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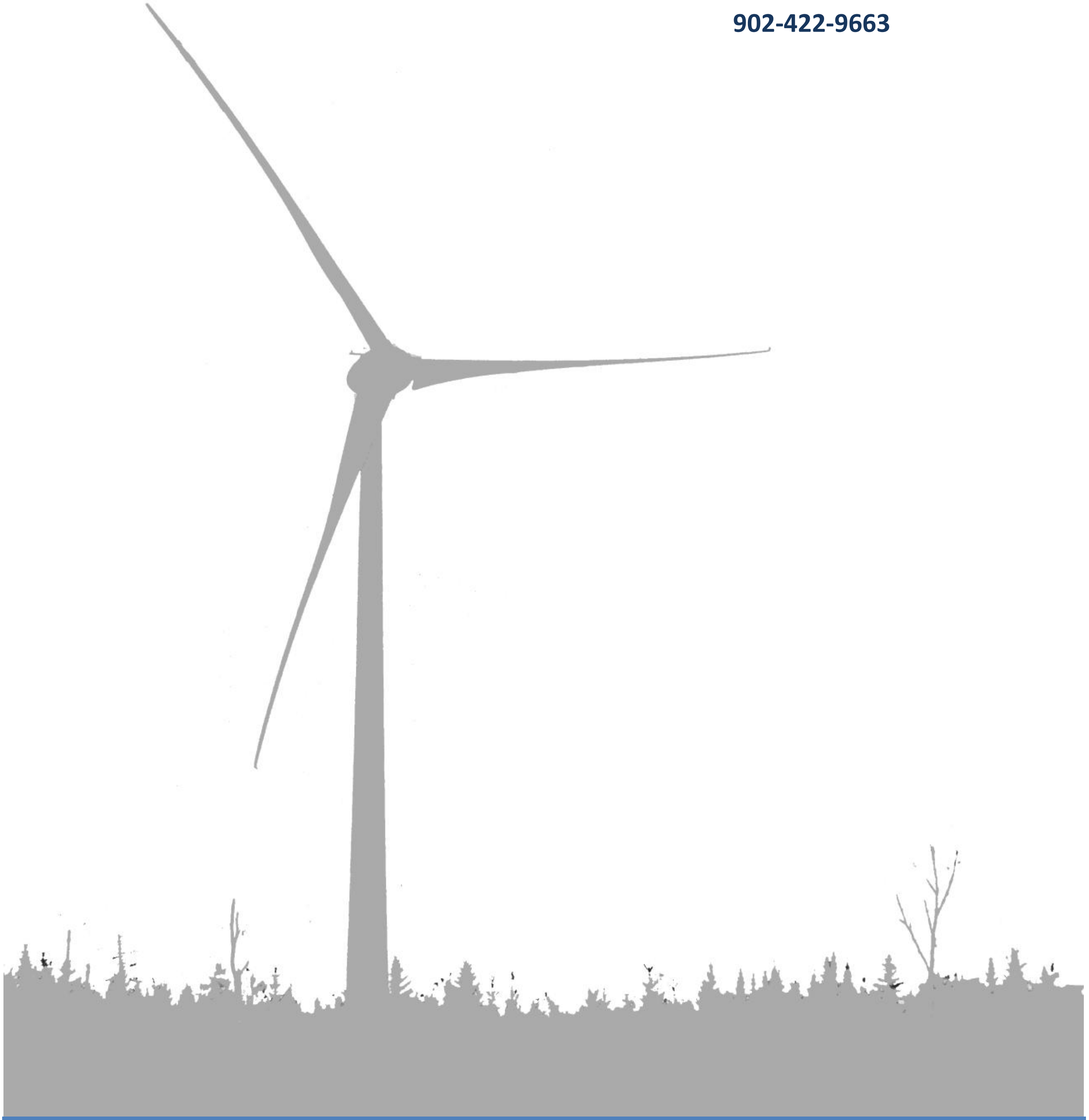

AMHERST COMMUNITY WIND FARM

ENVIRONMENTAL ASSESSMENT – DECEMBER 2014

Executive Summary

This Environmental Assessment has been prepared for the proposed Amherst Community Wind Farm by Natural Forces Wind Inc. on behalf of Mi'kmaq Wind4All Communities L.P. in accordance with the Nova Scotia Department of Environment guidelines entitled *A Proponents Guide to Environmental Assessment* (NSE, 2009) and the Nova Scotia Department of Environment guidelines entitled *Proponents Guide to Wind Power Projects: Guide for preparing an Environmental Assessment Registration Document* (NSE, 2012)

Work completed as part of this Environmental Assessment includes desktop and field studies to gather background information and to identify biophysical, physical and socio-economic valued environmental components; consultation with federal, provincial, municipal, local stakeholders and Mi'kmaq right–holders also took place as part of the assessment. The significance of residual effect due to project activities was studied for the Valued Environmental Components identified in the background studies based on potential impacts after employing the proposed mitigative measures. Finally, appropriate follow up measures were proposed based on the Valued Environmental Component analysis.

It has been determined from this Environmental Assessment that there are no significant residual environmental effects expected for the proposed Amherst Community Wind Farm on the Valued Environmental Components. This project promotes responsible renewable energy development in Nova Scotia and will help Nova Scotia meet the provincial requirement of 25% renewable energy by 2015 and the further target of 40% renewable energy by 2020 set by the Department of Energy.

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List of Acronyms

ACCDC	Atlantic Canada Conservation Data Center
ACWF	Amherst Community Wind Farm
AMO	Abandoned Mine Openings
CEDIF	Community Economic Development Investment Fund
CLC	Community Liaison Committee
COMFIT	Community Feed In Tariff
COSEWIC	Committee of the Status of Endangered Wildlife in Canada
CWS	Canadian Wildlife Study
dB(A)	Decibel A-weighting
DFO	Fisheries and Oceans Canada
EA	Environmental Assessment
EMP	Environmental Management Plan
IPCC	Intergovernmental Panel for Climate Change
km	Kilometer
MEKS	Mi’kmaq Ecological Knowledge Study
MBBA	Maritime Breeding Bird Atlas
MGS	Membertou Geomatics Solutions
MoCC	Municipality of Cumberland County
MW	Megawatt
NSDNR	Nova Scotia’s Department of Natural Resources
NSE	Nova Scotia Environment
NSPI	Nova Scotia Power Inc.
PGI	Pellet Group Inventories
PPA	Power Purchase Agreement
Project	Amherst Community Wind Farm
Proponent	Natural Forces Wind Inc.
SCADA	Supervisory Control and Data Acquisition
SODAR	Sonic Detection and Ranging
Strum	Strum Environmental
SPL	Sound Pressure Level
VEC	Valued Environmental Component
W4All	Wind4All Communities Inc.
WAM	Wet Area Mapping
WTG	Wind Turbine Generator

1.0 Introduction

1.1 Overview

The Amherst Community Wind Farm (Project or ACWF) as proposed is a 6.0 megawatt (MW) three wind turbine generator (WTG) project. The Project is located in the Municipality of Cumberland County (MoCC), near the town of Amherst, Nova Scotia.

Mi’kmaq Wind4All Communities LP (Proponent) is proposing to develop the Project under the Nova Scotia Department of Energy Community Feed in Tariff (COMFIT) program. The proposed WTG locations are situated on existing privately owned land located approximately 5.5 km east of Amherst town center. Currently, construction activities are expected to begin in the spring of 2015, and Project completion is expected in the fall of 2015. The Project will have an operational phase of 20 years.

A recent report by the Intergovernmental Panel on Climate Change (IPCC) reports that human influence on the climate system is clear and green house gas emissions have increased since the pre-industrial era, driven mainly by economic and population growth, and are now higher than ever. Continued emissions of green house gasses will amplify existing risks and create new risks for natural and human systems; the risk of abrupt of irreversible changes increase as the magnitude of warming increases. Mitigation measures must be used to reduce the greenhouse gas intensity; measures such as reducing energy usage and moving towards decarbonised energy supply should be taken to move towards achieving these goals. (IPCC, 2014)

The Nova Scotia *Renewable Electricity Plan* sets out clear legal requirements in regards to the source of electricity supplied. The purpose of Project is to help achieve provincially mandated targets outlined in the *Renewable Electricity Plan*. The province of Nova Scotia needs to achieve 25 percent energy from renewable sources by 2015 and a further target of 40 percent renewable by 2020. The Project will also enable local ownership in the wind farm and community economic development.

The COMFIT program is part of the Nova Scotia 2010 *Renewable Electricity* Plan and is designed to introduce locally-based renewable electricity projects that are partially owned by residents from communities throughout the province. The Proponent will use a Community Economic Development Investment Fund (CEDIF) to enable local investment and ownership in the Project.

The COMFIT program is integral to Nova Scotia’s 2010 *Renewable Electricity Plan* and is designed to promote locally-based renewable electricity projects that are majority owned by one of six qualifying eligible entities. The following entities are eligible to participate in the COMFIT program:

- Community Economic Development Investment Funds;
- Co-operatives;
- Mi’kmaq band councils;

- Municipalities or their wholly-owned subsidiaries;
- Not-for-Profit Organizations; and
- Universities.

COMFIT approval for the proposed ACWF was initially awarded to the KMK, or the Kwilmu'kw Maw-klusuaqn. The KMK, also know, as the Mi'Kmaq Rights Initiative is the group that represents the negotiations on behalf of the Mi'kmaq of Nova Scotia, with the Province of Nova Scotia and the Government of Canada. The COMFIT approval was later assigned over to the Limited Partnership structured company, which continues to represent all Mi'kmaq Communities in the Province of Nova Scotia.

It typically takes approximately three years to develop and construct a wind farm. Although, the proposed ACWF is still in the development phase, public consultation has been ongoing in the Amherst area with two public information sessions being held in 2014.

The Proponent will not be using any source of public funding for the purpose of this project.

1.2 Proponent

The Proponent for the Amherst Community Wind Farm is Mi'kmaq Wind4All Communities LP. Mi'kmaq Wind4All Communities LP (the Proponent) is a partnership between Nova Scotia's thirteen Mi'Kmaq Communities; a Community Economic Development Corporation (to be established in 2015); and Natural Forces Wind Inc.

The Environmental Assessment (EA) has been prepared by Natural Forces Wind Inc. on behalf of the Mi'kmaq Wind4All Communities LP.

Natural Forces is a company that was established in 2001 based in Halifax, Nova Scotia. Composed of a small team, Natural Forces has over 45 years of local, national and international experience in the wind industry. Natural Forces Wind is a wind farm developer, constructor, operator and asset owner.

Natural Forces Wind has three operational wind farms in the Maritime Provinces; Kent Hills Wind Farm, Fairmont Wind Farm and Gaetz Brook Wind Farm. Kent Hills Wind Farm is a 150 MW wind farm in New Brunswick constructed in two phases beginning in 2008 and ending in 2010. The Fairmont Wind Farm is a 4.6 MW wind farm near Antigonish, Nova Scotia, which became energized at the end of 2012 and Gaetz Brook Wind Farm is a 2.3 MW wind farm on the Eastern Shore of Nova Scotia, energized in 2014.

Natural Forces Wind is currently working on developing and constructing projects in Nova Scotia and British Columbia.

In the next few years, the Natural Forces Wind Inc. aims to have five operational COMFIT wind farms in Nova Scotia with a total approximate capacity of 21 MW. The five proposed wind projects are detailed in Table 1-1.

Table 1-1: Proposed wind energy projects.

Project Name	Number of WTGs	Rated Capacity
Hillside Boularderie Wind Farm	2	4 MW
Gaetz Brook Wind Farm	1	2.3 MW
Barrachois Wind Farm	2	4 MW
Aulds Mountain Wind Farm	2	4.6 MW
Amherst Community Wind Farm	**3**	**6 MW**

1.3 Regulatory Framework

1.3.1 Federal

Federal environmental approvals are not required for the proposed project. The Project is not expected to require permitting through harmful alteration, disruption or destruction of fish habitat or have an impact to navigable waters.

Consultation with Federal authorities has been ongoing with Navigation Canada, Transport Canada, the Department of National Defence, and the Canadian Wildlife Service (CWS).

1.3.2 Provincial

The Environmental Assessment process, as required under the provincial *Environmental Assessment Act* is a Proponent-driven, self-assessment process. The Proponent is responsible for determining if the Environmental Assessment (EA) process applies to the Project, what category the Project belongs to and when the EA process should be initiated.

Under Section 49 of *the Environmental Assessment Act*, new electricity Projects or 'Undertakings' can be classified under one of two categories, Class 1 undertakings or Class 2 undertakings (EAR, 1995). Wind farms with a rated capacity of 2 MW or greater are considered Class 1 undertakings. It is anticipated that the rated capacity for the ACWF is 6.0 MW and therefore is a Class 1 undertaking.

Three guidance documents were used in the preparation of this EA for the ACWF Project, they are:

1. *A Proponent's Guide to Environmental Assessment*, published by the Environment Assessment Branch of the Nova Scotia Department of Environment (NSE, 2009);
2. *Proponent's Guide to Wind Power Projects: Guide for preparing an Environmental Assessment Registration Document*, also published by the Environment Assessment Branch of the Nova Scotia Department of Environment (NSE, 2012); and
3. *Guide to Addressing Wildlife Species and Habitat in an EA Registration Document,* published by the Environment Assessment Branch of the Nova Scotia Department of Environment (NSE, 2005).

1.3.3 Permitting

At the provincial level, a number of permits are required to progress the various stages of development and construction of a wind farm. A list of the required provincial permits is shown in Table 1-2, although additional permits may be required following continued stakeholder consultation.

Table 1-2: Federal and Provincial permitting requirements.

Permit Required	Permitting Authority	Status
Heritage Research Permit	NS Department of Tourism, Culture and Heritage	Issued
Special Move Permit	NS Transportation and Infrastructure Renewal	Not issued
Transportation Plan	NS Transportation and Infrastructure Renewal	Not issued
Environmental Assessment Approval	NS Environmental Assessment Branch	Under review
Work Within Highway Right-of-Way Permit	NS Transportation and Infrastructure Renewal	Not issued

Table 1-3 lists the municipal permits and authorizations required. Additional permits may be required following further consultation with municipal stakeholders.

Table 1-3: Municipal permitting requirements.

Permit Required	Permitting Authority	Status
Development Permit	Municipality of Cumberland County	Issued

1.4 Development and Structure of Document

This EA was prepared by Natural Forces Wind Inc. by Development Engineer – Chris Veinot, who compiled primary and secondary data sources to draft this EA document. The EA document will follow the structure as presented in Figure 1-1.

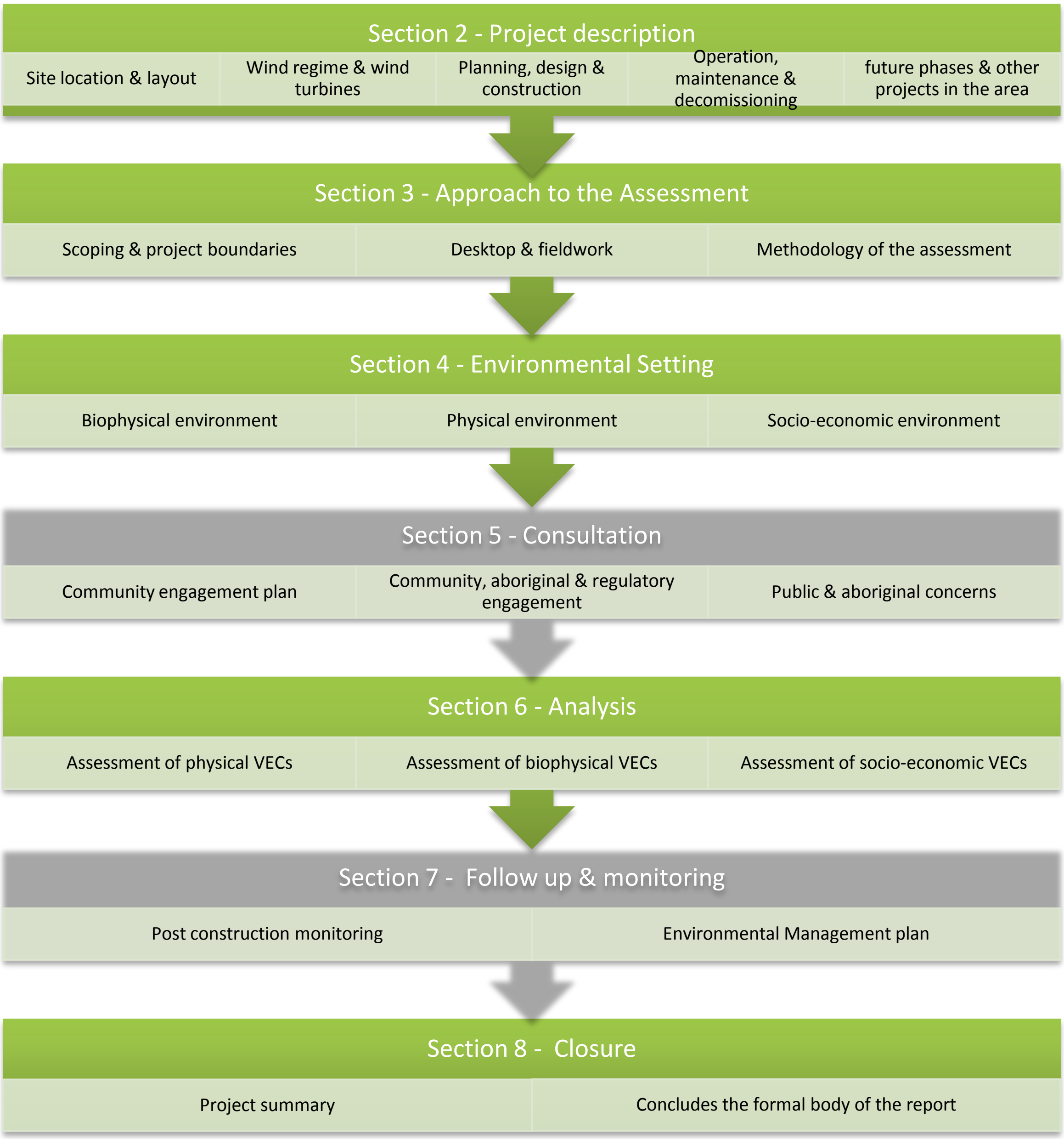

Figure 1-1: Structure of document.

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2.0 Project Description

2.1 Site Location

The ACWF is located on privately owned land in the Municipality of Cumberland County, located approximately 5.5 km east of Amherst town center. The Proponent plans to construct and operate a 3 WTG, 6.0 MW wind farm; the proposed locations for the WTG 1, 2 & 3 can be seen in Figure 2-1, Figure 2-2 and Figure 3-3 respectively. Figure 2-44 shows a general overview of the project location. The WTG coordinates are shown below in Table 2-1.

Table 2-1: Turbine coordinates in UTM Zone 20.

	Easting	Northing
Wind Turbine 1	411,127 m E	5,076,367 m N
Wind Turbine 2	411,150 m E	5,075,827 m N
Wind Turbine 3	410,871 m E	5,075,939 m N

Figure 2-1: Proposed location for WTG 1.

Figure 2-2: Proposed location for WTG 2.

Figure 2-3: Proposed location for WTG 3.

The ACWF will comply with the Municipality of Cumberland County by-law setbacks, maintaining a minimum distance of 600 m between residential dwellings and all WTGs.

The ACWF will connect to the Nova Scotia Power Inc’s (NSPI) distribution grid via 3-phase distribution line located on the John Black Road, which originates from the Church Street substation (22N) located approximately 3.5 km west of the Project site.

The lands under option consist of three privately owned land parcels; each land parcel will accommodate one WTG and associated infrastructure such as roads, crane pads and distribution lines. The overall project footprint will be approximately 4.0 hectares but will only require 1.7 hectares of clearing by making use of an existing road and previously cleared land.

The access road will be constructed by entering the Project site from John Black Road. The proposed access road will make use of an existing road that will be upgraded to accommodate the wind farm equipment; by using existing roads, the Proponent aims to minimize the overall environmental impact of the project.

The Proponent has extensive knowledge in site finding and development of community based wind farms. There are three main factors to consider during the site finding phase of the development of a wind farm. These factors include wind regime, local power grid infrastructure and environmental/ socio-economic concerns. Detailed assessment of these three factors have led the Proponent to determine that the location of the ACWF presents the best opportunity to capture the wind regime in an effort provide efficient renewable energy to the local community.

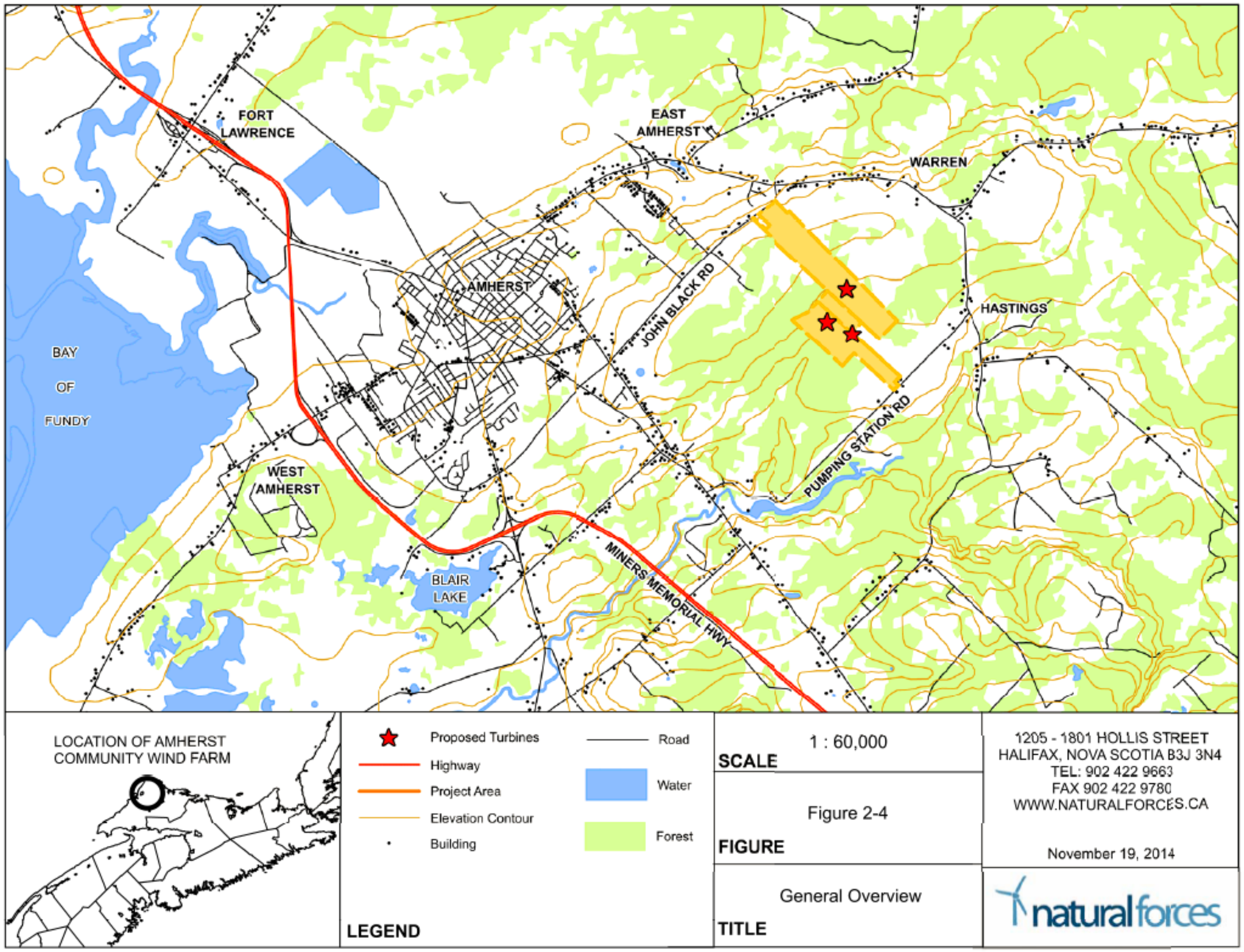

Figure 2-4: General Project overview.

2.2 Planning and Design

The site layout has been designed primarily based on constrains that have been identified during the development process.

The planning and design phases are crucial steps of the Project that can set the stage for following project activities and help avoid issues that may be encountered in future project phases. Specifically, the ACWF site is an attractive site due to the wind resource, distance from dwellings, proximity to and capacity of the distribution grid and minimal ecological concerns.

A variety of criteria has been considered in the site selection of the ACWF. The criteria include technical, environmental and land use consideration. The following is a list of the criteria considered and has been included in the design process that has produced the project layout as shown in Figure 2-5.

- Technical Considerations;
    - Sufficient wind resource;
    - Proximity to electrical distribution network;
    - Capacity of the local electrical distribution network (~3 km to substation); and
    - Proximity to communication links.
- Environmental Considerations;
    - Proximity to known wetlands;
    - Proximity to residential dwellings or other noise/shadow sensitive areas;
    - Sensitivity of flora & fauna; and
    - Proximity to provincial or national parks and nature reserves.
- Land use considerations;
    - Available access to the land and suitable ground conditions; and
    - Proximity to residential properties, communities and towns.
- Planning Considerations.
    - County or Municipal zoning by-law regulations.

Technical Considerations

The ACWF is located on the Isthmus of Chignecto, which connects New Brunswick and Nova Scotia. The isthmus is bounded by the Bay of Fundy with the Northumberland Straight. As a result of the project being in close proximity to the Bay of Fundy and ground elevation, stronger winds are found at the Project site providing an attractive wind resource for a wind farm with prevailing winds from the southwest.

A Distribution System Impact Study conducted by NSPI on behalf of the proponent indicates the Project can be connected to the nearby local electrical distribution system. Through an agreement with NSPI, the Project will be connected to the 22N-402 circuit of the Church Street substation, which provides electricity to Amherst and surrounding areas. The proximity of the ACWF to a high electrical load center such as Amherst is a key determinate in securing a feasible grid connection to the existing NSPI distribution system. Projects located further from load centers and substations tend to be less feasible in terms of securing a successful grid connection.

Two existing license microwave radio links have been found near the Project site, 1,000 m and 3,000 m from the nearest turbine. Based on the results of an electromagnetic interference study the proposed turbines are not expected to significantly impact the existing radio systems in the area. Figure 2-6 presents two identified microwave radio links that have been assessed, this figure also shows how this constraint among others have been incorporated into identifying an area suitable for development.

Environmental Considerations

In consultation with Department of Natural Resources the Proponent has identified a requirement for a buffer between wetlands and wind turbines. The Proponent has applied a 30 m plus rotor radius (76 m) buffer from all wetlands and watercourses identified during the wetland delineation survey. This buffer will minimize the potential for impact to wetlands during the construction and operation phases of the project.

The ACWF is setback over 951 m from all residential dwellings. Sufficient setback has mitigated potential impact on dwellings from elevated noise or shadow flicker as a result of the turbines during operation.

A thorough review of flora and fauna has been conducted to identify species at risk or of high importance that may be impacted by the proposed development. Results of the studies have not identified any species at risk or high importance that would be significantly impacted by the proposed development. Recommendations have been made by the scientific professionals who conducted the specific studies, which will be considered and incorporated in the final design and proposed mitigation measures.

Land Use Considerations

The three participating landowners have made their lands available for the installation of three WTGs and ancillary infrastructure. An existing access road will be upgraded and extended to gain access to the proposed WTG location. The existing access road is also very important when considering the overall impact of the Project footprint, by using the existing road a significant reduction in the amount of clearing will be noticed.

Planning Considerations

The Municipality of Cumberland County requires that all wind turbines be setback at least 600 m from dwellings. Further wind turbines must be setback turbine height plus 7.5 m from external property boundaries. Figure 2-6 presents these two constrains and also show how they have been incorporated in identifying a development area.

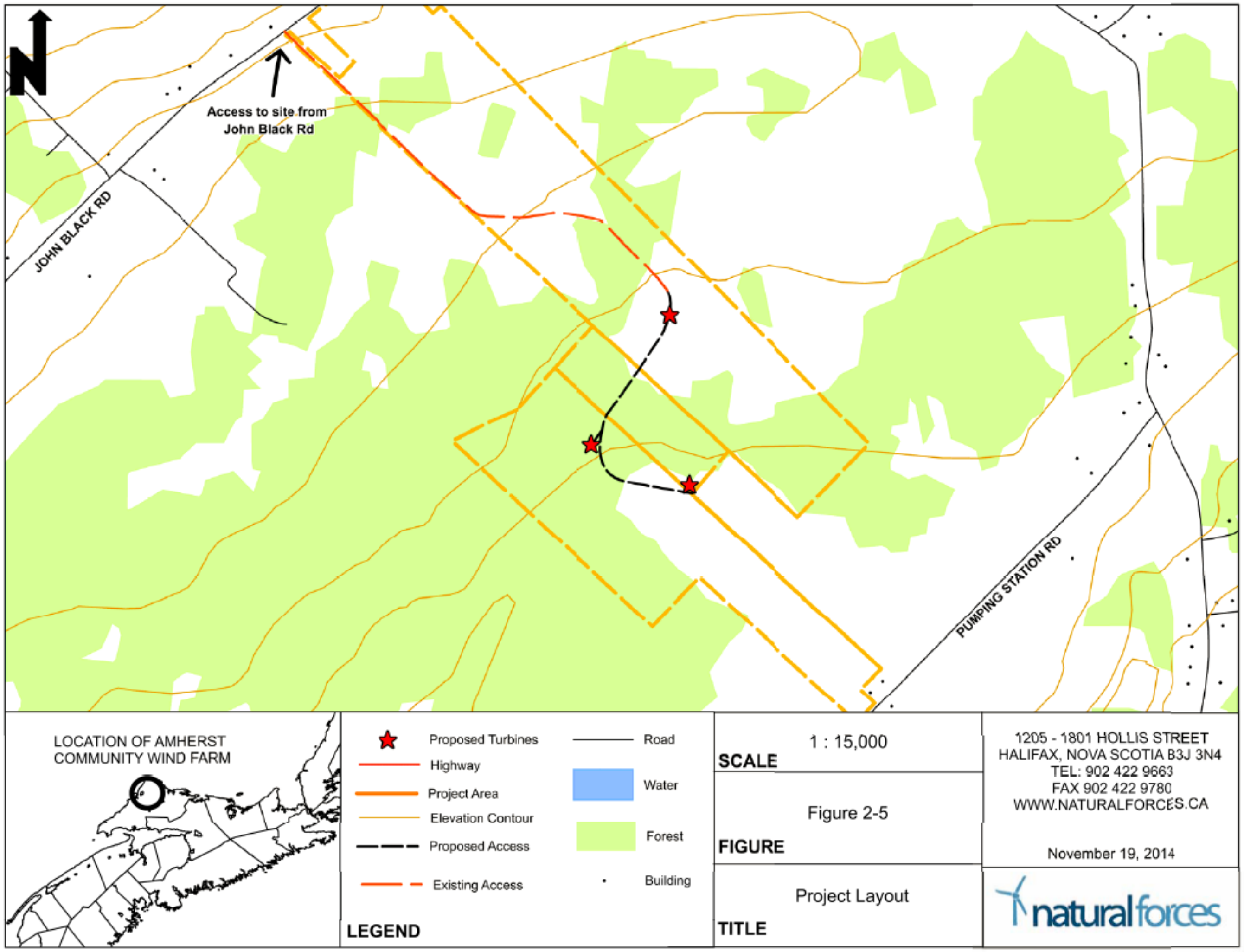

Figure 2-5: Project layout.

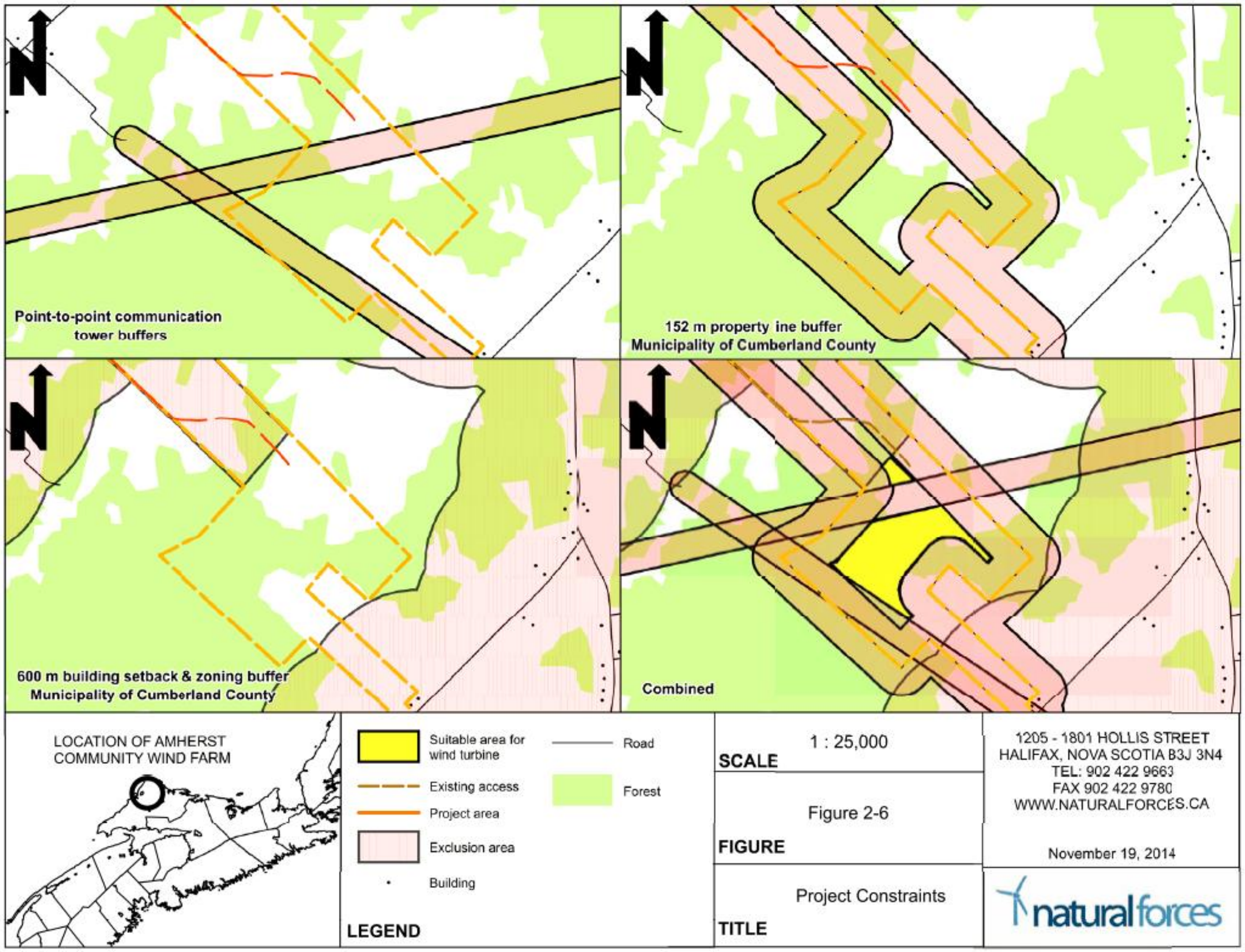

Figure 2-6: Project constraints.

2.3 Wind Turbine Generator

Three Enercon E92 WTGs will be used on site for the duration of the Project. The Enercon E92 has a total rated capacity of 2.0 MW, a turbine tower height range of 85 – 98 m and rotor blade diameter of approximately 92 m. From base to blade tip the WTG will have a maximum height of 144 m.

All Enercon WTGs are designed and certified according to the latest international standards. Currently the basis for design is the International Electrotechnical Commission (IEC) standards of the IEC-61400 series.

This IEC standard utilizes assumptions and conditions that are used to define the load cases that the WTGs have to endure. The safety system of the Enercon WTG features various control sensors that protect the turbine and its components from damage. This includes, among other things, high and low temperatures, vibrations, oscillations and strain. In the case that one or more of these sensors detect conditions outside the design limits, the main control of the WTGs will take the appropriate measures, which range from small power limitations to complete stop of the turbine (Enercon, 2012).

Ice may form on the rotor blades of the WTGs in specific weather conditions. The ice build-up poses the risk of ice fragments detaching, creating safety hazards to the surrounding area. The Enercon WTGs will be equipped with a reliable ice detection system. Once ice has been detected, the Enercon blade de-icing system will activate and effectively melt the ice on the WTG blade to reduce the risk of ice throw.

Additional WTG specifications are presented in Table 2-2 as well as in Appendix A.

Table 2-2: Enercon E92 specifications (Enercon, 2012).

Characteristic	Value
Rotor diameter	92 m
Swept area	6648 m^2
Rotations per minute	5 – 16 min^{-1}
Cut out wind speed	28 – 49 m/s (Enercon storm control)
Hub height	85 - 98 m
Max sound pressure level	105 dB(A)

2.4 Construction

Construction of the ACWF is proposed to take approximately six months and will include the following main construction activities:

- Clearing and grubbing of Project area;
- Construction of access road, lay down area and crane pads;
- Construction of turbine foundation;
- Construction of power pole, power lines and underground electrical;
- Turbine installation;

- Commissioning of the WTG; and
- Removal of all temporary works and restoration of the site.

The approximate proposed schedule for the construction activities is presented in Table 2-3. Construction scheduled for month 1 is expected to start in May 2015 with construction activities ending at the end of October 2015. Operation of the ACWF is expected to start approximately during the month of November 2015, following the completion of construction activities.

Table 2-3: Schedule of construction activities.

Construction Activity	Typical Distribution (months)					
	1	2	3	4	5	6
Surveying and siting activities	■					
Construction of access road and crane pad		■	■			
Construction of crane pad & turbine foundation			■	■		
Construction of electrical works				■	■	
Wind turbine assembly and installation				■	■	
Removal of temporary works and site restoration						■

2.4.1 Surveying, Siting and Logistic Activities

Prior to the commencement of access road, foundation construction and turbine installation, a number of enabling works need to be undertaken. These will include:

- Engineering site visits to evaluate the Project land and soils conditions;
- Boring of holes and/or excavation pits for geotechnical investigations;
- Improvement of land drainage as required to facilitate construction; and
- Widening and improvement of the site entrance for safe vehicle access.

The Proponent and the turbine manufacturer will coordinate transportation of the turbine components that will require overweight special move permits. Service Nova Scotia and Municipal Relations officers will be consulted to ensure any other potential permits (ie. over-dimensional and overweight vehicle permits) are obtained and transportation regulations are followed. Although the WTG transportation route has yet to be planned, the Proponent is aware of certain road weight restrictions. Roads used for the construction phase of the Project will comply with intermediate and maximum weight road restriction lists (Road designation, 2012).

