activities of the *Canadian Environmental Assessment Act (CEAA) (*2012*).*

Additional federal requirements are provided in Section 11.2 and 16.0.

1.4.2 Provincial

The Project is subject to a Class I EA as defined by the Environmental Assessment Regulations under the *Nova Scotia Environment Act (*NS*EA)*. As such, the proponents are required to register the Project with Nova Scotia Environment (NSE) and subsequently comply with the Class I registration process as defined by the document “A Proponent’s Guide to Environmental Assessment” (NSE 2009a).

The use of provincial roads during the construction, operation, and decommissioning phases of the Project will be in compliance with the “Nova Scotia Temporary Workplace Traffic Control Manual” (NSTIR 2009).

Additional provincial permits will be required as outlined in Section 16.

1.4.3 Municipal

Land use by-laws exist in the Municipality of the District of East Hants, which require approval for wind power projects. This Project will require submission of a Large Scale Wind Turbine (LWT) development application. The Municipality of East Hants Land Use By-law outlines application requirements, as well as several setbacks and guidelines (Appendix A).

All required municipal permits (Section 16) and approvals will be obtained prior to construction.

1.5 Structure of Document

Table 1.2 outlines the content of each section of the EA report.

Table 1.2: EA Report Structure

Section	Content
Section 1	Project Information
Section 2	Project Description including an overview of Project location, activities and schedule
Section 3	Project Schedule
Section 4	General Environmental Mitigation/Best Practices
Section 5	Environmental Management
Section 6	Project Scope
Section 7	EA Methodology
Section 8	Biophysical Environment
Section 9	Socio-Economic Environment
Section 10	Cultural and Heritage Resources.
Section 11	Other Considerations
Section 12	Consultation and Engagement
Section 13	Effects Assessment
Section 14	Effects of the Environment on the Project
Section 15	Cumulative Effects Assessment
Section 16	Other Approvals
Section 17	Conclusions
Section 18	References

1.6 Author of the Environmental Assessment

This EA was completed by Strum Consulting, an independent, multi-disciplinary team of consultants with extensive experience in undertaking EAs across Atlantic Canada and internationally. This report was prepared and reviewed by:

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2.0 PROJECT DESCRIPTION

2.1 Turbine Specifications

The Project will be powered by two wind turbines, rated at 2.0 MW each, for a nominal capacity of 4.0 MW in total. Under normal conditions the turbines will operate 24 hours per day, 7 days per week. The Vestas V100 has been selected as the turbine model for the Project. Specifications are provided in Table 2.1.

Drawing 2.1 provides the turbine and access road layout.

Table 2.1: Turbine Technical Specifications Vestas V100

Turbine Component	Vestas V100 Specifications
Rated capacity	2 MW
Cut – in wind speed	3.0 m/s
Cut – out wind speed	20.0 m/s
Rated wind speed	12.5 m/s
Number of blades	3
Diameter	100.0 m
Swept area	7,850 m^2
Rotor speed (variable)	8.8 – 14.9 rpm
Tower (hub) height	95 m
Generator	Synchronous, permanent magnet, liquid-cooled
Yaw system	6 electric gear motor(s)
Control system	Vestas

2.2 Project Phases

The proposed Project will include three phases: site preparation and construction; operations and maintenance; and decommissioning. Activities and requirements associated with each phase are discussed in the following sections. Standard environmental mitigations that have been incorporated into the Project design are presented in Section 4.0.

N

Nine Mile River

C.P.Thompson Rd

Highway 414

Blois Rd

Abdelghani Dr

Old Barr Rd

Hogan Rd

Easy St

Old Renfrew Rd

Renfrew Rd

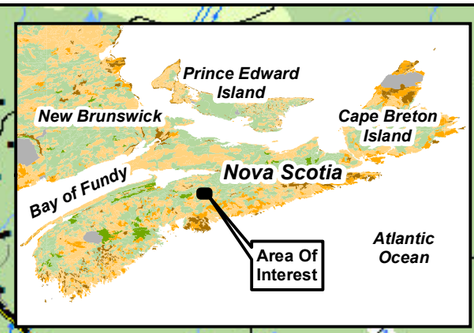
Allens Lake

Old Renfrew Rd

Nine Mile River

1

2



0 125 250 500 750 1,000 1,250 Metres

Notes:

1. Reference: Digital Topographic Mapping by Nova Scotia Geomatics Centre.
2. Projection: NAD83(CSRS), UTM Zone 20 North.

Legend:

- Proposed Turbine
- Proposed Access Road
- Project Site Boundary
- Building
- Major Roads and Highways
- Roads
- Access Roads / Trails
- Existing Transmission Lines
- Large Structure
- Mapped Stream
- Indefinite Stream
- Water Bodies
- Mapped Wet Area
- Cleared Area

Turbine and Road Layout

Strum CONSULTING

Date:	Project #:
October 2013	12-4550
Scale: 1:25,000	Drawing #: **2.1**
Drawn By: H. Serhan	
Checked By: M. Henley	

2.2.1 Site Preparation and Construction

Services required prior to and during construction include, but are not limited to:

- Staging and storage facilities;
- Temporary offices;
- Laydown areas for construction and maintenance equipment;
- Temporary sanitary facilities;
- Water and rinsing facilities;
- Utilities and communications; and
- Garbage collection and off-site disposal.

Site preparation activities include:

- Land surveys for placement of roads, turbines, and associated works;
- Geotechnical investigations;
- Placement of erosion and sedimentation control measures; and
- Clearing of trees and grubbing areas for construction.

General construction activities include:

- Access road upgrading and construction;
- Laydown area and turbine pad construction;
- Transportation of turbine components;
- Turbine assembly;
- Grid connection;
- Removal of temporary works and site restoration; and
- Commissioning.

Weather constraints may affect the proposed schedule and weather dependent activities (*e.g.,* turbine delivery construction) which have been scheduled to occur during optimal time frames to minimize delay. For example, the delivery of the turbine pieces will occur outside of the spring weight restrictions, which are pursuant to Subsection 20(1) of Chapter 371 of the Revised Status of Nova Scotia, *The Public Highways Act (*1989*).*

Equipment needs will likely include:

- Light trucks;
- Drilling rigs;
- Backhoes; and
- Bunch feller (and similar harvesting equipment).

Access Road Construction

Approximately 7.2 km of the existing Renfrew Road will be used to access the Project site. The detail design phase of the Project will determine which portions of the road will require upgrades or modification. Approximately 300 m of new road construction is required to provide direct access to

the turbines. The new access road is expected to be constructed to a standard carriageway width of 6 m; plus shoulders sloped at a ratio of 2:1. There will be areas where the road width could increase to 8 to 10 m to accommodate cut and fill areas and/or wide turns. Conversely, areas of flat straightaways can allow for a road surface as narrow as 4.5 m.

During the construction phase, the Project roads will be maintained with additional stone or periodic grading. Any material removed for road construction will be stored or disposed of in accordance with regulations and best practices for road construction. Any material stored on-site will be accompanied with appropriate erosion and sedimentation control measures, or re-used.

The following equipment is typically used during road upgrading and construction:

- Excavators;
- Dump trucks;
- Bull dozers;
- Rollers;
- Graders;
- Crusher; and
- Light trucks.

Laydown Area and Turbine Pad Construction
General activities during the creation of the laydown and turbine pad construction areas may include:

- Installation of erosion and sedimentation control measures;
- Removal of vegetation;
- Removal of overburden and soils;
- Blasting/chipping of bedrock (to be determined);
- Pouring and curing of concrete pads (complete with reinforcing steel);
- Placement of competent soils to bring area to grade;
- Compaction of soils; and
- Excavation for electrical conduits and fibre optic communication trenches.

The tower foundations will be approximately 15 m diameter (typical for a 2 MW wind turbine) and extend to a depth of 3 m below grade.

Each turbine laydown area is expected to be approximately 100 m x 100 m. The exact arrangement of each turbine pad and crane pad will be designed to suit the specific requirements of the turbine and the surrounding topography during the detailed design process.

The construction of a typical turbine pad (from clearing to final preparation for erecting of the turbine) can take between 1 to 4 months, depending on weather, soil, and construction vehicle access.

The following equipment may be used for the laydown area and turbine pad construction:

- Excavators;

- Dump trucks;
- Bull dozers;
- Rollers;
- Graders;
- Crusher (not required if a local quarry can supply gravel sizes);
- Concrete trucks;
- Light cranes; and
- Light trucks.

Transportation of Turbine Components
A detailed transportation study will be completed by the turbine supplier as part of the design phase to determine appropriate routes and means for equipment and materials to be delivered to Project site. It is anticipated that as many resources and components as possible will be purchased from local suppliers and manufacturers. Upon completion, the study will be provided to NSTIR for review and comment.