2.4.2 Access Road

Access roads required for the development are typically 5 – 6 m wide with a maximum width of 12 m in certain areas to facilitate moving a fully assembled crane. The access road will be used to move workers and equipment about the site during construction, operation and decommissioning phases.

The upgrade and extension of the access road will involve the removal of soil to a depth of between 0.25 – 1.0 m (depending on the ground conditions encountered during the geotechnical investigations) and placing layers of crushed stone. The stone would be compacted, with a finished construction depth between 0.25 – 0.5 m, again dependent on the strength of the underlying road formation. The internal site road would be maintained in good condition during construction and throughout the lifetime of the Project to facilitate maintenance and on-going environmental studies.

The removed topsoil would be stored in accordance with best practice guidance, and later used for site restoration. Soils needed for backfill would be stored temporarily in bunds adjacent to the excavations until needed. Any remaining excavated material would be shaped into fill slopes in the road bed, or removed from site to an approved landfill. The proposed access road layout can be seen in Figure 2-5. This figure demonstrates where existing road will be used to help reduce the footprint of the project that will require clearing. The road shown in red is the existing road and therefore should not require further clearing. The road that is indicated by black has not been cleared or constructed. By making use of the existing road, the total footprint of the project requiring clearing is reduced from 4.0 hectares to 1.7 hectares.

Figure 2-7: Existing access road that will be used for site access.

2.4.3 Crane Pad & Turbine Foundation

Crane Pad

The installation of the Enercon E92 WTGs will require crane pads that will be approximately 80 m by 80 m. Its purpose is to safely accommodate the weight of the large crane necessary for turbine installation and maintenance. The exact arrangement of the crane pads would be designed to suit the specific requirement of the turbines and the surrounding topography of the Project site.

Construction of the main crane pads would involve the removal of soil to a depth of between 0.25 – 0.5 m, depending on the ground condition encountered during the geotechnical investigation. The subsoil would be covered by layers of graded crushed stone. Total construction depth is between 0.25 – 0.5 m, again dependent on the characteristics of the underlying soil formations.

The crane pads may be retained throughout the operation life of the wind farm to allow for periodic WTG maintenance, and to accommodate any crane necessary for the replacement of large components should they require replacement during the operation phase of the Project.

Turbine Foundations

A concrete foundation approximately 15 m in diameter will be required for each WTG. A detailed geotechnical investigation will be undertaken to establish the nature of the soil at each identified WTG location. A registered Civil Engineer will design the foundations to match the soil conditions. Foundations will most likely be a gravity (inverted “T”) design, designed by Enercon.

The construction of the reinforced concrete foundation will include excavation to a depth of several meters, the placement of concrete forms and steel reinforcement, and the pouring of concrete within the forms. The upper surface of the base will lie approximately 1 m below ground level. Rock chipping may be required to facilitate excavation. The central support pedestal would extend 0.20 m above existing ground level to receive the bolted bottom tower section. Suitable excavated material would be compacted in layers on top of the concrete foundation to terminate in line with the existing ground level, leaving room to allow sufficient topsoil reinstatement for vegetation growth.

The soils removed would be stored in accordance with provincial regulations and best practice guidelines, and replaced during the restoration phase in consultation with the landowner. Soil material needed for backfill would be stored temporarily in a designated area adjacent to the excavations until needed. Any remaining excavated material will be recycled to another site needing clean fill material or removed from site and sent to an approved landfill.

2.4.4 Civil and Electrical Works

The electricity produced from the WTGs will be stepped up to 25 kV by a transformer located in the base of each of the WTGs. The electricity will then be conducted via insulated electrical cables through cable ducts cast into the WTG foundation routed out to new power poles on site, and then to the new point of connection to the existing NSPI distribution system.

A bare copper earthing (grounding) cable will be laid alongside the WTG foundation for lightning protection of the WTG; grounding will also be installed at other areas as determined by the electrical design.

The electrical, communications and grounding cable will leave the WTG foundations below grade via cable ducts cast into the WTG foundations. Where the cables are to cross the site roads and crane base, they may be located in cable ducts surrounded by 0.15 m of concrete to ensure the integrity of the cable is maintained independent of the vehicle site crossings above. The overhead cabling configuration will be similar to the standard 12 m wooden utility poles found throughout the surrounding area. Any buried electrical cable will likely be marked with permanent safety signs to warn of potential hazards from excavation. The size, type and location of the marker signs will be determined in consultation with the landowner and be in accordance with applicable safety standards.

2.4.5 Interconnection to Grid

The connection point to the NSPI electrical distribution system will be located on the Project site. The ACWF will connect to the NSPI's distribution grid via 3-phase distribution line originating from the Church Street substation (22N) located approximately 3 km east of the Project site. This connection will connect to an existing 3-phase distribution, which is part of circuit 22N-402. Figure 2-8 presents the approximate location of the interconnection to the NSPI grid.

Figure 2-8: Approximate location of interconnection to existing NSPI infrastructure

2.4.6 WTG assembly and installation

The main WTG components include the tower sections, nacelle, hub and blades. Towers are normally delivered in four sections if using steel towers or approximately 20 sections if using the pre-cast concrete variety. The overall erection process for the WTG will take approximately two to six days, depending on the wind conditions, and would not start until suitable wind conditions prevail.

Once delivered, the tower sections will be erected in sequence on the WTG foundations using a 150 tonne tailing crane and a large 800 – 1000 tonne main lift crane. The smaller crane will erect the base and lower-midsection of the towers and then assist the main crane with the erection of the upper-midsection, the tower top section, the nacelle and the rotor. The main erection crane also lifts heavy internal components such as the generators.

For the nacelle and blades, the assembly will involve the use of a small 135 tonne rough-terrain crane for vehicle off-loading, a 150 tonne tailing crane for preliminary assembly, and a main erection crane of approximately 800-1000 tonnes for the main lift.

The blades are attached to the hub on the ground. The hub and blades are then lifted as one unit, called the rotor. The tailing crane helps to control the orientation of the rotor during this lift, while the main crane lifts the weight.

2.4.7 Site Restoration

After construction, erection and commissioning are completed and the Project is in the operation phase, all temporary works will be removed and the land re-graded. The stored topsoil will be replaced and fine graded, and the site will be dressed to restore maximum tillable area and a pleasing appearance.

2.4.8 Other Site Activities

Entry to the Project site will be adjacent to John Black Road. This will be the entry point for all workers, construction equipment and WTG components for the duration of the construction phase. Minor, temporary road widening may be required along specific portions of the road. This road widening would be coordinated with Nova Scotia Transportation and Infrastructure Renewal and all necessary permits will be required before commencing work.

During construction of the access road and the WTG foundations, there will be an increase in truck traffic on the roads leading to and from the Project site. Increased dust is possible, although water trucks will dampen the roads and excavation area when necessary to control fugitive dust.

During delivery of the WTG components, delivery of oversized loads may slow traffic flow. Every effort will be made to ensure that oversized loads are delivered during times of lowest area traffic. Pilot vehicles and licensed flaggers will be provided to coordinate traffic flow and ensure public safety.

Delivery of materials and equipment will be phased throughout the construction period depending upon the specific construction activity. The vehicles likely to be involved include:

- Large trucks with trailers for delivery of materials, earth-moving equipment and cargo containers for storage of tools and parts;
- Dump trucks to deliver and/or move stone for constructing internal site roads;
- Concrete trucks for constructing WTG foundation;
- One 800-1000 tonne main lift crane;
- One 150 tonne tailing crane;
- One 135 tonne rough-terrain crane for assembling WTG;
- WTG component delivery vehicles; and
- Miscellaneous light vehicles including cars and pickup trucks.

Of these predicted vehicle movements, approximately 35 will be oversized loads associated with the delivery of WTGs component parts (towers, blades, and nacelles) and the cranes required for erection. These deliveries are anticipated within months 4 through 6 of the construction schedule and subject to movement orders as agreed upon with governing authorities.

2.5 Operation and Maintenance

2.5.1 Site Access and Traffic

Once the wind farm is operational, minimal vehicle activity will be required. The internal site roads will be used for periodic maintenance and safety checks. A comprehensive Supervisory Control and Data Acquisition (SCADA) system will be installed within the turbine for remote monitoring and control of the wind turbine, which will minimize the need for on-site personnel. The SCADA system ensures safe efficient operation of the turbine and of the overall Project site.

2.5.2 Project Safety Signs

A Project sign will be located at the entrance to the site. This sign will provide essential safety information such as emergency contacts and telephone numbers. As well, the sign will provide information about the wind farm and the companies involved in the Project. Safety signs and information will also be installed throughout the Project Site. These signs will be maintained throughout the operational life of the wind farm.

2.5.3 Maintenance Plans

Scheduled maintenance work will be carried out several times each year throughout the operational phase. Unscheduled maintenance is minimal, as the SCADA system provides 24-hour monitoring of the turbines. Maintenances procedures may require the use of small or large cranes for brief periods of time, for replacement of blades or other turbine components.

2.5.4 VEC Monitoring

Birds and bats will be monitored for a period of time during the first few years of the operational phase.

2.6 Decommissioning

The Amherst Community Wind Farm project will be in operation for approximately 20 years. The lifetime is based on the duration of the Power Purchase Agreement (PPA) signed between NSPI and the Proponent. This is also consistent with the length of the land lease that will be signed by participating land owners.

Decommissioning will commence within six months after the license has been terminated. The decommissioning phase will be completed within six months after its commencement.

The WTGs components will be dismantled and removed from the site. Similar traffic movements to those experienced during the delivery of the turbine components are anticipated. The decommissioning phase will require considerably lower vehicular support than during the construction phase. The following four steps are anticipated in the decommissioning phase:

1. The WTGs will be dismantled and removed from the site for scrap or resale. The bases will be removed to below plough depth, and the top soil will be reinstated so that the land may be returned to its former use.
2. The internal site roads and site entrance, if not required may be removed. After removal, the land will be reinstated to its former use.
3. The underground cables will be below plough depth and contain no harmful substances. They may be recovered if economically attractive or left in the ground. Terminal connections will be cut back below plough depth.
4. All other equipment will be dismantled and removed, and the land will be returned to its former use.

2.7 Future Phases of the Project

There are no future phases planned for the ACWF Project. There are three contributing factors that have been considered in determining the 20 year project duration.

1. The current land lease agreement details that the duration of the lease once the Project has been commissioned will be 20 years.
2. The Proponent has agreed upon a 20 year fixed rate PPA with NSPI.
3. The WTGs have a life expectancy of approximately 25 years.

Based on these three factors, at this time the has no further plans to develop this Project after the proposed 20 year Project life has elapsed.

2.8 Other Projects in Area

The Amherst Wind Farm is located 7.5 km west of the proposed Project site and consists of 15 Suzlon wind turbines. The project is currently owned and operated by Capstone Infrastructure and has been in operation since 2012 (NSPI, 2014)

There are no other operating, proposed or under construction wind farms within a 10 km radius of the ACWF.

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3.0 Approach to the Assessment

3.1 Scoping and Bounding

The scoping process identifies the physical, biophysical and socio-economic Valued Environmental Components (VECs) that may be subject to impact given the works proposed as described previously in Section 2. The proposed work is composed of the construction, operation and maintenance phases of the Project conducted by the Proponent including any accidents and malfunctions that may occur. The decommissioning of the ACWF is also included as part of the assessment. The identification of the VECs is based on the potential interaction of the Project within the environmental and socio-economic settings described in Section 4. Additionally, any concerns from stakeholders and the general public as identified through the consultation process described in Section 5 are taken into great consideration when identifying the VECs to be assessed.

The scope of the assessment is formed by the potential interaction of the project activities with the VECs. The scoping was completed at a preliminary level to define the appropriate desktop and field studies that would be relevant to the Project. The scoping is continually refined as the Project progresses, the environmental setting is studied and consultations are held. While it is difficult to assess all of the potential effects of a project, properly defining a scope reduces the risk of overlooking an important project impact.

The Proponent has identified the physical, biophysical and socio-economic aspects that will be subject to assessment based on knowledge and experience, review of the regulatory requirements, as well as feedback from the community, First Nations, regulatory authorities and other stakeholders. This process has identified the physical, biophysical and socio-economic VECs to be evaluated for the Project; these VECs are listed in Table 3-1.

Table 3-1: Identified Valued Environmental Components.

Physical	Biophysical	Socio-economic
Ambient Air	Wetlands / Watercourses	Property Value & Land Use
Ground & Surface Water	Fish and Fish Habitat	Aboriginal Resources / Uses
Ambient Noise	Migratory and Breeding Birds	Archaeological Resources / Uses
Ambient Light	Flora	Vehicular Traffic
	Moose	Telecommunications and Radar
	Wood Turtle	Landscape Aesthetics
		Public Health and Safety
		Local Economy

Spatial and temporal boundaries must be determined in the assessment process to properly evaluate the Projects impacts on the aforementioned VECs. Spatial boundary is the physical bounds in which the Project facilities and activities are located as well as zones affected by project activities, i.e. discharge and emissions. Temporal boundary is the time frame in which the activities within the spatial boundary overlap with the presence of identified VECs.

Based on the *Proponent's Guide to Wind Power Projects'* it has been determined that the Project site sensitivity is classed as very high , which classifies the ACWF as a category 4 on the level of concern category, this is primarily due to the fact that the site is located within 10 km to several Provincially and Nationally important bird areas. Projects in this category present a high level of risk to wild species and/or their habitat, and require comprehensive surveys, spread over a one year period, to obtain quantitative information on wild species and habitats on the site (NSE, 2012). The proponent has engaged the services of external consultants and University researches to conduct these surveys, which will be discussed throughout this EA.

The study area includes a spatial boundary that encompasses the footprint of all activities associated with the construction, operation and decommissioning of the proposed Project. Further, the study area also includes all areas that interactions between the project and environment could be reasonably expected to occur. The spatial boundary will be defined for each separate VEC assessment since it is not reasonably possible to define a single spatial boundary to encompass all project activities and VECs.

The temporal boundaries include, but are not limited to the timeline for short term construction activities, as a long term temporal boundary includes the 20 year operation of the project as well as its decommissioning. The temporal and spatial boundaries are identified in the VEC analysis in Section 6.

3.2 Desktop and Field Work Completed

3.2.1 Avian Survey

Avian studies consisted of two main components. The first component was an avian baseline study conducted by John F. Kearney & Associates from April through November 2014. The second component was a fall radar study conducted by Phil Taylor of Acadia University. In addition, a modest early 2014 winter survey was conducted by Strum Environmental. A control area was also used to better determine the relative avian activity on site.

The results of the Avian surveys were also compared to avian survey data from existing wind farms in operation around the province in order to show relative activity at the ACWF.

Avian Baseline Study

The avian baseline study conducted by John F. Kearny & Associates was initiated in spring 2014 and continued to November 2014. The study had three major objectives:

1. To provide information on birds to ensure that the Project complies with the federal *Migratory Bird Convention Act*, the *Species at Risk Act*, and associated laws and policies of the Province of Nova Scotia.

2. To provide durnal and nocturnal information to inform the siting, operation and monitoring of the proposed project in regard to the direct and indirect effects on birds.
3. To provide a quantitative baseline for measuring the impacts of the project in the short and long term and to contribute to a global understanding of wind energy projects on birds.

Six types of survey methodologies were used to meet the objectives of the study. All the surveys include quantities survey methodologies consisting of counts within the Project area and in the control area (the acoustic surveys are only in the Project area).

1. Migration stop-over transects

Two transects were used for the study of stop-over migration. These transects are shown in Appendix B – Figure 6. Transects were chosen to sample representative habitats in the study area, on in the Project area and one in the control area.

Each transect was surveyed one every weed during the migration period; April 15 – June 7, 2014 and August 31 – October 31, 2014. Transects were 1,500 m in length with all birds recorded within the following distance categories from the observer: <50 meters, 50-100 meters, >100 meters and flying overhead.

2. Early breeding survey

The spring stop-over transects also provide data on early breeding birds using the study area

3. Peak breeding survey point counts

Point counts were made throughout the study area during the months of June in both the Project and control area. The duration of a point count is ten minutes with birds recorded in the same distance categories as for transects and stop counts.

4. Directed searches for species of conservation interest during the early and peak breeding seasons

In addition to transects and point counts, it was necessary to search out habitats that may be the residences of species of conservation interest. This is especially true for the COSEWIC and Species at risk act listed species that could be found in the study area. Potential habitats for these species were surveyed through general area searches.

5. Diurnal Passage Observation

Two observation stations that gave a 180-360 degree view of the airspace over sections of the study area were chosen for the study of diurnal passage. These stations are shown in Appendix B – Figure 6 (Station #1 & #2). All birds flying through the airspace over sections of the study area were noted by species, flock size, altitude, direction of flight, and proximity to a proposed turbine. For woodpeckers and passerines these observations were focused early in the morning hours, for raptors peak numbers were expected from mid-morning to early afternoon, as well as for many water birds and shorebirds according to the tides. Flying birds seen in apparent diurnal migration during stopover transects were also noted along with the flight heading. The diurnal passage study was conducted during the same weeks as the stop-over surveys in both spring and fall.

6. ***Acoustic monitoring of nocturnal passage***

Acoustic monitoring of nocturnal passage provides data on the species of birds migrating through an area, their relative abundance, and migration timing. Two recording stations were set up and were located at stations #1 and #3 as shown in Appendix B - Figure 6. Recording took place every night from sunset to sunrise from mid-April to early June and early August to mid November 2014.

Fall Radar Study

A fall radar study was conducted by Phil Taylor of Acadia University and Holly Lightfoot in an effort to characterize the migration activity near the proposed ACWF.

Two modified marine radars were set up in late summer 2014. The radar antennas made a complete 360 degree revolution every 2.4 seconds. The radar locations can be found in Appendix B – Figure 1. Data was collected from mid August to late October 2014 to help describe the volume, direction and altitude of migration of presumed bird targets, and the relationships between those variables and the weather. The focus of the study was nocturnal migrants, data collected between sunset and sunrise was primarily analyzed. However, some assessment of diurnal movements has been assessed during times identified through stopover surveys.

Further, to provide additional information about species specific passage rates, radar data has been correlated with data collected from acoustic sensors as described the study conducted by John F. Kearny & Associates.

Finally, the data was interpreted and a view on relative risk of the proposed Project on bird migration was provided.

3.2.1 Bats

The Proponent has engaged the expertise of Hugh Broders from the Department of Biology at Saint Mary's University to provide a characterization of the magnitude of bat activity at the Project site.

The objectives of this characterization were to:

(1) Provide information on the occurrence and relative magnitude of bat activity in the proposed development area, based on analysis of echolocation survey results;

(2) Provide relevant information on the resource requirements of local bat species that may be useful for the decision-making process on the proposed development; and

(3) Make relevant recommendations based on the results of this project and recent developments in the field of bats and wind energy.

Ultrasonic Surveys

Four automated bat detectors were used to sample at four locations within the Project development area. One detector was placed on the edge of the forest near the entrance of the site (Site 1:Figure 3-1) and a second was placed at the meteorological tower (Site 2: Figure 3-1) with microphones recording at 2 m and approximately 33 m above ground level. The third and fourth detectors were placed on forest edges (Site 3 and 4: Figure 3-1). The seasonal timing of sampling likely corresponded to the end of the summer residency period, through to the autumn movements of resident species to local hibernacula, and autumn migration my migratory species. The bat detectors were deployed on July 21, 2014 and retrieved November 4, 2014. Each bat detector was programmed to turn on ½ hour before sunset and to turn off ½ after sunrise and were reprogrammed throughout the season to adjust for increasing night length.

Table 3-2 provides detail on the type of bat detector, location and site description.

Table 3-2: Description of bat detectors and locations. (NAD83 UTM Zone 20)

Site	Detector type	Coordinates		Description
1	Anabat	410882 m E	5076671 m N	Forest edge, microphone oriented into a clearing at ground level
2	SM2Bat+	411009 m E	5076486 m N	Detector at met tower with one microphone at 2 m and the other at approx. 33 m
3	SM2Bat+	410975 m E	5076369 m N	Forest edge, microphone oriented into a clearing 2 m above ground level
4	SM2Bat+	410958 m E	5076025 m N	Forest edge, microphone oriented into a clearing 2 m above ground level

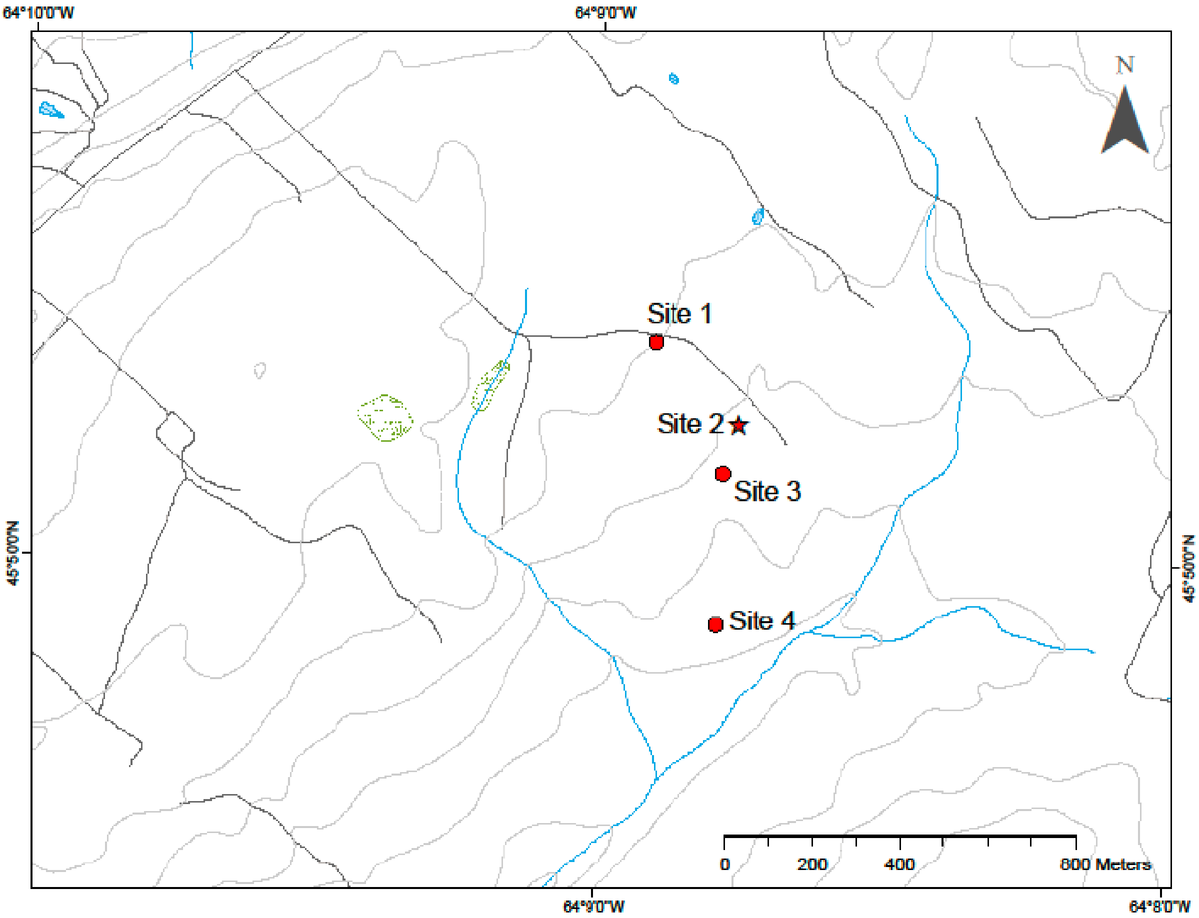

Figure 3-1: Location of automated bat detectors.

Assessment of Potential for Hibernacula

To assess the potential for hibernacula in proximity to the Project area, we examined the available literature and the Nova Scotia Abandoned Mine Openings (AMO) Database. To assess the AMO database, location and attribute data were imported into a Geographic Information System. A 25 km buffer surrounding the ACWF was applied to locate potential for hibernacula.

3.2.2 Wetland and Watercourse

The wetland and watercourse assessment consisted of a desktop review of available data for the Project area. The desktop review was then used to identify areas with a high potential for wetland habitat and incorporate that into developing a field survey strategy.

Desktop Review

A desktop review of the general project area was conducted to identify location and extent of potential wetlands. Information was reviewed from the following sources:

- Nova Scotia Wet Areas Mapping database (WAM);
- Aerial imagery;
- NS Significant Species and Habitats database;
- Topographical maps; and
- Site constrains: property boundary setback, radio wave link setbacks.

This information was used to identify areas with a high potential for wetland habitat. All high potential areas were incorporated into developing a field survey strategy.

Field Survey

The field survey was completed in August 2014 and was designed to focus on assessing land associated with the proposed turbine locations. Through Natural Forces' previous experience with the provincial environmental assessment process it is understood that WTGs must be setback 30 meters + blade length from wetlands and watercourses; the field assessment has been conducted in a conservative manner to aid in micro-siting to maintain this setback.

The wetland assessment followed the methodology outlined in the US Corps of Engineers Wetland Delineation Manual (1987). The following three criteria were used to determine wetland habitat:

1. Presence of hydrophytic vegetation;
2. Presence of hyrologic conditions; and
3. Presence of hydric soils.

Wetland boundaries were defined by walking strategic transects based on the proposed WTG locations. Frequent soil pits were dug to assess the presence of hydric soils and the presence/absence of hydrology. Vegetation surveys were conducted to confirm the presence of hydrophytic vegetation for indentified wetlands.

Watercourses within the assessment area were recorded; general notes were taken regarding the watercourses such as direction of flow, depth and connectivity with assessed wetlands.

Coordinates of wetlands extents and watercourses were captured by using a GPS approximately every 5 meters along the wetland boundary.

3.2.3 Flora

The proponent has engaged the services of Atlantic Canada Conservation Data Center's (ACCDC) botanists Sean Blaney and David Mazerolle to conduct a vascular plan survey at the ACWF project site.

Field Survey

ACCDC botanists Sean Blaney and David Mazerolle conducted a filed assessment of vascular plant species at the project site on June 9, 2014 and July 2, 2014. Collectively, the two botanists covered a walking distance of 17.6 kilometers; a GPS track of the site coverage can be found in Appendix E – Figure 1.

A full list of vascular plant species was compiled from field observations with locations documented for the first observation of each species. In addition, Sean Blaney documented plant communities present within the approximate turbine construction footprints, by photograph and by recording dominant species in the canopy, sapling, low shrub/tree seedlings and herbaceous strata.

3.2.4 Moose

In consultation with Nova Scotia Department of Natural Resources (NSDNR), mainland moose *Alces alces americana* were identified as a species at risk that may be inhabiting near the general Project area. The Chignecto Isthmus is an important corridor for Moose which move between the Provincial boundaries.

Since 2003 the native moose population in Nova Scotia has been listed as endangered and is limited to approximately 1000 individuals in isolated sub-populations across the province. The decline is not fully understood but involves multiple threats such as over harvesting, illegal hunting, climate change, parasitic brainworm, increased road access to moose habitat, spread of white - tailed deer, high levels of cadmium, deficiencies in cobalt and potentially unknown viral disease (NSDNR, 2013).

Mainland moose surveys were conducted during the winter/spring 2014 as a result of the provincial status of mainland moose and though consultation with NSDNR. The surveys consisted of 3 winter track surveys and two pellet group inventory (PGI) surveys.

Each winter track survey consisted of walking 7 defined transects spanning the Project site and surrounding areas to search for moose tracks or supporting evidence of moose. Each transect ranged from 1,400 meters to 2,300 meters.

Winter track surveys were completed on March 14, March 26 and April 6. PGI surveys were completed on April 29 and May 12.

The Proponent has also consulted with the regional Department of Natural Resources biologist to gain local knowledge of the presence of mainland moose near the Project site.

3.2.5 Wood Turtle

Through consultation with Nova Scotia Department of Natural Resources and through a review of the Nova Scotia Significant Species and Habitats database, potential Wood Turtle (*Glyptemys insculpta*) habitat was identified just over 2 km south of the Project site along Nappan River.

In addition to discussions with wildlife regional biologists, the Proponent has used the Special Management Practices document published by NSDNR for guidance in assessing the potential impacts and mitigation measures for wood turtles.

3.3 Socio-economic Desktop and Field Work Methods

3.3.1 Archaeological Resource Impact Assessment

An archaeological resource impact assessment was conducted by Davis MacIntyre & Associates Limited in June 2014. Historical maps, manuscripts and published literature were consulted as well as previous archaeological assessments in the general vicinity. The Maritime Archaeological Resource Inventory, a database of known archaeological resources in the Maritime region, was searched to understand prior archaeological research and known archaeological resources neighbouring the study area. Finally, a field reconnaissance was conducted in order to further evaluate the potential for archaeological resources. An initial reconnaissance was conducted in June 2014 of the preliminary access road and turbine layout. A reconnaissance of an updated layout was conducted in November 2014. (Davis MacIntyre Associates, 2014 –Appendix D)

3.3.2 Mi’kmaq Ecological Knowledge Study

The proponent has engaged the services of Membertou Geomatics Solutions (MGS) to provide a Mi’kmaq Ecological Knowledge Study (MEKS). The MEKS mandate is to consider land and water areas that the proposed Project will utilize, and to identify what Mi’kmaq traditional use activities have occurred, or are currently occurring within, and what Mi’kmaq ecological knowledge presently exists in regards to the area. The MEKS consisted of two major components:

1. Mi’kmaq traditional land and resource use activities, both past and present; and
2. A Mi’kmaq significant species analysis, considering the resources that are important to Mi’kmaq use.

The MEKS focuses on the Project site, defined by the land parcels associated with the Project. The study area consisted of areas that fall within a 5 kilometer radius of the Project site. The Project site and study area are shown in Figure 3-2.

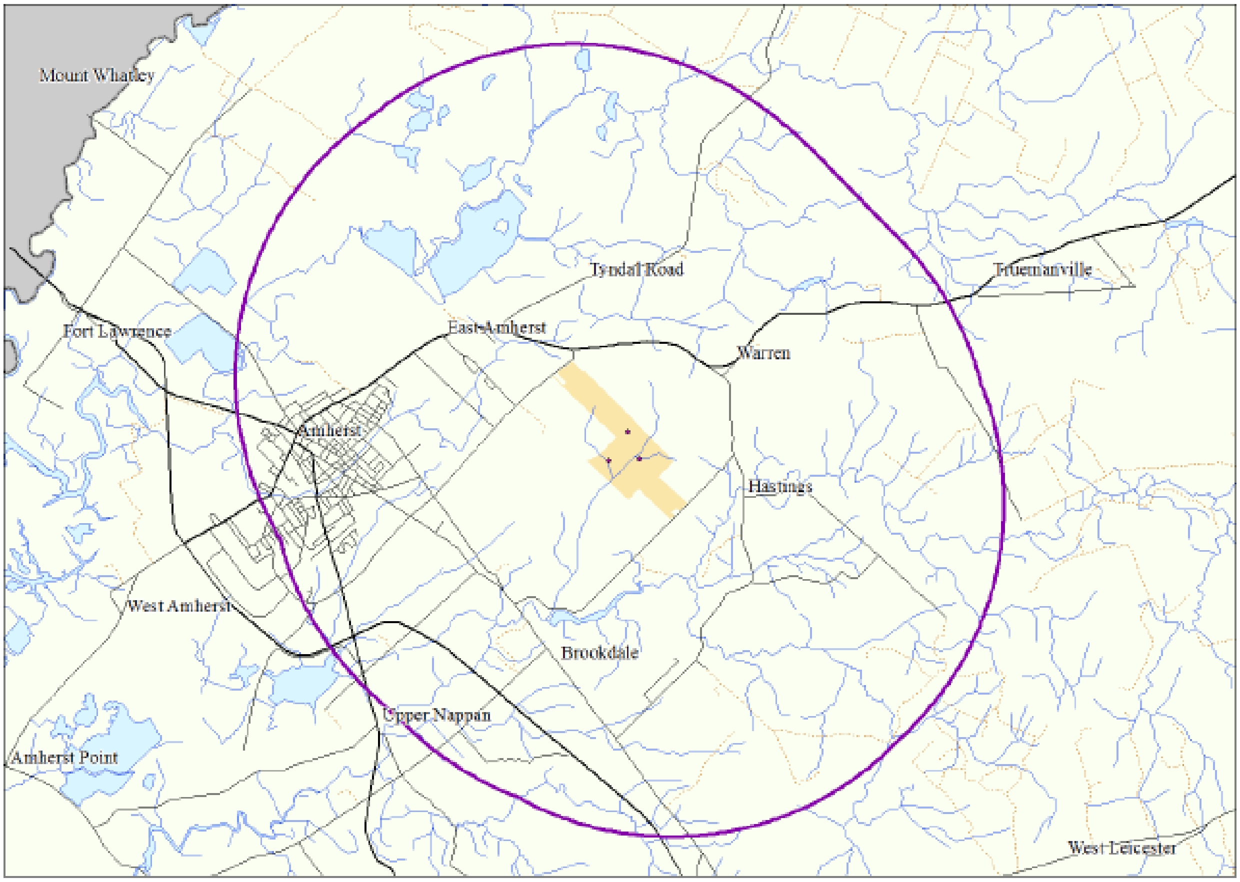

Figure 3-2: MEKS Project area in orange and study area inside purple oval.

Interviews

As a first step to gathering traditional use data, the MEKS team initiated dialogue and correspondence with Mi'kmaq communities in close proximity of the Project site: Sipekne'katik (Shubenacadie), Millbrook, Paq'tnkek, and Pictou Landing. Discussions occurred to identify individuals who undertake traditional land use activities or those who are knowledgeable of the land and resources. An initial list of key people was then developed by the team. These individuals were the contacted by the MEKS team members and interviews were scheduled.

Twenty four (24) individuals provided information in regards to past and present traditional use activities. Interviewees resided within or were from the communities of Sipekne'katik (Shubenacadie), Millbrook, Paq'tnkek, and Pictou Landing. All of the interviews followed the procedures identified within the Mi'kmaq Ecological Knowledge Protocol (MEKP) document. Prior to each interview, interviewees were provided information about the MEKS, including the purpose and use of the MEKS, the non-disclosure of their personal information in any reports, and the future use of the traditional use information they provided.

Interviewees were asked to sign a consent form, providing permission for MGS to use their interview information within the MEKS. During each interview, individuals were provided maps of the Project site and study area and were asked various questions regarding Mi'kmaq use activities, including where they undertook their activities or where they knew of activities by others, when such activities were undertaken, and how that type of resource was used. When required, interviews were conducted in the Mi'kmaq language.

Literature and Archival Research

With regards to this MEKS, various archival documents, maps, oral histories and published works were reviewed in order to obtain accurate information regarding the past and present Mi'kmaq use or occupation relevant to the Project site and study area. A complete listing of the documents that were referenced is outlined within the *Sources* section of Appendix E.

Field Sampling

Site visits to the Project site took place in September, 2014 by MGS staff members, guided by a Mi'kmaq ecological knowledge holder over a period of three days. A member of Mi'kmaq Wind4All Communities Steering Committee also joined MGS staff members on one day during the site visit.

The site visits consisted of a site reconnaissance and walkthroughs of the Project site, noting and identifying any particular species in the area, plant and animal habitats or other land/water features or areas that would be of importance to the Mi'kmaq. MGS staff and the Mi'kmaq ecological knowledge holder would either take notes of observations points at set, and at irregular intervals, or whenever a species or observation was worth noting.

Mi'kmaq Significant Species Process

In order to identify possible project activities that may be of significance to the Mi'kmaq with regards to traditional use of the Study Area, the project team undertakes a number of steps in order to properly consider the Mi'maq ecological knowledge data. This involves three main components: Type of Use, Availability and Importance.

(1) Type of Use

The first component of analysis is the "Type of Use" of the resource, which involves the categorization of the resource. All resources are placed into various general categories regarding the type of use. The categories are:

- Medicinal/ceremonial;
- Food/sustenance; and
- Tool/art.

These general headings are used so as to ensure further confidentiality with respect to the resources and the area where they are harvested. As well, the total number of instances where a resource harvest has been documented by the study is quantified as well.

(2) Availability

After the data is considered by the type of use, it is considered in accordance with its availability; this involves considering whether the resource is abundant in the Study Area or whether it is rare or scarce. Based on the information that is provided to the team from the ecological knowledge holders and/or written literature sources, the availability of the resource is then measured in regards to other water or land areas that are outside of the Study Area. This measurement is primarily done in the context of the areas adjacent to the Study Area, and if required, other areas throughout the province. By proceeding in this manner, the study can provide an opinion on whether that resource may be rare, common or abundant.

- Rare: only known to be found in a minimum of areas, may also be on the species at risk or endangered plants list;
- Common: known to be available in a number of areas; and
- Abundant: easily found throughout the Study Area or in other areas in the vicinity.

This allows the study team to identify the potential impact of a resource being impacted by the Project.

(3) Importance

The final factor the MEKS team considers when identifying the significance of a resource to Mi'kmaq use is whether the resource is of major importance to Mi'kmaq traditional use activities. This can be a subjective process, as any traditional resource use will be of importance to the individual who is acquiring it, regardless if its use is rare, common or abundant. However, to further identify the importance, the MEKS team also considers the frequency of its use by the Mi'kmaq; whether the resource is commonly used by more than one individual, the perceived importance to the Mi'kmaq in the area, and finally the actual use itself.

These factors support the broad analysis of many issues in formulating an opinion on significance and supports identifying whether the loss of a resource will be a significant issue to future Mi'kmaq traditional use, if it is impacted by the Project.

3.3.3 Noise Impact Assessment

A noise impact assessment was conducted by Natural Forces Wind to assess the impact of wind turbine generated noise on houses and dwellings near the project site. The noise impact assessment uses WindPRO software that is designed to predict noise levels at specific geographic locations from sound emitted by turbines.

The MoCC does not have any noise guidelines or by-laws pertaining to maximum noise levels from wind turbines, for this reason, Ontario Provincial guidelines were used as these are widely accepted as the industry standard in Nova Scotia. Ontario guidelines recommend that noise experienced by a receptor (home or dwelling) should not exceed 40 db(A). For the purpose of the noise assessment study, all receptors within 2,500 m of a turbine were assessed to predict the maximum noise level that could be expected.

The model uses conservative assumptions to produce a maximum expected noise level, or a worst case scenario. Details on input parameters can be found in the full noise impact assessment in Appendix I.