The following permits are expected to be required:

- Work Within Highway Right of Way Permit: required if removing access signs and guard rails.
- Overweight Special Moves Permit from Service NS and Municipal Relations: to transport oversized and overweight components. In some cases, due to the size and weight of the components, some may only be transported on Sundays.
- Road weight restrictions, especially Spring Weight Restrictions, for heavier equipment and materials that will be transported to the Project site.
- Access points will be designed with proper height and width to accommodate large trucks and will adhere to commercial stopping sight distances.

The transportation route is expected to require a few slight road modifications, mostly involving the removal of signage and guardrails. To mitigate any negative effects on motorists where modification is required, a notice will be placed in public areas to inform local residents of signage removal or road infrastructure alterations. Removed signage and guardrails will be immediately replaced and appropriate temporary signage will be provided as necessary to ensure travelling public safety. Upgrades will also be made to roads and overhead wires, branches, and signs if conflicts arise. For areas requiring modifications, these will be completed to relevant specifications and any areas requiring reinstatement will also be completed as requested.

To the extent possible, transportation through Halifax will avoid high traffic times (*e.g.*, 7-9 am and 3-6 pm; Monday to Friday). All travel will be conducted using safe work practices for transporting oversized loads.

Transport of equipment will be via a minimum number of vehicles to minimize impacts to road-way flow and impacts on air quality due to exhaust.

During the Project's construction phase, trucks and other vehicles will be frequently visiting the Project site resulting in increased vehicular sound. To mitigate this effect, vehicles will only be visiting and working on-site during normal daytime hours of operation and will avoid high-traffic times of day to reduce local traffic congestion.

Turbine Assembly
The wind turbine assembly includes tower sections, the nacelle, the hub, and three-blade rotors (*i.e.,* a total of eight major components). All sections will be delivered by several flatbed trucks and the pieces will require a crane for removal from the vehicle at each of the prepared turbine pads.

The tower sections will be erected in sequence on the turbine foundation, followed by the nacelle, hub, and rotors. Rotors are usually attached to the hub on the ground prior to lifting. This assembly will occur with the use of cranes. Erection will depend on weather, specifically wind and lightening conditions. Typical assembly duration should be between 2 to 5 days.

The following equipment is expected to be used for turbine assembly:

- Main crane unit (up to 400' high in some cases);
- Assembly cranes; and
- Manufacturer's support vehicles.

Grid Connection
Electricity produced by this Project will be fed into the local distribution-level grid. Standard three-phase power lines will be constructed from the Project site to the existing lines that follow the Highway 14 corridor; connecting between Upper and Lower Nine Mile River. This circuit connects to a substation located in Elmsdale and will supply power to the Elmsdale, Enfield, Gays River, Shubenacadie, Nine Mile River, Kennetcook and Noel areas.

The following equipment is expected to be used during the grid connection process:

- Excavator and/or back hoe;
- Bucket trucks;
- Light cranes; and
- Light trucks.

Removal of Temporary Works and Site Restoration
Once construction has been completed, all temporary works will be removed and the site will be appropriately graded.

The following equipment is expected to be used this process:

- Excavator and/or back hoe;
- Grader;
- Hydroseeder; and
- Light trucks.

Commissioning
The turbines will undergo a series of tests for mechanical, electrical, and controls prior to unit start-up sequence. Once the start-up sequence has been initiated, another series of performance checks for safety systems will be completed. When the turbines have cleared all tests, the commissioning of the units can begin.

Commissioning will require coordination with Nova Scotia Power Inc. (NSPI) as electrical energy will need to be managed both within the substations and on the transmission line. These performance tests will be completed by qualified wind power technicians and NSPI employees.

Additional testing may also be required for transformers, power lines, and substation components, all of which will be performed by qualified engineers and technical personnel.

2.2.2 Operations and Maintenance
Maintenance will conform to manufacturer equipment specifications, industry best management practices (BMPs), and standard operating procedures.

The life span of the Project is estimated to be a minimum of 20 years. During this time, roads will be used to access the turbines by staff and maintenance personnel. The roads will be maintained with additional gravel and grading, as required. During the winter months, all roads will be plowed, sanded, and/or salted, as required for safe driving and to ensure access in the event of an emergency.

A vegetation management plan will be initiated to ensure that access roads and turbine locations remain clear of vegetation. Timing of vegetation management will depend on site specific conditions.

Due to the potential for public access to the wind farm, signage will be affixed and maintained on all access roads to provide essential safety information such as emergency contacts and telephone numbers, speed limits, and the hazards associated with being within close proximity to the turbines (*i.e.*, ice throw). These signs will be maintained during the life of the Project.

Scheduled maintenance work will be carried out on a periodic basis. Maintenance work may require the use of a variety of cranes for brief periods of time for replacement of blades or other turbine components. The most common vehicle during maintenance work will be light/medium pickup trucks.

2.2.3 Decommissioning
As noted above, the operational life of the Project is estimated to be a minimum of 20 years. Prior to year 20, NSE will be either provided with decommissioning plans or a copy of the new power purchase agreement.

Generally, the decommissioning phase will follow the same steps as the construction phase:

- Dismantling and removal of the turbines from the Project site.

- Removal of the turbine foundations to below grade and reinstatement with top soil to ensure stabilization of the land.
- Removal, recycling (where possible), and disposal of collection system, conductor, and poles with NSPI's permission/cooperation.
- Removal of all other equipment and reinstatement and stabilization of land.

3.0 PROJECT SCHEDULE

Table 3.1 presents the Project schedule from EA registration to Project decommissioning.

Table 3.1: Project Schedule

Project Activity	Timeline
EA Registration	Fall 2013
Follow-up Environmental Studies	2013/2014
Geotechnical Assessment	Fall 2013
Engineering Design	Fall 2013 - Winter 2014
Power Purchase Agreement	Summer 2013
Clearing	Winter 2014
Construction	Summer-Fall 2014
Commissioning	Fall 2014
Operation	Fall-Winter 2014
Decommissioning	TBD

4.0 GENERAL ENVIRONMENTAL MITIGATION

The following general environmental mitigation is considered to be standard practice and will be implemented as part of the Project design. Specific mitigation, monitoring, and follow-up that may be required to address residual environmental effects are discussed in Section 13.

4.1 Clearing and Grubbing

- Environmentally sensitive features will be identified and clearly marked where feasible (*e.g.,* watercourses, wetlands, areas of high archaeological potential).
- All watercourses will be kept free of chips and debris resulting from clearing activities.
- Appropriate erosion and sedimentation controls will be implemented to stabilize the slopes/banks on either side of watercourses and prevent sediment run-off.

4.2 Blasting (if necessary)

- Blasting will be conducted in accordance with provincial legislation and subject to terms and conditions of applicable permits.
- All blasts are to be conducted and monitored by certified professionals.
- Once the location of any required blasting is confirmed and the geotechnical investigation is completed, the need to implement mitigation measures or monitoring programs will be evaluated.
- If required, all protective measures will be outlined in the Environmental Protection Plan (EPP) and approved by NSE in advance of blasting activities.
- Landowners will be notified of any blasting activities

- Following any blasting or disturbance of soils or bedrock, exposed soils or bedrock will be recovered with soil and re-vegetated as required to minimize any exposure.
- Blasting near watercourses will only occur in consultation with Fisheries and Oceans Canada (DFO), and will follow the requirements of the *Fisheries Act* (1985) as well as the requirement of the DFO Factsheet: "Blasting – Fish and Fish Habitat Protection" (DFO 2010a); and/or the DFO "Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters" (Wright and Hopky 1998), as applicable.
- If sulphide bearing materials are identified through pre-construction geotechnical surveys, these areas will be referenced in the EPP.
- Rock removal in known areas of elevated potential will conform to relevant legislation (*e.g.,* the Sulphide Bearing Material Disposal Regulations of the NS*EA*), and in consultation with relevant regulatory departments).

4.3 Transportation

- A notice will be placed in public areas along Renfrew Road to inform local residents of signage removal or road infrastructure alterations. Removed signage and guardrails will be immediately replaced and appropriate temporary signage will be provided as necessary to ensure public safety.
- To the extent possible, transportation of materials through Halifax will avoid high traffic times (7-9 am and 3-6 pm; Monday to Friday). All travel will be conducted using safe work practices for transporting oversized loads. Consideration will be given to transporting turbine blades and other oversized loads at night to avoid high traffic periods and allow lane closures, as necessary, to navigate turns along the route.
- Equipment transport will utilize a minimum number of vehicles to minimize effects to road-way flow and effects to air quality from exhaust.
- Upgrades will be made to roads and overhead wires, branches, and signs if conflicts arise. Modifications and subsequent reinstatement will be completed to NSTIR specifications.

4.4 Avifauna

- Tree clearing activities will be executed in a manner that complies with the *Migratory Bird Convention Act* (*MBCA*) and the *Species at Risk Act* (*SARA*), specifically to avoid incidental take.
- Primary mitigation for avifauna will be through Project planning and scheduling of clearing activities, on a best-efforts basis, to avoid key migratory bird nesting periods.
- Should vegetation clearing be required during nesting periods, searches for migratory bird nests should be undertaken within the area to be disturbed, in consultation with CWS, and all identified nests should be flagged.

4.5 Dust and Noise

- Where required, dust will be controlled by using water or a suitable, approved dust suppressant.
- Construction equipment will be maintained in good working order and properly muffled.
- Noise control measures (*e.g.,* sound barriers, shrouds, enclosures) will be used where warranted.

- Noise-generating construction activities will comply with the requirements of existing by-laws (where applicable) [*e.g.*, A By-Law Relating to the Prevention of Excessive Noise in the Municipality of East Hants (1995)].
- Engine idling will be restricted.

4.6 Erosion and Sedimentation Control

Contractors will use the erosion and sedimentation control measures listed below at all sites where soil or sub-soil has been exposed and there is potential for erosion:

- A site specific erosion and sedimentation control plan will be developed during the design phase of the Project.
- The area of exposed soil will be limited, and the length of time soil is exposed without mitigation (*e.g.,* mulching, seeding, rock cover) will be minimized through scheduled work progression.
- Both temporary and permanent control measures for erosion and sedimentation will be implemented in an appropriate time frame.
- Erosion and sedimentation control structures will be maintained and inspected regularly with particular emphasis before and after forecasted heavy rain events, and with consideration of the timing and types of activities involved.
- Existing roads and access routes will be used to the extent feasible.
- With the exception of temporary water crossing locations, travel through wetlands and within watercourse buffers with machinery will be avoided, when feasible. If travel through a wetland is required, the appropriate mitigation measures will be employed, (*e.g.,* geotextile matting, work timed to occur during frozen ground conditions, and travel routed through drier portions of the wetland).
- Care will be taken to ensure that the potential for surface run-off containing suspended materials or other harmful substances is minimized.
- Where necessary, erosion and sedimentation control measures will remain in place after work is completed, areas have stabilized, and natural re-vegetation occurs. All temporary erosion and sedimentation control materials will eventually be removed from the construction site.
- Permits/approvals related to site construction will be kept on-site.

4.7 Wetlands

- Wetlands will be avoided to the extent possible. Where unavoidable, wetland crossings/alteration will be completed in accordance with the Nova Scotia Wetland Conservation Policy and the wetland alteration application process during the permitting stage of the Project.
- Crossing of wetlands will not result in permanent diversion, restriction or blockage of natural flow, such that hydrologic function of wetlands will be maintained.
- Run-off from construction activities will be directed away from wetlands.
- Any wash water from the cleaning of construction vehicles will be disposed of on-site, using standard industry practices and following environmental regulations/guidelines for the protection of wetlands.

- Work vehicles and/or heavy equipment will be cleaned and inspected prior to use to prevent the introduction of weed/invasive/non-native species to sensitive habitats such as wetlands.

4.8 Dangerous Goods Management

- All fuels and lubricants used during construction will be stored according to containment methods in designated areas, located a minimum 30 m from surface waters and wetlands.
- Where possible, refueling in the field will not occur within 30 m of watercourses, water bodies or wetlands.
- Storage of all hazardous materials will comply with Workplace Hazardous Materials Information System (WHMIS) requirements. Appropriate material safety data sheets will be located at the storage site.
- Transportation of dangerous goods will comply with the *Transportation of Dangerous Goods Act* (1992).
- Equipment will be kept in good working order, will be inspected regularly, and any observed leaks will be repaired.

4.9 Waste

- Solid wastes, including waste construction material, will be disposed of in approved facilities.
- Temporary on-site storage of waste materials will be located at least 30 m from known watercourses, wetlands, and water bodies.
- Waste materials will be removed from the site by a qualified waste hauler and disposed/recycled in accordance with provincial waste regulations. All applicable materials will be stored as per WHMIS requirements and transported as per requirements of the *Transportation of Dangerous Goods Act* (1992).

4.10 Excavation and Site Reinstatement

- All soils removed during the excavation phase will be stored according to provincial regulations and best practice guidelines.
- Any soil needed for backfilling, after foundations have been poured, will be stored temporarily adjacent to the excavations until needed. Any remaining excavated material will be used on-site or removed and sent to an approved facility.
- Prior to excavation activities, erosion and sedimentation control measures will be deployed and assessed on a regular basis.
- Once backfilled material has stabilized, temporary erosion and sedimentation controls will be removed. Attention will be paid during site reinstatement to ensure areas will promote wildlife return to the area, to the extent possible.

4.11 Watercourse Crossings

- Any watercourse crossings required will comply with existing regulatory requirements.
- Crossing of watercourses will not result in permanent diversion, restriction, or blockage of natural flow.
- Crossings will be restricted to a single location on a watercourse and occur at right angles to the watercourse or wetland.
- Crossings should be located in areas which exhibit a stable soil type and where grades approaching the crossings will not be too steep.

- The approaches to watercourse crossings will be stabilized with brush mats, where necessary. Stream banks prone to erosion may require additional stabilization. Material used to stabilize/repair stream banks will be clean, non-erodible, and will not come from the stream bank or bed.
- Any wash water from the cleaning of construction vehicles will be disposed of on-site, using standard industry practices and following environmental regulations/guidelines for the protection of watercourses.

5.0 ENVIRONMENTAL MANAGEMENT

5.1 Environmental Protection Plan

An EPP will be developed following EA approval of the Project. The EPP will be approved by NSE prior to start of construction of the Project and will detail best practices and mitigative measures to be employed during construction to minimize potential environmental impacts. The EPP document is the primary mechanism for ensuring that mitigation is implemented, as determined through the EA process, to avoid or mitigate potential adverse environmental effects that might otherwise occur from construction activities, and as required by applicable agencies through permitting processes.

The EPP is a plan for all Project personnel, including contractors, and describes the responsibilities, expectations, and methods for environmental protection associated with Project activities. The EPP will incorporate:

- means to comply with requirements of relevant legislation;
- environmental protection measures identified as part of the EA; and
- environmental commitments made as part of the EA.

A suggested Table of Contents for the EPP is provided in Appendix B.

6.0 PROJECT SCOPE

As a Class 1 EA, this registration document and supporting studies have been developed to meet all requirements under Section 9(1A) of the NS*EA.*

In addition, the document has been prepared using the following provincial guidelines:

- “A Proponent’s Guide to Wind Power Projects: Guide for preparing an Environmental Assessment” (NSE 2012a); and
- “A Proponent’s Guide to Environmental Assessment”, published by the Environmental Assessment Branch of NSE and revised in 2009 (NSE 2009a).

The following regulatory bodies have been contacted by the Project team to provide input into the Project planning process and advice regarding the EA scope:

- Canadian Wildlife Service (CWS);
- Nova Scotia Department of Communities, Culture and Heritage;

- NSE; and
- Nova Scotia Department of Natural Resources (NSDNR).

During the EA review process, additional consultation may be required with these and other agencies.

6.1 Site Sensitivity

Potential wind farms are assigned a category level, according to a matrix provided in "A Proponent's Guide to Wind Power Projects" (NSE 2012a). This matrix considers the overall Project size and the sensitivity of the Project site to determine the category level. The category level then outlines guidance with respect to the collection of baseline data for the EA, as well as post-construction monitoring requirements.

As the Project consists of two turbines, it is considered a small project. Based on the known existence of five bird species ranked 'Red' by NSDNR; and the presence of a bat hibernaculum less than 25 km from the Project site, the Project is classified as having a 'Very High' potential sensitivity. Overall, the Project is has therefore been determined to be a Category 4.

6.2 Assessment Scope

EA is a planning tool used to predict the environmental effects of a proposed project, identify measures to mitigate adverse environmental effects, and predict whether there will be significant adverse environmental effect after mitigation is implemented.

The EA focuses on specific environmental components called valued environmental components (VECs). VECs are specific components of the biophysical and human environments that, if altered by the Project, may be of concern to regulatory agencies, Aboriginal peoples, stakeholders, resource managers, scientists, and/or the general public. VECs incorporate biological systems as well as human, social, and economic conditions that are affected by changes in the biological environment. As such, VECs can relate to ecological, social, cultural, or economic systems that comprise the environment as a whole.

The scope of the assessment for this Project includes: selection and preliminary assessment of potential interactions; identification of VECs; identification of environmental effects; and identification of the standards or thresholds that are used to determine the significance of residual environmental effects. This scoping relies upon direction from regulatory authorities; consideration of input from stakeholders; and the professional judgment of the Project team.

6.3 Spatial and Temporal Boundaries of the Assessment

For this Project, unless otherwise identified, the assessment of effects was undertaken for the area identified as the Project site (Drawing 2.1). For the purpose of data collection and the socio-economic environment, the Municipality of the District of East Hants was considered. In addition, residences located within a 2 km buffer of the Project site were assessed as potential receptors for the purposes of evaluating potential impacts from sound.

The temporal scope of this assessment covers the construction, operation, and decommissioning phases of the Project, and associated activities, as described in Sections 2.2.1, 2.2.2, and 2.2.3. Accidents, malfunctions, and unplanned events are addressed separately.