3.3.4 Shadow Impact Assessment

A shadow flicker impact assessment was conducted by Natural Forces Wind to assess the impact of wind turbine generated shadow flicker on houses and dwellings near the project site. The shadow flicker impact assessment uses WindPRO software that is designed to predict shadow flicker that may occur at specific geographic locations from turbine blades impeding the line of sight between the sun and a receptor.

The MoCC does not have any noise guidelines or by-laws pertaining to shadow flicker, for this reason, German shadow flicker guidelines were used as these are widely accepted as the industry standard in Nova Scotia. Ontario guidelines recommend the following acceptable levels of shadow flicker at a receptor:

- No more than 30 hours per year of astronomical maximum shadow flicker; and
- No more than 30 minutes on the worst day of astronomical maximum shadow flicker.

For the purpose of the shadow flicker impact assessment, all receptors within 2,500 m of a turbine were assessed to predict the maximum shadow flicker exposure that could be expected.

The model uses conservative assumptions to produce a maximum expected duration of shadow flicker, or a worst case scenario. Details on input parameters can be found in the full shadow flicker impact assessment in Appendix J.

3.3.5 Electromagnetic Interference Study

The Proponent has engaged the services of MACNEIL Telecom Inc. to provide an impact assessment of the proposed ACWF on the performance of existing microwave radio links. The desktop and field study was initiated by completing a search of the Industry Canada database to identify all licensed radio systems within 35 km of the proposed Project. All applicable radio links were plotted on a map to identify their proximity to the proposed WTGs of the ACWF. Once plotted a desktop review and a field review was conducted to verify the location and existence of the radio link antennas.

Based on radio links that were identified and confirmed, an assessment of the potential impact was then completed by calculating the recommended required clearance between radio links. A recommended clearance buffer was applied to any radio link that crossed through the Project site, to determine whether or not a proposed turbine was within this buffer.

Following the analysis, recommendations were made to the Proponent as to where turbines could be located so they would not impede or interfere with existing radio links.

3.4 Methodology of Assessment

The assessment focuses on the evaluation of potential interactions between the VECs and socio-economic aspects with the various Project activities as described in Section 2.

As defined in the Nova Scotia Environment Act:

"Environment" means the components of the earth and includes

> *(i) air, land and water;*
> *(ii) the layers of the atmosphere; organic and inorganic matter and living organisms;*
> *(iii) the interacting systems that include components referred to in sub clause (i) to (iii); and*
> *(iv) for the purpose of Part IV, the socio-economic, environmental health, cultural and other items referred to in the definition of environmental effect.*

"*Environmental Effect" means in respect of an undertaking*

> *(i) any change, whether positive or negative, that the undertaking may cause in the environment, including any effect on socio-economic conditions, environmental health, physical and cultural heritage or on any structure, site or thing including those of historical, archaeological, paleontological or architectural significance, and;*
> *(ii) any change to the undertaking that may be cause by the environment, whether that change occurs inside or outside the Province.*

The assessment is designed to focus on the evaluation of the potential interactions between the VECs and the various Project activities that have been previously outlined in Section 2. The residual environmental effects are those that remain after mitigation and control measures have been applied. The prediction of residual environmental effects follows three general steps.

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

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

- *Significant:* Potential impact could threaten sustainability of the resource in the study area and should be considered a management concern;
- *Minor:* Potential impact may result in a small decline of the quality of the resource in the study area during the life of the Project – research, monitoring and/ or recovery initiatives should be considered;
- *Negligible:* Potential impact may result in a very slight decline of the quality of the resource in the study area during the life of the Project – research; monitoring and/ or recovery initiatives would not normally be required;
- *No impact:* the consequences of the Project activity have no effect on the specific VEC; and
- *Beneficial impact:* the consequence of a Project activity enhances the specific VEC.

Further, a review of the effect of the environment on the Project is included in the assessment. This includes climate impact and extreme events.

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4.0 Environmental Setting

4.1 Biophysical

4.1.1 Geophysical

Amherst is located in the Northumberland Strait sub-Unit of the Northumberland Plain theme region. This region covers the area from Cumberland Basin to Pictou and contains an anticline that runs from Pugwash Harbour to Nappan and Amherst Point. The area contains fine red sandstones. The soil ranges from sandy loam to sandy clay loam and is derived from sandstone and shales, which underlie the entire area. The subsoil tends to be compacted and impermeable and the soils are usually imperfectly drained. (Davis MacIntyre & Associates, 2014 – Appendix D)

4.1.2 Atmospheric

Historic climate data was taken from an Environment Canada weather station located in Nappan, near Amherst, Nova Scotia located approximately 10 km from the Project site. The data collected from Environment Canada representing climate averages and extremes are shown in Table 4-1.

Table 4-1: Nappan, Nova Scotia Atmospheric Conditions (Environment Canada, 2012).

Parameter	Time Period	Data Source	Value
Average Daily Temperature (°C)	Yearly Average (1971-2000)	Environment Canada	6.0
Extreme Maximum Temperature (°C)	August 18, 1935	Environment Canada	34.4
Extreme Minimum Temperature (°C)	February 18, 1922	Environment Canada	-37.2
Average Total Rainfall (mm)	Yearly Average (1981-2010)	Environment Canada	886.0
Maximum Daily Rainfall (mm)	September 22, 1942	Environment Canada	153.7
Average Annual Snowfall (cm)	Yearly Average (1981-2010)	Environment Canada	254.0
Maximum Snow Depth (cm)	February 20, 2004	Environment Canada	128

Visibility & Fog

The presence and frequency of fog events at a wind farm site can have a detrimental effect on migratory birds due to collisions during adverse weather conditions. Artificial lighting, particularly work lights inadvertently left on by turbine maintenance crews are also known to have an adverse effect on migratory birds (Kearney, 2012) During adverse weather events, sporadic artificial lighting during dawn and dusk at a wind farms may attract migrating birds, signaling a potential safe area of refuse.

The Project setting is considered rural, with little to no presence of artificial lighting. Light pollution from Amherst can be considered the only significant sources of artificial light.

According to the internationally-accepted definition of fog, it consists of suspended water droplets or ice crystals near the Earth's surface that lead to a reduction of horizontal visibility to below 1 km (NOAA, 1995). Environment Canada's database of Canadian Climate Normals 1971-2000 was consulted to provide baseline fog data relevant to the Project site. A weather station in Moncton, New Brunswick was selected (Environment Canada, 2012). Based on this data presented in Table 4-2, fog can be expected to occur 2.0% of the time throughout the duration of an average year.

This data will provide background site information for the assessment of the significance of adverse affect on the environment in the VEC analysis section.

Table 4-2: Moncton, New Brunswick fog data average from 1971 – 2000 (Environment Canada, 2012).

Month	Hours with visibility less than 1 km	% of foggy weather*
January	18	2.4
February	19.5	2.9
March	24.2	3.3
April	18.4	2.6
May	12.5	1.7
June	10.4	1.4
July	11.3	1.5
August	9.5	1.3
September	9.8	1.4
October	9.7	1.3
November	12.6	1.8
December	15.7	2.1
Annual	**171.8**	**2.0 %**

* Based on days/month x 24 hr/day.

4.1.3 Wind Resource

The Nova Scotia wind atlas was used in preliminary site finding and indicates an approximate wind speed of 6.0 – 7.0 m/s at 80 m (NS Wind Atlas, 2013).

A detailed wind resource assessment program at the ACWF site was initiated in May 2014 with the installation of a 60 m meteorological mast (met mast) containing anemometers at 40 m, 50 m and 60 m above ground level. The instrumentation on the meteorological mast measures wind direction, wind speed, temperature, relative humidity and atmospheric pressure. A collective assessment of these parameters will be used to determine the feasibility of harnessing the wind regime. A long-term wind resource assessment is currently being conducted with the data collected from the meteorological mast and Triton Sodar unit.

Based on Natural Forces' independent Wind Resource Assessment a wind rose found in Figure 4-1 indicates the prevailing wind at the Project site location is southwest.

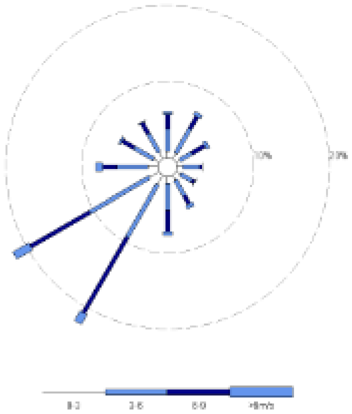


Figure 4-1: Wind rose showing prevailing southwest wind direction taken from meteorological mast.

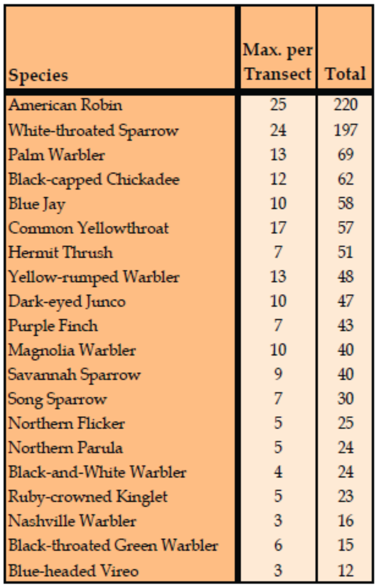
4.1.1 Avian Survey

Baseline Avian Survey

The following is a summary of the results from the baseline avian study that the Proponent found would be of most interest to the reader. A considerable amount of data was collected and analysed through Radar and Nocturnal acoustic sampling, in addition to traditional avian transect surveys. Full results can be found in Appendix B.

1. ***Spring Migration nocturnal & daytime transects***

The spring migration surveys reveal nocturnal and diurnal passage over the study area was light. During the spring migration survey portion of the baseline study the most abundant migratory species present along the stop-over transects were; American robin, White-throated sparrow and Palm warbler. Figure 4-2 shows the twenty most abundant species present during the spring migratory stop-over transects. Further, Figure 4-3 presents the total birds observed on each transect at both the Project area and control area.



Species	Max. per Transect	Total
American Robin	25	220
White-throated Sparrow	24	197
Palm Warbler	13	69
Black-capped Chickadee	12	62
Blue Jay	10	58
Common Yellowthroat	17	57
Hermit Thrush	7	51
Yellow-rumped Warbler	13	48
Dark-eyed Junco	10	47
Purple Finch	7	43
Magnolia Warbler	10	40
Savannah Sparrow	9	40
Song Sparrow	7	30
Northern Flicker	5	25
Northern Parula	5	24
Black-and-White Warbler	4	24
Ruby-crowned Kinglet	5	23
Nashville Warbler	3	16
Black-throated Green Warbler	6	15
Blue-headed Vireo	3	12

Figure 4-2: Twenty most abundant migratory species during stop-over transects.

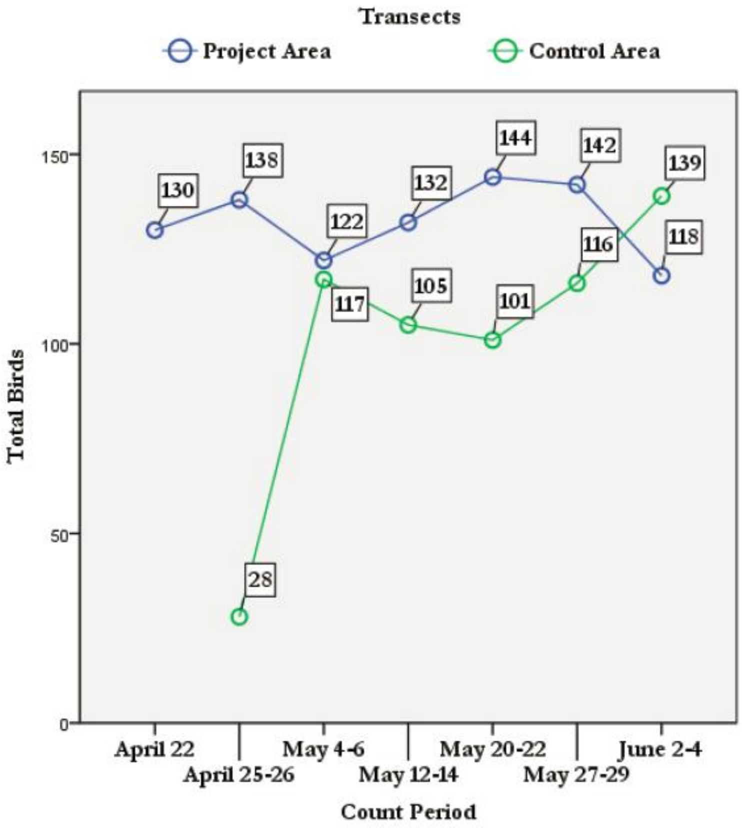
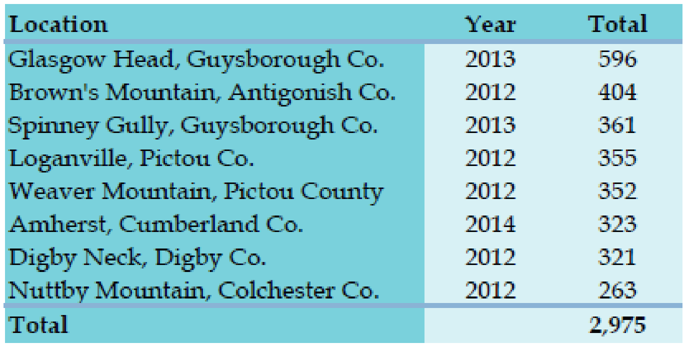


Figure 4-3: Total number of birds per count period during the spring.

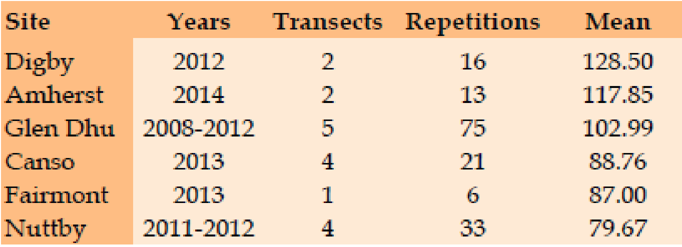
The nocturnal acoustic monitoring during the spring migration period revealed a high frequency of night flight calls from sparrows and warblers. Compared to seven other existing or proposed wind farms in Nova Scotia as shown in Figure 4-4, the Amherst site ranked 4/7 in terms of total high frequency night calls.



Location	Year	Total
Glasgow Head, Guysborough Co.	2013	596
Brown's Mountain, Antigonish Co.	2012	404
Spinney Gully, Guysborough Co.	2013	361
Loganville, Pictou Co.	2012	355
Weaver Mountain, Pictou County	2012	352
Amherst, Cumberland Co.	2014	323
Digby Neck, Digby Co.	2012	321
Nuttby Mountain, Colchester Co.	2012	263
Total		2,975

Figure 4-4: Total high frequency night flight calls recorded during the spring in Nova Scotia.

Figure 4-5 presents the mean total number of birds observed at six wind farms in Nova Scotia during spring migration transects. Results at the Amherst Project site are the second highest of the six sites with Digby Neck wind farm being the highest. These relatively high counts at the Amherst Project site are likely due to the presence of birds that prefer edge and disturbed habitats. This could also be due to the movement of birds from the nearby marsh to inland habitat near the site.



Site	Years	Transects	Repetitions	Mean
Digby	2012	2	16	128.50
Amherst	2014	2	13	117.85
Glen Dhu	2008-2012	5	75	102.99
Canso	2013	4	21	88.76
Fairmont	2013	1	6	87.00
Nuttby	2011-2012	4	33	79.67

Figure 4-5: Mean number of birds counted on spring transects at six wind farm sites in Nova Scotia.

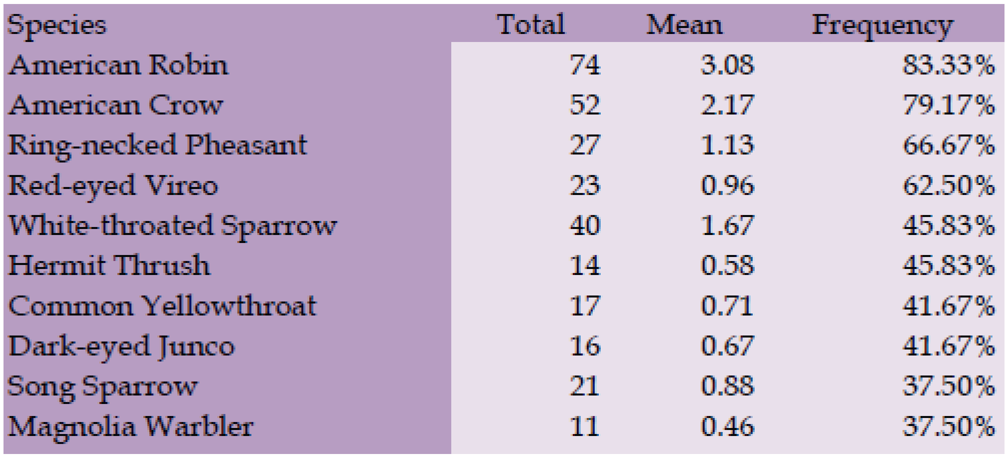
2. Breeding Season

A number of species breed early in the spring and are thus not as actively engaged in courtship and breeding activities by the time the peak season arrives in June. The three most common birds observed in the early season were American black duck, Mallard and Ruffed grouse; Figure 4-6 presents the ten most abundant early season breeding birds that were observed in the study area.

Species	Number
American Black Duck	15
Mallard	13
Ruffed Grouse	16
Spruce Grouse	1
Downy Woodpecker	1
Hairy Woodpecker	4
Pileated Woodpecker	1
Gray Jay	4
Common Raven	28
Common Grackle	20

Figure 4-6: Early season breeding birds observed in the study area.

During the peak season for breeding birds, starting in June, the most abundant birds were both forest birds and those associated with agricultural lands. The most common bird, American robin is one that benefits equally from forested and agricultural lands. The second and third most abundant birds are American crows and Ring-necked pheasant, two largely agriculturally dependent species. Figure 4-7 presents the ten most abundant birds observed during peak migration season in numbers of total observations, mean observations and frequency of observation.



Species	Total	Mean	Frequency
American Robin	74	3.08	83.33%
American Crow	52	2.17	79.17%
Ring-necked Pheasant	27	1.13	66.67%
Red-eyed Vireo	23	0.96	62.50%
White-throated Sparrow	40	1.67	45.83%
Hermit Thrush	14	0.58	45.83%
Common Yellowthroat	17	0.71	41.67%
Dark-eyed Junco	16	0.67	41.67%
Song Sparrow	21	0.88	37.50%
Magnolia Warbler	11	0.46	37.50%

Figure 4-7: Peak season breeding birds observed in the study area.

3. Fall Migration

The total birds on both the control area and the Project area are presented in Figure 4-8. The two transects follow corresponding patterns with migration peaks during mid-September and mid-October, with the higher number of observations occurring along the control area transect.

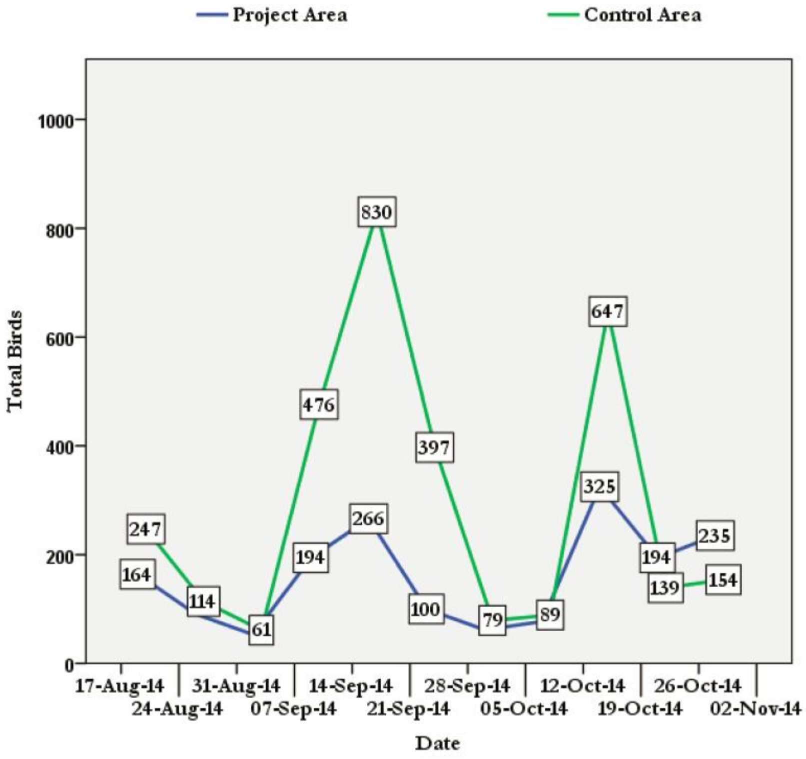
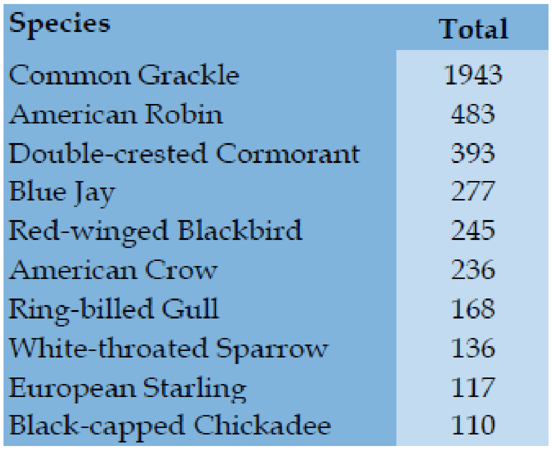


Figure 4-8: Total birds per transect by date in the fall.

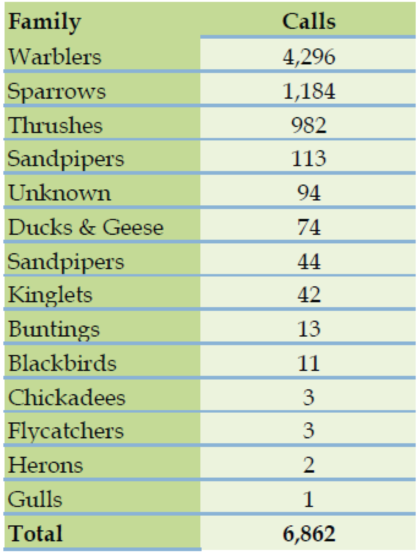
The most common species observed during the fall migration study was the Common grackle followed by the American robin and the Double-crested cormorant. The American robin, Blue jay and Black-capped chickadee were also observed in the ten most abundant species during the spring migration surveys.



Species	Total
Common Grackle	1943
American Robin	483
Double-crested Cormorant	393
Blue Jay	277
Red-winged Blackbird	245
American Crow	236
Ring-billed Gull	168
White-throated Sparrow	136
European Starling	117
Black-capped Chickadee	110

Figure 4-9: Ten most abundant species during fall transects.

The most abundant family of birds observed during the night from the acoustic detectors were warblers, followed by sparrows and thrushes. Figure 4-10 presents the number of night calls detected from every family during the fall acoustic monitoring surveys. In total, 74 calls from water fowl were detected and three shorebird calls were detected.

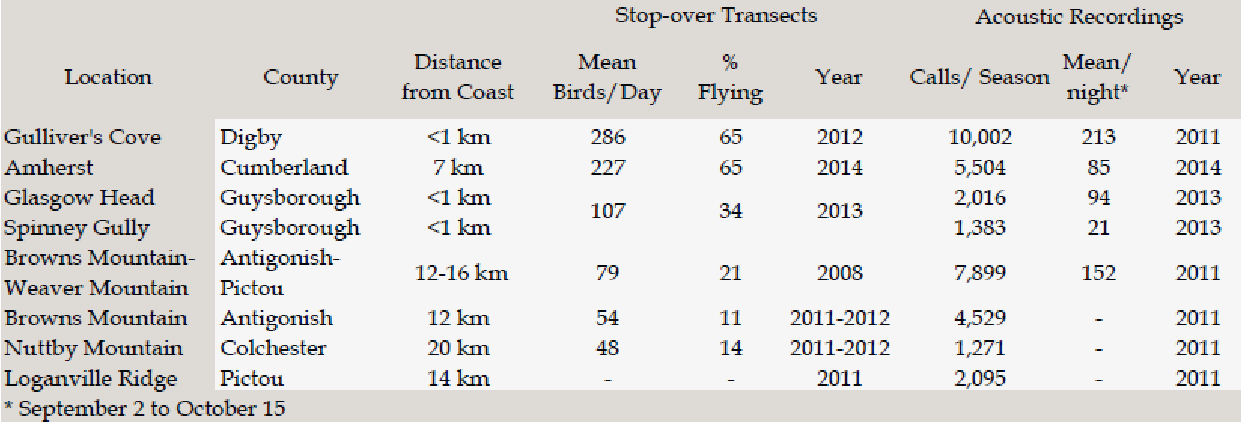


Family	Calls
Warblers	4,296
Sparrows	1,184
Thrushes	982
Sandpipers	113
Unknown	94
Ducks & Geese	74
Sandpipers	44
Kinglets	42
Buntings	13
Blackbirds	11
Chickadees	3
Flycatchers	3
Herons	2
Gulls	1
Total	**6,862**

Figure 4-10: Number of night flight calls recorded by acoustic detectors by family in the fall.

In contrast to spring migration surveys, the number of birds observed during the fall migration surveys was high. Figure 4-11 compares stop-over counts and nocturnal passage recordings at eight existing or proposed wind farm sites in Nova Scotia. The stop-over counts in Amherst approached the high counts at Digby Neck in mean total birds and were on par with that location for the percentage of birds that were in flight in the morning. For nocturnal migration, Amherst was in the middle range of total and mean number of high frequency night flight calls.

The large number of birds in the air over the Amherst site in the first two hours of the day consisted of three components; true diurnal migrants, re-orienting nocturnal migrants and non-migratory movements to local feeding areas. The inappropriate direction of the nocturnal migrants in the early morning is consistent with the similar reports and supports the view of re-orientation over the study area. The American Robin was dominant in this group. The non-migratory movements were primarily large flocks of Common Grackles and Red-winged Blackbirds. Some of these flocks could also have been engaged in diurnal passage. Most diurnal migration was represented by Double-crested Cormorants, Blue Jays, and winter finches.



			Stop-over Transects			Acoustic Recordings		
Location	County	Distance from Coast	Mean Birds/Day	% Flying	Year	Calls/ Season	Mean/ night*	Year
Gulliver's Cove	Digby	<1 km	286	65	2012	10,002	213	2011
Amherst	Cumberland	7 km	227	65	2014	5,504	85	2014
Glasgow Head	Guysborough	<1 km	107	34	2013	2,016	94	2013
Spinney Gully	Guysborough	<1 km				1,383	21	2013
Browns Mountain-Weaver Mountain	Antigonish-Pictou	12-16 km	79	21	2008	7,899	152	2011
Browns Mountain	Antigonish	12 km	54	11	2011-2012	4,529	-	2011
Nuttby Mountain	Colchester	20 km	48	14	2011-2012	1,271	-	2011
Loganville Ridge	Pictou	14 km	-	-	2011	2,095	-	2011

* September 2 to October 15

Figure 4-11: Comparison of stop-over counts and high frequency night flight call counts at eight sites in Nova Scotia.

Fall Radar Study

As previously mentioned in Section 3.2, two modified marine radars were set up near the site in late summer 2014. The radar antennas made a complete 360 degree revolution every 2.4 seconds. The radar locations can be found in Appendix B – Figure 1. Data was collected from mid August to late October 2014 to help describe the volume, direction and altitude of migration of presumed bird targets, and the relationships between those variables and the weather.

The following is just a snapshot of some of the results from the fall radar study that the Proponent found would be of most interest to the reader. This is not a full presentation of the results, for full results please see Appendix B.

The bulk of fall migration activity occurred between September 27 and October 3, 2014 at both radar sites. There also was a smaller peak in early September and mid-October. Furthermore, approximately 50% of the total number of targets detected occurred on only 8 nights (or 17% of the nights at house 1 and 16% of the nights at house 2).Figure 4-12 presents the number of tracks detected at both radar stations over the fall season.

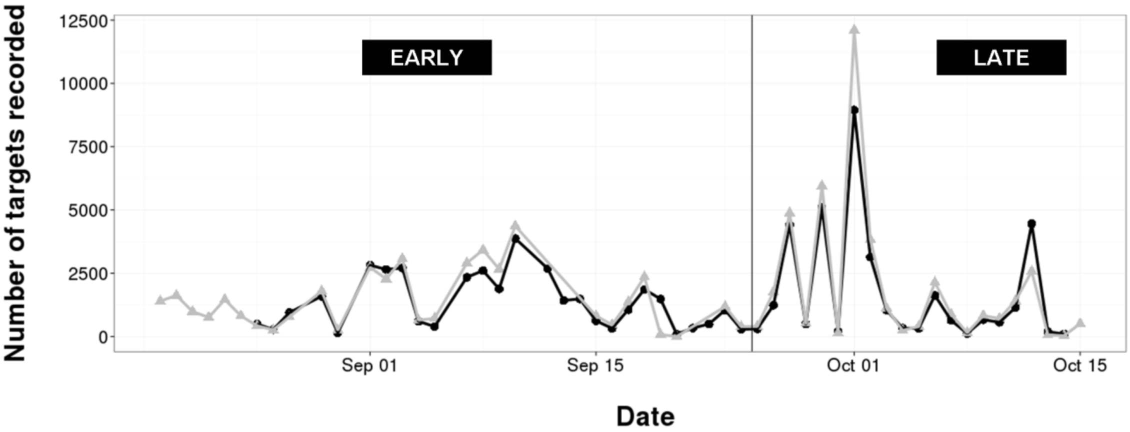


Figure 4-12: number of tracks detected over fall migration season (grey = house 2, black = house 1).

Direction of movement and variability

There was approximately the same number of targets detected through radar in the early and late seasons at both radar locations. Figure 4-13 below is a snap shot of four different nightly data sets from both radar locations early and late in the fall season. The mean direction of tracks was similar at both sites in the early season (220° and 215°) and shifted to the west in the late season (252° and 254°) The variance in headings differed considerably between seasons, with a large decrease in heading variance in the later season (0.37 and 0.36 vs. 0.62 and 0.60;). The large variance early in the season shows that many targets are moving in all directions, with modal directions to the SW and to the SE.

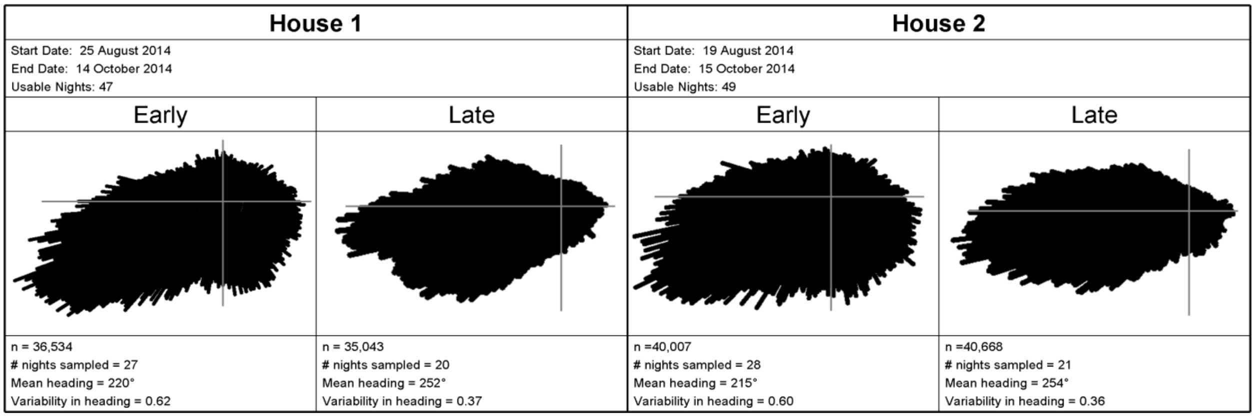


Figure 4-13: Circular heading plot of mean heading and variability in heading of tracks across the fall migration season.

Further insight into the patterns of movement can be obtained by examining particular nights with relatively high amounts of migratory activity, as shown in Figure 4-14.

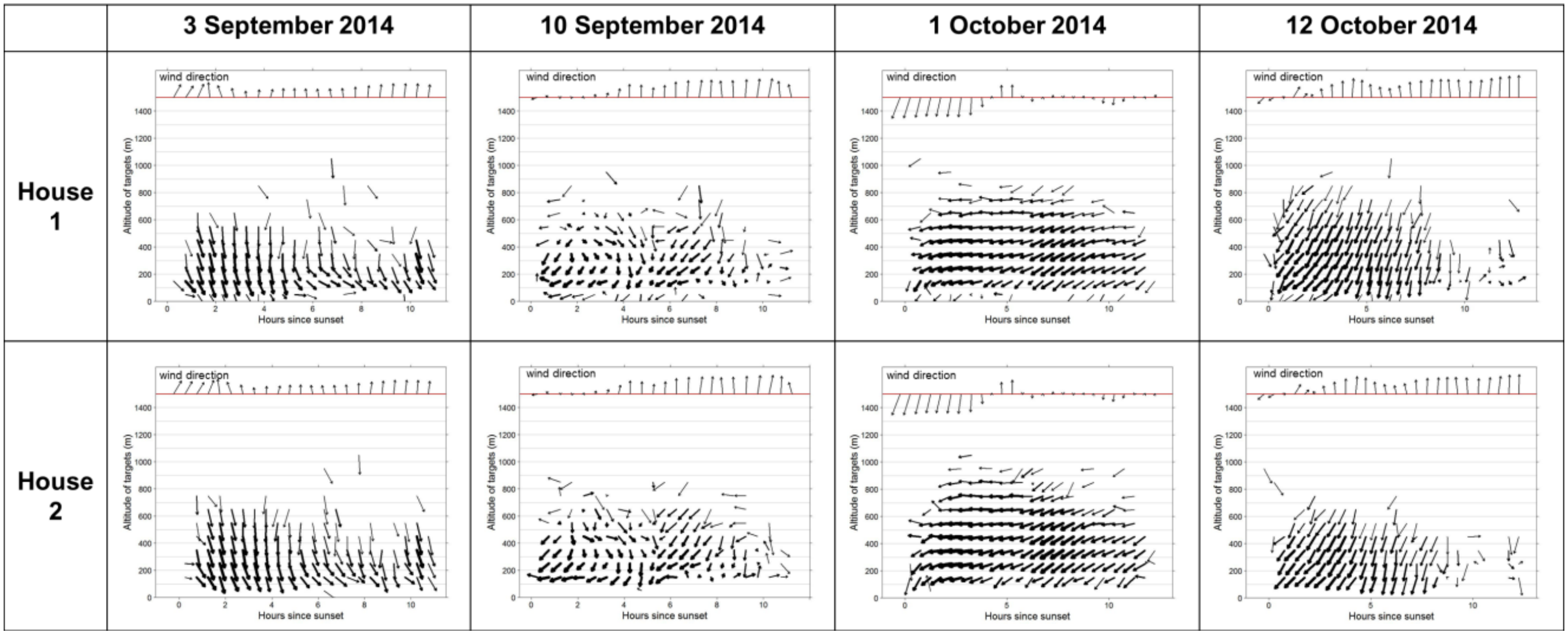


Figure 4-14: Arrow plots showing nights of high activity during fall migration. Plots show the number of targets (darkness of arrow), mean direction (direction of arrow) and variability in direction (shorter arrows are more variable). Y axis is Altitude of target in 100m increments and X axis is hours since sunset in 2 hour increments.

Correlation between Radar & Acoustic data

Finally, data correlations were examined between radar data and acoustic monitoring, the results are presented in Figure 4-15. The volume of migration detected by the radar and the acoustic microphone do not appear to be highly correlated. In general, the peaks in the radar do not necessarily correspond with the peaks in acoustic data, and vice versa. However, it is still likely that the suite of species detected on the acoustic microphone represents at least partially, the suite of species detected by the radar.

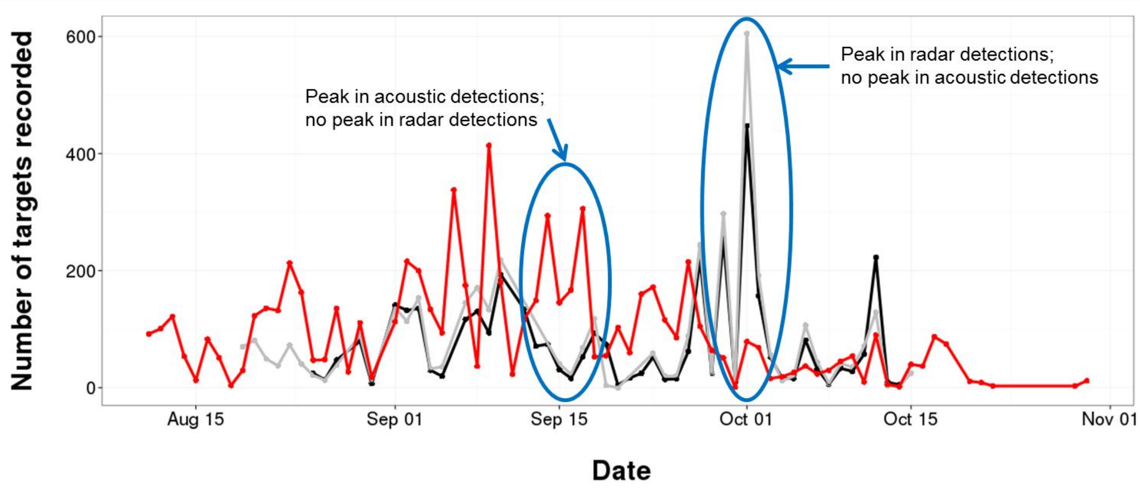


Figure 4-15: Radar data and acoustic monitoring data (black = house 1, grey = house 2 & red = acoustic microphone).

Although the correlation is weak, these results point to the importance of combining the two observational methods. Ground-based surveys are picking up movements at lower altitudes, because radar surveys are not able to detect low-altitude movements.

A more detailed analysis and discussion on the fall migration radar data can be found in Appendix B.

Furthermore, the proponent is committing to continue the Radar and Acoustic monitoring programs into the 2015 spring migration season in order to add to the existing data set which will better characterise the movement of avian migratory species over the site. This is further discussed in Section 7 Follow up and Monitoring.

4.1.1 Bats

Results

In total at the Project site 2047 acoustic files were recorded at the 4 detector locations over a period of 106 nights. After evaluation, 1028 were classified as bat-generated ultrasound files and the remaining were classified as extraneous noise. Table 4-3 provides a general summary of the number of bat echolocation calls that were detected at each detector location over the duration of the acoustic sampling period.