6.4 Site Optimization

As part of the Project planning process, a detailed constraints analysis was conducted to ensure that potential effects to the environment and neighboring residents were minimized. This analysis was continually updated and refined based on the results of Project specific desktop studies, modeling, and field assessments. As a result, several layout iterations were reviewed to reflect a growing knowledge of the Project site and surrounding community. Specifically, layout modifications were incorporated into the planning process in consideration of the following:

- Sighting within an optimal wind regime;
- Avoidance of interference with telecommunication and radar systems;
- Maintenance of a vegetated buffer between turbine locations and field identified watercourses;
- Avoidance of lakes, or other visible open water bodies as identified in 1:50,000 provincial mapping;
- Maintenance of a minimum 30 m (from tip of blade) buffer between turbine locations and field identified wetlands (NSE standard);
- As requested by NSDNR, larger buffer distances (*i.e*., 70 m from tip of blade) have been incorporated into the Project design where a species of conservation interest (SOCI) has been identified during breeding season within a wetland;
- Avoidance of known protected areas, field identified archaeological resources, significant habitats, wildlife sites, provincial parks or reserves;
- Avoidance of Mi'kmaq resources;
- Maintenance of a minimum 550 m setback (NSE standard) between turbines and occupied dwellings, cottages, camps, daycares, hospitals, and schools; and
- Predictive sound modeling results to meet NSE standards (*i.e.,* 40 dBA for dwellings, daycares, hospitals, and schools).

In addition to the general planning "constraints" and minimum setbacks mentioned above, the Project site and associated layout offers considerable development and ecological advantages that were incorporated into the Project design to minimize potential effects to surrounding land uses, local residents and environmental features. These include:

- Accommodation of a large residential setback of over 1.3 km, well in excess of the NSE standard;
- Development at site that has been previously disturbed by forestry activities (*i.e*., tree clearing and logging trails/roads throughout the Project site);
- Incorporation of 7.2 km of existing roads into the Project design, resulting in minimal (*i.e*., 300 m) overall new road disturbance impacts and clearing requirements;
- No wetland or watercourse alterations required at turbine locations;
- No new wetland or watercourse crossings associated with roads and most minor alterations associated with road upgrades will improve hydrological function and connectivity, as old and

often clogged or collapsed culverts will be repaired or replaced, as required. As new field data became available, the road layout underwent modifications to specifically avoid new crossings; and
- Accommodation of a buffer distance between turbines and field identified watercourses in excess of 100 m.

This siting exercise resulted in the current turbine locations used for this EA.

7.0 ENVIRONMENTAL ASSESSMENT METHODOLOGY

The methodological framework used in this EA has been developed to meet the requirements of the N*SEA*. This framework is based on a structured approach that:

- focuses on issues of greatest concern;
- considers Aboriginal concerns as well as concerns raised by the public and other stakeholders; and
- integrates mitigative measures into Project design.

The methodology provides an overview of the baseline conditions and an assessment of VECs that reflect key issues of concern. Within the specified spatial and temporal boundaries, the potential for interaction between individual VECs and Project activities are determined. Where there is potential for Project-related environmental effects, each effect is assessed using the results of preliminary investigations, guidance from regulators, and the collective knowledge and expertise of the Project team. The residual Project-related environmental effects, (*i.e.*, after mitigation has been applied), are characterized using specific criteria (direction, magnitude, geographic extent, duration, frequency, and reversibility) that are applied to each VEC. The significance of these residual effects is then determined based on pre-defined and VEC-specific thresholds.

Project-related environmental effects are assessed and include potential interactions; mitigation and environmental protection measures proposed to reduce or eliminate adverse environmental effects; and the characterization of the residual environmental effects of the Project. The ultimate focus of the assessment is on residual environmental effects that remain after planned mitigation has been applied.

7.1 Preliminary VEC Selection

A preliminary assessment of potential interactions between selected environmental components and the Project was undertaken to identify VECs. This preliminary assessment is summarized in Table 7.1. For some of the identified environmental components, additional information has been provided in the report. Many of the interactions can be addressed using industry BMPs and adhering to existing regulations to mitigate potential effects. Where environmental BMPs and regulations are considered to be insufficient to fully mitigate potential effects, or where additional information is required, the components are identified as VECs and are therefore subject to further assessment in Section 13.0. Specific environmental requirements and mitigation practices are identified in the effects assessment and will be refined in subsequent environmental regulatory permitting processes.

Table 7.1: VEC Selection Table

Environmental Component	Description	Assessed further?	Applicable Section in the Report
Atmospheric Environment	Atmospheric environment includes consideration of air quality and climate conditions. Concerns include: • Dust generation from construction and operation activities. • Interaction with air quality due to exhaust emissions, including greenhouse gas emissions from Project equipment and vehicles during construction and operation. Only minimal amounts of dust and air emissions are expected. Mitigation for these potential effects is provided in Section 4. Project-related emissions are anticipated to be temporary, localized, and minor in nature. Measurable changes to the atmospheric environment are not expected.	No	Section 8.1
Geophysical Environment	Geophysical components include consideration of hydrogeology, groundwater, and bedrock and surficial geology. Concerns include: • Damage from blasting to domestic water sources. • Localized disturbances to surface soils and shallow bedrock. • Potential for acid rock drainage (ARD) at the site. Once the location of any required blasting is confirmed and the geotechnical investigation is completed, the need to implement mitigation measures or monitoring programs will be evaluated. The likelihood of ARD to occur at the site is considered low, but will be determined following the results of the geotechnical evaluation. If ARD is found to be present, it will be handled in accordance with the Sulphide Bearing Material Disposal Regulations under the NS*EA*. Project-related effects on the geophysical environment are anticipated to be temporary, localized, and minor in nature. Measurable changes to the geophysical environment are not expected.	No	Section 8.2

Environmental Component	Description	Assessed further?	Applicable Section in the Report
Freshwater Environment	Freshwater environments involve consideration of fish and fish habitat and water quality which may be impacted by watercourse crossings, erosion and sedimentation etc. Concerns include: • Loss or damage to fish habitat. • Decreased water quality. • Mortality of aquatic species. It is expected that watercourse crossings will be required along access roads (refer to Section 8.3.3). All construction activities near watercourses will comply with the applicable regulations and guidelines. Additional mitigation is described in Section 4. Project-related effects on the freshwater environment are anticipated to be temporary, localized, and minor in nature. Measurable changes to the freshwater environment are not expected.	No	Section 8.3
Terrestrial Habitat, Flora and Fauna (including wetlands)	Terrestrial habitat involves consideration of general and specialized terrestrial habitats, such as wetlands, as well as terrestrial flora and fauna *(Note: Birds and rare species have been considered separately)*. Concerns include: • Habitat fragmentation. • Introduction of invasive species. • Damage to wetland ecosystems. • Mortality of some smaller faunal species due to clearing activities. • Loss of vegetation and effects to fauna and flora species due to herbicide application (vegetation management). Habitat fragmentation is considered to be minimal due to the small-scale clearing required. Environmental protection practices will be incorporated into clearing and grubbing activities as described in Section 4. Mitigation to control and prevent the introduction of invasive species is provided in Section 4 and will be included as part of the Project Vegetation Management Plan. Herbicides and pesticide use is not expected. Avoidance of wetland habitat has been taken into consideration in Project planning and design including access roads and placement of turbines. Additional mitigative measures provided in Section 4 will be employed to protect wetland habitat. It is expected that temporary sensory disturbance to fauna related to the site preparation and construction phases of the Project will not persist in the long-term. Sensory disturbance related to turbine operations will be negligible. Mortality of fauna will be minimal due to the utilization of existing access roads, small scale clearing requirements and attention to seasonal mitigation.	No	Section 8.4, 8.5, and 8.6

Environmental Component	Description	Assessed further?	Applicable Section in the Report
	Project-related effects on the terrestrial environment are anticipated to be temporary, localized, and minor in nature. Measurable changes to the terrestrial habitat and flora and fauna are not expected.		
Species of Conservation Interest (SOCI)	SOCI are those species assessed as being at risk or sensitive to some degree. For the purposes of this EA, SOCI include those species listed as: • "Endangered", "Threatened", or "Special Concern" under *SARA;* and • "Endangered", "Threatened " or "Vulnerable" under the Nova Scotia *Endangered Species Act* (NS *ESA*) Consideration is also given to species: • Ranked as "Red" or "Yellow" under the NSDNR General Status Ranks of Wild Species in Nova Scotia; and • Listed "Endangered", "Threatened", or "Special Concern" by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Based on the above criteria, three fish SOCI, and four fauna SOCI have potential to occur at the Project site. One plant SOCI was also identified at the Project site; however, Project activities will not disturb this species and it is therefore, not considered further in the EA. Concerns include: - Sensory disturbance. - Direct and indirect adverse environmental effects to habitat (loss or alteration). - Effects to fish passage/migration. - Direct mortality of individuals. Loss of terrestrial fauna and aquatic SOCI is considered minimal due to the utilization of existing access roads, small scale clearing requirements, and attention to seasonal mitigation. However, due to special status under federal and provincial federal legislation/guidance, aquatic and terrestrial fauna SOCI are considered further in the assessment as a VEC.	Yes	Sections 8.3, 8.5, 8.6 and 14.2.1
Avifauna	The effects of wind turbines on avifauna are variable and depend on factors such as the development design, topography of the area, habitats affected, and the bird community in the wind farm area. Concerns include: • Mortality resulting from direct collision. • Habitat alteration. • Sensory disturbance. The requirements as set out in the *MBCA* will be adhered to for clearing activities (Section 4). Due to the potential effects of wind turbines on avifauna, this component is considered for further assessment.	Yes	Sections 8.7 and 14.2.2

Environmental Component	Description	Assessed further?	Applicable Section in the Report
Bats	The installation of wind turbines has the potential to impact bats both directly and indirectly. Concerns include: • Mortality resulting from direct collision and/or barotrauma. • Habitat alteration. • Sensory disturbance. The significance of these impacts at the population level depends on a number of biotic and abiotic variables, including the number of individuals affected and the stability of the population, season, physiologic condition of the individuals affected, and weather factors. Due to the potential effects of wind turbines on bat populations, this component is considered for further assessment.	Yes	Sections 8.8 and 14.2.3
Local Economy/Land Use/Recreation and Tourism	Socio-economic aspects such as economy, land use/value, and recreation and tourism may be affected by the Project; however these effects may be positive and/or negative. The Project will likely create more local jobs, increase municipal tax revenues, and provide a community dividend, thereby resulting in a positive change for economy. Impacts to land use are not expected in the area since the Project is located on privately owned land. Research has consistently demonstrated that, in a variety of spatial settings and across a wide temporal scale, sale prices for homes surrounding wind energy facilities are not significantly different from those attained for homes sited away from wind energy facilities. The Project represents a small footprint on privately owned land. Therefore, impacts to the broad recreational/tourism community are not expected. Effects on the socio-economic environment are expected to be positive in nature, or temporary, localized, and minor in nature. Measurable changes to the local economy, recreation and tourism are not expected.	No	Sections 9.1, 9.2, and 9.3
Human Health	The public is often concerned about the potential for impacts to human health from wind turbines. Concerns include: • Sound (addressed as a separate section). • Shadow flicker (addressed as a separate section). • Infrasound. • Electromagnetic fields (EMF). • Effects to air quality from dust and air emissions. • Risk of ice throw. A literature review regarding the potential for impacts to human health from wind turbines was completed (Appendix C). The main findings from this review are as follows: • There is no evidence that the levels of infrasound produced by the turbines present a risk to human health. • There is no discernible evidence that there are health	No	Section 11, Appendix C

Environmental Component	Description	Assessed further?	Applicable Section in the Report
	risks associated with EMFs. • Effects to air quality are expected to be temporary, minor, and localized in nature (refer also to Section 4.4 and to 'Atmospheric Environment', above). • Setbacks and safety awareness measures minimize any potential risk from ice throw. Effects to human health are considered minimal or non-existent due to the size and location of the wind farm, mitigation, and setback distances.		
Cultural and Heritage Resources	If present, cultural and heritage resources may be affected by ground disturbance during construction and decommissioning activities. An Archeological Resource Impact Assessment (ARIA) indicated that no impacts to cultural and heritage resources are expected. Effects to cultural and heritage resources are considered non-existent. Procedures related to potential discovery of archaeological items or sites during construction will be described in the EPP.	No	Section 10
Shadow Flicker	Shadow flicker can occur when rotating blades cast flickering shadows during times of direct sunlight. Shadow flicker is not expected to be an issue since there are no structures present within the expected maximum shadow extent.	No	Section 11.1
Electromagnetic Interference (EMI)	The rotating blades and support structures of wind turbines can interfere with various types of electromagnetic signals emitted from telecommunication and radar systems. An EMI study completed for this Project indicated that there were no objections regarding EMI effects associated with the Project provided to date.	No	Section 11.2
Visual Landscape	Wind farms produce visual effects to the local landscape. A visual assessment was completed for the Project. Predicted view planes generated by the assessment are presented in Section 11.3. Effects to the visual landscape are considered minimal to non-existent due to the size and location of the wind farm and setback distances.	No	Section 11.3

Environmental Component	Description	Assessed further?	Applicable Section in the Report
Sound	Sound is generated during all phases of the wind farm. Concerns include: • Noise during construction and decommissioning phases. • Annoyance and unpleasantness, for local residents in close vicinity, from turbine blades during operation. Construction and decommissioning phases will be short-term. Effects of noise created during these phases are expected to be temporary, minor, and localized in nature. Operational sound effects from the turbines will be long-term; however, predictive modeling indicates that sound levels will not exceed NSE guidelines at any receptor. Effects from sound are considered minimal to non-existent due to the size and location of the wind farm and setback distances.	No	Section 11.4

Based on the preliminary assessment of potential interactions summarized in Table 7.1, the VECs addressed in this EA are as follows:

- SOCI;
- Avifauna; and
- Bats.

8.0 BIOPHYSICAL ENVIRONMENT

8.1 Atmospheric Environment

8.1.1 Weather and Climate

Nova Scotia's climate is quite varied and is largely governed by coastal influences and elevation (Davis and Browne 1996). The Project site (centered at 45°1'28"N, 63° 39'27"W) lies within the Eastern Interior Ecodistrict of Nova Scotia, which encompasses an area from Pockwock Lake in the west to the Town of Guysborough in the east (Neily *et al*. 2003). The climate is conducive to farming and the area has been extensively used for dairy and beef production and the growing of forage and cereal crops, including corn. The typical growing season in the area of the Project site is 196 days (Webb and Marshall 1999).

Local temperature and precipitation data were obtained from the Halifax Stanfield International Airport meteorological station (44°53'00N, 63°31'00.00W) located approximately 19 km southeast of the Project site. For the period from 1971-2000, the mean annual temperature was 6.3°C, with a mean daily high of 11°C and a mean daily low of 1.6°C (EC 2011a). January and February were the coldest months (-6 °C and -5.6°C, respectively), while the warmest months were July and August (18.6 °C and 18.4°C, respectively) (EC 2011a).

From 1971-2000, mean annual snowfall was 230.5 cm and rainfall was 1,238.9 mm (EC 2011a). Most snowfall is received in January and February (54.6 cm and 50.1 cm, respectively), while the rainiest months are October and November (126.4 mm and 133 mm, respectively) (EC 2011a). Environment Canada (EC) measures wind conditions in Nova Scotia at those meteorological stations that are under long term observation. The closest such station to the Project site is the Halifax Stanfield International Airport, mentioned above. The Canadian Climate Normals (1971-2000) for this station indicate an annual wind speed of 16.8 km/h, most commonly out of the south (EC 2011a). The maximum hourly wind speed for this station was 89 km/h, recorded on February 10, 1969, with the highest single wind gust measuring at 132 km/h on December 26, 1976 (EC 2011a). According to the NS Wind Atlas (NSDE 2007), average wind speeds at 30 m and 50 m above the ground at the Project site range from 16.2-21.6 km/h, and range from 19.8-23.4 km/h at 80 m above the ground.

8.1.2 Air Quality

Currently in Nova Scotia, 42% of total greenhouse gas (GHG) emissions come from electricity use and 89% of electricity comes from fossil fuels (NSDE 2009). Because of this heavy reliance on coal and other fossil fuels for electricity, every MW of wind power installed reduces GHG emissions by as much as 2,500 tonnes per year (NSDE 2011). By reducing Nova Scotia's reliance on fossil fuels, wind energy will therefore contribute to improving local air quality (NSDE 2011).

Nova Scotia monitors air quality at six stations throughout the province. Measured parameters include ground-level ozone (O_3), particulate matter (PM2.5), and nitrogen dioxide (NO_2), and these values are used to calculate a score on the Air Quality Health Index (AQHI) (EC 2011b). The AQHI is a scale from 1-10+, in which scores represent the following health risk categories: Low (1-3), Moderate (4-6), High (7-10), and Very High (10+). The AQHI monitoring station closest to the Project site is located at Halifax, approximately 42 km south of the Project site. The AQHI at this site is usually low at all times of the year (EC 2011c).

Mitigation measures for potential effects to the atmospheric environment are provided in Section 4.0

8.2 Geophysical Environment

8.2.1 Physiography and Topography

The Project site lies within the Eastern Interior Ecodistrict of the Eastern Ecoregion (Neily *et al*. 2003). In some areas of this ecodistrict, thin glacial till exposes ridge topography with highly visible bedrock (Neily *et al*. 2003). The Eastern Interior Ecodistrict is underlain by resistant Meguma Group quartzite and slate, with till thickness throughout the ecodistrict ranging from 1-10 m but averaging less than 3 m (Neily *et al.* 2003). Till is predominantly gravely, moderately fine textured, and reddish-brown derived from Carboniferous shale (Webb and Marshall 1999). Lands at the Project site rise to the south from a low of 85 m at the northern Project site boundary to a high of 145 m in the vicinity of turbine 2.