Table 4-3: Summary of number of echolocation calls at each detector location. (Burns & Broders 2014)

Site ID	Total # of echolocation sequences
1	16
2 lower microphone	58
2 upper microphone	80
3	27
4	847
Total	**1028**

The majority of call sequences identified during the study have been identified as hoary bats with the second most abundant species being *Myotis* species. No attempt was made to identify what species of *Myotis* was identified. Other species detected were silver-haired bats and red bats.

Hoary bats are a type of migratory tree bat which have been shown to be the most susceptible to deaths caused by wind turbines. Due to the higher number of hoary bats detected early in the season, the proponent is committing to further 2015 field surveys in order to better characterise hoary bat movement throughout the site. This is further discussed in section 7.2.1.

Table 4-4: Quantification of bat species detected during the study. (Burns & Broders, 2014)

Species of bat detected	Number of echolocation sequences detected	Percentage of abundance
Hoary bat	955	92.9 %
Myotis	48	4.7 %
Silver-haired bat	18	1.7 %
Red bat	7	0.7 %

The average number of recorded bat call sequences per night averaged over all detectors at all four sites together) in the proposed development area was 2.16 (SD = 21.2) during the sampling period.

Detailed results of the echolocation sequence calls that were recorded are presented in Table 4-5. Where:

- LAB = *Lasiurus borealis* (Eastern red bat)
- LAC = *Lasiurus cinereus* (Hoary Bat)
- MYO = *Myotis* species (Northern long-eared and little brown bat)
- LAN = *Lasionycteris noctivagans* (Silver-haired bat)

According to the Nova Scotia AMO database, there are 366 underground abandoned mine opening records in the vicinity of the ACWF project within 25 km. Following the exclusion analysis, 56 of the AMO records remain that could potentially act as bat hibernacula, where to the knowledge of the study team have never been surveyed for bats before.

The information provided in the main text of this environmental assessment is a summary of the data gathered during the bat survey conducted by Lynn Burns and Hugh Broders. Full results and discussion can be found in Appendix C.

Table 4-5: Number of echolocation bat call sequence files recorded per night for the 2014 ACWF study.

Night of	Site 1			Site 2 low mic				Site 2 high mic				Site 3			Site 4				Total
	LAB	LAC	MYO	LAB	LAC	LAN	MYO	LAB	LAC	LAN	MYO	LAC	LAN	MYO	LAB	LAC	LAN	MYO	
21-Jul-14	0	0	0	1	3	3	3	0	7	0	0	2	0	1	0	122	0	0	142
22-Jul-14	0	0	0	0	2	0	0	0	4	0	0	1	0	0	0	263	0	0	270
23-Jul-14	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	357	0	0	360
24-Jul-14	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	6	0	0	10
25-Jul-14	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	25	0	0	28
26-Jul-14	0	2	0	0	1	0	0	0	1	0	0	0	0	0	0	4	0	1	9
27-Jul-14	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	8
28-Jul-14	0	2	0	0	0	0	0	0	0	0	0	0	0	1	0	15	0	1	19
29-Jul-14	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	8	0	1	10
30-Jul-14	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	2
31-Jul-14	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	2	0	1	5
1-Aug-14	0	0	1	1	0	0	12	0	0	0	0	0	0	1	0	0	0	2	17
2-Aug-14	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2
3-Aug-14	0	1	0	0	2	0	0	0	5	0	0	1	0	1	0	2	0	0	12
4-Aug-14	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	3
5-Aug-14	0	0	0	0	21	0	0	0	28	0	0	1	0	0	1	0	0	0	51
6-Aug-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7-Aug-14	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	4
8-Aug-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9-Aug-14	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	3
10-Aug-14	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
11-Aug-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12-Aug-14	0	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	3

Night of	Site 1			Site 2 low mic				Site 2 high mic				Site 3			Site 4				Total
	LAB	LAC	MYO	LAB	LAC	LAN	MYO	LAB	LAC	LAN	MYO	LAC	LAN	MYO	LAB	LAC	LAN	MYO	
13-Aug-14	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
14-Aug-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15-Aug-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16-Aug-14	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	2
17-Aug-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18-Aug-14	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
19-Aug-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20-Aug-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21-Aug-14	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2
22-Aug-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23-Aug-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
24-Aug-14	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
25-Aug-14	0	0	0	0	1	0	0	0	1	0	0	1	0	0	0	0	0	1	4
26-Aug-14	0	0	0	0	0	0	1	0	1	0	0	1	1	0	0	1	0	0	5
27-Aug-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
28-Aug-14	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	2
29-Aug-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30-Aug-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	1	0	10
31-Aug-14	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
1-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2-Sep-14	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	2
3-Sep-14	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	2
4-Sep-14	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0	6	2	0	11
5-Sep-14	0	0	0	0	0	1	0	0	1	1	0	3	0	1	0	1	2	0	10
6-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Night of	Site 1			Site 2 low mic				Site 2 high mic				Site 3			Site 4				Total
	LAB	LAC	MYO	LAB	LAC	LAN	MYO	LAB	LAC	LAN	MYO	LAC	LAN	MYO	LAB	LAC	LAN	MYO	
7-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
8-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
10-Sep-14	0	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	3
11-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12-Sep-14	0	0	0	0	0	0	0	1	0	0	1	0	0	1	-	-	-	-	3
13-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	0
14-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	2	-	-	-	-	2
15-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	0
16-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	0
17-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	0
18-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	0
19-Sep-14	0	0	0	0	0	0	0	0	1	0	0	0	0	0	-	-	-	-	1
20-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	0
21-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	0
22-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	0
23-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	0
24-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	0
25-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	0
26-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	0
27-Sep-14	0	0	0	0	0	0	1	0	0	0	0	0	0	0	-	-	-	-	1
28-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	0
29-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	0
30-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	0
1-Oct-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	0

Night of	Site 1			Site 2 low mic				Site 2 high mic				Site 3			Site 4				Total
	LAB	LAC	MYO	LAB	LAC	LAN	MYO	LAB	LAC	LAN	MYO	LAC	LAN	MYO	LAB	LAC	LAN	MYO	
2-Oct-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	0
3-Oct-14	0	0	0	0	0	0	0	0	0	0	0	0	0	1	-	-	-	-	1
Data not shown from 5-Oct-14 to 03-Nov-14 when no bat call sequences were recorded																			

4.1.2 Wetlands and Watercourses

A detailed wetland field assessment was undertaken as part of this EA to identify areas of wetland habitat and watercourses coinciding with Project infrastructure. Multiple areas of wetland habitat, primarily treed swamp and clear cut swamp, were identified during the field assessment.

Consultation with NSNDR has led the Proponent to apply a 30 m plus WTG blade length buffer from wetlands and watercourses, this equates to a 76 m buffer. Figure 4-17 presents the proposed WTG locations along with a 76 m radius buffer (46 m blade length + 30 m) with no impedance on wetlands or watercourses. The WTG locations have been optimized such that they follow NSDNR recommendations to maintain a minimum 30 m buffer from the WTG blade tip, and therefore reducing the potential impacts to species living within and adjacent to wetland and watercourse ecosystems.

The proposed access road layout has been designed to minimize disturbance to existing conditions, primarily by making use of the existing access road that is used for agriculture. It is anticipated that one wetland alteration and one watercourse alteration will be required for the construction of the access road. Figure 4-16 shows the wetland that the Proponent is proposing to alter to allow access to WTG 2 & 3. This degraded wetland has been clear cut in the past few years and has been highly disturbed by skidder tracks and felled trees. Expansions and modifications of the existing access road where necessary will avoid wetland habitat in an effort to reduce the overall ecological impact of the Project.

The Proponent is aware of the Nova Scotia Wetland Alteration Approval process and has successfully navigated this process in the past in close consultation with the Department of Environment. The process defines the following four activities as wetland alteration:

1. Filling;
2. Draining;
3. Flooding; and
4. Excavating.

The wetland alteration is anticipated to be 0.2 hectares; the Proponent will be required to complete a simplified/standard wetland alteration application. For the purpose of this wetland alteration application, it is anticipated that a certified third party consulting will be conducting a functional assessment and will be engaged to conduct the alteration process.

The watercourse crossing would be required to complete the access road where the proposed access road design crosses two creeks to gain access to WTG 2 & 3.

Figure 4-4 provides a closer view of all three turbine locations demonstrating that the WTGS have been located to maintain a 30 m setback plus blade length from all wetlands and watercourses.

Figure 4-16: Proposed access route through highly disturbed field identified wetland.

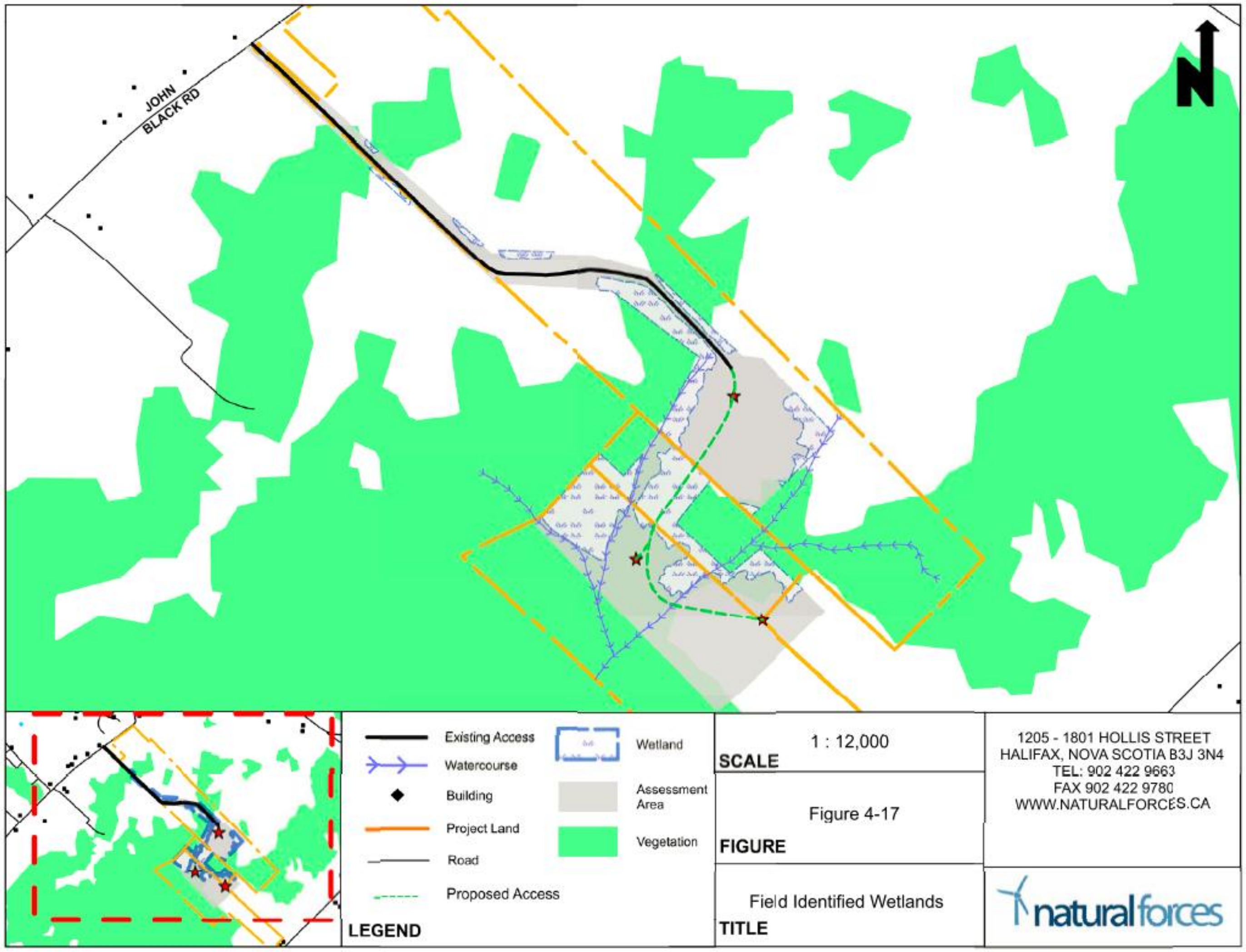


Figure 4-17: Field Identified Wetlands.

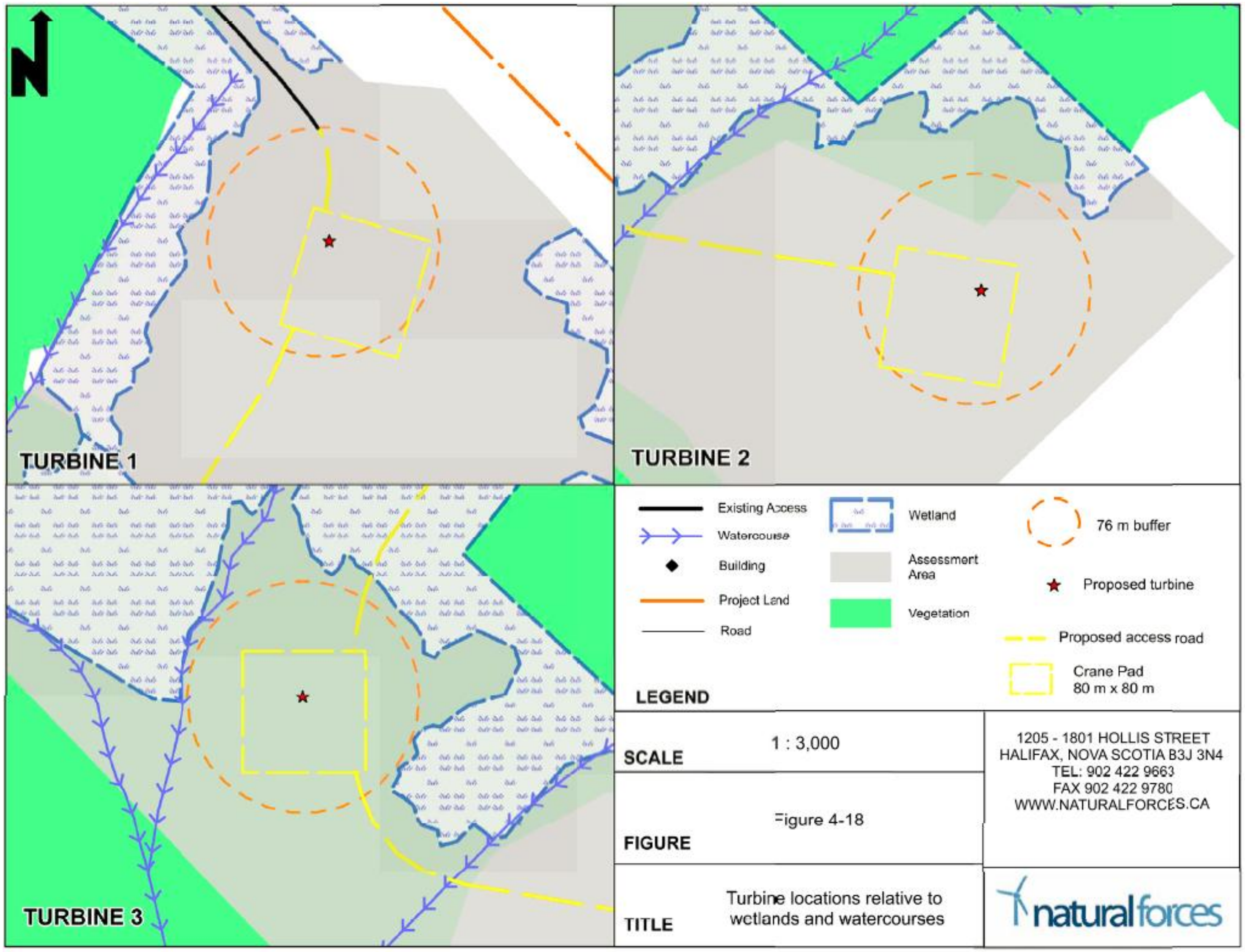


Figure 4-18: Turbine locations relative to wetlands and watercourses.

4.1.3 Fish and Fish Habitat

Based on the wetland and watercourse assessment, the wetlands have been identified as treed swamps. These swamps and marshes do not provide an adequate environment for fish to use as habitat.

4.1.4 Flora

A total of 263 vascular plant taxa were recorded during the field surveys (211 native and 52 exotic), two of which are of some conservation significance.

Halberd-Leaved Tearthumb (*Polygonum arifolium*) is a species of wet deciduous forest and thickets, known from 17 locations in Nova Scotia between Yarmouth and Cumberland Counties, but with the greatest concentration of records being from Cumberland County. This species is classified as S2 – sensitive (ACCDC, 2012).

Weigand's Sedge (*Carex weigandii*) is uncommon sedge of wet, generally acidic swamps and bog margins. It is similar to more common sedges (ie. *Carex atlantica* and *Carex echinatazia*), as a result, Weigand's sedge has been poorly documented up until 10 years ago. Weigand's sedge has been found to be fairly common in peat land margins of the Cape Breton Highlands.

None of the plant communities documented within the WTG or road construction footprint area are considered provincially rare (ACCDC data, S. Blaney, pers. obs). Relatively little of the proposed project footprint falls within forest older than 40 years, as a large proportion of the footprint area is either very recent clear cut (within the last three years), or is regenerating forest under 20 years old. The WTG 3 site is within a mature forest and on somewhat richer soil than the remainder of the site, supporting Sugar Maple (*Acer sccharum*), Eastern Hemlock (*Tsuga Canadensis*) and Ostrich Fern (*Matteuccia struthiopteris*) among other species not found elsewhere at the project site. The gently sloping ground to the north of the stream has groundwater seepage mixed with forested swamp, again with a slightly richer soil than is present over most of the project area. A full list of plant species observed during the survey can be found in Appendix E – Table 1.

4.1.5 Moose

Winter Track and Pellet Grain Inventory Field Surveys

The Chignecto Isthmus plays an important role in allowing Moose to move between provinces. The North-East area of the Isthmus has been generally accepted as a corridor to protect from development activities which could hinder inter-provincial moose movement. Organisations such as the Nature Conservancy of Canada are protecting large tracks of land on the northeastern side of the isthmus. The proposed project is located in the south west region of the Isthmus near highly developed lands (Town of Amherst) and is therefore in a less sensitive area of the Isthmus.

In consultation with NSDNR it was determined necessary to conduct both winter track and PGI surveys to identify potential moose habitat in the Project area. Surveys were conducted by Forest Technician, Jody Hamper and consisted of three winter track surveys and two PGI surveys. The moose survey results are shown in **Error! Not a valid bookmark self-reference.**. Results of the moose surveys have identified one pellet group inventory over 3 km east of the nearest turbine.

Table 4-6: Summary of moose surveys.

Survey Date	Survey Type	Observations (UTM zone 20)		
March 14, 2014	Winter track	No moose tracks observed. Three deer tracks were observed.		
		Deer Track 1	412,478 m E	5,078,101 m N
		Deer Track 2	411,602 m E	5,076,643 m N
		Deer Track 3	412,000 m E	5,074,382 m N
March 26, 2014	Winter track	No moose tracks observed. Three deer tracks were observed.		
		Deer Track 1	412,391 m E	5,079,153 m N
		Deer Track 2	410,356 m E	5,075,740 m N
		Deer Track 3	412,225 m E	5,074,488 m N
April 6, 2014	Winter track	No moose tracks observed. Four deer tracks were observed.		
		Deer Track 1	412,450 m E	5,078,436 m N
		Deer Track 2	411,640 m E	5,076,685 m N
		Deer Track 3	413,231 m E	5,075,958 m N
		Deer Track 4	411,107 m E	5,073,960 m N
April 29, 2014	PGI	No moose scat observed. Three deer scat observed.		
		Deer Scat 1	409,523 m E	5,075,492 m N
		Deer Scat 2	409,523 m E	5,075,492 m N
		Deer Scat 3	414,234 m E	5,076,043 m N
May 12, 2014	PGI	1 Moose scat observed. Three deer scat observed.		
		Moose Scat 1	**414,383 m E**	**5,076,056 m N**
		Deer Scat 1	412,492 m E	5,077,942 m N
		Deer Scat 2	409,523 m E	5,075,492 m N
		Deer Scat 3	412,093 m E	5,074,426 m N

The Proponent has also relied on both the Mainland Moose Recovery Plan and the Special management Practices documents published by NSDNR in order to better assess and attempt to mitigate the potential impact the project may have on mainland moose population in the surrounding area. Full survey results including maps can be found in Appendix H.

Nova Scotia Department of Natural Resources Database

Through consultation with the regional NSDNR biologist a list of moose sightings near the Project site has been compiled. The list is comprised of public sightings that have been reported to the Department of Natural Resources for their database. The results of this desktop screening can be found in Appendix H.

4.1.6 Wood Turtle

Through consultation with NSDNR, and a thorough review of the Nova Scotia Significant Species and Habitats database (NSDNR, 2012a); potential Wood Turtle (*Glyptemys insculpta*) habitat was identified just over 2 km south of the Project site along Nappan River.

Wood turtles are considered a "species at risk" throughout their range. They are listed nationally as "threatened" (COSEWIC, 2007) and provincially as "vulnerable" (NSDNR, 2000) because of their susceptibility to human activities and land use practices. (NSDNR, 2012b) Since project infrastructure is not proposed in close proximity to the identified wood turtle habitat it is not expected that the Project will have a significant impact on wood turtles or wood turtle habitat.

General mitigation and avoidance measures will be proposed in the VEC assessment in Section 6.

4.2 Socio-economic

4.2.1 Community

The 2011 Stats Canada census identified the population of Amherst, Nova Scotia was 9,717 with an average growth over 5 years of 2.2 %. In 2011, the town Amherst was composed of 4,403 private dwellings occupied by residents. Amherst residents have a median age of 45.9. (Stats Canada, 2011)

While Amherst is the main community within the proximity of the Project site, many smaller communities are within the area. Brookdale, Hastings, Warren and East Amherst are all within 3 km of the Project site. Furthermore, West Amherst, Amherst Point, Nappan, Salem, Stanley, West Leicester, Truemanville and Aulac are all within a 10 km radius of the project site. The proponent has focused their public consultation program to include these communities throughout the development of the site.

4.2.2 Archaeological Resource Impact Assessment

Based on the archaeological resource impact assessment conducted by Davis MacIntyre & Associates, there is no evidence of historic cultural activity in the impact areas of the proposed access roads and proposed turbine locations. The only indications of cultural activity were found to be fairly modern, consisting of modern logging activity such as skidder trails, clear-cut, logging roads and cut stumps, modern agricultural activity and a natural gas pipeline.

Although there was historical activity in the general vicinity of Amherst, historic maps and documents indicated that there was little historic cultural activity in the study area. The potential for First Nations archaeological resources in the impact area is low. The only noted watercourse is small and non-navigable. First Nations peoples are known to have been in the general vicinity and may have taken advantage of the area for hunting and/or gathering. However there is little reason for them to have settled here. Activity such as short-term forays into the area for hunting and/or gather is unlikely to leave an archaeological footprint.

Recommendations

Avoidance is the preferred method of mitigation in all instances where archaeological resources are present. The results of the historic background study and archaeological reconnaissance indicate that the study area is of low potential for First Nations archaeological resources. Furthermore, no historic period archaeological resources were encountered during the reconnaissance. The only identified cultural activity consisted of modern logging and agricultural activity.

In the unlikely event that archaeological features are encountered during ground disturbance activities, all activities will cease and the Coordinator of Special Places will be contacted immediately.

4.2.3 Mi'kmaq Ecological Knowledge Study

Historical Review Findings

There is a wide distribution of pre-contact and post-contact archaeological sites in this portion of Cumberland County but no such sites are known within the Study Area.

Acadians began to settle the area and reclaimed the tidal marshes in the 1660's and they named the high ground on the marsh the *isle de Indiens* where the Mi'kmaq had an encampment. The encampment location is the present site of the CBC radio towers.

Father Abbe' LeLoutre had a strong influence over the Acadians, Mi'kmaq and the French commanders during his stay in Acadia at the Mission in Shubenacadie and later at Chignecto. He incited the Mi'kmaq against the British at Halifax and later recruited the Mi'kmaq and displaced Acadians for his land reclamation and fortification projects. He is also responsible for the burning of Beaubassin.

The British defeat of the French at Chignecto and the surrender of the forts in the area marked the first British victory in a campaign to remove the French from North America.

After the treaties of the 1760's, the Mi'kmaq had to adapt to a *Mi'kma'ki* under British rule.

There were some stumbling starts to setting aside the required 1000 acres for the Mi'kmaq within the area of Cumberland County of today. Land set aside for the Mi'kmaq in Pugwash was lost due to a questionable transaction and later lands at Shimmicas Bridge were lost due to subdivision of the parcel and granting to settlers. Franklin Manor I. R. 22 is the only reserve in Cumberland County and is not currently occupied.

A review of the Aboriginal Affairs and Northern Development Canada, Status Report on Specific Claims does not show any specific claims that would directly impact the Project site.

Traditional Use Findings

The traditional use data gathered for this MEKS was drawn from one primary source: the Mi'kmaq individuals who reside in the surrounding communities and those who are familiar with or undertake these types of activities. This data was acquired through interviews with informants that allowed the study team to identify the various traditional use activities, resources and areas that are currently or have been used by the Mi'kmaq, and any information that was gathered in previous MEKS in the area. Interviewees were asked to identify areas within the Study Area and Project Site where they knew of traditional use that had taken place, or currently in use. These interviews took place in September 2014.

To easily identify the traditional use data findings of this study, the analysis has been categorized into two (2) geographic areas. The first is the Project Site area and the second is the Study Area.

Based on the data that was gathered by the study team, it appears there are some Mi'kmaq traditional use activities that have occurred, or are occurring, within the Study Area.

Project Site

The Project Site, as well as locations in the immediate vicinity (<50 meters) of the Project Site were considered when analyzing traditional use activities.

There was no fishing or hunting areas identified within the Project Site by informants.

The northwest area of the Project Site was identified as an area to gather apples, blueberries, cow lilies, flag root, ground juniper, and princess pine with one area recorded for each species. This area can be found in Figure 4-21.

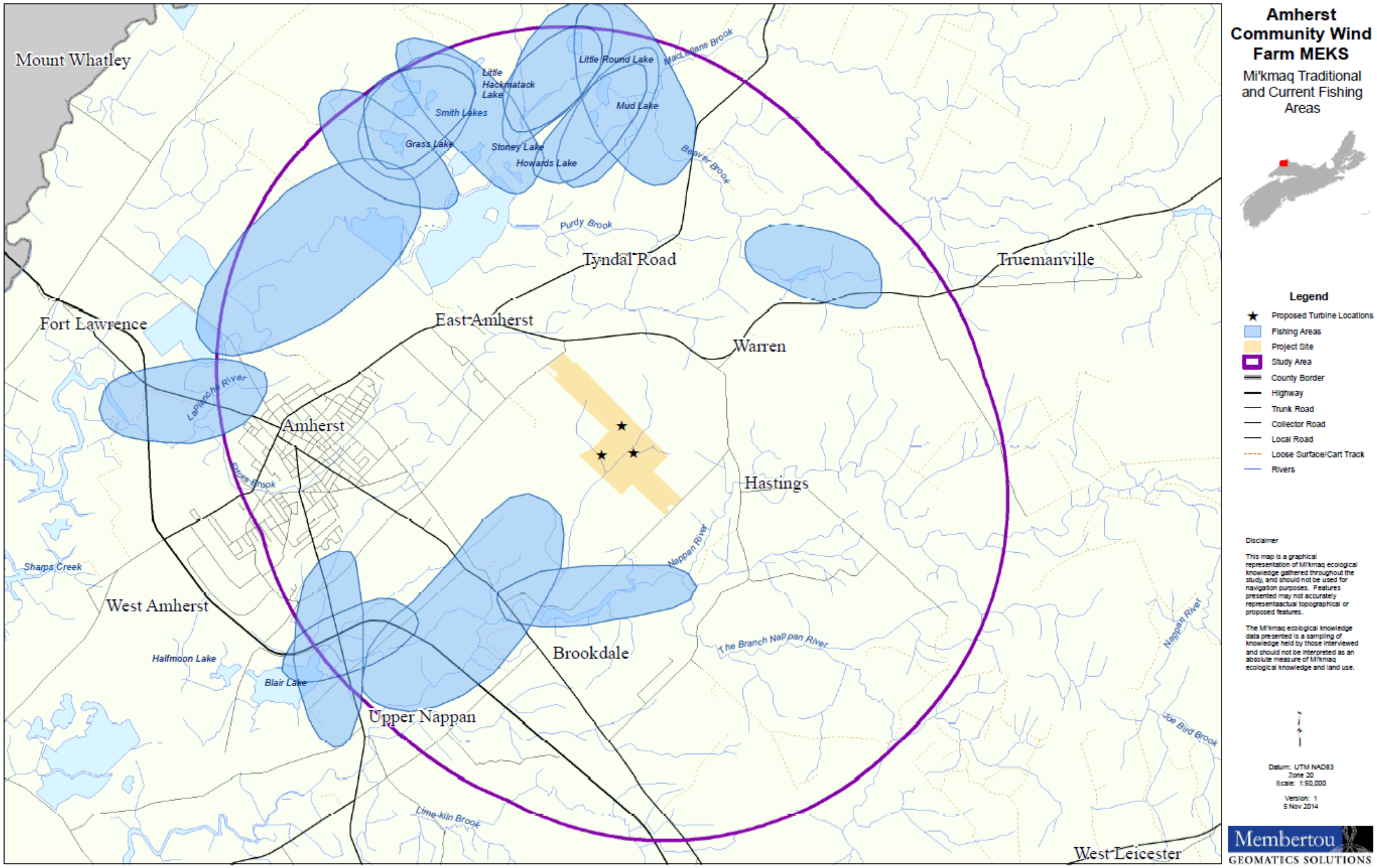
Study Area

As mentioned previously, the MEKS data is also drawn from the Study Area, which encompasses areas within 5 kilometers of the Project Site. The purpose of this portion of the study is to portray other land use activities that may have been missed in the Project Site analysis data.

From the data gathered, the study found that trout (including lake, brook and sea) and bass (including stripped and small mouth) were the species reportedly caught in the highest frequency in the Study Area. Fifteen trout and eight bass fishing areas were reported by informants and can be found in Figure 4-19. Other species reportedly fished in the Study Area were salmon, clams, perch, eel and smelt.

Deer and rabbit were found to be the most hunted species within the Study Area; these areas can be found in Figure 4-20. Other species reportedly hunted in the Study Area are partridge, pheasant, beaver, fox, muskrat and raccoon.

Blueberries and apples were reported as the most gathered plants in the Study Area; these areas can be found in Figure 4-21. Other species reportedly gathered were cranberries, ash trees, cow lily, crab-apple, firewood, flag root, ground juniper, mushrooms and princess pine.



Disclaimer

This map is a graphical representation of Mi'kmaq ecological knowledge gathered throughout the study, and should not be used for navigation purposes. Features presented may not accurately representaactual topographical or proposed features.

The Mi'kmaq ecological knowledge data presented is a sampling of knowledge held by those interviewed and should not be interpreted as an absolute measure of Mi'kmaq ecological knowledge and land use.

Figure 4-19: Fishing areas in the Study Area.

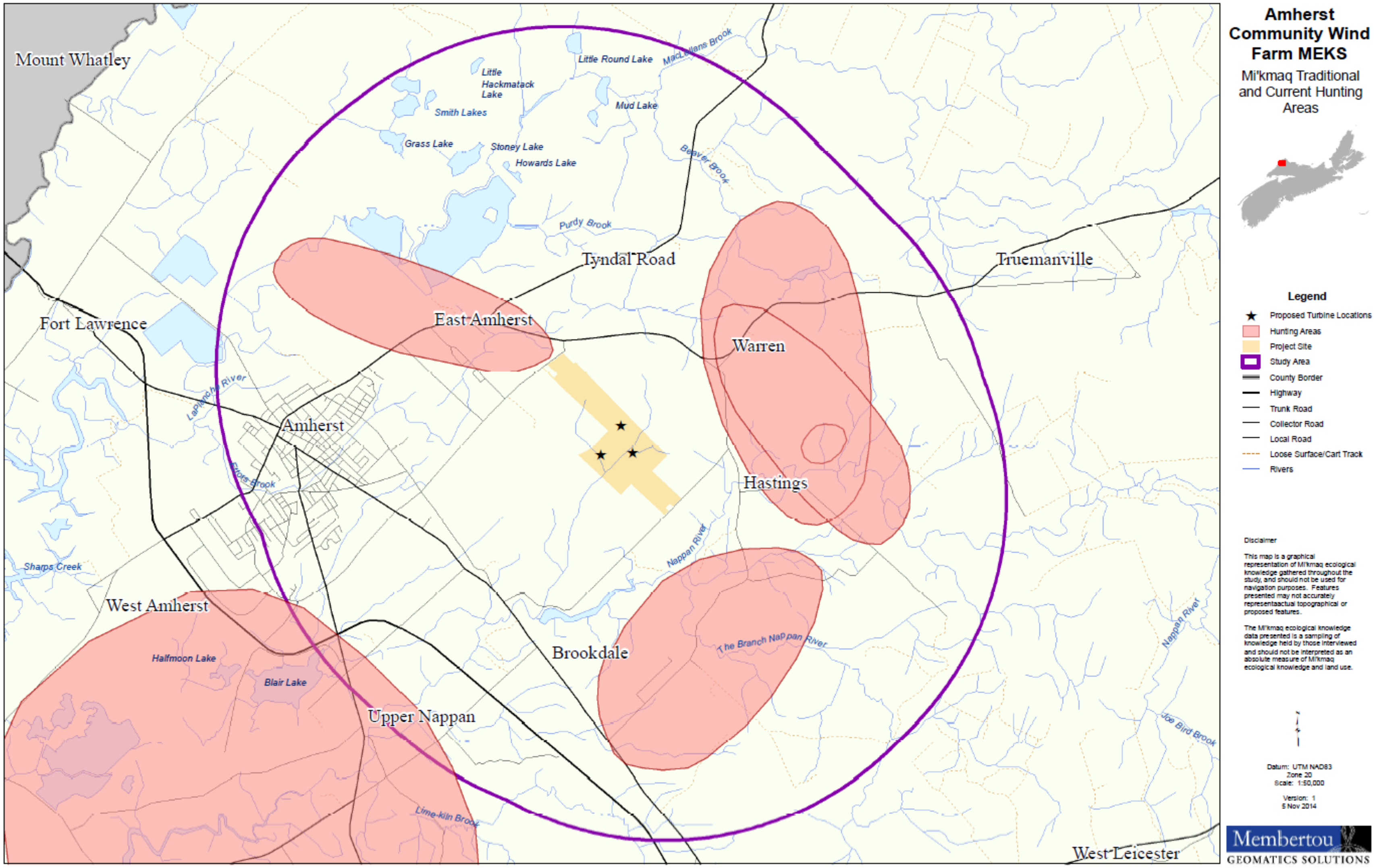


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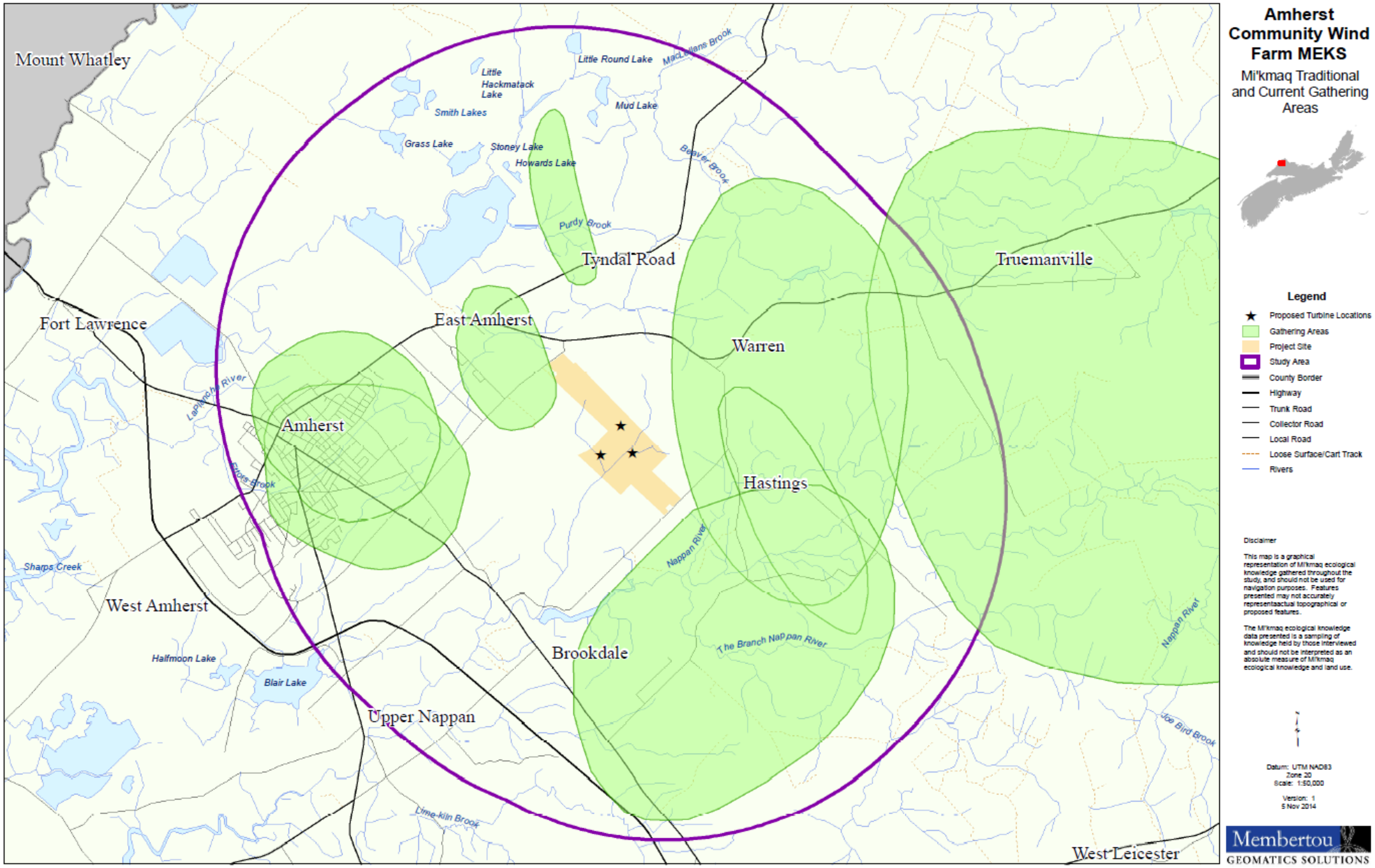
Figure 4-20: Hunting areas in the Study Area.



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The Mi'kmaq ecological knowledge data presented is a sampling of knowledge held by those interviewed and should not be interpreted as an absolute measure of Mi'kmaq ecological knowledge and land use.

Figure 4-21: Gathering areas in the Study Area.

Significant Species Findings

The MEKS identified resource and land/water use areas within the Project Site and Study Area that continue to be used by the Mi’kmaq people to varying degrees. The MEKS identified the following:

Table 4-7: Mi'kmaq Significant species findings.

Type of Use	Number of Areas	Number of Species
Food / Sustenance	70	28
Medicinal / Ceremonial	21	10
Tools / Art	2	2

During the information gathering for the Study Area, informants had mentioned fishing for salmon. The Atlantic salmon is considered an endangered species in Canada. No other rare or endangered species were identified by informants.

While stated above, it is worth noting again that assigning an importance designation for any activity done by Mi’kmaq can be a subjective process, and that all activities are considered ways of preserving Mi’kmaq way of life, in some shape or form.

Recommendations

Amherst Community Wind Farm MEKS has identified a small amount of Mi’kmaq Traditional Use Activities occurring in the Project Site, as well as additional activities within the Study Area that have occurred in the past, as well as the present. Based on the information gathered and presented in this report, there is some potential this project could affect some Mi’kmaq traditional use, specifically trout and bass fishing, deer and rabbit hunting, and some blueberry and apple gathering identified in the Study Area. Although the possible effects from the project could be minimal, it is recommended that the proponent communicate with the Assembly of Nova Scotia Mi’kmaq Chiefs to discuss further steps, if required, with regards to Mi’kmaq use in the area.

4.2.4 Noise

Sound pressure level (SPL) is defined as the force of sound on a surface area. This is measured in dB(A); dB or decibels is a logarithmic unit that is used to measure SPL and (A) is the weighting applied to denote, as perceived by humans. Nova Scotia does not currently have any regulations pertaining to maximum SPL required at receptor locations near wind farms; further, the Municipality of Cumberland County land use by-laws do not specify any restrictions pertaining to SPLs relating to WTG activities. As a best practice effort, the Proponent has followed the *Ontario Noise Guidelines for Wind Farms* as a guideline regarding acceptable noise emission from the ACWF. The Ontario guidelines present a 40 dB(A) SPL as the maximum exposure level for a noise receptor (Ministry of the Environment, 2008).

A noise assessment was completed for the ACWF using WindPRO software; the software uses ISO 9613-2: Acoustics – Attenuation of sound during propagation outdoors standards. By assuming conservative estimates of factors contributing the SPLs of the WTGs, the model yields results that represent a worst case scenario. A WTG hub height of 98 m was used with a SPL of 105 dB(A) being produced from the turbine nacelle, located at the hub height.

A total of 314 receptor points were used to represent 314 dwellings within a 2,500 m range of the proposed turbine locations. The model was run using two turbines with no added vegetation layer and continuous downwind propagation for conservative results. The closest receptor is located 951 m from a turbine, this receptor was subjected to a maximum SPL of 37.3 dB(A). Full results for the noise impact assessment at each specific receptor location can be found in Appendix I.

Low Frequency Sound and Infrasound

Low frequency sound is defined as sound with a frequency less than 200 Hertz (Hz) or cycles per second. Infrasound, also referred to as low-frequency sound, is sound that is not audible to humans, which is typically below a frequency of 20 Hz (HGC Engineering 2006).

Infrasound levels created by wind turbines are often comparable to the ambient levels prevalent in the natural environment, such as wind. In terms of health, at sufficiently high levels, infrasound can be dangerous; however, it is grossly inaccurate to conclude that infrasound, at any level, causes health risk (HGC Engineering 2006).

A recent study conducted by Massachusetts Institute of Technology found that infrasound near wind turbines does not exceed audibility thresholds. Epidemiological studies have shown a relationship between living near turbines and annoyance. Infrasound and low-frequency sound do not present unique health risks; however, annoyance seems strongly related to individual characteristics rather than noise from turbines (McCunney et. At., 2012).

4.2.5 Visual

ReSoft Ltd WindFarm software was used to create a photomontage of the ACWF. The following two locations were chosen to present a predicted view of the wind farm using a 98 m hub height. Figure 4-228 shows the photomontage taken from John Black Road looking east at the Project site. Figure 4-238 shows the photomontage taken from Pumping Station road looking north at the Project site.

Figure 4-22: Photomontage from John Black Road.

Figure 4-23: Photomontage from Pumping Station Road.

4.2.6 Shadow Flicker

The Proponent has undertaken a shadow flicker impact assessment for the ACWF to assess the potential impact of shadow flicker on the surrounding dwellings within a 2,500 m radius. Shadow flicker is the change in light received by a receptor due to a WTG blade impeding the light path between the sun and the receptor. As there are few federal, provincial or municipal guidelines or policies for governing or quantifying what is an acceptable amount of shadow flicker, the German standards, *Hinweise zur Ermittlung und Beurteilung der optischen Immissionen von Windenergianlagen* have been adopted for the purpose of this study and are generally used within the wind energy industry as standard guidelines. These guidelines, based on astronomic worst case scenario suggest that acceptable levels at each shadow receptors are:

- No more than 30 hours per year of astronomical maximum shadow (worst case); and
- No more than 30 minutes on the worst day of astronomical maximum shadow (worst case).

The guidelines also specify two factors that limit the shadow flicker effect, due to optic conditions in the atmosphere:

1. The angle of the sun over the horizon, which must be at least 3 degrees; and
2. The blades of the WTG must cover at least 20 % of the sun.

Receptors exposed to less than 30 minutes per day on the worst affected day or a total of 30 hours per year from all WTGs are considered unlikely to require technical mitigation.

Receptors used in the shadow flicker assessment are at the same locations used for the noise assessment; this being a total of 314 receptors representing 314 dwellings. The model was run with WindPRO software to predict astronomical worst case shadow flicker at each receptor in terms of total hours per year, days per year, and maximum minutes per day. Table 4-8 presents a summary of the results for the shadow flicker assessment at the 12 receptors that may experience some shadow flicker. Of the 12 receptors listed below, some may not experience any shadow flicker at all as the model uses conservative assumptions, which is described in detail in the full shadow flicker impact assessment in Appendix J.

Table 4-8: Predicted maximum worst case shadow flicker results summary.

Receptor ID	Shadow hours per year (h/year)	Shadow days per year (days/year)	Max shadow hours per day (h/day)
BI	12:44	42	0:26
AA	11:13	64	0:18
KL	8:17	48	0:16
BK	8:16	48	0:14
CW	7:45	52	0:14
KM	7:44	44	0:16
HV	6:57	36	0:14
AE	6:55	41	0:15
DW	6:44	41	0:15
KT	6:34	40	0:19
DX	6:12	38	0:15
LA	5:26	36	0:14
AY	5:22	37	0:13
DY	5:21	36	0:14
CX	5:06	37	0:13
DH	5:06	35	0:14
BT	4:31	33	0:13
M	4:13	24	0:12
AT	4:12	32	0:13
HO	4:02	33	0:12
HQ	3:59	34	0:12
AP	3:58	33	0:12

Receptor ID	Shadow hours per year (h/year)	Shadow days per year (days/year)	Max shadow hours per day (h/day)
CA	3:55	33	0:12
BJ	2:48	21	0:10
DT	2:40	18	0:13
KN	2:38	18	0:13
DV	2:35	18	0:13
AD	2:28	19	0:12
KK	2:13	16	0:12
HN	2:11	17	0:12
HT	2:08	16	0:12
HM	2:06	17	0:11
JU	2:05	16	0:12
DB	2:00	16	0:11
HL	2:00	16	0:11
HJ	1:52	17	0:10
HH	1:50	17	0:11

5.0 Consultation

5.1 Community Engagement

Open, transparent and comprehensive community engagement is crucial to the success of any development. Community engagement forms an integral part of the proposed ACWF development and consists of various engagement activities the Proponent will undertake throughout the development, construction, and operation of the wind farm. The Proponent is committed to addressing, to the best of their abilities, all concerns pertaining to this proposed development raised by local residents and community members.

The engagement activities described in the following section have provided an opportunity to facilitate meaningful dialogue between various stakeholders and the Project Proponent; and to provide accurate information pertaining to the Project in an open and transparent fashion. A comprehensive stakeholder engagement list has been formed, and will be kept up to date as further stakeholders express their interest in the Project throughout the lifetime of the Project.

5.2 Community

First Public Meeting

An open house was held on July 10, 2014 at the Super 8 Motel in Amherst from 5 pm to 8 pm. The meeting was advertised via Canada Post Admail, a service offered that facilitates the distribution of invitations/ flyers to a defined geographic location, as well as in the Amherst News. The first open house attracted 28 members of the Amherst community who signed in to ask questions and voice concerns about the proposed Project.

The Proponent handed out questionnaires to attendees at the first public meeting that were designed to gather contact information so interested persons could be provided with up to date information, to learn about the public’s interest in having a wind farm in their community and provide an opportunity for the public to express any concerns they had regarding the ACWF Project. The open house format was held as an open discussion where posters providing Project relevant information were displayed with Proponent representatives present to answer questions and discuss concerns the public had.

Following the meeting, the proponent addressed any questions/concerns that were submitted via the questionnaires by addressing some questions through telephone and personal meetings including the concerns on the FAQ section of the Project website.

Community Meeting – Attended by Natural Forces Wind Inc.

Several community members living near the proposed project site held a meeting to discuss general concerns that were apparent within the community regarding the proposed Amherst Community Wind Farm. Two members of the Natural Forces team were present at the meeting to gain insight on the community's sentiment towards the proposed Project. Natural Forces team members were there to observe and listen and did talk to many community members at the end of the meeting.

As a result of attending the meeting, the Proponent decided to hold a second public meeting to provide an opportunity to further discuss the project with Natural Forces in an open forum.

Second Public Meeting

The meeting was advertised via Canada Post Admail, a service offered that facilitates the distribution of invitations/ flyers to a defined geographic location, and was also advertised in the Amherst News. The second open house attracted 53 members of the Amherst community who attended to ask questions and voice concerns about the proposed Project.

Again, the proponent handed out questionnaires as described above in an effort to collect valuable public feedback. The open house was held as an open discussion with Proponent representatives engaging in conversation with the attendees to address any issues or concern.

Following the public meeting questions and concerns brought up in questionnaires were addressed by email, personal letters and phone calls. Every question was also publicly addressed on the ACWF website.

The meeting was also attended by Eric Christmas of Beaubassin Mi'kmaq Wind LP who held discussion with many concerned community members and as a result decided to conduct a round table with community members at a later date.

Beaubassin Mi'kmaq Round Table with Local Residents

On November 4, 2014 two members of Beaubassin Mi'kmaq Wind held round table discussions with local residents at the Wandlyn Hotel in Amherst from 6:30 – 9 pm.

The meeting was very cordial with Beaubassin leading off the discussions with a presentation. The presentation was to inform the residents as to how the Project site was chosen as well as to correct misinformation that had been portrayed in the media.

The discussions were also very important in informing the residents as to why this Project is important to the Mi'kmaq communities and how it has led to the creation of a partnership between the 13 First Nations of Nova Scotia.

The discussion ended with the local residents expressing their specific concerns regarding the Project. The most important concern raised by the residents was the impact the Project may have on property values and their ability to utilize their property for future endeavours. These concerns have been addressed in Table 5-2.

Website

The Proponent has set up a Project website for the ACWF. The website: www.amherstcommunitywindfarm.ca is updated periodically and used to inform the general public right-holders and stakeholders about all aspects of the proposed development. Website content and updates will include some or all of the following items:

- FAQ (Frequently Asked Questions) section that addressed concerns indentified during consultation activities.
- Contact information for the Project Proponent and Natural Forces;
- Notices for public information sessions;
- Photos of the Project location and turbine types;
- Progress reports on the Environmental Assessment;
- Environmental Assessment;
- Construction activity notifications;
- Online questionnaire and comment form (Have Your Say); and
- Media and PR related material; and

Newsletters

Previous wind farms developed by the Proponent included newsletters as a key engagement tool to update and inform the local community on recent Project activities. The Proponent may circulate newsletters via email, website and Canada Post to the community throughout the 2015 and 2016 calendar years.

Newspaper Advertisements

Two advertisements were placed in the Amherst News to offer information to residents regarding the Project. The advertisement also detailed benefits of the Project as well as contact info for the Proponent. The advertisements were published on August 5, 2014 and September 5, 2014.

Issues Resolution

The Proponent has drafted a Complaint Resolution Plan, which covers what community members should do and whom to contact should there be negative impacts affecting the community members or the environment caused by the ACWF development. The Complaint Resolution Plan can be found in Appendix K.

5.3 Aboriginal Peoples

The proposed Amherst Community Wind Farm is being developed in partnership with Mi’kmaq Beaubassin Wind, an entity that represents the 13 First Nation bands in Nova Scotia. Throughout the development process the Nova Scotia First Nations community has been consulted numerous times through meetings, presentations, personal mailings and phone calls.

Table 5-1: Summary of First Nations consultation activities.

Date	Person Contacted	Band/Organization	Method of Communication	Content
December 2011	KMK Representative	KMK	Meeting	Amherst project introduction
September 2012	KMK Assembly	KMK	Presentation	Project introduction & partnership opportunity
September 2012	Members of Membertou	Membertou	Presentation	Proponent introduction
October 2012	Chief & Council	Chapel Island	Meeting	Project introduction & partnership opportunity
October 2012	Chief & Council	Paq’tnkek	Meeting	Project introduction & partnership opportunity
November 2012	Chief & Council	MIllbrook	Meeting	Project introduction & partnership opportunity
November 2012	Chief & Council	Bear River	Meeting	Project introduction & partnership opportunity
November 2012	Chief & Council	Pictou Landing	Meeting	Project introduction & partnership opportunity
April 2013	KMK Representative	KMK	Meeting	Amherst site details presentation
December 2014	Office of Aboriginal Affairs Representative	Office of Aboriginal Affairs	Letter	Update on Environmental Assessment
December 2014	KMK Representative	KMK	Letter	Update on Environmental Assessment

Date	Person Contacted	Band/Organization	Method of Communication	Content
December 2014	Chief and President Grace Conrad	Native Council of Nova Scotia	Email	Update on Project and Environmental Assessment

5.4 Regulatory

The Proponent has engaged in consultation with Municipal, Provincial and Federal Government bodies regarding the proposed ACWF Project.

Municipal Consultation

The Proponent has engaged members of the MoCC planning department to discuss the planning regime such as permitting requirements on numerous occasions. Consultation provided the Proponent with detail regarding regional by-laws, land use and other policies within the MoCC that would relate to the proposed development of the ACWF.

Appendix L presents a log of communication between the Proponent and members of the MoCC and council member throughout the duration of the Project thus far.

As a continuous effort, the Proponent will continue to liaise with Council and Staff throughout the development and construction of the ACWF.

Provincial Consultation

The Proponent has met with various provincial organizations regarding the development of the ACWF.

The scoping of this Environmental Assessment document was designed in consultation with the Nova Scotia Department of Environment – Environmental Assessment branch (EA branch) and the Wildlife Divison within NSDNR.

Consultation topics with the EA Branch and NSDNR included:

- Scoping and guidance of Wildlife surveys and studies to conduct as part of the ACWF Environmental Assessment;
- Ideal dates to conduct effective bat monitoring surveys; Potential for bat hibernacula in the region;
- Presence of mainland moose in the area through inventory reports;
- Presence of wood turtles in the area;
- Provide insight on proper course of action to take in effectively avoiding wetlands, mitigating impacts on wetlands and compensation that is required when direct wetland alteration is required;

- Species at risk in general, and approach to assessment in EA.

As a continuous effort, the Proponent will continue constant consultation with the appropriate provincial departments throughout the duration of the Project.

Federal Consultation

The Proponent has consulted with various Federal Government entities regarding the construction of the ACWF. Environment Canada, NAV Canada, Transport Canada and the Department of National Defence were all contacted regarding the development of the ACWF. Like their provincial counterparts, they have assisted in the preparation of this EA, Project planning and design.

The Proponent will continue to engage Federal regulators when required throughout the development, construction and operation of the ACWF as appropriate.

5.5 Public and Aboriginal Concern

Based on the public meeting questionnaires, individual discussions, and aboriginal consultation, local residents and other stakeholders have raised concerns relating to the Project and project activities. The majority of these concerns have been addressed in this EA, while others were addressed directly at public meetings, through telephone conversations, and one on one meetings. The most frequently raised issues have been identified in Table 5-2; included in this table is the section(s) in which the public and aboriginal issues have been addressed. As previously mentioned in Section 5.1 the Proponent is committed to addressing, to the best of their abilities, all concerns pertaining to this proposed development raised by local residents and community members.

Table 5-2: Summary of frequently raised questions and concerns.

Issues Raised	Section(s)
Are moose affected by the turbines?	4.1.5 & 6.2
What are the setbacks for this project?	2.1, 2.2, Figure 2-6, 4.1.2, Figure 4-18
Why does Natural Forces look at studies from other provinces or countries for health and property value issues?	5.5
How do wind farms affect human health?	Noise: 4.2.4, 6.1 Shadow: 4.2.6, 6.1 Other: 6.3, 6.4, 7.2.2
Will the wind farm affect property values?	6.4
What is the risk of oil or lubricant spill from the turbines?	6.1, 6.2, 6.3
Why does your Noise Impact Assessment report not address infrasound from turbines?	4.2.4
Will there be a risk of Ice being thrown from the turbine blades?	6.4

Issues Raised	Section(s)
How many birds are these turbines going to kill?	6.1

During the development process the Proponent has compiled a table of every comment or question the community has had with the Project. Table 5-3 presents these comments and questions and provides detail on how the Proponent responded.

Table 5-3: A table of all questions and concerns received and how they were addressed.

Comment or question made pertaining to this subject	How it was addressed
Voicing concerns or objections	• At public meetings • In discussions concerning interest in the formation of a Community Liaison Committee • Take home information sheets from public meeting concerning the Community Liaison Committee • On the project website • Through emails
Community input in the Environmental Assessment	• At public meetings • In an article in the local newspaper • On the project website • Through emails
Set back distances	• At public meetings • On the project website • In a newsletter sent via admail • Through email • In letter
Specific project location	• At public meetings • On the project website • In the Environmental Assessment • Through emails • In letter

Comment or question made pertaining to this subject	How it was addressed
Property value	• At public meetings • Take home information sheets from public meetings • In a newsletter sent via admail • On the project website • Through email
Guarantee that property values won't decrease	• At public meetings
Payment for decrease in property value	• At public meetings
Noise impact	• At public meetings • Take home information sheets from public meetings • In an article in the local newspaper • In a newsletter sent via admail • On the project website • Though email
Shadow flicker impact	• At public meetings • Take home information from public meetings • In an article in the local newspaper • In a newsletter sent via admail • On the project website
Bird mortality	• At public meetings • In a newsletter sent via admail • On the project website • In the Environmental Assessment
Bat mortality	• At public meetings • On the project website • In the Environmental Assessment
Health issues	• At public meetings • Take home information sheets from public meetings • In a newsletter sent via admail • On the project website • In emails

Comment or question made pertaining to this subject	How it was addressed
Moose and deer	• At public meetings • On the project website • In the Environmental Assessment • In letter
Community entity	• At public meetings • On the project website • In the Environmental Assessment • In emails
How this project is a community project	• At public meetings • On the project website • In the Environmental Assessment
Power distribution	• At public meetings • On the project website • In letter
Community input not listened to	• At public meetings • In discussions concerning interest in the formation of a Community Liaison Committee • Take home information sheets from public meeting concerning the Community Liaison Committee • On the project website
Withholding information	• At public meetings • In discussions concerning interest in the formation of a Community Liaison Committee • Take home information sheets from public meeting concerning the Community Liaison Committee • On the project website • In the Environmental Assessment

Comment or question made pertaining to this subject	How it was addressed
Health studies conducted by third parties	• At public meetings • Take home information sheets from public meeting • On the project website • In a newsletter sent via admail
Health studies conducted in other provinces	• At public meetings • Take home information sheets from public meeting • On the project website • In a newsletter sent via admail • In letter
Why studies used are from sources from outside Nova Scotia	• At public meetings • On the project website
Distance from turbines to other properties	• At public meeting
Specific landowners for the project area and land area	• At public meeting • In the Environmental Assessment
ComFIT eligibility	• At public meetings • On the project website • In the Environmental Assessment • In letter
Do Natural Forces team members live in Amherst	• At public meetings
Project construction and operation period	• At public meetings • On the project website • In the Environmental Assessment • In an article in the local newspaper • In a newsletter sent via admail

Comment or question made pertaining to this subject	How it was addressed
Investors in the project	• At public meetings • On the project website • In the Environmental Assessment • In emails • In an article in the local newspaper • In a newsletter sent via admail • In an ad placed in the local newspaper
Size of the turbines	• At public meetings • On the project website • In the Environmental Assessment • In a newsletter sent via admail • In an ad placed in the local newspaper
Number or turbines	• At public meetings • On the project website • In the Environmental Assessment • In an article in the local newspaper • In a newsletter sent via admail • In an ad placed in the local newspaper • Through email
Benefits to residents	• At public meetings • On the project website • In an ad in the local newspaper • In the Environmental Assessment • Take home information sheets from public meeting • Through emails • In letter
Is the project part of the ComFIT program	• At public meetings • On the project website • In an ad in the local newspaper • In the Environmental Assessment • Take home information sheets from public meeting

Comment or question made pertaining to this subject	How it was addressed
Is this project the same as the project previously proposed in the area	• At public meetings • In emails • In a newsletter sent via admail
Will there be a new substation	• At public meetings • On the project website
Payment of the project	• At public meetings • On the project website
Environmental Assessment process and next steps once approved	• At public meeting • In email • On project website • In a newsletter sent via admail • Through emails • In letter
Studies included in the Environmental Assessment	• At public meeting • In email • On project website • In a newsletter sent via admail • Through emails
Payment of Environmental Assessment	• Through email
Who will write the Environmental Assessment	• In a letter
Number of residents living near project	• In an email
Support for the project based on questionnaires filled at public meeting and follow-up in newsletter	• In email
Community Liaison Committee involvement	• In email
Interest in having a wind farm on their land	• In email • At public meetings • Through phone calls
Representatives from the County and Province at information session	• In email

Comment or question made pertaining to this subject	How it was addressed
Reduction of power rates	• At public meetings • In email
Monetary benefits to residents	• At public meetings • In emails
Turbine company stating 2km setback safe distance	• In email

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6.0 Analysis

The construction, operation and decommissioning phases of the ACWF Project have the potential to affect physical, biophysical, and socio-economic environment. Identifying the Valued Environmental Components (VECs) is an important part of the EA process. Following the presentation of the Project's activities in Section 2, the Environmental Setting in Section 4 and the review of issues identified from consultation in Section 5, the interaction of the Project activities with the VECs can be completed.

An interaction matrix in Table 6-1 presents the potential interactions between Project activities and each identified VEC. These VECs are presented in the following sub-sections in terms of potential environmental effects of Project activities including accidents and malfunctions, as well as proposed mitigation strategy, cumulative effects and finally, the level of significance of the residual effects. This VEC assessment is completed as outlined in the methodology as presented in Section 3.

Table 6-1: Potential Linkages of Project and the Environment.

	Site Preparation and Construction								Operation and Maintenance			Decommissioning		
	Clearing and Grubbing	Access Road and Laydown Area	Turbine Foundation	Power Pole and Line & U/G Electrical	Crane Pad Construction	Turbine Installation	Commissioning	Accidents and Malfunctions	Turbine Operation	Inspection and Maintenance	Accidents and Malfunctions	Infrastructure Demolition	Site Reclamation	Accidents and Malfunctions
Physical VECs														
Ambient air	•	•			•			•				•		•
Ground and Surface Water	•	•	•	•				•			•	•	•	•
Ambient noise	•	•	•	•	•		•		•			•	•	
Ambient light						•			•					
Biophysical VECs														
Wetlands / Watercourses	•	•			•			•	•					•
Fish and Fish Habitat	•	•						•			•			•
Migratory and breeding birds	•	•			•	•			•				•	

	Site Preparation and Construction								Operation and Maintenance			Decommissioning		
	Clearing and Grubbing	Access Road and Laydown Area	Turbine Foundation	Power Pole and Line & U/G Electrical	Crane Pad Construction	Turbine Installation	Commissioning	Accidents and Malfunctions	Turbine Operation	Inspection and Maintenance	Accidents and Malfunctions	Infrastructure Demolition	Site Reclamation	Accidents and Malfunctions
Bats									•					
Flora	•	•			•								•	
Wood Turtle	•	•			•				•		•		•	
Mainland Moose	•	•			•						•		•	
Socio-economic VECs														
Property Value & Land use	•	•				•			•		•			
Aboriginal resources / uses	•	•	•	•									•	
Archaeological resources / uses	•	•	•	•									•	
Vehicular traffic			•	•	•	•					•			
Telecommunications & Radar Communications									•					
Landscape aesthetics									•					
Public Health and safety								•			•			•
Local economy	•	•	•	•	•	•	•		•	•		•	•	

6.1 Assessment of Physical VECs

Ambient Air

Control and monitoring of ambient air quality is important in maintaining a healthy work, recreation and living environment. Based on the nature of activities that will take place at the Project site, ambient air quality has been identified as a VEC.

A significant environmental effect would result if a significant increase in contaminant concentration was determined a result of Project activities.

Boundaries – Spatial boundaries include the Project site for over all vehicular emissions but also focusing on gravel access roads up to the WTGs for fugitive dust. The temporal boundary focuses on the Project construction and decommissioning phases during high vehicular traffic activities from machinery and trucks.

Table 6-2: Potential impacts and proposed mitigative measures for ambient air.

Potential Impacts on Ambient Air	Proposed Mitigative Measures
Local air quality may be affected through fugitive dust from access roads during construction and decommissioning	• Fugitive dust during dry weather conditions may be controlled with the application of water.
Local air quality may be affected through tailpipe emissions from construction vehicles and machinery	• All vehicles and machinery will comply with current emission standards and will be used efficiently, minimizing distances travelled whenever possible.

Cumulative Effects – As described in Section 2.9 the only other wind farm in the area is the Amherst Wind Farm located on the Tantramar Marsh 7.5 km northwest of the Project. No cumulative effects are expected to occur with respect to ambient air.

Significance of Residual Effects – A decrease in ambient air quality is determined to be negligible; fugitive dust will be eliminated through mitigative measures and vehicle emissions will comply with current emission standards. Therefore, the significance of residual effects on ambient air is to be considered negligible.

Ground and Surface Water

Management of ground and surface water quality is important as they are an integral aspect of a diverse ecosystem and functional ecology. Some dwellings in this area rely on well water; therefore ground and surface water are also directly related to human health for this Project. Wetlands and watercourses have been identified at the Project site and are assessed in detail in Section 6.2 under wetlands and watercourses. As a result, ground and surface water quality and quantity have been identified as a VEC.

A significant environmental effect would result if a considerable change to ground or surface water quantity or quality is identified as a result of project activities.

Boundaries – Spatial boundaries include the ground and surface water at the Project site as well as any water bodies and watercourses that are supplied by the ground and surface water. Temporal boundaries are focused on the construction and decommissioning phases but include all phases of the Project in the unlikely event of an unplanned release.

Table 6-3: Potential impacts and proposed mitigative measures for ground and surface water.

Potential Impacts on Ground and Surface Water	Proposed Mitigative Measures
Vegetation clearing, grubbing, ground stripping, excavation and machinery traffic during the construction of the WTG pads and access road might induce a change in hydrology or sediment input into ground and surface water.	• A minimum setback distance will be adhered to of 30m + blade length (76m) between the wind turbine and all wetlands • Efforts will be made to design the access road such that it does not interfere with a watercourse, water body or drainage channel; • Where possible, clearing shall take place in the winter months on frozen ground; • Erosion control strategies (ie. Straw bales and geo-textiles) will be outlined in the Erosion and Sedimentation Control Plan hopes to maintain baseline water quality conditions in the watercourses and wetlands at the site; and • Where water must be pumped out of excavation pits, there will not be a discharge into a wetland, watercourse or defined channel. If pumped water contains total suspended solids (TSS) the water will be pumped to vegetated land with gentle slope to allow sediment to filter, or filtered before release with a filter bag.
Exposure or accidental spillage of hazardous materials such as fuel, oils and hydraulic fluids has potential to contaminate ground water supplies during construction, operation and decommissioning phases.	• Equipment shall be in good working order and maintained so as to reduce risk of spill/leaks and avoid water contamination; • Spill response kits will be provided on site to ensure immediate response to a potential waste release; and • Routine maintenance, refuelling and inspection of machinery will be performed off-site whenever possible.

Potential Impacts on Ground and Surface Water	Proposed Mitigative Measures
Vehicular traffic during decommissioning might induce a change in hydrology or sediment input into ground and surface water.	• Efforts will be made such that the access road does not interfere with a watercourse, water body or drainage channel; • Erosion control strategies (ie. Straw bales and geo-textiles) will be outlined in the Erosion and Sedimentation Control Plan hopes to maintain baseline water quality conditions in the watercourses and wetlands at the site; and • Used oil filters, grease cartridge containers and other products associated with equipment maintenance shall be collected and disposed of in accordance with regulatory guidelines.

Cumulative Effects – As described in Section 2.9 the only other wind farm in the area is the Amherst Wind Farm located on the Tantramar Marsh 7.5 km northwest of the Project. No cumulative effects are expected to occur with respect to ground and surface water.

Significance of Residual Effects – After employing the proposed mitigative strategy, should any sedimentation and/or erosion occur it will be temporary, of small magnitude and contained. While any direct release into ground or surface water would be a negative effect, it will be of small magnitude, of short duration and local. The significance of residual effects on ground and surface water is to be considered negligible.

Ambient Noise

Noise is defined as a sound, especially one that is loud, unpleasant or that causes disturbance. The Project poses two issues with noise pollution, which could affect local residents. Noise from the construction and decommissioning phase, as well as noise from the WTG operation is to be expected. As a result, ambient noise has been identified as a VEC.

A significant environmental effect would result if a considerable change in the ambient noise was found to be the result of project activities.

Boundaries – The spatial boundary is the area in which the noise impact study was conducted; this being a 3,500 m radius from the WTG location. The temporal boundary includes all Project activities from site preparation, construction, and operation to decommissioning.

Table 6-4: Potential impacts and proposed mitigative measures for ambient noise.

Potential Impacts on Ambient Noise	Proposed Mitigative Measures
During construction and decommissioning phases the ambient noise sound pressure levels will be affected as a result of the use of equipment and machinery such as excavators, dump trucks and bulldozers. Elevated noise levels can disturb fauna and local residents.	• Noise impact will be limited by restricting construction and decommissioning activities to daytime hours when feasible; • Health Canada recommends the long-term average day-night sound level (Ldn) be below 57 db(A) at the closest residence. An Ldn of 57 db(A) is expected to be within the threshold for widespread complaints for construction noise. (USEPA, 1974).
Elevated sound pressure levels will be observed during operation from the nacelle, which is 98 m above ground level.	• A noise impact assessment has been conducted to predict a 'worst case scenario' sound pressure level that can be expected at the surrounding dwellings; • The turbine locations have been sited in order to exceed Provincial wind turbine noise guidelines • The wind turbines chosen for the project incorporate advanced noise reduction technologies in order to mitigate noise generated by the moving blades. • By minimizing grubbing and clearing, flora on the Project site will aid in attenuation of noise produced from the WTG as perceived by local receptors.
Infrasound from wind turbines.	• Infrasound from wind turbines is not a concern given the distance the wind turbines are located in relation to homes and dwellings.

Cumulative Effects – As described in Section 2.9 the only other wind farm in the area is the Amherst Wind Farm located on the Tantramar Marsh 7.5 km northwest of the Project. No cumulative effects are expected to occur with respect to ambient noise. The Ontario noise guidelines for wind farms require an adjacent wind farm within 5 km of the proposed wind farm to be included in the noise assessment. The Amherst Wind Farm located on the marsh is 7.5 km from the Project site it was not included in the noise assessment. (Ontario, 2008)

Significance of Residual Effects – Elevated SPLs caused by construction and decommissioning phases will be temporary, during the day and short term. Noise production from the WTG during operation has been mitigated by setback distances and confirmed by a noise impact assessment. The Project is not anticipated to have any significant residual environmental effect on the ambient noise levels. While any effect on ambient noise will be negative, the significance of residual effects on ambient noise is to be considered negligible.

Ambient Light

There are three attributes associated with the Project that have potential to cause an impact on ambient lighting; lighting during night time construction activities, WTG lighting, and shadow flicker are expected to contribute to ambient lighting. By employing the proposed mitigation strategy, the effect of the Project on ambient lighting can be considered minor.

A significant environmental effect would result if a considerable change in the ambient light was found to be the result of project activities.

Boundaries – The spatial boundary is the area in which the noise impact study was conducted; this being a 3,500 m radius from the WTG location. The temporal boundary is focused on the operation phase of the WTG but also includes the turbine installation phase of construction.

Table 6-5: Potential impacts and proposed mitigative measures for ambient light.

Potential Impacts on Ambient Light	Proposed Mitigative Measures
During the night time, lighting will be seen atop some of the WTG, depending on the WTG layout.	• LED lighting will be used to minimize light throw; • Only the minimum amount of pilot warning and obstruction avoidance lighting will be used; • Only lights with short flash durations and the ability to emit no light during the 'off phase' of the flash (i.e. as allowed by strobes and modern LED lights) will be installed on WTG structures; and • Lights will operate at the minimum intensity and minimum number of flashes per minute (longest duration between flashes) allowable by Transport Canada.
Shadow flicker may occur during certain weather conditions and times of the year.	• The potential negative effect of shadow flicker has been mitigated at the design stage through responsible turbine siting; and • Compliance with industry standard guidelines on shadow flicker. All dwellings will, in a worst case scenario experience less than 30 hours of shadow flicker per year and 30 minutes of shadow flicker on the worst day.

Potential Impacts on Ambient Light	Proposed Mitigative Measures
Lighting during night time construction activities such as turbine installation.	• Construction activities will be limited to the day time when possible. The turbine may be erected during the evening as the activity must be completed when the wind is less than 4 m/s. These conditions are commonly seen in the early evening.

Cumulative Effects – As described in Section 2.9 the only other wind farm in the area is the Amherst Wind Farm located on the Tantramar Marsh 7.5 km northwest of the Project. No cumulative effects are expected to occur with respect to ambient light.

Significance of Residual Effects – Annoyance during project construction from work lighting, if necessary, will be temporary and of short duration. Lighting concerns from residents during operations such as shadow flicker and WTG lighting is expected to be limited, as mitigation measures were employed during site design. Therefore, while any effect on ambient light will be negative, the significance of residual effects on ambient light is predicted to be negligible.

6.2 Assessment of Biophysical VECs

Wetlands / Watercourses

Management of wetlands and watercourses is an important and integral aspect of maintaining a diverse ecosystem. The Projects impact on ground and surface water quality and quantity as assessed in Section 6.1 was predicted to be minor in terms of significance of environmental effect. While the quality and quantity of ground and surface water is important in terms of ecological functionality of wetlands and watercourses the Project may also interact with wetlands and watercourses in terms of direct alteration.

As discussed in Section 4.1.3, the WTGs have been re-located a minimum of 30 m plus blade length (76 m total) from the identified wetlands and watercourse. As a result of the wetland and watercourse surveys identifying numerous water features at the Project site, wetlands and watercourses have been identified as a VEC. The mitigation sequence of avoidance, minimization of impact and compensation as detailed by NSE's Wetland Conservation Policy will be followed (NSE, 2011).

A significant environmental effect would result if a considerable change to wetlands and watercourses was the result of project activities.

Boundaries – Spatial boundaries are limited to works associated with the Project focusing on the access road and WTG locations. The temporal boundary focuses on Project construction but also includes operation and decommissioning for the unlikely event of an accident or malfunction.

Table 6-6: Potential impacts and proposed mitigative measures for wetlands / watercourses.

Potential Impacts on Wetlands / Watercourses	Proposed Mitigative Measures
During the construction phase, possible impacts to wetlands may arise from clearing, grubbing, infilling and excavation of the soil needed for constructing the access road. Such activities might induce silt run-off, alter flow into the wetlands or see them become repositories of significantly increased water flow, nutrients or sediments.	• Avoidance of all wetlands and locating turbines at least 76m from delineated wetlands; • Two wetland and watercourse field surveys have been completed to date to ensure wetlands have not been missed; • In wetlands associated with sensitive water crossings, grubbing shall be minimized by the placement of geo-textile; • Construction of the access road will attempt to create a buffer surrounding the wetland; • NSE will be continually consulted throughout the wetland and watercourse alteration process; and • The Environmental Management Plan will include all Provincial and Municipal regulations as well as all conditions determined by the Nova Scotia Wetland Alteration approval.

Cumulative Effects – As described in Section 2.9 the only other wind farm in the area is the Amherst Wind Farm located on the Tantramar Marsh 7.5 km northwest of the Project. No cumulative effects are expected to occur with respect to wetlands and watercourses.

Significance of Residual Effects – The Project will be continually optimized around the access road design constraints to avoid direct alteration of wetlands and watercourses. The WTGs have been located such that a minimum 76 m buffer (blade length + 30 m) exists between each WTG and any wetland. NSE will be provided with additional detail and all work will be completed as per Provincial requirements. Direct alteration is expected and will follow NSE's Wetland Conservation Policy (NSE, 2011). Compensation will be completed as required under the Nova Scotia Wetland Conservation Policy. The significance of residual effects on wetlands and watercourse is predicted to be minor.

Fish and Fish Habitat

Alteration of freshwater environments such as the potential watercourse alteration proposed for the proposed access road may be required; however it is not expected to impede any fish habitat on the Project site. The wetlands and watercourse survey identified all wetlands on the Project site as swamps or marshes, therefore not providing a suitable environment for fish habitat. The Proponent expects the significance of residual effects on fish and fish habitat to be negligible.

Migratory and Breeding Birds

Throughout the construction, operation and decommissioning of a wind farm the potential negative impacts can be classified into four categories: collision, displacement due to disturbance, barrier effects, and habitat loss. As a result, migratory and breeding birds have been identified as a VEC. The Proponent will comply with the *Migratory Bird Convention Act* at all times and for all Project related activities.