8.2.2 Surficial Geology

The surficial geology of the Project site is characterized as a silty till plain otherwise referred to as ground moraine (Drawing 8.1). The silty, compact material is derived from both local and distant

N

Nine Mile River

C-P-Thompson-Rd

Highway-414

Blois-Rd

Old-Renfrew-Rd

Allens Lake

Nine Mile River

Abdelghani Dr

Old-Barr-Rd

Hogan-Rd

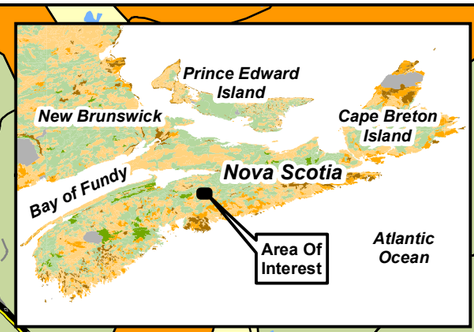
Easy-St

Old-Renfrew-Rd

Renfrew-Rd

1

2



0 125 250 500 750 1,000 1,250 Metres

Notes:

1. Reference: Digital Topographic Mapping By Nova Scotia Geomatics Centre. DP ME 36, Version 2, 2006, Digital Version of Nova Scotia Department of Natural Resources Map ME 1992-3, Surficial Geology Map of the Province of Nova Scotia, scale 1:500 000, by R. R. Stea, H. Conley and Y. Brown, 1992
2. Projection: NAD83(CSRS), UTM Zone 20 North.

Legend:

- Proposed Turbine
- Proposed Access Road
- Project Site Boundary
- Major Roads and Highways
- Roads
- Access Roads / Trails
- Water Bodies

Surficial Geology By Unit

- Alluvial Deposits
- Kame Fields and Esker Systems
- Organic Deposits
- Silty Till Plain
- Stony Till Plain

Surficial Geology

Strum CONSULTING

Date: October 2013	Project #: 12-4550
Scale: 1:25,000	Drawing #: 8.1
Drawn By: H. Serhan	
Checked By: M. Henley	

sources. Till thickness ranges from 3 – 30 m, creating a flat to rolling topography with few surface boulders (Stea *et al.* 1992).

8.2.3 Bedrock Geology

Bedrock geology across the Project site consists of Cambrian – Ordovician aged metamorphic rocks of the Goldenville Formation (Keppie 2000) (Drawing 8.2). This bedrock is typically characterized by thickly-bedded metasandstone with minor interbedded metasiltstone and slate. Directly north of the Project site lies the carbonate/evaporate deposits of the Windsor Group.

According to the NSE Well Log Database (NSE 2011b), there are no drilled wells within a 1 km radius of the Project site. However, six wells were identified within 4 km of the Project site, ranging in depths from 30.5 m to 115.7 m. All six wells were drilled through varying surficial materials including clay, gravel and boulders ranging from 1.5 m to 7.3 m in thickness, followed by quartzite bedrock.

Bedrock containing sulphide bearing minerals (*e.g.,* pyrite, pyrrhotite, etc.) can potentially generate acid run-off if fresh surfaces are exposed to oxygen and water. The physical disruption of such bedrock leads to oxidation of iron-sulphide minerals and the generation of ARD (Fox *et al*. 1997). ARD can result in the acidification of surface and groundwater and promote the mobilization and leaching of toxic contaminants into the environment, including heavy metals. The likelihood of generating ARD within the Project site is low. The Goldenville Formation has been proven to contain only trace sulphide content, and therefore is less likely to contribute to ARD when exposed to oxidizing conditions (Fitzgerald and Goodwin 2004).

8.2.3 Hydrogeology and Groundwater

Groundwater Quantity

Water supplies near the Project site are generally derived from individually drilled or dug wells. A summary of the pertinent (within 4 km of the Project site) well properties included in NSE Well Log Database (NSE 2011b) is presented in Table 8.1.

Table 8.1: Summary of Drilled Well Records

	Drilled Date (yr)	Well Depth (m)	Casing Length (m)	Estimated Yield (Lpm)	Water Level (m)	Overburden Thickness (m)	Water Bearing Fractures (m)
Minimum	1989	30.5	6.1	2.3	1.8	1.5	13.7
Maximum	1998	115.7	11.3	54.5	2.1	7.3	103.7
Average	1993	68.5	7.0	13.8	2.0	4.0	50.2
Geomean	1992	59.5	6.7	7.0	2.0	3.5	41.0
Number of well records	5	5	5	5	2	5	5

Source: NSE 2011b

N

Nine Mile River

C P Thompson Rd

Highway 414

Blois Rd

Old Renfrew Rd

Allens Lake

Nine Mile River

Abdelghani Dr

Old Barr Rd

Hogan Rd

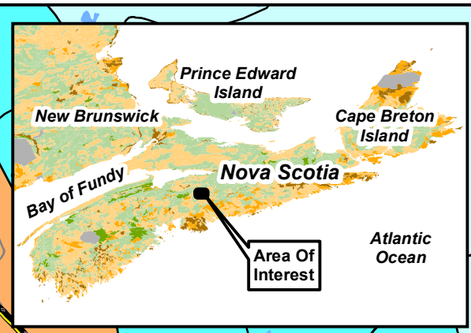
Easy St

Old Renfrew Rd

Renfrew Rd

1

2



Legend:

- Proposed Turbine
- Proposed Access Road
- Project Site Boundary
- Major Roads and Highways
- Roads
- Access Roads / Trails
- Water Bodies

Bedrock Geology By Formation

- Murphy Road, Pesaquid and Green Oaks Formations
- Wentworth Station, Miller Creek, MacDonald Road and Elderbank Formations
- White Quarry, Stewiacke, Carrolls Corner, Macumber and Gays River Formations
- Halifax Formation
- Goldenville Formation

0 125 250 500 750 1,000 1,250 Metres

Notes:

1. Reference: Digital Topographic Mapping By Nova Scotia Geomatics Centre. DP ME 43, Version 2, 2006, Digital Version of Nova Scotia Department of Natural Resources Map ME 2000-1, Geological Map of the Province of Nova Scotia, scale 1:500 000, Compiled by J. D. Keppie, 2000
2. Projection: NAD83(CSRS), UTM Zone 20 North.

Bedrock Geology

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Date: October 2013	Project #: 12-4550
Scale: 1:25,000	Drawing #: **8.2**
Drawn By: H. Serhan	
Checked By: M. Henley	

Based on short term driller's estimates for the wells in Table 8.1, the average yield is approximately 13.8 Lpm (3.6 gpm) and average well depth is approximately 68.5 m (224.7 ft). These measurements represent very short term yields estimated by the driller at the completion of well construction. Fracture depths ranged from 13.7 m (44.9 ft) to 103.7 m (340.1 ft). The closest drilled well to the Project site is located along Highway 354, approximately 3.2 km from the nearest turbine location.

The NSDNR Pump Test Database (NSDNR 2011a) provides longer term yields for select wells throughout the province. Two regional wells, both drilled through glaciofluvial/alluvial deposits located within 13 km of the Project site, indicate long term safe yields (Q_{20}) of 363.6 Lpm (96.1 gpm) and 1431.5 Lpm (1091.3 gpm). Apparent transmissivity and storativity values were not available from the two pump tests.

NSE maintains the Nova Scotia Groundwater Observation Well Network (NSE 2011c). The nearest observation well to the Project site is located approximately 23 km south, in Fall River. This well was drilled to a depth of 61.0 m through slate bedrock of the Halifax Formation and has been monitored since 2008. In 2010, the average water level elevation was 103.95 m above sea level and the annual water level fluctuation was 6.08 m. The average depth to water in this well was 4.72 m below ground surface.

Groundwater Quality
The water quality in the Goldenville Formation is expected to be good, with most parameters meeting the Canadian Drinking Water Guidelines (Health Canada 2012). The presence of arsenic is a common naturally-occurring water quality issue, especially near anticline axis or gold districts. Other potential aesthetic problems such as iron, manganese and moderate hardness have occasionally been reported.

Mitigation measures for potential effects to the geophysical environment are provided in Section 4.0.

8.3 Freshwater Environment

The Project site lies within the Eastern Interior Ecodistrict of the Eastern Ecoregion (Neily *et al.* 2003). This ecodistrict is heavily covered with freshwater lakes (27,312 ha, representing 7.4% of the total area). Bogs, fens and swamps are common in poorly drained depressions, level terrain, and slowly flowing rivers and streams (Webb and Marshall 1999).

The Project site lies within the Shubenacadie/Stewiacke Watershed (1DG). This watershed, which is commonly referred to as the Shubenacadie River Watershed, occupies most of north-central Nova Scotia and discharges into the Minas Basin.

Prominent water bodies in the Shuebenacadie/Stewiacke Watershed include Shubenacadie (Grand) Lake, Shortts Lake, and Kinsac Lake. The closest water body to the Project site is Three Cornered Lake, located 800 m from the southern Project site boundary.

A total of twelve lakes within Hants County are included in the Nova Scotia Lake Inventory Program (NSE 2012b), which determines the baseline biophysical attributes of lakes throughout the province. Two of the lakes, Cockscomb Lake (19.6 km southwest of the Project site) and Lewis Lake (16.3 km

southwest of the Project site) are located within 20 km of the Project site. However, the data are from sampling events completed almost 30 years ago and therefore, are outdated.

No lakes or water bodies are present within the Project site boundaries (Drawing 8.3). However, nine watercourses were identified within the Project site and along proposed access roads during field assessments completed in 2012 and 2013 (Drawing 8.4 A-C.). General characteristics for these watercourses are provided in Table 8.2.

Table 8.2 Watercourse Characteristics

Feature ID	Bankfull Width (m)	Water Depth (cm)		Substrate	Drainage Direction
		Bank Full	Wet		
Watercourse 1	1.5 to 2.5	30	12	Organic, silt	South to north
Watercourse 2	2 to 2.5	38	20	Organic	North to south
Watercourse 3	2.5	60	20	Sand, cobble	West to east
Watercourse 4	1	20	Dry at the time of observation	Organic, gravel	West to east
Watercourse 5	1	15	Dry at the time of observation	Organic, gravel	West to east
Watercourse 6	0.5	25	Dry at the time of observation	Organic, cobble	West to east
Watercourse 7	0.45	24	12	Gravel, pebbles	West to east
Watercourse 8	2	49	20	Organics, cobble	West to east
Watercourse 9	0.5	20	Dry at the time of observation	Gravel	North to south

8.3.1 Watercourse Alterations

Based on the proposed Project layout, several culvert replacements, and at least one clear span bridge replacement may be required along the access road. No watercourse alterations are expected in association with turbine pads as there are no watercourses within 200 m of the turbine locations. The detailed design phase of the Project will determine where road upgrade and modifications, as well as associated culvert/bridge replacements, are required. As noted in Table 8.2, all of the identified watercourses are small in size (*i.e.,* none exceeded a bankfull width of 2.5 m). Any potential impacts should be easily addressed through the provincial permitting process.

8.3.2 Fish and Fish Habitat

For the purposes of the EA, all watercourses on the Project site have been assumed to be 'fish bearing' and shall be treated as such throughout site development plans.

Grand Lake is popular among recreational fishers, thus fish species present in the lake have been well-documented. Species known to inhabit Grand Lake include striped bass (*Morone saxatilis*), Atlantic salmon (*Salmo salar*) (landlocked population), brook trout (*Salvelinus fontinalis*), chain pickerel (*Esox niger*), white perch (*Morone Americana*), yellow perch (*Perca flavescens*), brown bullhead (*Ameiurus nebulosus*), American eel (*Anguilla rostrata*), rainbow smelt (*Osmerus mordax*),

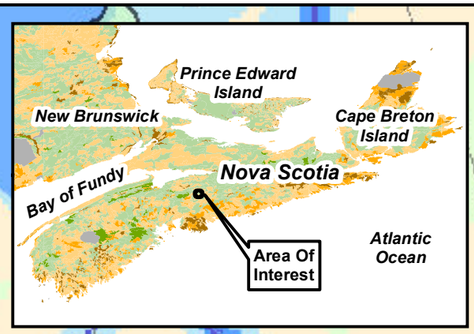
N

Old Renfrew Rd

Allens Lake

1

2



0 50 100 200 300 400 500 Metres

Notes:

1. Reference: Digital Topographic Mapping By Nova Scotia Geomatics Centre. Wetland Inventory And Wet Areas Mapping By Nova Scotia Department Of Natural Resources (NS DNR).
2. Projection: NAD83(CSRS), UTM Zone 20 North.

Legend:

- Proposed Turbine
- Proposed Access Road
- Project Site Boundary
- Major Roads and Highways
- Roads
- Access Roads / Trails
- Mapped Stream
- Indefinite Stream
- Water Bodies
- Mapped Wet Area

NS DNR Wetland Inventory

Wetland Type

- Bog or Fen
- Fen
- Marsh
- Salt Marsh
- Swamp

Depth to Water Table (m)

- 0 - 0.10 m
- 0.11 - 0.50 m
- 0.51 - 2 m
- 2.01 - 10 m
- > 10 m

Wetland and Watercourse Desktop Review Results

Strum CONSULTING

Date: October 2013	Project #: 12-4550
Scale: 1:10,000	Drawing #: **8.3**
Drawn By: H. Serhan	
Checked By: M. Henley	

alewife (*Alosa pseudolarengus*) and American shad (*Alosa sapidissima*), banded killifish (*Fundulus diaphanous*), and stickleback (species unspecified).

A review of the Atlantic Canada Conservation Data Center (ACCDC) database for fish species recorded within a 100 km radius of the Project site was completed. All species, including status rankings, are provided in Table 8.3.

Table 8.3: Fish Species Recorded within a 100 km radius of the Project site

Common Name	Scientific Name	*SARA* Status[1]	NS *ESA* Status[2]	COSEWIC Status[3]	NSDNR Status[4]
Atlantic salmon	*Salmo salar*	No Status	Not Listed	Special Concern	Red
Atlantic salmon - Inner Bay of Fundy population (IBoF)	*Salmo salar*	Endangered	Not Listed	Endangered	Red
Atlantic sturgeon	*Acipenser oxyrhynchus*	Not Listed	Not Listed	Threatened	Red
American eel	*Anguilla rostrata*	Not Listed	Not Listed	Threatened	Green
Striped bass	*Morone saxatilis*	No Status	Not Listed	Endangered	Red

Source: ACCDC 2012

[1] Government of Canada 2012; [2] NS *ESA* 2013; [3] COSEWIC 2012a; [4]NSDNR 2010

Fish species recorded within a 100 km radius of the Project site were screened against the criteria outlined in the document "Guide to Addressing Wildlife Species and Habitat in an EA Registration Document" (NSE 2009b) to develop a list of priority species (*i.e.*, SOCI), which are assessed further as a VEC.

In the context of this EA, SOCI include those that are:

- Listed under *SARA* as "Endangered", "Threatened", or "Special Concern";
- Listed under the NS *ESA* as "Endangered", "Threatened", or "Vulnerable";
- Assessed by COSEWIC as "Endangered", "Threatened", or "Special Concern"; or
- Assessed by NSDNR as "Red" (at risk or may be at risk) or "Yellow" (sensitive).

Priority fish species include:

- Atlantic salmon – "Special Concern" (COSEWIC), "Red" (NSDNR);
- Atlantic salmon (Inner Bay of Fundy population) – "Endangered" (*SARA*), "Endangered" (COSEWIC) "Red" (NSDNR);
- Atlantic sturgeon – "Threatened" (COSEWIC), "Red" (NSDNR);
- American eel – "Threatened" (COSEWIC); and
- Striped bass – "Threatened" (COSEWIC), "Red" (NSDNR).

Atlantic Salmon

Atlantic salmon are an anadromous species native to the North Atlantic Ocean and coastal rivers, which undertakes long feeding migrations to the ocean as older juveniles and adults, and return to freshwater streams to reproduce. The species requires rivers that are clear, cool and well oxygenated, with pools and shallow riffles and gravel, rubble, rock or boulder bottoms for reproduction (NS Fisheries and Aquaculture 2007; COSEWIC 2010a). All watercourses identified at the Project site form part of the Shubenacadie/Stewiacke River watershed, therefore any Atlantic salmon present would form part of the IBoF population or the landlocked population which inhabits Grand Lake (Halfyard 2008; COSEWIC 2010a).

IBoF salmon spawn in those rivers of Nova Scotia and New Brunswick that drain into the Minas Basin and Chignecto Bay (COSEWIC 2010a). Although IBoF Atlantic salmon have been recorded in 32 rivers in recent years, the population is estimated to have declined by 94% in the past decade (DFO 2008). However, the species is still known to be present in both the Shubenacadie and Stewiacke rivers (DFO 2008; Atlantic Salmon Federation 2012)

The on-site watercourses drain into the Shubenacadie River, which then drains to the Minas Basin. It is possible; therefore that Atlantic salmon may be encountered at the Project site.

The recovery strategy for the species includes a live gene-banking program which has been developed to prevent the imminent extinction of the species (DFO 2010b), and several key populations are maintained in DFO Biodiversity Centres in New Brunswick and Nova Scotia. These stocks will be used to restore self-sustaining populations in select Inner Bay of Fundy rivers. The recovery strategy sets a goal of conserving the genetic characteristics of the few remaining anadromous IBoF Atlantic salmon populations in order to re-establish self-sustaining populations of the species. Nineteen rivers are identified as being critical to the success of this strategy, including the Shubenacadie and Stewiacke rivers (DFO 2010b).