A significant environmental effect would result if a considerable change to migratory and breeding birds was the result of project activities.

Boundaries – The spatial boundaries include the area in that the WTG will be located, also including pathways and locations that are frequented by birds. The temporal boundary is all phases of the Project.

Table 6-7: Potential impacts and proposed mitigative measures for migratory and breeding birds.

Potential Impacts on Migratory and Breeding Birds	Proposed Mitigative Measures
During construction (clearing/grubbing) some vegetation might be cleared that may be habitat to some migratory birds.	• The Proponent will endeavor to conduct construction activities such as clearing and grubbing during a time period that does not coincide with the time period in which migratory birds would possibly be in the area.
During operation there is a possibility that migrating birds could collide with the WTG.	• A follow up avian mortality survey will be conducted after the WTG commissioning and appropriate actions will be taken in consultation with NSDNR and CWS should there be a significant negative impact to migration flyways; and • 1 – 2 bird mortalities per year, per turbine at Natural Forces other wind farms have been observed.
Birds may alter their migration flyways and/or local flight paths to avoid WTG.	• A follow up avian mortality survey will be conducted after the WTG commissioning and appropriate actions will be taken in consultation with NSDNR and CWS should there be a significant negative impact to migration flyways.

Potential Impacts on Migratory and Breeding Birds	Proposed Mitigative Measures
Fog events can impair avian visibility, increasing the likelihood of mortality from collision with WTG.	• Environment Canada climate database has been consulted to predict the rate of fog occurrence; • An annual average of 2 % fog is observed at a weather station in close proximity to Project site; and • Instructions will be given to wind farm maintenance staff to ensure all work lights are turned off upon leaving the site particularly during foul weather events.
The Project footprint will cause a loss of habitat for breeding and migratory birds.	• Desktop and field studies conducted suggest that no more than 1.7 hectares will be considered a loss of habitat. This is considered to have no negative impact on migratory and breeding birds.
Lighting on turbines can result in adverse impacts on birds. The Proponent recognizes that nocturnal migrant and night-flying seabirds are the birds most at risk of attraction to lights.	• Only the minimum amount of pilot warning and obstruction avoidance lighting will be used; • Only lights with short flash durations and the ability to emit no light during the 'off phase' of the flash (i.e. as allowed by strobes and modern LED lights) will be installed on tall structures; • Lights will operate at the minimum intensity and minimum number of flashes per minute (longest duration between flashes) allowable by Transport Canada; • Instruction will be given to wind farm maintenance staff to ensure all work lights are turned off upon leaving the site particularly during foul weather events; and • A follow up avian mortality survey will be conducted after the wind farm commissioning, and appropriate actions will be taken in consultation with NSDNR and CWS should there be a significant negative impact to night migrants.
There will be an increase in habitat when the Project site is reclaimed at the end of the 20 year project lifetime.	• N/A – no mitigation measures necessary for a positive potential impact.

Potential Impacts on Migratory and Breeding Birds	Proposed Mitigative Measures
When the WTG are removed there will no longer be the potential barrier effect impeding flyways or local flight paths.	- N/A – no mitigation measures necessary for a positive potential impact.

Cumulative Effects – As described in Section 2.9 the only other wind farm in the area is the Amherst Wind Farm located on the Tantramar Marsh 7.5 km northwest of the Project. No cumulative effects are expected to occur with respect to migratory and breeding birds.

Significance of Residual Effects – Disturbance of bird habitat during construction will be unlikely to occur by employing the proposed mitigation measures. It is expected that the mortality rate of birds from collision or habitat loss during Project operation, if at all, will be low. Monitoring for bird mortality during operation will verify the effect the Project has on migratory and breeding birds. While not all phases of the Project are negative, construction and operation phases pose potential for negative impact. With the proposed mitigation measures employed, the significance of residual effects on migratory and breeding birds is predicted to be minor.

Bats

Throughout the construction, operation and decommissioning of a wind farm the potential negative impacts can be classified into two categories: collision and habitat disturbance. As a result, bats have been identified as a VEC.

A significant environmental effect would result if a considerable change to bats was the result of project activities.

Boundaries – The spatial boundaries include the area in that the WTG will be located. The temporal boundary is all phases of the Project.

Table 6-8: Potential impacts and proposed mitigative measures for migratory and breeding birds.

Bats	Proposed Mitigative Measures
Clearing and construction activities have the potential to cause disturbance to bat habitat.	- The project site has been designed to make use of previously cleared land. This reduces the ecological impact of the project footprint and minimizes the potential impact to bat habitat.

Bats	Proposed Mitigative Measures
During operation there is a possibility that migrating birds could collide with the WTG.	• A follow up bat mortality survey will be conducted after the WTG commissioning and appropriate actions will be taken in consultation with NSDNR and CWS should there be a significant negative impact to bats; and • A mitigation scenario for this site may involve increasing the rotor cut-in speed from 2 m/s to 5 m/s on all three turbines, from half hour before sunset to half hour after sunrise.

Cumulative Effects – As described in Section 2.9 the only other wind farm in the area is the Amherst Wind Farm located on the Tantramar Marsh 7.5 km northwest of the Project. No cumulative effects are expected to occur with respect to bats.

Significance of Residual Effects – Disturbance of bat habitat during construction will be unlikely to occur by employing the proposed mitigation measures. It is expected that the mortality rate of bats from collision or habitat loss during Project operation, if at all, will be low. Monitoring for bat mortality during operation will verify the effect the Project has on bats. The proposed curtailment scenario may be implemented if a significant amount of bat mortality is observed. While not all phases of the Project are negative, construction and operation phases pose potential for negative impact. With the proposed mitigation measures employed, the significance of residual effects on bats is predicted to be negligible.

Flora

Information collected during a desktop review and a field survey to ensure that all habitat types were surveyed. The field survey revealed four major habitat types: regenerating forest, mature forest, clear-cut and wetlands. In an effort to preserve local flora species and to ensure flora species of conservation interest remain unharmed, flora has been identified as a VEC.

A significant environmental effect would result if a considerable change to flora was the result of Project activities.

Boundaries – The spatial boundary is the entire Project site. The temporal boundary includes the construction phase focusing on clearing, grubbing and building the access road, WTG crane pads and foundations, as well as the decommissioning phase focusing on site reclamation.

Table 6-9: Potential impacts and proposed mitigative measures for flora.

Potential Impacts on Flora	Proposed Mitigative Measures
Clearing and grubbing will result in the disturbance of flora.	• There will be an approximate land/habitat loss of 1.7 Hectares attributable to the construction phase as determined by desktop and field studies. By using existing roads this area has been reduced from 4.0 hectares. This will minimize the impact on flora and fauna; • The access road have been optimized to make use of existing roads at the Project site to reduce the amount of flora to be cleared; and • Location of the access road will be optimized to reduce footprint and to avoid sensitive areas where feasible.
There is a risk of introducing invasive species through plant matter attached to construction equipment	• Construction equipment will be cleaned prior to transportation and use to ensure that no plant matter is attached to the machinery.

Cumulative Effects – As described in Section 2.9 the only other wind farm in the area is the Amherst Wind Farm located on the Tantramar Marsh 7.5 km northwest of the Project. No cumulative effects are expected to occur with respect to flora.

Significance of Residual Effects – The Project will decrease the flora footprint approximately 1.7 hectares. While the construction phase presents potential for negative impact, once the decommissioning phase has started, land reclamation will restore the Project site to its previous state. With the proposed mitigation measures employed, the significance of residual effects on flora is predicted to be minor.

Wood Turtle

Through consultation with NSDNR the Wood Turtle *(Glyptemys insculpta)* was identified to potentially reside in suitable habitat approximately 2km south of the Project site. As the wood turtle is considered a Species at Risk, a significant environmental effect would result if a considerable change to wood turtle population or wood turtle habitat was the result of Project activities.

Boundaries – The Project boundary is the entire Project site. The temporal boundary includes the construction and operation phases.

Table 6-10: Potential impacts and proposed mitigative measures for Wood Turtle.

Potential Impacts on Wood Turtle	Proposed Mitigative Measures
Wood Turtle habitat loss, fragmentation and disturbance maybe occur as a result of the Project.	• Apply Special Management Practices when relevant to site activities as outlined in NSDNR Wood Turtle SMP publication; • Minimizing the total project footprint by utilizing existing access roads ;Avoidance of areas of high quality and important habitat; and • SMP recommendations will be included in the Project's environmental management plan.

Cumulative Effects – As described in Section 2.9 the only other wind farm in the area is the Amherst Wind Farm located on the Tantramar Marsh 7.5 km northwest of the Project. No cumulative effects are expected to occur with respect to the wood turtle.

Significance of Residual Effects – Thorough desktop and field studies have been conducted to identify fauna that may be present at the Project site. Presence of wood turtle at the Project site is low to nonexistent; combined with the detailed mitigative measures, the significance of residual effects on fauna is predicted to be negligible.

Moose

Through consultation with NSDNR the mainland moose was identified as a species of interest. As the wood turtle is considered a Species at Risk, a significant environmental effect would result if a considerable change to moose population or habitat was the result of Project activities.

Boundaries – The Project boundary is the entire Project site. The temporal boundary includes the construction and operation phases.

Table 6-11: Potential impacts and proposed mitigative measures for Moose.

Potential Impacts on Moose	Proposed Mitigative Measures
Mainland moose habitat loss, fragmentation and disturbance maybe occur as a result of the Project.	• Apply Special Management Practices when relevant to site activities as outlined in NSDNR mainland moose SMP publication; • Minimizing the total project footprint by utilizing existing access roads ;Avoidance of areas of high quality and important habitat; and • SMP recommendations will be included in the Project’s environmental management plan.

Cumulative Effects – As described in Section 2.9 the only other wind farm in the area is the Amherst Wind Farm located on the Tantramar Marsh 7.5 km northwest of the Project. No cumulative effects are expected to occur with respect to mainland moose.

Significance of Residual Effects – Thorough desktop and field studies have been conducted to identify fauna that may be present at the Project site. Presence of moose on the Project site is low; combined with the detailed mitigative measures, the significance of residual effects on moose is predicted to be negligible.

6.3 Assessment of Socio-economic VECs

Property Value & Land Use

The proposed ACWF makes use of three land parcels outside of Amherst, in the Municipality of Cumberland County. The lands are privately owned and have been leased to the Proponent for the purpose of developing the proposed ACWF. Lands surrounding the Project land parcels are rural residential and agricultural properties that consist of year round and seasonal homes. There are 314 dwellings within 2,500 m of the Project. As a result land use has been identified as a VEC

A significant environmental effect would result if a considerable change to land use, or property devaluation was the result of project activities.

Boundaries – The spatial boundaries proposed WTG locations. The temporal boundary includes all phases of the Project including construction, operation and decommissioning.

Table 6-12: Potential impacts and proposed mitigative measures for property value & land use.

Potential Impacts on Property Value & Land Use	Proposed Mitigative Measures
Public concern that property value may decrease as a result of the Project	• Recent real estate value studies have consistently determined no correlation between proximity to wind farms and property devaluation (Canning et. al., 2010); and • Education through public consultation can be effective in providing factual, relevant information to alleviate the concerns of local residents.

In 2010 a study in the Municipality of Chatham-Kent, Ontario was prepared to assess the effects of wind energy on real estate values. This report was prepared in accordance with the *Canadian Uniform Standards of Professional Appraisal Practice* for the APPRAISAL INSTITUTE OF CANADA (Canning et al., 2010). The report is widely recognized in the wind industry as a thorough study and demonstrates what many other studies also indicate. The study found that it was highly unlikely that a relationship exists between wind farms and the market values of rural residential real estate. (Canning et. al., 2010)

A recent study by the University of Guelph analyzed more than 7,000 home and farm sales that occurred between 2002 and 2010 in Melancthon Township, Ontario, which saw 133 turbines erected between 2005 and 2008. Melancthon Township is of comparable landscape to that of the proposed Project site, being mainly residential and farm properties. Of the 7,000 homes and farms, 1,000 were sold once, and some multiple times. Co-authors, Richard Vyn and Ryan McCullough conclude that the turbines in question have not impacted the value of the surrounding properties. Further, the nature of the results, which indicate a lack of significant effect, is similar across both rural residential properties and farm properties Vyn & McCullough, 2014).

Cumulative Effects – As described in Section 2.9 the only other wind farm in the area is the Amherst Wind Farm located on the Tantramar Marsh 7.5 km northwest of the Project. No cumulative effects are expected to occur with respect to property value and land use.

Significance of Residual Effects – The significance of residual effects on property value and land use is expected to be negligible.

Aboriginal Resources / Uses

Desktop and field studies have been completed as part of a Mi'kmaq Ecological Knowledge Study to promote a strong relationship between the Proponent and the Mi'kmaq population. Focusing on vegetation and fauna the study identified any species that has significant importance for use of traditional medicine, food, clothing or other living necessities.

A significant environmental effect would result if a considerable change to Aboriginal resources / uses was the result of Project activities.

Boundaries – The spatial boundary includes all areas of the Project site and an area spanning 10 km radius from the Project site. The temporal boundary focuses on the early construction phases of the Project when clearing and grubbing, access road construction and turbine pad construction will take place.

Table 6-13: Potential impacts and proposed mitigative measures for aboriginal resources / uses.

Potential Impacts Aboriginal Resources / Uses	Proposed Mitigative Measures
Potential impact on culturally significant plant species and general habitats.	• Mi'kmaq ecological knowledge study was conducted to identify potential for valued aboriginal resources; • Through roundtable discussions with Mi'kmaq right holders it was determined that the Projects impact on culturally significant flora and fauna species is negligible; • The Proponent will maintain communications with the local Mi'kmaq communities; and • Location of the access roads may be optimized to reduce footprint and to avoid areas of cultural significance.
Direct impact to Mi'kmaq artifacts during construction activities, such as blasting and excavation.	• If an artifact or object of potential Aboriginal significance is thought to have significance is discovered during project activities the KMK will be contacted immediately along with other appropriate individuals and organizations to determine a suitable method of mitigation.
The Project is being developed in partnership with the 13 First Nations of Nova Scotia	• The 13 First Nations in Nova Scotia will see an economic benefit from revenues of selling the energy produced by the wind farm to NSPI.

Cumulative Effects – As described in Section 2.9 the only other wind farm in the area is the Amherst Wind Farm located on the Tantramar Marsh 7.5 km northwest of the Project. No cumulative effects are expected to occur with respect to wetlands and watercourses.

Significance of Residual Effects – The significance of residual effects on land use is expected to be negligible. In the unlikely case that an artifact with potential interest/value to Mi'kmaq heritage is discovered appropriate individuals/ organizations will be contacted immediately.

Archaeological Resources / Uses

The results of the archaeological resource impact assessment indicated that the lack of navigable waterways and a landscape unsuitable to agriculture and settlement significantly diminish the likelihood of archaeological resources at the Project site. As a result, it is not expected that a significant adverse environmental effect is to occur.

A significant environmental effect would result if a considerable change to archaeological resources was the result of project activities.

Boundaries – The spatial boundary for this VEC is the entire Project site. The temporal boundary is the construction phase where ground disturbance is likely to occur.

Table 6-14: Potential impacts and proposed mitigative measures for archaeological resources.

Potential Impacts on Archaeological Resources	Proposed Mitigative Measures
Direct impact to cultural resources during construction activities, such as blasting and excavation.	• The Archaeological resource impact study concludes the Project site is of low potential for significant archaeological resources for First Nations and Euro-Canadians; • Avoidance is the preferred method of mitigation in all instances where archaeological resources are present; and • Should archeological resources be encountered, all activities are to stop and the Coordinator of Special Places will be contacted immediately to determine a suitable method of mitigation.

Cumulative Effects – As described in Section 2.9 the only other wind farm in the area is the Amherst Wind Farm located on the Tantramar Marsh 7.5 km northwest of the Project. No cumulative effects are expected to occur with respect to archaeological resources.

Significance of Residual Effects – The significance of residual effects on archaeological resources is expected to be negligible.

Vehicular Traffic

The Project will be accessed via John Black Road. During construction of the access road and WTG foundations, there will be an increase in truck traffic on the roads leading to and from the Project site. During delivery of the WTG components, delivery of oversized loads may slow traffic flow.

Of these predicted vehicle movements, approximately 35 will be oversized loads associated with the delivery of WTG component parts (towers, blades, and nacelles) and the cranes required for erection. These deliveries are anticipated within months 4 through 6 of the project construction schedule and subject to movement orders as agreed upon with governing authorities.

Boundaries – The spatial boundaries are all roads that will be used through the construction phase of the Project and the Project site. The temporal boundaries are those associated with the construction phase of the Project.

Table 6-15: Potential impacts and proposed mitigative measures for vehicular traffic.

Potential Impacts on Vehicular Traffic	Proposed Mitigative Measures
Vehicular traffic may increase as a result of construction activities and transportation of WTG components to the Project site.	• Every effort will be made to ensure that oversized loads are delivered during times of lowest traffic to mitigate traffic jams.

Cumulative Effects – As described in Section 2.9 the only other wind farm in the area is the Amherst Wind Farm located on the Tantramar Marsh 7.5 km northwest of the Project. No cumulative effects are expected to occur with respect to vehicular traffic.

Significance of Residual Effects – The time frame in which an impact to traffic may occur will be temporary, and combined with the proposed mitigative measure of avoiding high traffic times; the significance of residual effects on vehicular traffic is expected to be negligible.

Telecommunication and Radar Communications

With the installation of WTGs there is the possibility that the turbine rotor may interfere with the transmission and receiving of telecommunication signals. The Proponent has consulted with NavCanada, Department of Nation Defence and Transport Canada to mitigate potential negative impacts on telecommunications and radar communications. A desktop study for electromagnetic interference was conducted to identify potential of impact on microwave link communication. A third party consultant was engaged to verify the desktop study and to conduct a field study to confirm desktop findings. As a result, telecommunication and radar communication has been identified as a VEC.

A significant environmental effect would result if a considerable change to telecommunication and radar communications was the result of project activities.

Boundaries – The spatial boundary consists of the local area including the proposed WTG and neighbouring communication infrastructure. Temporal boundaries include the operation phase of the Project.

Table 6-16: Potential impacts and proposed mitigative measures for telecommunications and radar communications.

Potential Impacts on Telecommunications	Proposed Mitigative Measures
WTG operation may interfere with telecommunication and/or radar communication infrastructure	• Consultation was completed as recommended by CanWEA and Radio Advisory Board of Canada's guidance document – *Technical Information and Guidelines on the Assessment of the Potential Impact of Wind Turbines, on Radio Communications, Radar and Seismoacoustic Systems*; • A third party consultant was engaged by the Proponent to conduct and desktop and field study assessment of the potential for electromagnetic interference from the Project. This was used in micro siting WTGs and as a result no impacts are expected; • A desktop EMI assessment was conducted by the proponent in line with the Radio Advisory Board of Canada guidelines. The results of the assessment showed that the turbine will not interfere with the telecommunication links of nearby towers; • Application process with NAV Canada's Land Use Proposal Submission Form to ensure that the Project does not pose any hazard to the navigational systems of NAV Canada; and • Transport Canada and Department of National Defence has also been consulted.

Cumulative Effects – As described in Section 2.9 the only other wind farm in the area is the Amherst Wind Farm located on the Tantramar Marsh 7.5 km northwest of the Project. No cumulative effects are expected to occur with respect to telecommunications and radar communications.

Significance of Residual Effects – Based on consultation and the third party study with the appropriate authorities, no impedance on communication infrastructure is to be expected. As a result, the significance of residual effects on telecommunication and radar communication is expected to be negligible.

Landscape Aesthetics

The proposed WTGs are located outside of the town of Amherst amongst agricultural land; turbine pad elevations are approximate, 50, 51 and 57 m above sea level. A visual impact assessment was completed by collecting photographs from high-traffic areas around the Project site. Photomontages were created at two high traffic areas using WindFarm software. The photomontages on John Black Road and Pumping Station Road produce a realistic projection of what the WTG will look like superimposed on the Project landscape. Since the Project site is a rural, scenic area landscape aesthetics has been identified as a VEC.

A significant environmental effect would result if a considerable change to landscape aesthetics was the result of project activities.

Boundaries – The spatial boundary is defined as the areas surrounding the Project site in which the WTGs are visible. The temporal boundary is the Project operation phase.

Table 6-17: Potential impacts and proposed mitigative measures for landscape aesthetics.

Potential Impacts on Landscape Aesthetics	Proposed Mitigative Measures
Community members may have a negative reaction towards the aesthetics of the WTGs.	• The Proponent considered landscape aesthetics when deciding on specific siting of the WTGs; • The paint on the WTGs will be selected so that they do not contrast sharply with the environment; and • By-Laws regarding responsible siting of WTG were followed to minimize the potential impact on the landscape aesthetics during WTG siting;

Cumulative Effects – As described in Section 2.9 the only other wind farm in the area is the Amherst Wind Farm located on the Tantramar Marsh 7.5 km northwest of the Project. No cumulative effects are expected to occur with respect to visual landscape.

Significance of Residual Effects – The perception of landscape aesthetics is a subjective matter. The Proponent recognizes the development of the proposed WTGs may have a negative effect in the perception of the community. It is possible that the negative reaction may be a result of a change in the landscape and may diminish over time. While landscape aesthetics will be altered with the development of the ACWF, the significance of residual effects on landscape aesthetics is expected to be negligible.

Public Health and Safety

Public health and safety are of the greatest concern in the development of a Project such as the ACWF. During the construction, operation and decommissioning phase the protection of workers and the public's health and safety is protected under the provincial Occupational, Health and Safety Act (OHS). It is best practice to consider a 'worst case scenario' when developing a health and safety policy / plan, as a result, health and safety has been identified as a VEC.

A significant environmental effect would result if a considerable change to health and safety was the result of project activities.

Boundaries – The spatial boundary includes the Project site and for the sake of ambient noise and ambient light, a 2.5 km radius from the WTG. The temporal boundaries include all phases of the Project.

Table 6-18: Potential impacts and proposed mitigative measures for health and safety.

Potential Impacts on Public Health and Safety	Proposed Mitigative Measures
During extreme cold weather events there is the potential for ice to build up and throw ice from the WTG blades.	• WTGs are equipped with ice-detection systems on each blade; • WTGs are designed to shut down in the case of ice-buildup; and • When ice is detected the blade has a heating element that will effectively melt the ice to mitigate ice-throw; and • Personal Protection Equipment (ie. hard-hats) will be worn when near the WTGs.
During extreme weather events, there is the potential for electrical fires within the turbine nacelle through lightning strikes.	• WTGs are equipped with lightning protection that, in the unlikely event of a lightning strike, will dissipate the lightning current to the ground.
Potential aviation hazard to low flying aircraft.	• Application process with NAV Canada's Land Use Proposal Submission Form to ensure that the Project does not pose any hazard to the navigational systems of NAV Canada.
Increase in vehicular traffic may have the potential to affect public safety.	• Every effort will be made to ensure that oversized loads are delivered during times of lowest traffic to mitigate road traffic.
Shadow flicker may affect human health.	• This potential impact has been addressed in the Ambient Light Section 6.1.

Potential Impacts on Public Health and Safety	Proposed Mitigative Measures
Noise impact may affect human health.	• This potential impact has been addressed in the Ambient Noise Section 6.1.
Potential for accidents and malfunctions pose a risk to workers and the public's health and safety;	• The OHS Act will be followed.

Cumulative Effects – As described in Section 2.9 the only other wind farm in the area is the Amherst Wind Farm located on the Tantramar Marsh 7.5 km northwest of the Project. No cumulative effects are expected to occur with respect to health and safety.

Significance of Residual Effects – Based on Project planning and design, the top priority has been health and safety. This is to make every reasonably possible effort to eliminate any negative potential impacts the Project may have on the public's health and safety. By following the proposed mitigative measures as well as regulatory guidelines pertaining to health and safety, the significance of residual effects on health and safety is expected to be negligible.

Local Economy

During the Project phases, there will be a significant amount of money spent within the town of Amherst, Cumberland County and Nova Scotia. During the development, the need for contractors and trades will be required and the Proponent will make every effort to utilize local companies to promote the local economy.

The COMFIT program will guarantee a "feed-in-tariff" that is a rate per kilowatt hour that the community owned Project is guaranteed for the 20 year power purchase agreement.

A significant effect would result if a considerable change to local economy was the result of project activities.

Boundaries – The spatial boundary is any area, business and individual that may observe a financial impact from the Project. The temporal boundary includes all phases of the Project.

Potential Impacts and Proposed Mitigative Measures – Potential positive impacts during the development phase of the Project include:

- Hiring local consultants; and
- Use of local services such as accommodations, restaurants and fuel.

Potential positive impacts during the construction and decommissioning phase of the Project include:

- Contracting construction work to local businesses;
- Use of local services such as accommodations, restaurant and fuel; and

- Municipal taxes being paid to the MoCC.

Potential positive impacts during the operation phase of the Project include:

- Use of local services such as accommodations, restaurant and fuel;
- Involvement of Nova Scotia residents in the CEDIF to invest in the Project;
- Municipal taxes being paid to the MoCC; and
- Long term contracts may be used in the operation and maintenance of the Project.

Cumulative Effects – As described in Section 2.9 the only other wind farm in the area is the Amherst Wind Farm located on the Tantramar Marsh 7.5 km northwest of the Project. Together the two wind farms will provide clean, renewable energy to regions within the Municipality of Cumberland County.

Significance of Residual Effects – The Proponent will, when appropriate make every effort to utilize local services and products, this promotes local economy, which is in line with the Proponents ideology of community based projects. The predicted effects of this Project on the local economy are positive and as a result of the municipal taxes, CEDIF and economic spinoff, the significance of residual effects on local economy is expected to be beneficial.

6.4 Effect of Environment on Project

Extreme Weather

Severe weather events could potentially damage WTG due to conditions exceeding the operational design of the WTGs. High winds, extreme temperatures and icing on blades all have the potential to shut down the WTGs. Extreme weather events that could occur in Cumberland County region, Nova Scotia region are listed in Table 6-19.

Table 6-19: Extreme events, associated effects and mitigation.

Weather Event	Effect	Mitigation
Extreme wind	Damage to blades	Automated control system would initiate shut down
Hail	Damage to blades	Appropriate WTG maintenance
Heavy rain and flooding	None anticipated	None
Heavy snow	Damage to WTG components	Automated control system would initiate shut down
Ice storms	Icing on blades resulting in potential ice throw	Automated control system would initiate shut down and heating system
Lightning	Potential for fires within nacelle of WTGs	Lightning protection system would conduct electrical surge away from nacelle
Seismic activity	None anticipated	None
Severe drought	None anticipated	None

Turbine Icing

Ice accumulation on WTG blades can occur during the winter months when the appropriate conditions of temperature and humidity exist, or during certain extreme weather conditions, such as freezing rain (Seifert et al., 2003). In the event that ice builds up on the WTG blades, there are two types of risks possible: the first is ice throw from an operating WTG, and the second is ice fall from a WTG that is not in operation.

When a WTG is in operation, it is assumed that ice may collect on the leading edge of the rotor blade and detaches regularly due to aerodynamic and centrifugal forces (Seifert et al., 2003). The distance that the ice will be thrown from the moving WTG blade will vary depending on the wind speed, the rotor azimuth and speed, the position of the ice in relation to the tip of the blade, as well as characteristics of the ice fragment.

In a Canadian study titled *Recommendations for Risk Assessments of Ice Throw and Rotor Blade Failure in Ontario* (LeBlanc et al., 2007) ice throw was investigated to determine the individual risk probability for an individual to be struck by ice thrown from an operating WTG. The following parameters and assumptions were used:

- Rotor diameter of 80 m;
- Hub height of 80 m;
- Fixed rotor speed of 15 RPM;
- Ice fragment is equally likely to detach at any blade azimuth angle and 3 times more likely from the blade tip than the rotor;
- Ice fragments have a mass of 1 kg and frontal area 0.01 square ms;
- All wind directions are equally likely; and
- Ever-present individual between 50 m and 300 m (dounut shaped buffer around WTG), individual equally likely in any given 1 square m within that area.

The statistical analysis found that individual risk probability for an individual is 0.000000007 strikes per year or, 1 strike in 137,500,000 years. For an individual to be ever-present in the defined area, this assumes that the individual would be outside during the unpleasant weather necessary for icing conditions. This analysis does not take into account the presence of trees that could provide shelter from potential ice throw (Seifert, H. Et al., 2003). The Enercon E92 has slightly different specifications than used in this example; however this should be used as general example to understand the risk probability of an individual being struck by ice throw.

As with trees, power lines masts and buildings, ice can accumulate on a stationary WTG, and will be eventually be released and fall to the ground. Depending on the rotor position of the stationary rotor, different fall distances along the current prevailing wind will occur (Seifert, H. Et al., 2003).

Potential Surface Water Impacts

Activities associated with the Project that can impact surface water resources include the development of gravel pits, road construction, stream crossings, concrete use and disposal, and petroleum products from WTGs and heavy ground moving. To mitigate such impacts, a Spill Contingency Plan will be enforced, as well as the Environmental Management Plan.

6.5 Summary of Impacts

Based on the completed VEC analysis, it has been determined that the Project activities are only expected to have minor negative effects on wetlands/watercourses, ambient noise, bats and migratory and breeding birds, while the local economy will see a beneficial impact. All other VECs are predicted to observe a negligible residual effect from the Project. Where a minor effect is predicted, monitoring and follow up initiatives should be considered. A summary of the VEC assessment is presented in Table 6-20, in terms of the following assessment criteria:

- Nature – positive (+), negative (-), or No impact where no impact is predicted;
- Magnitude – order of magnitude of the potential impact: small, moderate, large;
- Reversibility – reversible (REV) or irreversible (IRR);
- Timing – duration of impact, short for construction or decommissioning and long for Project operation or longer;
- Extent – spatial extent of the impact, local, municipal, provincial etc.; and
- Residual Effect – negligible, minor, significant, and beneficial or no impact as described in Section 3.4.

	Nature	Magnitude	Reversibility	Timing	Extent	Residual Effect
Ambient Air	-	small	REV	Short	Local	Negligible
Ground and Surface Water	-	small	REV	Short	Local	Negligible
Ambient Noise	-	small	REV	Long	Local	Negligible
Ambient Light	-	small	REV	Long	Local	Negligible
Wetlands / Watercourses	-	small	REV	Short	Local	Minor
Fish and Fish Habitat	-	small	REV	Short	Local	No Impact
Migratory and Breeding Birds	-	small	REV	Long	Local	Minor
Bats	-	small	REV	Long	Local	Negligible

	Nature	Magnitude	Reversibility	Timing	Extent	Residual Effect
Flora	-	small	REV	Short	Local	Minor
Wood Turtle	-	small	IRR	Long	Local	Negligible
Mainland Moose	-	small	IRR	Long	Local	Negligible
Property Value & Land Use	-	small	REV	Long	Local	Negligible
Aboriginal Resources / uses	-	small	IRR	Long	Local	Negligible
Archaeological Resource / uses	-	small	IRR	Short	Local	Negligible
Vehicular Traffic	-	small	REV	Short	Local	Negligible
Telecommunications & Radar Communications	-	small	REV	Short	Local	Negligible
Landscape Aesthetics	-	small	REV	Long	Local	Negligible
Public Health and Safety	-	small	IRR	Long	Local	Negligible
Local Economy	+	moderate	REV	Long	Provincial	Beneficial

Table 6-20: Summary of identified VECs.

7.0 Follow Up and Monitoring

The purpose of this section is to describe the follow-up ecological field surveys, management plans and consultation, which the proponent is committing to during the construction, operation and decommissioning phases of the Project.

7.1 Pre-construction/Construction

7.1.1 Avian

2015 Avian Radar & Acoustic monitoring

Throughout the remainder of the Development phase which is expected to run into late spring the proponent has committed to continue the radar and nocturnal acoustic avian monitoring program.

Further processing of autumns 2014 radar & acoustic data will be undertaken early next year and be incorporated into a revised report, which will be available on the project website. Spring 2015 radar and acoustic migration surveys will begin April 1st and continue through to early June. The spring migration data will be analysed and incorporated into a final report which will also be available to the public on the project website.

The proponent believes that furthering research into alternative avian survey methods such as Radar and Acoustic monitoring will not only lead to a greater understanding of site specific avian behavior, but also will lead to a more accurate prediction of migration pathways used by avian species throughout the Maritimes. This in turn will help the wind industry in siting wind farms away from known sensitive areas.

7.1.2 Bats

2015 early season monitoring

Field monitoring of the 2014 bat research program started on July 21st and continued until Oct 4th, well inside the prime seasonal bat activity window as recommended by NSDNR. Although the data captured during the 2014 season was a complete dataset and sufficiently characterized bat activity throughout the site, there may be value in continuing a monitoring program into 2015.

The results of the 2014 monitoring program indicated high activity of Hoary bats in the first few days of monitoring, specifically July 21st to 23rd. Due to this high activity early in the season it was recommended by Dr. Broders who conducted the survey to initiate further monitoring earlier in the 2015 season outside of the usual monitoring window.

The proponent is committing to conduct this further monitoring which will likely begin in early to mid-June 2015. The proponent will liaise with Dr. Borders and NSDNR in order to design the 2015 monitoring program in order capture the potential early season Hoary bat activity.

7.2 Post-Construction Monitoring

7.2.1 Avian

A post-construction monitoring plan will be developed and implemented in consultation with NSDNR, NSE and CWS. The avian plan will be constructed to understand the impacts on habitat and its suitability for birds for not less than two years from the time turbines become operational. This plan will typically involve point count surveys at various locations around the site as well as a mortality study.

Acoustic nocturnal monitoring

The proponent is investigating the use of further acoustic nocturnal migration surveys in conjunction with the mortality surveys. The purpose of using the acoustic monitoring is estimate bird and bat densities, and when combined with meteorological data, can help predict mortality caused by collisions with the wind turbines. In one paper by Korner-Nievergelt et al. (2013), it was shown that these predictions were found to be as accurate as or better than by using a carcass search method.

7.2.1 Bats

Turbine curtailment

Active turbine mitigation at wind farms can lead to a significant decrease in bat fatalities. The mitigation involves increasing the turbine rotor 'cut-in' speed, essentially preventing the rotor from spinning at low wind speeds when bats are most active.

A mitigation scenario for this site may involve increasing the rotor cut-in speed from 2 m/s to 5 m/s on all three turbines, from half hour before sunset to half hour after sunrise, during the months which showed high hoary bat migration activity in the 2014 and 2015 baseline surveys.

The Proponent will commit to active mitigation should the post construction carcass searches reveal higher than normal mortality levels of Hoary or other migratory tree bats on site. Currently, it is industry standard to conduct post construction carcass searches for at least two years at wind farms operating within the Province, and to forward on the results of those surveys to NSDNR and the Department of Environment. This practice is also most often mandated through conditions associated with Environmental Assessment approvals.

As there is already a mechanism in place to conduct post construction carcass monitoring, the Proponent will use this mechanism to review and assess the results of the post construction surveys. Should it be determined, in consultation with NSDNR and other bat researchers that in fact the wind farm is producing higher than normal bat fatalities, the Proponent, in collaboration with NSDNR and NSE will be open to adopt an active mitigation program, the ultimate aim of which is to reduce bat fatalities on site.

7.2.2 Ambient Noise

Referring to the VEC assessment in Section 6.2 the Project was assessed as having a minor significance of residual effects on ambient noise. As a result, a public input mechanism will be established to resolve issues pertaining to ambient noise levels.

7.3 Management Plan

Throughout the life of the Project, various management and contingency plans, as listed below, may be required to aid in the responsible development, construction and operation of the Project. These plans will be developed and implemented prior to construction of the ACWF and will explicitly outline the steps taken for different Project concerns.

It is anticipated that some or all of the following management plans will be required as the Project development matures.

Management Plan Requirements

- Environmental Management Plan;
- Erosion and Sedimentation Control Plan;
- Spill Contingency Plan;
- Decommissioning and Site Reclamation Plan; and
- Public Complaint Procedure.

A number of permits will be required during pre-construction, all of which are listed in Section 1.3.

7.4 Continuing Consultation

Consultation will continue throughout the life of the Project, during pre-construction, construction and post construction activities. During the registration and public review period of this Environmental Assessment document, the Proponent will be available within the community to answer questions and explain the content to community members. The Proponent will notify the community newspaper ads, admail invites, on the Project website and through personal invitations.

Website – www.amherstcommunitywindfarm.ca

Websites have proven to be an excellent vehicle for making project information available for the general public to access to stay up to date and informed on the progress of wind farm developments. The Proponent will continue to maintain the Project website and will post up to date information regarding the development, construction, operation and ongoing consultation activities.

The Project website also contains a “Have Your Say” page, which can be used to submit comments, questions and concerns directly to the Natural Forces.

Newsletters

Natural Forces has, and currently uses newsletters as a way of informing community members about project activities. Newsletters are sent periodically to provide residents and businesses in the area surrounding the project with an update of development, construction and operation updates.

Community Liaison Committee (CLC)

A CLC acts as an advisory body to a project proponent by providing input on existing or potential concerns the community may have with respect to the Project. CLCs have been used successfully to facilitate communication between the community and a project proponent.

A CLC typically consists of a few members of the community who have been nominated by the community to act as representatives on the CLC. Other members of the CLC may include First Nations, economic development organizations, municipal councillors and members of other community groups.

During previous public open houses and discussions with local community groups the Proponent has presented the opportunity to create a CLC. The Proponent will facilitate the formation of a CLC if interest is expressed by the community.

8.0 Closure

The Proponent wishes to develop the proposed Amherst Community Wind Farm with the intent of helping Nova Scotia meet its renewable energy regulations and targets.

Many adaptation and mitigation options can help address climate change; no single option is sufficient by itself. Substantial emissions reductions over the next few decades and a near zero emissions of carbon dioxide and other long-lived green house gasses by the end of the 21st century would be required to limit warming to below 2°C relative to pre-industrial levels. (IPCC, 2014) The Amherst Community Wind Farm represents an integral part of a global effort to reach these reduction targets.

This Environmental Assessment has been prepared in accordance with the guidelines set out by the Environmental Assessment and Approval Branch of the Nova Scotia Department of Environment. The scope of the EA was discussed in advance with Nova Scotia Department of Environment Environmental Assessment branch. Consequently, it is anticipated that this EA meets all criteria outlined by the Nova Scotia Environmental Assessment Act.

A thorough analysis of the Project components and activities has been carried out for the construction, operation and decommissioning phases of the Project. Baseline environmental characteristics of the region have been documented and Valued Environmental Components have been identified. Consultation has been undertaken with a wide variety of local stakeholders, right-holders, and government stakeholders to gauge the full range of impacts and concerns with regards to the Project. The impact of the Project on the local environment has been evaluated based on all of these criteria. Mitigative measures have been presented and adopted in an effort to reduce the significance of residual impact as a result of the Project's activities. Cumulative effects of the Project on the environment due to other regional Projects and activities have also been identified and assessed.

The following benefits would result due to the Amherst Community Wind Farm and are considered as advantages of the Project, these include:

- Production of emission-free energy, which will displace energy produced from dirty fossil fuels in Nova Scotia;
- Help Nova Scotia meet its renewable energy regulations and targets for 2015 and 2020.
- Help decrease anthropogenic induced climate change, which has been proven beyond a doubt to be putting our entire human civilization at risk.
- Increased revenue for the Municipality of Cumberland County through payment of annual property taxes by the Project Proponent;
- Increased revenue for local businesses due to activities surrounding the construction, operation and decommissioning phases of the Project;
- Creation of supplementary income and income diversity for local landowner;
- Creation of additional employment in the region during the entire Project life;

In conclusion, it is anticipated that through proposed mitigative measures the Amherst Community Wind Farm will have no significant residual effects on the physical, biophysical and socio-economic environment.

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9.0 Company Signature

Table 9-1 below defines the concluding signature of this Environmental Assessment for Natural Forces Wind Inc.

Table 9-1: Signature Declaration

EA CONDUCTED BY:	Chris Veinot, Natural Forces Wind Inc. on behalf of: Mi'kmaq Wind4All Communities L.P.
PROPONENT:	Mi'kmaq Wind4All Communities L.P.
PROPONENT SIGNATURE:	John Brereton, Director - Mi'kmaq Wind4All Communities L.P.
DATE:	December 10, 2014
CONTACT DETAILS	Chris Veinot cveinot@naturalforces.ca 1205 – 1801 Hollis Street Halifax, Nova Scotia B3J 3N4 Phone: 902 422 9663

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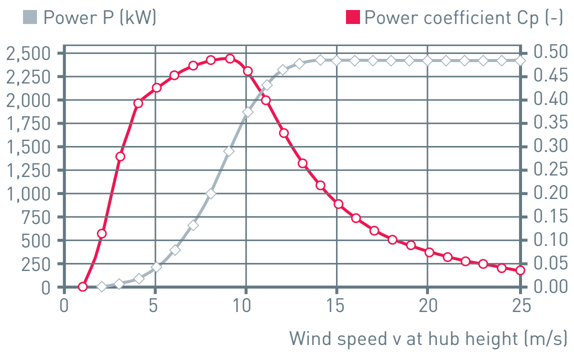
Appendix A:

Turbine Specifications

Calculated power curve



Wind (m/s)	Power P (kW)	Power-coefficient Cp (-)
1	0.0	0.00
2	3.6	0.11
3	29.9	0.27
4	98.2	0.38
5	208.3	0.41
6	384.3	0.44
7	637.0	0.46
8	975.8	0.47
9	1,403.6	0.47
10	1,817.8	0.45
11	2,088.7	0.39
12	2,237.0	0.32
13	2,300.0	0.26
14	2,350.0	0.21
15	2,350.0	0.17
16	2,350.0	0.14
17	2,350.0	0.12
18	2,350.0	0.10
19	2,350.0	0.08
20	2,350.0	0.07
21	2,350.0	0.06
22	2,350.0	0.05
23	2,350.0	0.05
24	2,350.0	0.04
25	2,350.0	0.04

$\rho = 1.225\ kg/m^3$

Technical specifications E-92

Rated power:	**2,350 kW**
Rotor diameter:	**92 m**
Hub height in meter:	**84 / 85 / 98 / 104 / 108 / 138**
Wind zone (DIBt):	**WZ III**
Wind class (IEC):	**IEC/EN IIA**
WEC concept:	Gearless, variable speed, single blade adjustment

Rotor

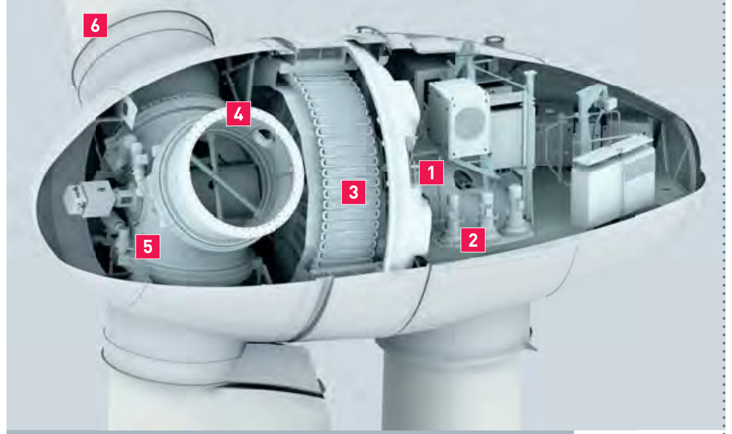
Type:	Upwind rotor with active pitch control
Rotational direction:	Clockwise
No. of blades:	3
Swept area:	6,648 m²
Blade material:	GRP (epoxy resin); Built-in lightning protection
Rotational speed:	Variable, 5 - 16 rpm
Pitch control:	ENERCON single blade pitch system; one independent pitch system per rotor blade with allocated emergency supply

Drive train with generator

Main bearing:	Double row tapered/cylindrical roller bearings
Generator:	ENERCON direct-drive annular generator
Grid feed:	ENERCON inverter
Brake systems:	– 3 independent pitch control systems with emergency power supply – Rotor brake – Rotor lock
Yaw system:	Active via yaw gear, load-dependent damping
Cut-out wind speed:	28 - 34 m/s (with ENERCON storm control*)
Remote monitoring:	ENERCON SCADA

E-92

2,350 kW



1 Main carrier
2 Yaw drive
3 Annular generator
4 Blade adapter
5 Rotor hub
6 Rotor blade

* For more information on the ENERCON storm control feature, please see the last page.

Appendix B:

Avian Baseline Surveys

Amherst Community Wind Farm

Avian Baseline Study

Preliminary Report

Prepared by:
John Kearney
John F. Kearney & Associates

for

Mi'Kmaq Wind4All Communities LP

December 2014

Introduction

The Mi'Kmaq Wind4All Communities are proposing the construction of a 6 megawatt, 3 turbine wind energy facility near the Town of Amherst, in Cumberland County, Nova Scotia. This document presents the preliminary results of an avian baseline study conducted by John F. Kearney & Associates from April through November 2014 as part of the environmental assessment of the project.

The project area is located on the Chignecto Isthmus, a narrow bridge of land only 17 kilometers in width at its narrowest point. The Isthmus is the only land connection between Nova Scotia and the mainland of North America and separates two major marine bodies; the Bay of Fundy and the Gulf of St. Lawrence. The region is recognized as an important breeding and migration stop-over area for birds. Starting within five kilometers of the Town of Amherst are two National Wildlife Areas, an Important Bird Area, a Ramsar site, and a Hemispheric Shorebird Reserve. A wind energy facility could potentially put birds at risk through collisions with wind turbines, alteration of important breeding or migration stop-over habitats, and the creation of a physical barrier along bird flight paths. Thus, the proposed construction of a wind energy facility near significant bird breeding and migratory areas requires detailed and comprehensive studies to determine the risk to birds and what mitigation measures may be necessary. Thus the components of this study include ground surveys of migration stop-over, diurnal passage, and breeding birds, and acoustic monitoring of nocturnal passage. A radar study conducted by Acadia University during the autumn migration of 2014 is another vital component of the avian baseline study.

Figure 1: Location of Amherst in Canadian Maritime Provinces

Figure 2: Map Showing Project Area East of the Town of Amherst

Definition of Study Area

The proposed Amherst Community Wind Farm is about three kilometers from the commercial areas of the Town of Amherst. The location of this town in the Maritime Provinces is shown in Figure 1. Figure 2 situates the project area relative to the Town of Amherst. The project area consists of three adjacent parcels of lands that total approximately 1.5 square kilometers in area. These lands are located between two roads that stretch from the Town of Amherst to the surrounding rural communities; the John Black Road to the north and the Pumping Station Road to the south.

The study area is defined here as the project area plus one control survey transect in the surrounding lands where specific bird surveys will be carried out as described later in this document.

Land Use, Forest Cover, and Topography

Figure 3 is developed from a Google Earth aerial view of the project lands photographed on 18 October 2012. As can be seen in Figure 3, there is intensive use of the lands for economic activities.

In the agricultural sector, there are wild blueberry fields on the northern border and grain and

Figure 3: Land Use in Project Area and Proposed Locations of Turbines (red)

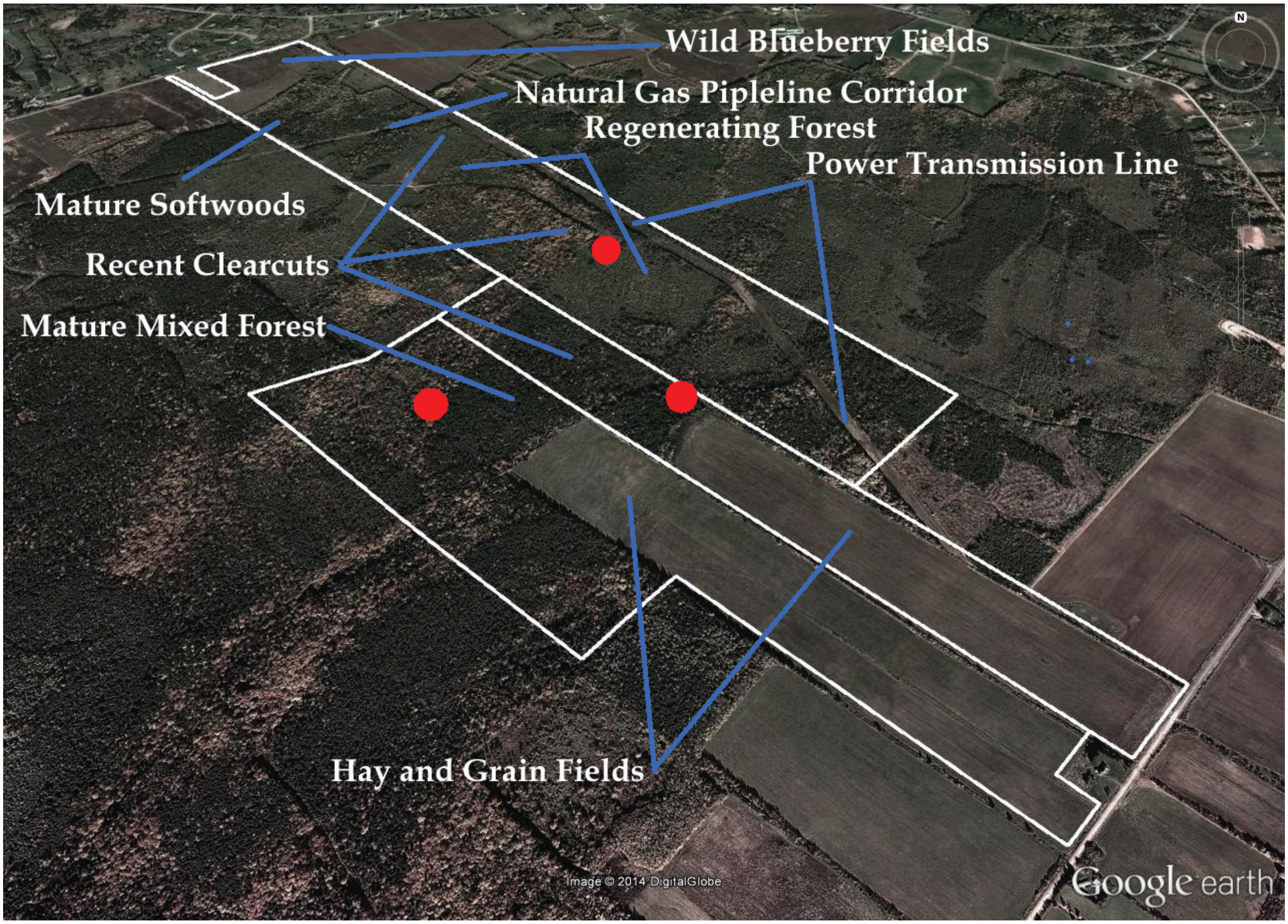
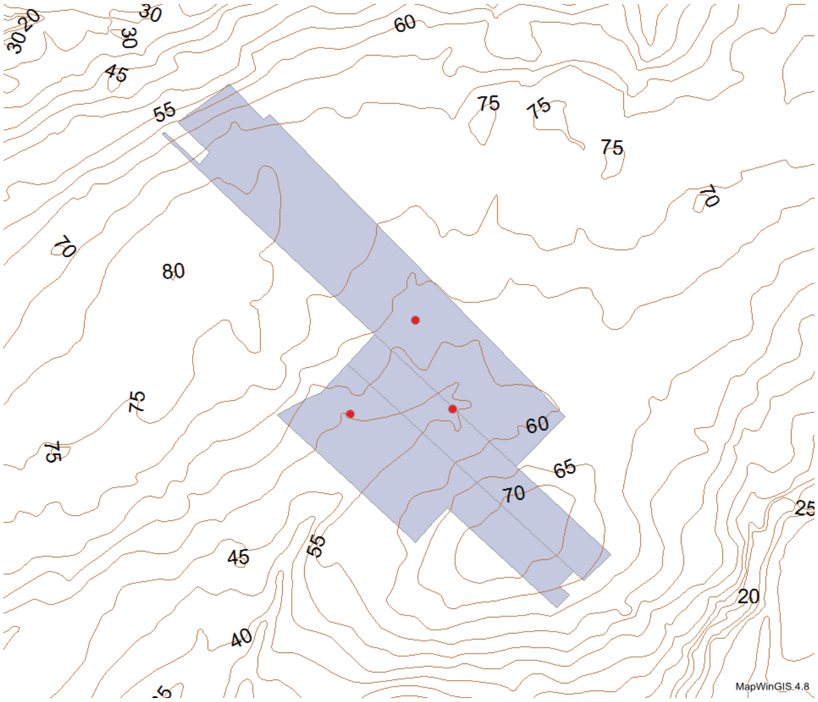


Figure 4: Map Showing Five-Meter Contour Lines in Project Area



hay fields in the southern section of the project lands. Pastures for cattle are located within a few meters of the project lands.

In the energy sector, there is an electric power transmission line and corridor on the east border and southeast section of the project area. There is a natural gas pipeline and corridor intersecting the northern part of the project area.

In the forestry sector, there are several clearcuts including large new clearcuts that have been carried out since the creation of the aerial photo upon which Figure 3 is based. The regenerating forest areas have been used recently as a training area in the art of forest thinning for new forestry workers. There are small patches of mature softwood forest and mature mixed forest remaining on the project lands.

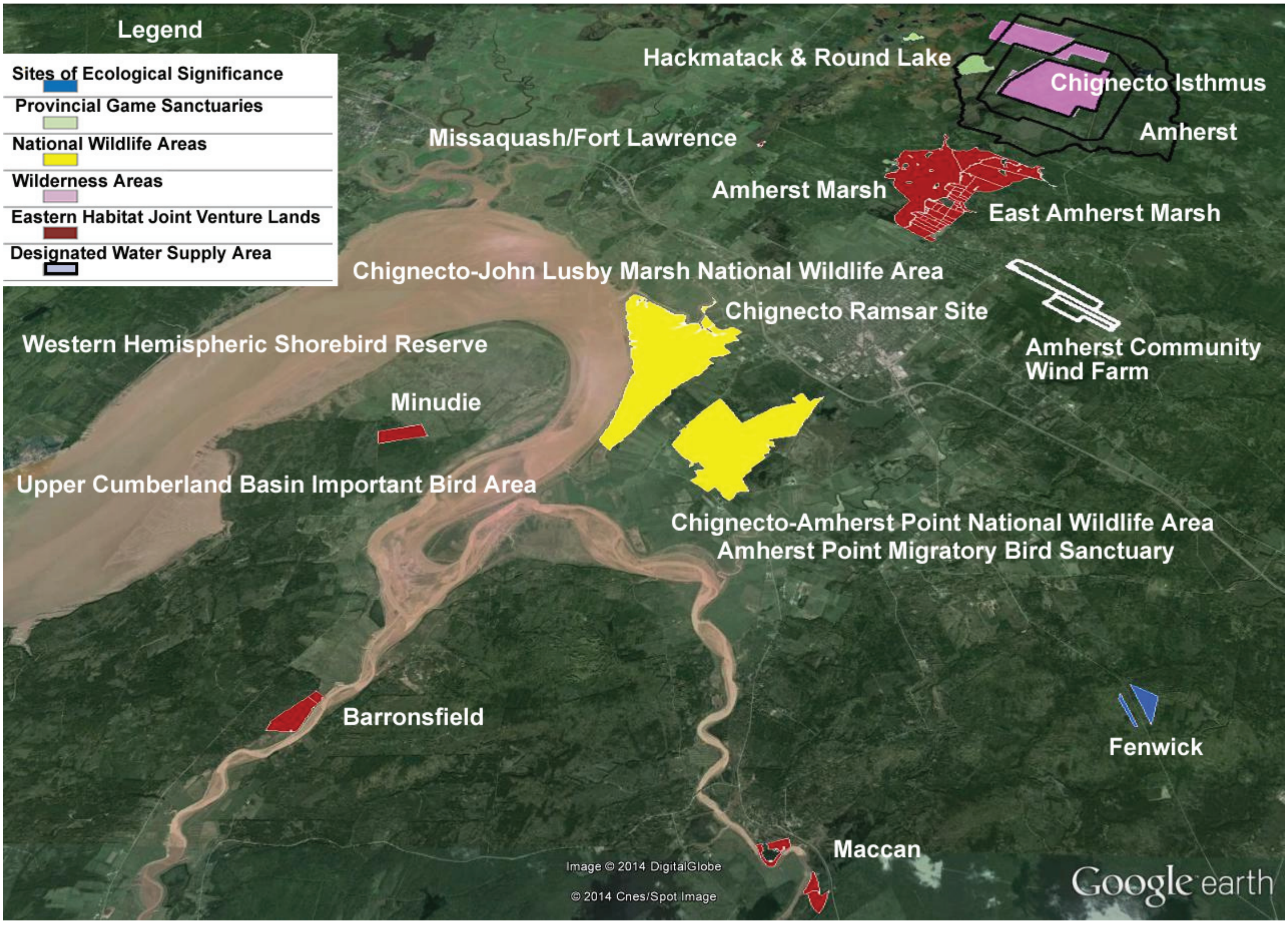
In addition, within 500 meters of the project area are three communication towers, a natural gas relay station, a golf course, and residential homes.

The project area is situated on some of the highest ground in the Nova Scotia portion of the border area with New Brunswick. However, higher ground in this part of Nova Scotia is still relatively low compared to other parts of the province. As shown in Figure 4, the maximum elevation in the project area is between 75 and 80 meters above sea level with a minimum elevation of 55 meters. The base of the proposed turbines would be between 55 and 65 meters above sea level.

Conservation Areas

A number of conservation areas can be found on the Chignecto Isthmus and in the Nova Scotia border region (see Figure 5). The closest to the project area are three freshwater management areas that are Eastern Habitat Joint Venture Lands (Ducks Unlimited, Province of Nova Scotia, and Canadian Wildlife Service). These are East Amherst Marsh, Amherst Marsh, and East Amherst

Figure 5: Conservation Areas within ~15 Kilometers of Project Area



Management Areas. These management areas are contiguous with each other and are 1.9 kilometers from the project area at their shortest distance. Other Eastern Habitat Joint Venture Lands in the vicinity of the project area are Missaquash/Fort Lawrence (7.6 kilometers), Minudie (14.1 kilometers), Maccan (14.4 kilometers), and Barronsfield (17.9 kilometers). One site of ecological significance, Fenwick, is 9.5 kilometers from the project area. The Hackmatack Lake and Round Lake Game Sanctuaries are 13.7 and 13.0 kilometers from the project area. The Chignecto Isthmus Wilderness Area is 6.9 kilometers and the Amherst Designated Water Supply Area is 4.7 kilometers from the project area. Finally the Chignecto National Wildlife Area which is also a Ramsar site consists of two components: John Lusby Marsh and Amherst Point Migratory Bird Sanctuary. These two areas are 7.2 and 6.8 kilometers respectively from the project area. These federal Wildlife Areas are part of the Upper Cumberland Basin Important Bird Area and are also within the Bay of Fundy Western Hemispheric Shorebird Reserve.

Table 1: Status of Breeding Birds Within 5 KM of Project Area as Determined by 8 Point Counts from 2006-2010

Common Name	Status
Bald Eagle	Confirmed breeding
Merlin	Confirmed breeding
Rock Pigeon	Possible breeding
Mourning Dove	Possible breeding
Ruby-throated Hummingbird	Possible breeding
Downy Woodpecker	Possible breeding
Hairy Woodpecker	Possible breeding
Alder Flycatcher	Probable breeding
Blue-headed Vireo	Possible breeding
Red-eyed Vireo	Possible breeding
Blue Jay	Possible breeding
American Crow	Probable breeding
Common Raven	Probable breeding
Black-capped Chickadee	Probable breeding
Red-breasted Nuthatch	Possible breeding
Golden-crowned Kinglet	Possible breeding
Ruby-crowned Kinglet	Possible breeding
Hermit Thrush	Possible breeding
American Robin	Probable breeding
Cedar Waxwing	Possible breeding
European Starling	Confirmed breeding
Nashville Warbler	Possible breeding
Northern Parula	Possible breeding
Yellow Warbler	Possible breeding
Chestnut-sided Warbler	Possible breeding
Magnolia Warbler	Possible breeding
Yellow-rumped Warbler	Possible breeding
Blackburnian Warbler	Possible breeding
American Redstart	Possible breeding
Ovenbird	Possible breeding
Common Yellowthroat	Possible breeding
Chipping Sparrow	Confirmed breeding
Savannah Sparrow	Possible breeding
Song Sparrow	Confirmed breeding
White-throated Sparrow	Possible breeding
Dark-eyed Junco	Probable breeding
Common Grackle	Probable breeding
Purple Finch	Possible breeding
American Goldfinch	Possible breeding

Desktop Survey of Birds in the Study Area

The birds of the Isthmus of Chignecto were extensively documented by Boyer (1972). He describes the dominant bird species found for each habitat type in the region. By far the most important habitats from a conservation perspective are the unique freshwater marshes in the area which are home to a variety of species that are not found elsewhere in Nova Scotia or in more limited numbers. These include grebes, bitterns, less common duck species, rails, marsh wrens, and the Black Tern. For the upland forest such as found in the project area, Boyer lists the dominant bird species as Broad-winged Hawk, Great Horned Owl, Hairy Woodpecker, Downy Woodpecker, Red-eyed Vireo, Swainson's Thrush, Hermit Thrush, both kinglet and chickadee species, a variety of warblers, Dark-eyed Junco, and White-throated Sparrow. In the agricultural areas adjacent to the upland forest, the dominant species are the common swallow species, American Robin, Yellow Warbler, Bobolink, Savannah Sparrow, and Song

Sparrow.

More recent data from the Maritimes Breeding Bird Atlas (Atlantic Canada Conservation Data Centre 2014, Bird Studies Canada et al. 2012) indicate a species composition of breeding birds near the project area that is similar to that described by Boyer. Table 1 shows the breeding status of 39 species of birds found on 8 roadside point counts conducted within 5 kilometers of the project area from June 24 to July 1 between 2006 and 2010. These point counts appear not to have been taken near any wetlands, given the absence of water birds.

Table 2 presents the status of species of conservation concern observed within 5 kilometers of the project area based on data provided by the Atlantic Canada Conservation Data Centre (2014). The table also shows the distance of the observed birds from the project area. None of the birds listed were seen or heard within it. Nonetheless, the data show that there are 28 species of conservation concern within 5 kilometers of the project area of which 3 are listed as threatened under the Species at Risk Act (SARA), an additional 2 ranked as threatened and 1 as special concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), and 4 out of the 5 threatened species also have legal protection from the Province of Nova Scotia. These species are Barn Swallow, Common Nighthawk, Olive-sided Flycatcher, Bobolink, Least Bittern, and Eastern Wood-Pewee. The Barn Swallow, Common Nighthawk, and Bobolink were less than 3 kilometers from the project area.

Objectives of the Baseline Study

The avian baseline study has three major objectives:

1. To provide information on birds such that the proposed project complies with the federal *Migratory Birds Convention Act*, the *Species at Risk Act*, and associated laws and policies of the Province of Nova Scotia,

2. To provide diurnal and nocturnal information to inform the siting, operation, and monitoring of the proposed project in regard to the direct (mortality from collision and construction activities) and indirect (displacement from habitat, fragmentation of habitat, avoidance of habitat, and flight path barrier) effects on birds, and

3. To provide a quantitative baseline for measuring the impacts of the project in the short and long term and to contribute to a global understanding of wind energy projects on birds.

These objectives will be met through the studies to:

A. Determine the relative abundance of breeding birds in the study area,

B. Determine the abundance of birds in migration stop-over in the study area,

C. Determine the numbers of birds wintering in the study area,

D. Determine the abundance, species composition, and movement patterns of birds in diurnal and nocturnal passage and the risk of collision with wind turbines,

Table 2: Status of Species of Conservation Concern within Five KM of Project Area

Common Name	COSEWIC	SARA	NS Legal Protection	NS Rarity Rank	NS Status Rank	Distance from Project Area
Barn Swallow	Threatened		Endangered	Breeding-Uncommon	1 At Risk	2.6 ± 0.15
Common Nighthawk	Threatened	Threatened	Threatened	Breeding-Uncommon	1 At Risk	2.7 ± 0.15
Olive-sided Flycatcher	Threatened	Threatened	Threatened	Breeding-Uncommon	1 At Risk	3.3 ± 0.15
Bobolink	Threatened		Vulnerable	Breeding-Uncommon to fairly common	3 Sensitive	2.6 ± 0.15
Least Bittern	Threatened	Threatened		Breeding-Unranked	5 Undetermined	3.8 ± 0.15
Eastern Wood-Pewee	Special Concern		Vulnerable	Breeding-Uncommon to fairly common	3 Sensitive	4.2 ± 7.07
Black Tern	Not At Risk			Breeding-Extremely rare	2 May Be At Risk	3.6 ± 0.15
Marsh Wren				Breeding-Extremely rare	5 Undetermined	3.6 ± 0.15
Virginia Rail				Breeding-Rare	5 Undetermined	4.8 ± 0.15
Willow Flycatcher				Breeding-Rare	3 Sensitive	3.5 ± 0.15
Vesper Sparrow				Breeding-Rare to uncommon	2 May Be At Risk	2.6 ± 0.15
Boreal Chickadee				Uncommon	3 Sensitive	4.2 ± 7.07
Cape May Warbler				Breeding-Perhaps uncommon	3 Sensitive	4.2 ± 7.07
Pied-billed Grebe				Breeding-Uncommon	3 Sensitive	4.2 ± 7.07
Blue-winged Teal				Breeding-Uncommon	2 May Be At Risk	4.2 ± 7.07
Cliff Swallow				Breeding-Uncommon	2 May Be At Risk	4.2 ± 7.07
Gray Catbird				Breeding-Uncommon	2 May Be At Risk	2.6 ± 0.15
Northern Cardinal				Uncommon to fairly common	4 Secure	3.9 ± 0.15
American Bittern				Breeding-Uncommon to fairly common	3 Sensitive	4.2 ± 7.07
Killdeer				Breeding-Uncommon to fairly common	3 Sensitive	4.2 ± 7.07
Spotted Sandpiper				Breeding-Uncommon to fairly common	3 Sensitive	4.2 ± 7.07
Wilson's Snipe				Breeding-Uncommon to fairly common	3 Sensitive	4.2 ± 7.07
Yellow-bellied Flycatcher				Breeding-Uncommon to fairly common	3 Sensitive	4.2 ± 7.07
Eastern Kingbird				Breeding-Uncommon to fairly common	3 Sensitive	4.2 ± 7.07
Tennessee Warbler				Breeding-Uncommon to fairly common	3 Sensitive	2.4 ± 0.15
Bay-breasted Warbler				Breeding-Uncommon to fairly common	3 Sensitive	4.2 ± 7.07
Rose-breasted Grosbeak				Breeding-Uncommon to fairly common	3 Sensitive	2.4 ± 0.15
Pine Siskin				Breeding-Uncommon to fairly common;	3 Sensitive	2.6 ± 0.15

E. Determine the possible effects, besides collisions, of wind turbines and human activities on the breeding, wintering, and migrating birds in the study area including

  a) the use of habitats by breeding and wintering birds and migrating birds in stop-over,

  b) displacement from habitats,

  c) avoidance of habitats,

  d) the possible effects of habitat fragmentation on bird populations, and

  e) the possible barrier effects on flight pathways.

F. Determine the presence and abundance of species of conservation concern in the study area, the kinds and amount of habitat they require, and the measures required by the project proponents for avoidance or mitigation,

G. Make recommendations for adaptive management of bird habitats and risk abatement at the wind energy facility,

H. Make recommendations for post-construction studies, and

I. Contribute to the national database on avian wind facility studies.

Survey Methods

Eight types of survey methodologies were used to meet the objectives of the study. All the surveys include quantitative survey methodologies consisting of counts within the project area and in the control area (the acoustic surveys are only in the project area).

1. MIGRATION STOP-OVER TRANSECTS

Two transects were used for the study of stop-over migration. These transects are shown in Figure 6. The transects were chosen so as to sample representative habitats in the study area, one in the project area (Transect 1) and one in a control area (Transect 2).

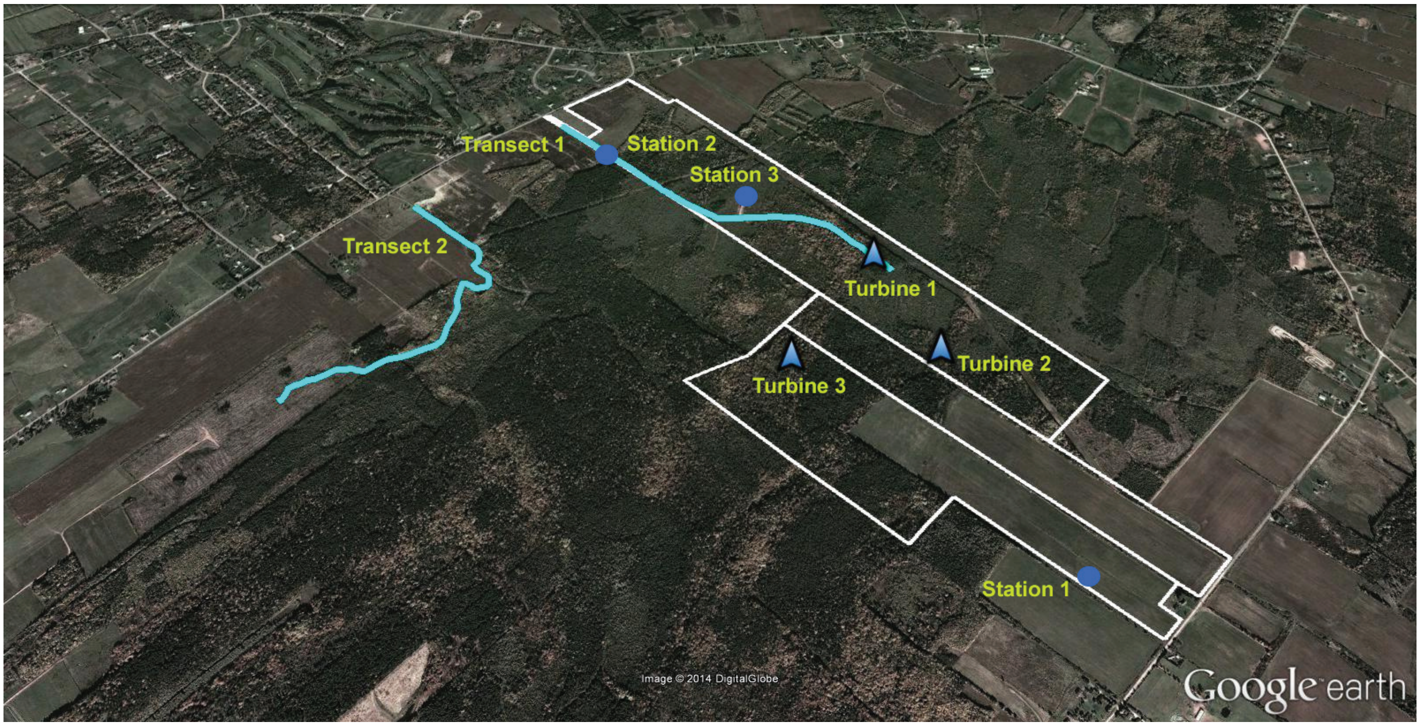
Each transect was surveyed once every week during the migration period, April 15-June 7, 2014 and August 15-October 31, 2014. The transects were 1,500 metres in length with all birds recorded in the following distance categories from the observer: <50 meters, 50-100 meters, >100 meters, and flying overhead. The transects are divided into three equal 500-meter segments which represent, when possible, distinct habitat types. Along each transect are six stop counts.

The duration of each stop count is ten minutes with birds recorded in the same distance categories as the rest of the transect. The stop counts provide a finer resolution of habitat utilization by birds in stop-over and increase survey time in a systematic fashion.

2. EARLY BREEDING SURVEY

The spring stop-over transects also provide data on early breeding birds using the study area.

Figure 6: Location of Stop-over Transects and Observation/Listening Stations



3. PEAK BREEDING SURVEY POINT COUNTS

Point counts were made throughout the study area during the month of June in both project and the control area. The duration of a point count is ten minutes with birds recorded in the same distance categories as for transects and stop counts.

4. DIRECTED SEARCHES FOR SPECIES OF CONSERVATION CONCERN DURING THE EARLY AND PEAK BREEDING SEASONS

In addition to transects and point counts, it was necessary to search out habitats that may be the residences of species of conservation concern. This is especially true for the COSEWIC and SARA listed species that could be found in the study area. Potential habitats for these species were surveyed through general area searches.

5. DIURNAL PASSAGE OBSERVATION

Two observation stations which give a 180-360 degree view of the airspace over sections of the study area were chosen for the study of diurnal passage. These stations are shown in Figure 6 (Station #1 and #2). All birds flying through a given air space were noted by species, flock size, altitude, direction of flight, and proximity to a proposed turbine. For woodpeckers and passerines these observations were focused in the early morning hours, for raptors peak numbers are to be expected from mid-morning to early afternoon, and for many water birds and shorebirds according to the tides. Flying birds seen in apparent diurnal migration during the stop-over transects were also noted along with the flight heading. The diurnal passage study was conducted during the same weeks as the stop-over surveys in both the spring and fall.

6. ACOUSTIC MONITORING OF NOCTURNAL PASSAGE

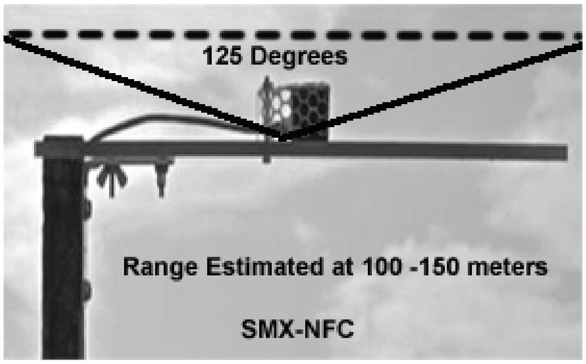
Acoustic monitoring of nocturnal passage provides data on the species of birds migrating through an area, their relative abundance, and migration timing. Two recording stations were set up and were located at stations #1 and #3 as shown in Figure 6. Recording took place every night from civil sunset to civil sunrise from mid-April to early June and early August to mid November 2014.

At both sites, a Song Meter SM2, made by Wildlife Acoustics, was used as a recording device. The Song Meter is powered by 2 AA and 4 D alkaline batteries. Settings were as follows:

Sampling format: 16 bit
Sampling rate: 24,000 Hz
High pass filter: 1,000 Hz
Pre-amp: 60 dB gain

Storage: 2-32GB SD cards

Wildlife Acoustics also produces a night flight call microphone, the SMX-NFC, to be used with the Song Meter. This weather-resistant microphone rests on a flat horizontal plate creating a pressure zone resulting in a 3-6 dB gain within a beam angle of 125 degrees. Based on experience in Nova Scotia, the range is estimated at 100-150 meters in altitude.



The Song Meter and SMX-NFC microphone were chosen for use in this study since they were also employed by the author at seven other existing or proposed wind energy facilities from 2011 to 2013 in Nova Scotia.

The detection of night flight calls recorded in the .wav format, and their organization and identification to bird species was conducted using the Raven Pro sound analysis software produced by the Cornell Lab of Ornithology. The detection parameters for high frequency calls (sparrows and warblers) and low frequency calls (thrushes and shorebirds) are shown in Table 3. The review panel of Raven Pro allows for a standardized process to classify, identify, and store night flight calls.

During periods of wind and/or rain, detection software can produce tens of thousands of false positives. This effect is more severe in the low frequency range.

Table 3: Detection Parameters

	High Frequency	Low Frequency
Minimum Frequency	6000 Hz	2250 Hz
Maximum Frequency	11000 Hz	3750 Hz
Minimum Duration	29 ms	29 ms
Maximum Duration	400 ms	330 ms
Minimum Separation	104 ms	52 ms
Signal to Noise Ratio Parameters		
Minimum Occupancy	25.0	20.0
Threshold	3.5	4.0
Noise Power Estimation Parameters		
Block Size	5000 ms	1000 ms
Hop Size	250 ms	250 ms
Percentile	50.0	50.0

To overcome this problem, a number of bandwidth filters were employed when normal detector runs produced more than 5,000 detections. For the high frequency detector, a bandwidth filter with a minimum of 100 Hz , a maximum of 1000 Hz, and an energy percentile of 40% (the fraction of total energy in the specified bandwidth) proved to be the most effective. For the low frequency detector, a filter with a minimum bandwidth of 100 Hz, a maximum of 500 Hz, and an energy percentile of 40% or more was used. Past studies showed that the high frequency filter captured about 98% of the true positives detected without the filter. For the low frequency detector, the bandwidth filter is less efficient but still captures the majority of night flight calls during the night.

Results

The results of the baseline study will be presented on a seasonal basis from April to November. The analysis for each season consists of three study components.

SPRING MIGRATION

The study of birds migrating in the spring consists of surveys of migration stop-over, diurnal passage, and nocturnal passage.