Potential effects of the Project on this species, as well as proposed mitigation measures, are discussed in more detail in Section 13.2.1.

Atlantic Sturgeon

Little is known about the habitat requirements for Atlantic sturgeon at the northern extent of its range, though important freshwater habitats for the species appear to be rivers with access to the sea, preferably with deep channels. Research suggests that the species spawns in freshwater over hard-bottom substrates at depths of 1-3 m in areas of strong currents, under waterfalls, and in deep pools just above the marine-freshwater demarcation (COSEWIC 2011). Juveniles remain in freshwater for the first summer before migrating to estuaries in winter. Juveniles remain in the freshwater-estuary system for 3 to 5 years before migrating to the near-shore marine environment as adults (NOAA 2006).

Occurring in rivers and estuaries near North Atlantic shore environments, the Atlantic sturgeon has been reported in the Annapolis, Avon, Shubenacadie, St. Croix and LaHave River systems, as well as the Minas Basin (Colligan *et al.* 1998; COSEWIC 2011). In Canada, the species is known to spawn only in two areas, the St. John River and middle St. Lawrence. Historically, the St. Croix River

in New Brunswick was also a known spawning area, although the current status of this population is unknown.

Although the watercourses on the Project site drain into the Shubenacadie River, they are not conducive to the spawning habitat requirements of Atlantic sturgeon, therefore it is unlikely that they would be found within the Project site.

The Project is therefore not expected to have any impact on Atlantic sturgeon and no further consideration of effects and mitigation for specific to this species has been undertaken.

American Eel
The distribution of the American eel ranges from South America to Greenland in accessible freshwater systems that are connected to the Atlantic Ocean. This species spawns in salt water, and juveniles drifts in ocean currents, eventually migrating inland through freshwater rivers and their tributaries. In later life stages, American eel persist in a variety of freshwater and estuarine habitats (COSEWIC 2012b). The American eel is common in Nova Scotia and has been documented in lakes and watercourses near the Project site (Halfyard 2008).

Potential effects of the Project on this species, as well as proposed mitigation measures, are discussed in more detail in Section 13.2.1.

Striped Bass
The striped bass is an anadromous species typically associated with estuaries and coastal waters, which spawns and over-winters in fresh and occasionally brackish water.

In Nova Scotia, the Annapolis River and the Shubenacadie–Stewiacke River system in the Bay of Fundy historically supported spawning populations (Rulifson and Dadswell 1995, as cited in COSEWIC 2004). Today, the species is known to spawn only in two river systems in eastern Canada: the Miramichi and the Shubenacadie-Stewiacke systems. Catches have been recorded throughout the province, including in the Annapolis River, River Phillip, Grand Lake, and the Minas Basin.

The Shubenacadie River population ascends the river to overwinter in GrandLake, then returns downstream to spawn in the Stewiacke River (a tributary of the Shubenacadie). Spawning occurs in the portion of the river affected by a tidal bore (COSEWIC 2004). Due to the close proximity to known striped bass habitat, striped bass cannot be ruled out at the Project site.

Potential effects of the Project on this species, as well as proposed mitigation measures, are discussed in more detail in Section 13.2.1.

8.4 Terrestrial Habitat
The forests of the Eastern Ecoregion are mostly softwood, consisting primarily of red (*Picea rubra*) and black spruce (*Picea mariana*) with scattered stands of hemlock (*Tsuga canadensis*) in river valleys (Neily *et al.* 2010). Local vegetation in the Eastern Interior Ecodistrict specifically is dependent on soil depth and drainage. On the deeper, well-drained soils, red spruce stands are

dominant and can form thick forests, with tolerant hardwoods such as sugar maple (*Acer saccharum*), yellow birch (*Betula alleghaniensis*), and American beech (*Fagus grandifolia*) occurring on the upper slopes of hills, drumlins, and some hummocks (Neily *et al*. 2010). In locations with imperfectly to poorly drained soils, however, black spruce forests occur along with red maple (*Acer rubrum*) and eastern larch (*Larix laricina*). Natural disturbances, including fire and hurricanes, are frequent in the ecoregion and limit the establishment of mature forest stands.

Forestry mapping indicates that the majority of the Project site is forested, with softwood and mixed wood stands as the dominant habitat features (Table 8.4; Drawing 8.5).

Table 8.4: Habitat Types at the Project Site

Habitat Type	Area (ha)	Percent of Site
Softwood	97.2	52%
Mixed wood	71.1	38%
Natural Stand	9.4	5%
Wetlands	6.5	3.5%
Clear-cut	2.8	1.5%
Total	**187**	**100%**

Source: NSDNR 2012a

Desktop mapping suggests that the Project site is predominantly covered by softwood forest, comprised mostly of black spruce, red spruce and balsam fir (*Abeis balsamea*). There is also a significant coverage of mixed wood forest, comprised mostly of red maple, grey birch (*Betula populifolia*) and white birch (*Betula papyrifera*) intermixed amongst the aforementioned softwood species. Much of the forested area is managed for silviculture and has been subject to clear-cutting or thinning activities within the past decade. This has resulted in a fragmented landscape, with pockets of intact forest.

The habitat in the general vicinity of Turbine 1 is a mixture of mature softwood and recently logged regenerating hardwood. The mature softwood stand is an even aged stand of mature red spruce trees overshadowing a sparse herbaceous under story of common woodland herbs, namely New York fern (*Thelypteris noveboracensis*), hay scented fern (*Dennstaedtia punctilobula*), bunchberry (*Cornus canadensis*) and goldthread (*Coptis trifolia*) growing in shallow, sandy mineral soils. The area that was recently logged is primarily covered by a dense layer of regenerating hardwood species, namely red maple and yellow birch, with small open areas where opportunistic under-story constituents such as woolgrass (*Scirpus cyperinus*) and dwarf raspberry (*Rubus pubescence*) have become established.

The habitat in the general vicinity Turbine 2 consists of regenerating softwood modified by silviculture activities. The majority of the hardwood was removed by pre-commercial thinning activities, leaving a tree and shrub layer dominated by immature balsam fir and red spruce. Open areas are colonized by opportunistic under-story constituents such as woolgrass and dwarf raspberry. The soils in this area consist of shallow sandy mineral soil.

Multiple areas of wetland habitat exist throughout the Project site. These wetlands are for the most part treed swamps that are covered by wetland plants such as woolly bullrush, fringed sedge (*Carex crinita*), and cinnamon fern (*Osmundastrum cinnamomeum*) growing in a carpet of sphagnum moss under a mixed wood treed canopy, unless disturbed by forestry activities.

8.4.1 Wetlands

A desktop identification of the location and extent of potential wetlands across the Project site was completed by reviewing the following information sources:

- Satellite and aerial photography;
- Nova Scotia Wet Areas Mapping database (WAM) (NSDNR 2012b);
- Nova Scotia Geomatics Centre; and
- NS Significant Species and Habitat Database (NSDNR 2012c).

The NS Significant Species and Habitat Database identifies several wetlands with proximity to the Project site (Drawing 8.3). A number of large (4.5 ha to 10 ha) swamps lie to the north of the Project site, with several small (less than 2 ha) marshes lying to the east of the Project site. Three wetlands extend into the Project site itself; two are low shrub marshes (3.45 and 3.5 ha, respectively) and are situated towards the Project site's western extent. The third is a 1.32 ha treed swamp that exists at the Project site's northeastern boundary. No mapped wetlands are identified within 500 m of a proposed turbine location.

WAM indicates the potential for wetland habitat and/or watercourses throughout the Project site, with the proposed turbines located in areas representing the lowest potential for wetland habitat and/or watercourses. Satellite imagery indicates a large open area that may be a bog or fen in southern portions of the Project site, which overlaps with a potentially wet area identified on WAM.

A total of nineteen wetlands were observed throughout the Project site and within a 50 m easement of the proposed access route. Four wetlands were observed within the Project site boundaries (Drawing 8.4A). These wetlands (wetlands 1, 2, 3 and 4) are all treed or shrub swamps that have been previously disturbed by forestry activities (*i.e.*, clearing and/or rutting). These swamps are either associated with watercourses that flow through them, or serve as headwater sources for ephemeral drainage features that contribute to watercourses in lower lying areas. These swamps occur in gentle basins with a thin layer of organic peat-based soil over a depleted mineral horizon. The general drainage direction of water across the Project site is from the south to the north.

Fifteen areas of wetland habitat were also observed along the proposed access road to the Project site (Drawings 8.4B and 8.4C). Most of these roadside wetlands are swamps that are associated with watercourses or serve as headwater sources for ephemeral drainage features or roadside ditches. They are characterized by robust herbaceous growth in peaty or mucky organic soils, under a hardwood or ericaceous shrub layer, often covered by a tolerant hardwood tree canopy or have been disturbed by forestry activity (*i.e.*, partial cutover). One wetland (wetland 18) is a fen with an open water component (watercourse 8) and is characterized by peaty organic soils and dense, deciduous shrub growth.