Figure 7: Mean Total Birds on Stop-over Transects by Count Period during the Spring

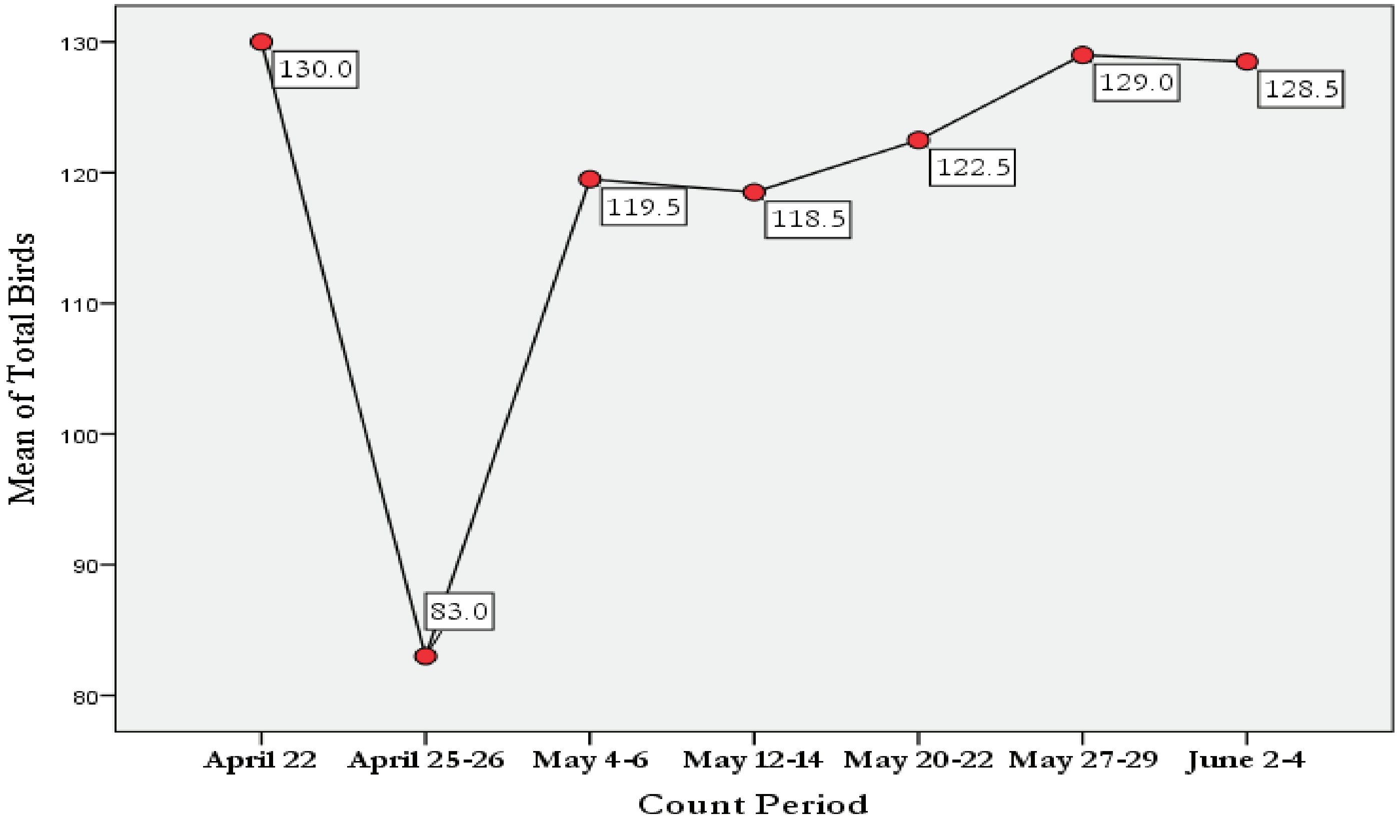


Figure 7 shows the mean number of birds on the stop-over transects by count period during the spring migration. Despite, the dip in the number of birds in late April, there is no statistically significant difference or clear seasonal trend in the number of birds present.

Figure 8: Birds per Stop-over Transect by Count Period in the Spring

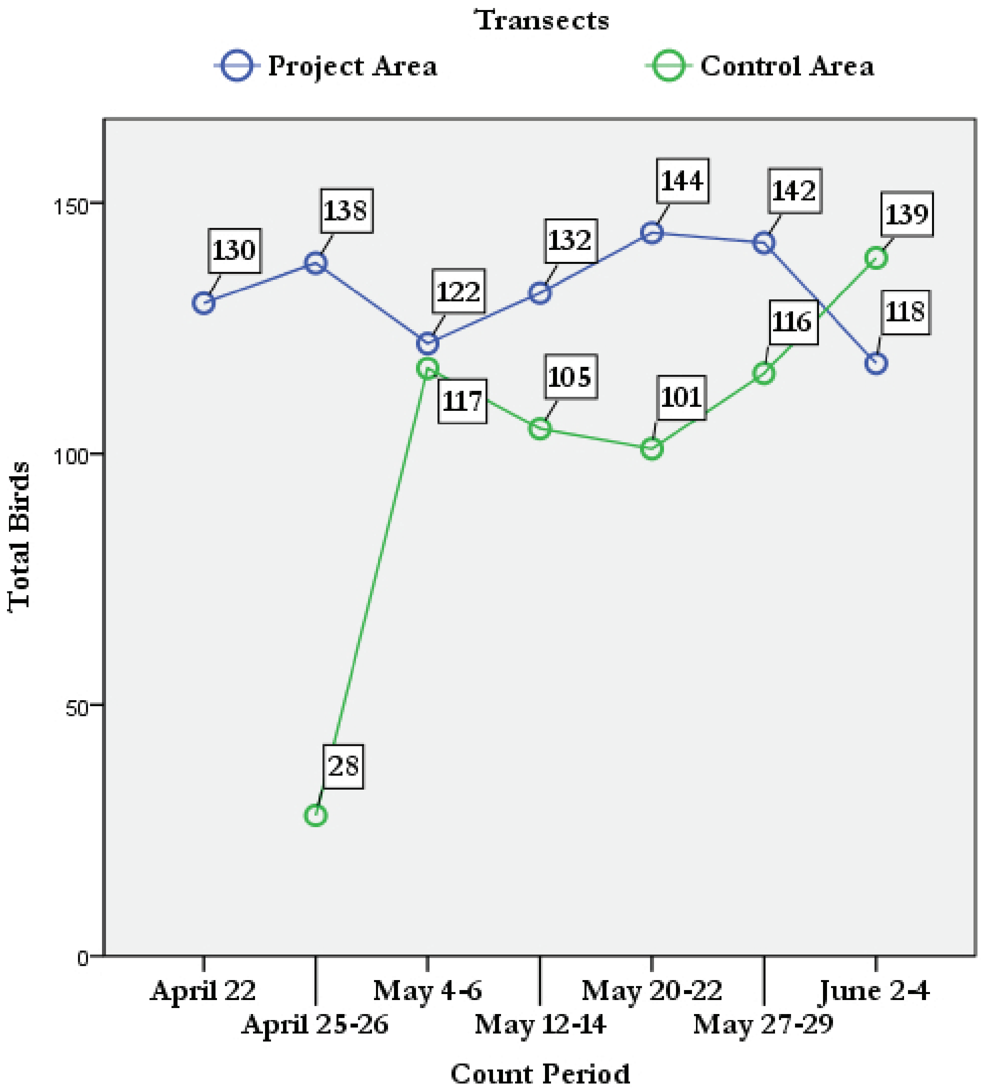


Figure 8 graphs the total birds seen on each transect in the project and control areas. The project transect has a greater number of birds but a statistical T-test indicates that there is not a significant difference in the number of birds on the transects at a 95% confidence level.

Figure 9 plots the mean total species recorded on the transects by count period. As with total birds, a statistical analysis reveals no significant differences between the periods.

The number of birds flying over a transect in the morning is an indication of the strength of diurnal migration that may be taking place. At the same time, the number of birds seen within 50 meters of the transect is the strongest indication of the density of birds in stop-over. Figure 10 compares the mean number of birds within 50 meters of the transect and the mean number of birds flying over the transect by count period. For the spring period, there was a mean number of 60.92 birds within 50 meters of the transect and a mean of 10.46 birds flying over the transect. A statistical T-test confirms that there is a significantly smaller number of birds flying over the transect than seen on the ground or in trees within 50 meters of the transect at the 95% confidence level.

Table 4 shows the most abundant migratory species present on the stop-over transects in the spring; with American Robin, White-throated Sparrow, and Palm Warbler being the top three species

Figure 9: Mean Total Species per Transect by Count Period in the Spring

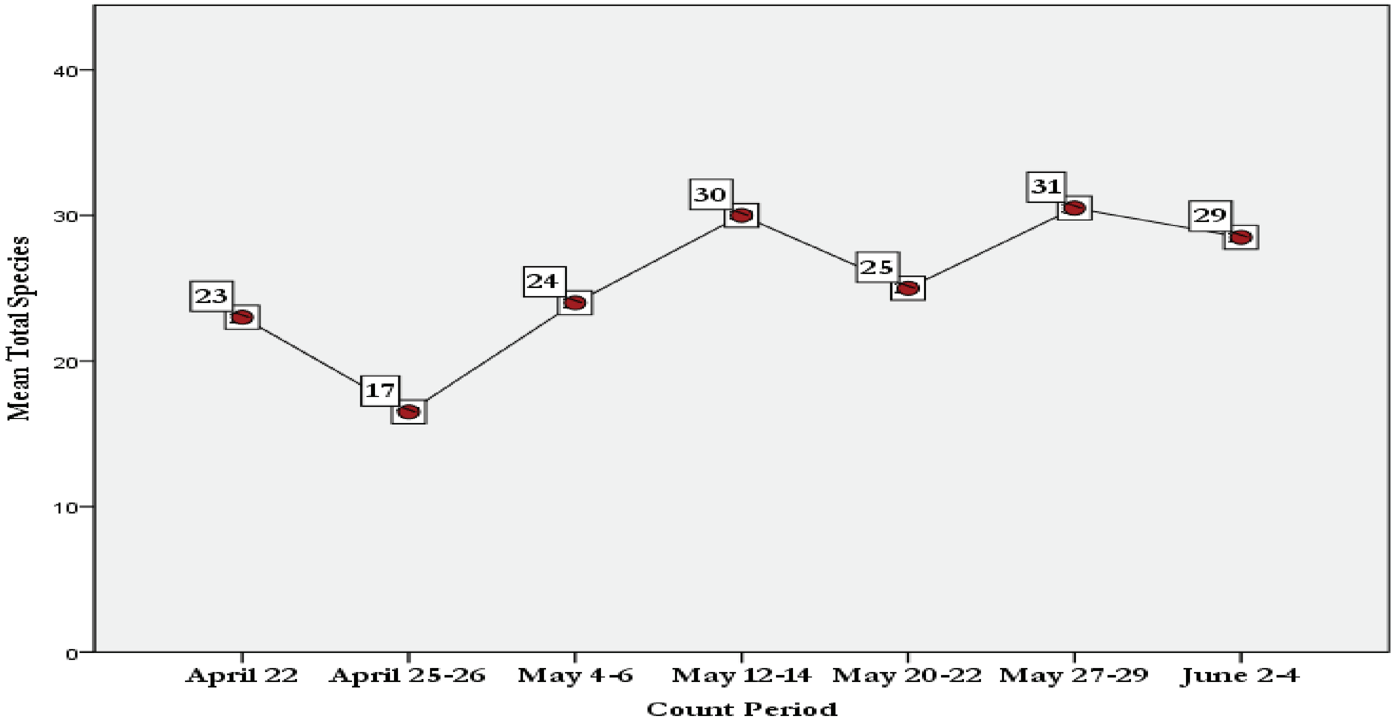


Figure 10: Mean Total Birds by Distance from Transect by Count Period in the Spring

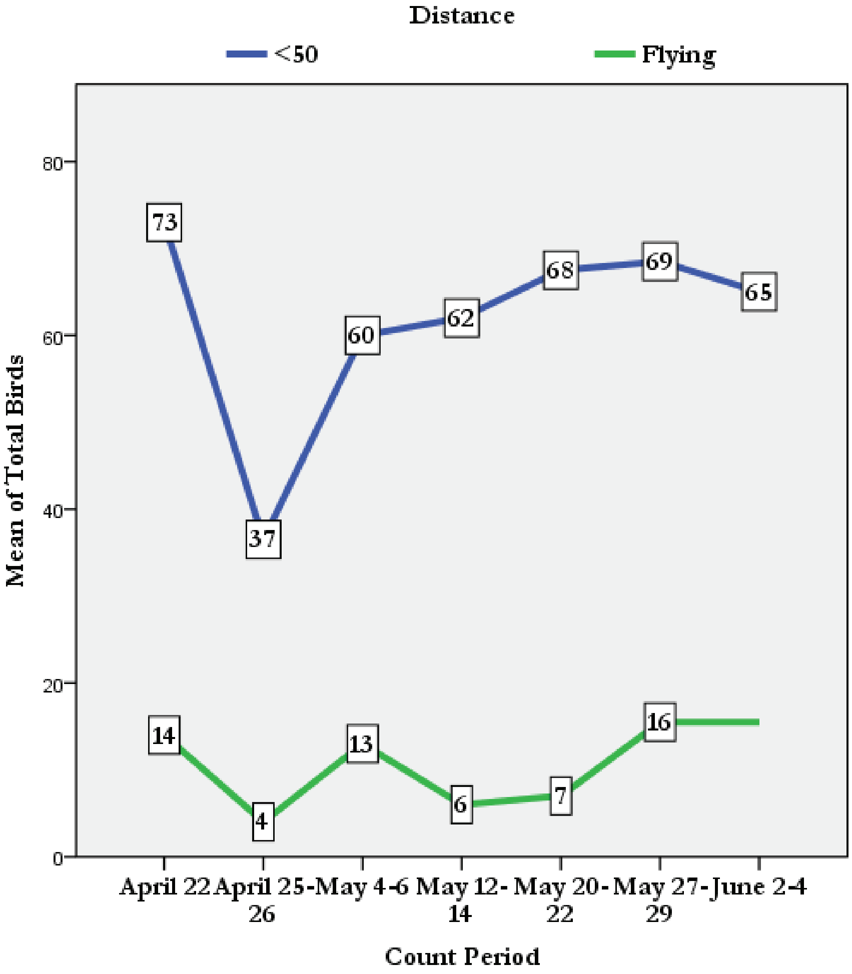


Table 4: Twenty Most Abundant Migrant Species on Stop-over Transects in the Spring

Species	Max. per Transect	Total
American Robin	25	220
White-throated Sparrow	24	197
Palm Warbler	13	69
Black-capped Chickadee	12	62
Blue Jay	10	58
Common Yellowthroat	17	57
Hermit Thrush	7	51
Yellow-rumped Warbler	13	48
Dark-eyed Junco	10	47
Purple Finch	7	43
Magnolia Warbler	10	40
Savannah Sparrow	9	40
Song Sparrow	7	30
Northern Flicker	5	25
Northern Parula	5	24
Black-and-White Warbler	4	24
Ruby-crowned Kinglet	5	23
Nashville Warbler	3	16
Black-throated Green Warbler	6	15
Blue-headed Vireo	3	12

detected.

DIURNAL PASSAGE

The diurnal passage observations from the transects and observation stations re-affirm a low level of diurnal passage in the spring in the study area. Only 26 birds, consisting of 8 different species, were seen that were clearly in diurnal migration. Figure 11 demonstrates that north was the predominate heading of these migrants.

Figure 11: Headings of Birds in Diurnal Passage in the Spring

The systematic observation of diurnal migrants and local birds from two observation stations (#1 and #2 in Figure 6) provided information on the altitude of birds flying over the project area and their proximity to the location of proposed turbines. These observations included both diurnal migrants and movements of local birds.

Out of 19 one-half hour observation blocks, there were only 2 blocks in which no flying birds (above tree-top level) were observed. In the 17 remaining blocks, there was a total of 16 observations of 1 to 2 birds that were over the project area but not close to a proposed turbine location (>250 meters). There were 9 other observations of 1 to 4 birds that were within 250 meters of a turbine location. Among these, 2 observations were of birds (one each of Common Raven and American Crow) that were flying below blade height (less than 40 meters). There were 7 observations of a total of 13 birds (2 American Crows, 1 Common Raven, 2 Northern Harriers, 6 Ospreys, and 2 Red-tailed Hawks) that were flying at blade height (40-120 meters). No birds were seen flying above blade height.

NOCTURNAL PASSAGE

Table 5: Number of Night Flight Calls by Family in Nocturnal Passage in the Spring

Family	Calls
Sparrows	134
Gulls	1
Warblers	178
Thrushes	16
Unknown	14
Total	343

For this preliminary report, the data for only one of the two acoustic monitoring stations were processed. This was station #1 as shown in Figure 6. In total 343 night flight calls were heard during the spring migration season. The vast majority were warblers (178 calls) and sparrows (134 calls). A breakdown of the night flight calls by family is shown in Table 5, and the ten most common species are presented in Table 6.

Figure 12 shows the relationship between the number of night flight calls detected and the total number of birds on the stop-over transects by date. While there is some correspondence between changes in nocturnal migration and stop-over counts, it is difficult to discern meaningful patterns due to the number of local birds and diurnal migrants during the day, and the number of species that do not give calls when migrating during the night. However, if one examines the results for one nocturnal species that uses night flight calls, such as the Savannah Sparrow, it is possible to discern some possible patterns.

Figure 13 compares the number of night flight

Table 6: Ten Most Common Species Heard in Nocturnal Passage in the Spring

Species	Calls
Savannah Sparrow	69
White-throated Sparrow	35
Ovenbird	29
Magnolia Warbler	20
American Redstart	17
Song Sparrow	15
Northern Waterthrush	14
Common Yellowthroat	13
Hermit Thrush	12
Northern Parula	11

Figure 12: Comparison of Night Flight Calls with Total Birds on Stop-over Transects by Date in the Spring

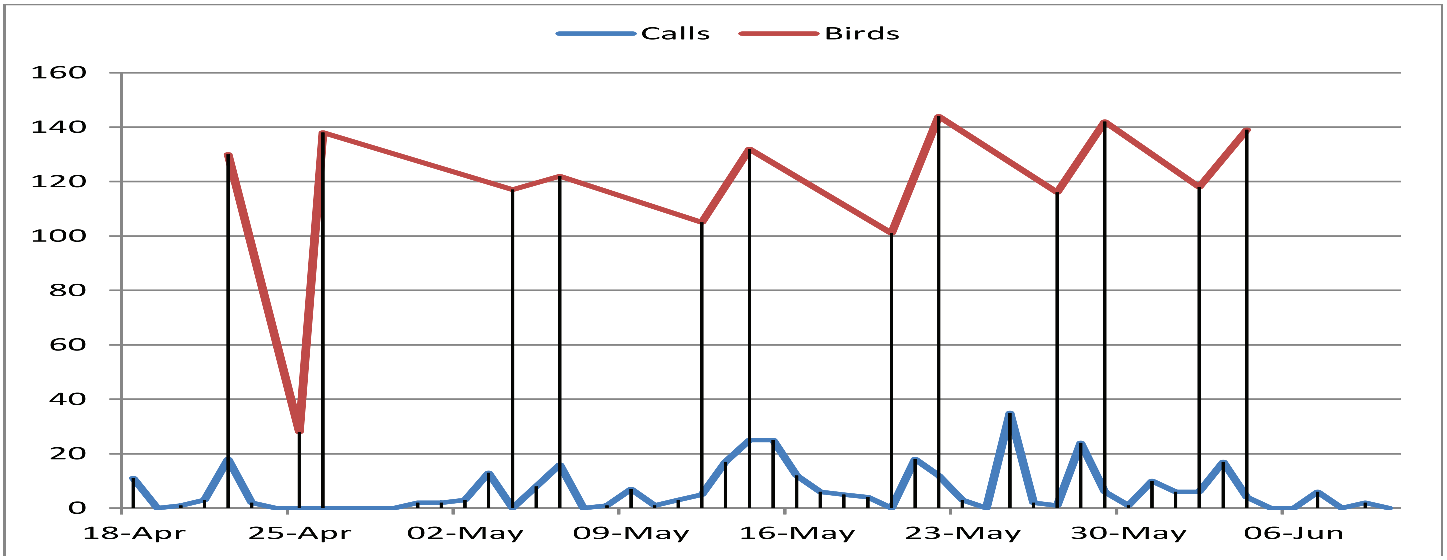
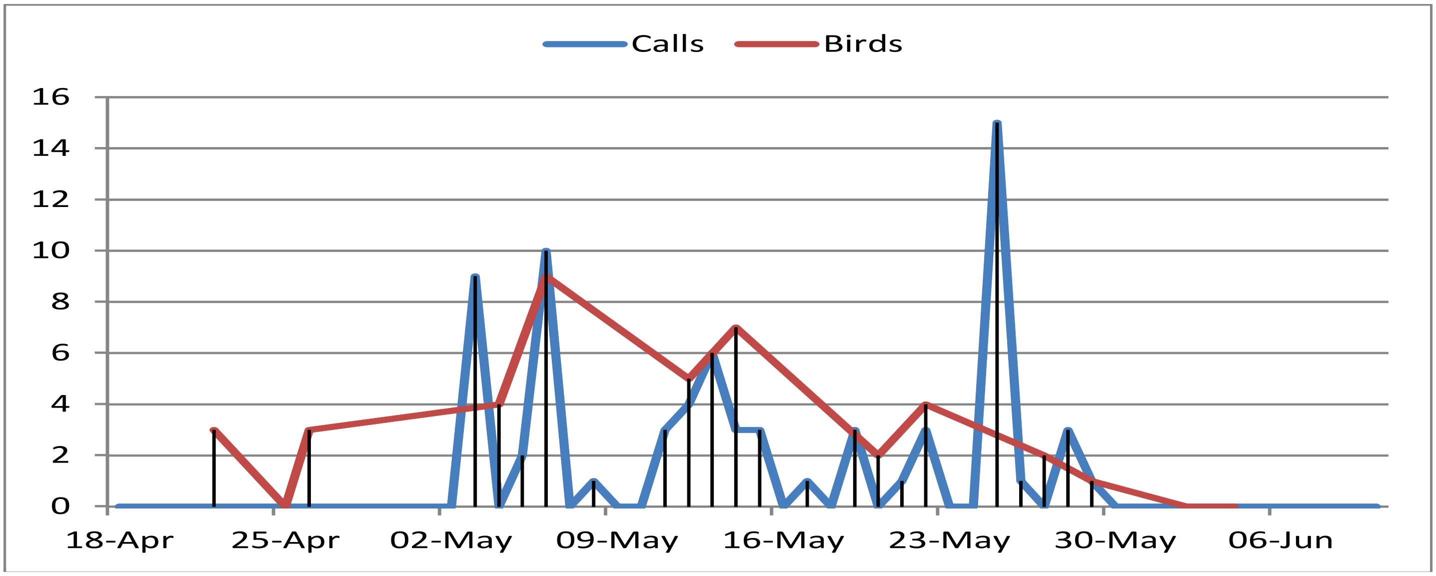


Figure 13: Comparison of Night Flight Calls and Total Birds on Stop-over Transects for Savannah Sparrow by Date in the Spring



calls recorded for Savannah Sparrow to the number detected on the stop-over transects.It appears that there are arrivals of Savannah Sparrows in the period May 3-13 and then a departure of migrating birds on May 25.

BREEDING SEASON

The breeding season is divided into three parts: nocturnal breeding birds, early breeding birds, and peak breeding birds. Breeding surveys focused on the peak breeding birds.

NOCTURNAL/CREPUSCULAR BREEDING BIRDS

Nocturnal breeding birds were surveyed by acoustic monitoring. Data processing for Station #1 (see Figure 6) showed that American Woodcocks were already engaged in courtship displays by April 18, the first night of recording. A Common Nighthawk was heard on the last night of recording on June 10. Common Nighthawks were frequently recorded both at evening and morning twilight hours when recording started again August 11 and on a number of nights thereafter. These data suggest that Common Nighthawks bred in the southeastern section of the project area near Pumping Station Road.

No owls were recorded at Station #1. However, a Great Horned Owl was observed on the control transect on September 30; most likely a locally breeding bird.

Table 7: Early Breeding Birds Detected in Study Area

Species	Number
American Black Duck	15
Mallard	13
Ruffed Grouse	16
Spruce Grouse	1
Downy Woodpecker	1
Hairy Woodpecker	4
Pileated Woodpecker	1
Gray Jay	4
Common Raven	28
Common Grackle	20

EARLY BREEDING

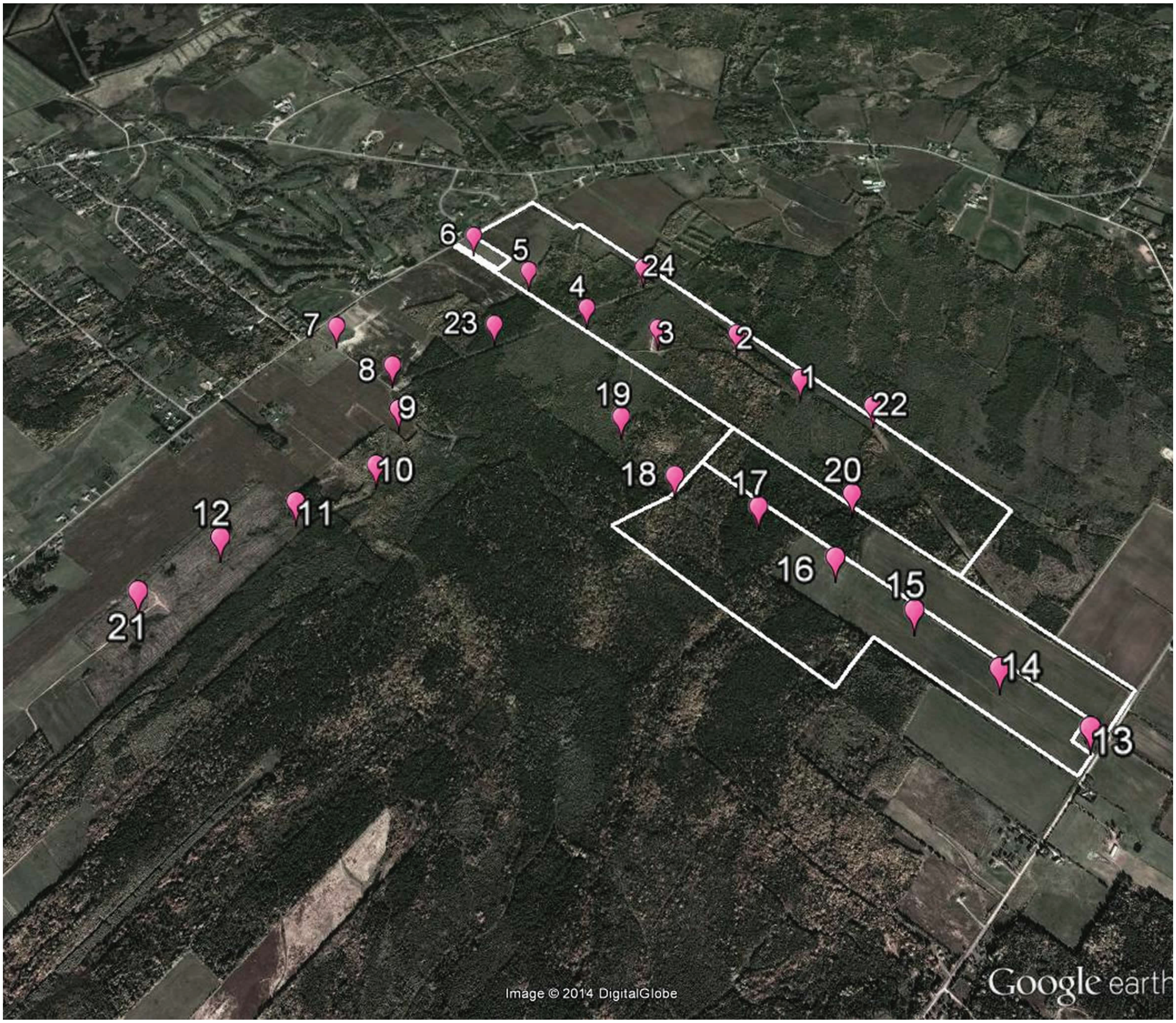
A number of species breed early in the spring and are thus not as actively engaged in courtship and breeding activities by the time the peak season arrives in June. Table 7 list a number of these species detected during the stop-over transects.

PEAK BREEDING BIRDS

The location of the 24 peak breeding point counts in the study area is shown in Figure 14. Table 8 lists the total number, mean number, and frequency of occurrence of birds on the breeding point counts by species. Given the land use patterns in the study area, the most common birds are both forest birds and those associated with agricultural lands. The most common bird, American Robin, is one that benefits equally from forested and agricultural habitats. The second and third most common birds are American Crows and Ring-necked Pheasant, two largely agriculturally dependent species. The next seven most common species are forest or forest-edge associated species. These are Red-eyed Vireo, White-throated Sparrow, Hermit Thrush, Common Yellowthroat, Dark-eyed Junco, Song Sparrow, and Magnolia Warbler.

Figure 15 shows the location of the two species of birds that are listed as “threatened” by Canada Species at Risk Act (SARA). Two Olive-sided Flycatchers (perhaps the same one but on different days) were heard calling in a recent clearcut near the east side of the project area. As

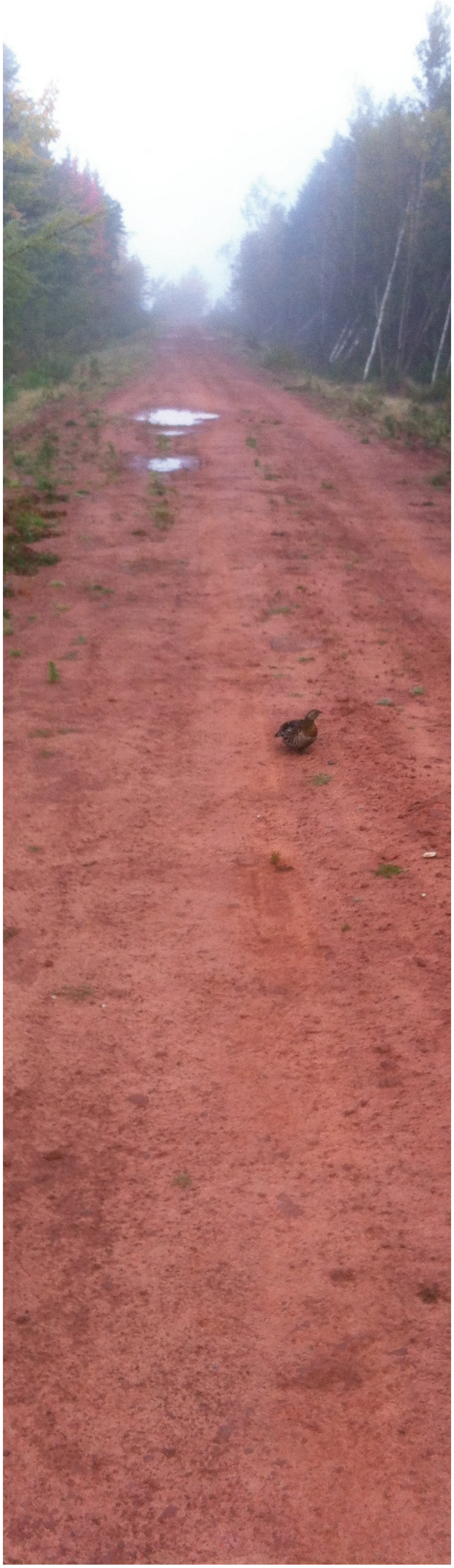
Figure 14: Location of Breeding Point Counts in the Study Area



Common Nighthawk in Flight

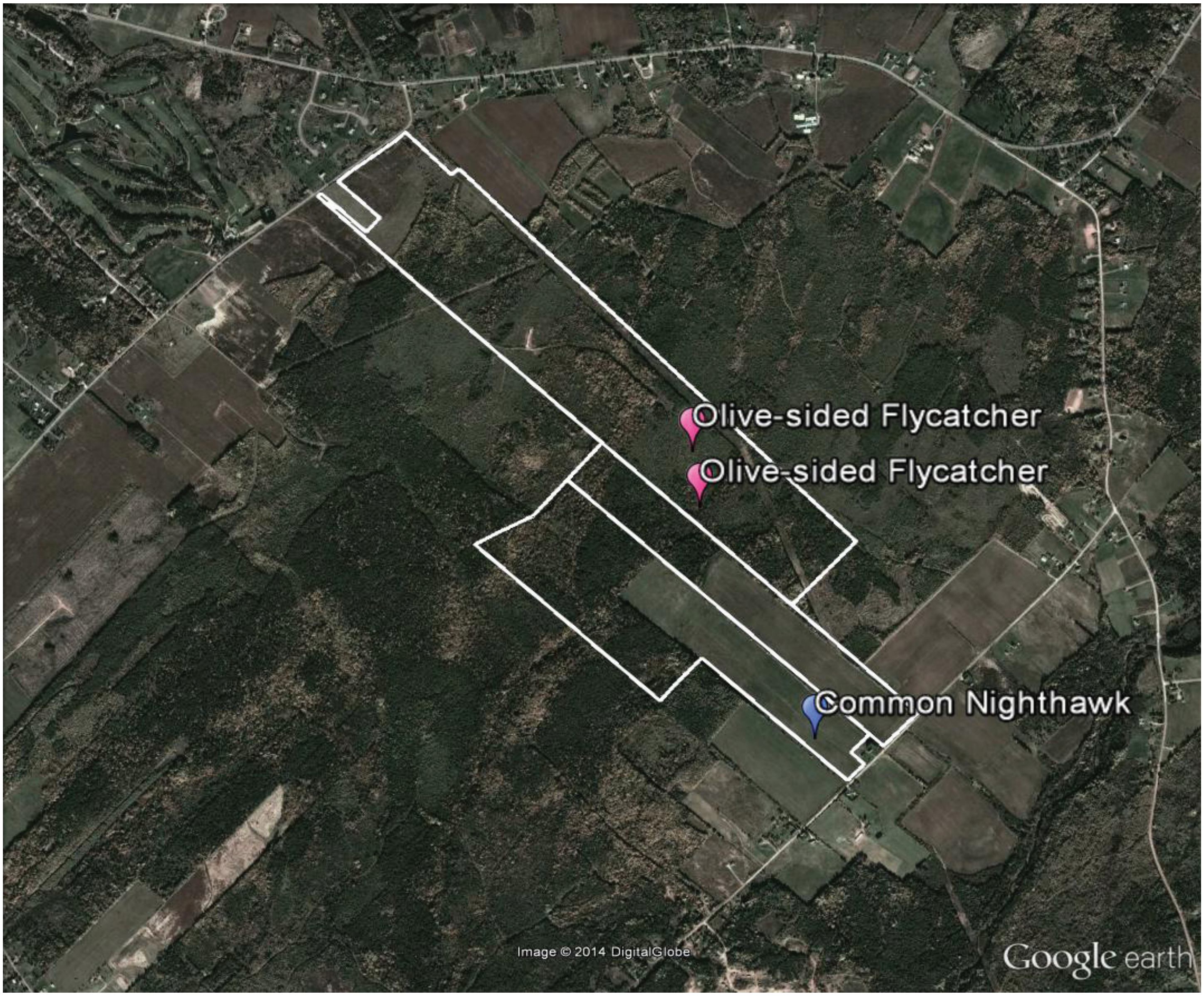
Table 8: Abundance of Breeding Birds in Study Area by Species

Species	Total	Mean	Frequency
American Robin	74	3.08	83.33%
American Crow	52	2.17	79.17%
Ring-necked Pheasant	27	1.13	66.67%
Red-eyed Vireo	23	0.96	62.50%
White-throated Sparrow	40	1.67	45.83%
Hermit Thrush	14	0.58	45.83%
Common Yellowthroat	17	0.71	41.67%
Dark-eyed Junco	16	0.67	41.67%
Song Sparrow	21	0.88	37.50%
Magnolia Warbler	11	0.46	37.50%
Mourning Dove	9	0.38	37.50%
Alder Flycatcher	17	0.71	33.33%
Savannah Sparrow	16	0.67	29.17%
Northern Parula	7	0.29	29.17%
Yellow-rumped Warbler	7	0.29	25.00%
Black-and-White Warbler	6	0.25	25.00%
Purple Finch	6	0.25	25.00%
Blue Jay	7	0.29	20.83%
Black-throated Green Warbler	6	0.25	20.83%
American Goldfinch	6	0.25	20.83%
Blue-headed Vireo	5	0.21	20.83%
Palm Warbler	5	0.21	16.67%
Chestnut-sided Warbler	4	0.17	16.67%
Black-capped Chickadee	4	0.17	12.50%
Northern Flicker	3	0.13	12.50%
American Redstart	3	0.13	12.50%
Common Raven	4	0.17	8.33%
Tree Swallow	3	0.13	8.33%
Nashville Warbler	3	0.13	8.33%
Swainson's Thrush	2	0.08	8.33%
European Starling	24	1.00	4.17%
Golden-crowned Kingle	2	0.08	4.17%
Green-winged Teal	1	0.04	4.17%
Osprey	1	0.04	4.17%
Yellow-bellied Sapsucker	1	0.04	4.17%
Pileated Woodpecker	1	0.04	4.17%
Olive-sided Flycatcher	1	0.04	4.17%
Yellow-bellied Flycatcher	1	0.04	4.17%
Least Flycatcher	1	0.04	4.17%
Red-breasted Nuthatch	1	0.04	4.17%
Winter Wren	1	0.04	4.17%
Ruby-crowned Kinglet	1	0.04	4.17%
Blackburnian Warbler	1	0.04	4.17%
Common Grackle	1	0.04	4.17%



Greeted by Spruce Grouse on Access Road to Project Area

Figure 15: Location of SARA "Threatened" Species Detected during the Breeding Season



mentioned previously, the Common Nighthawk, also listed as "threatened", was detected by the acoustic recording equipment in the southwest corner of the project area.

AUTUMN MIGRATION

As with the spring migration, the studies of autumn migration consist of three survey components; migration stop-over, diurnal passage, and nocturnal passage.

MIGRATION STOP-OVER

The mean total birds seen on the stop-over transects during the autumn is plotted in Figure 16. There were two peaks in the birds observed; the first during the period September 16-17 and the second on October 14-15. Despite these peaks, an analysis of variance indicates no statistically significant seasonal trend in the abundance of birds on the stop-over transects. In contrast, an analysis

Figure 16: Mean Total Birds on Stop-over Transects by Count Period in the Autumn

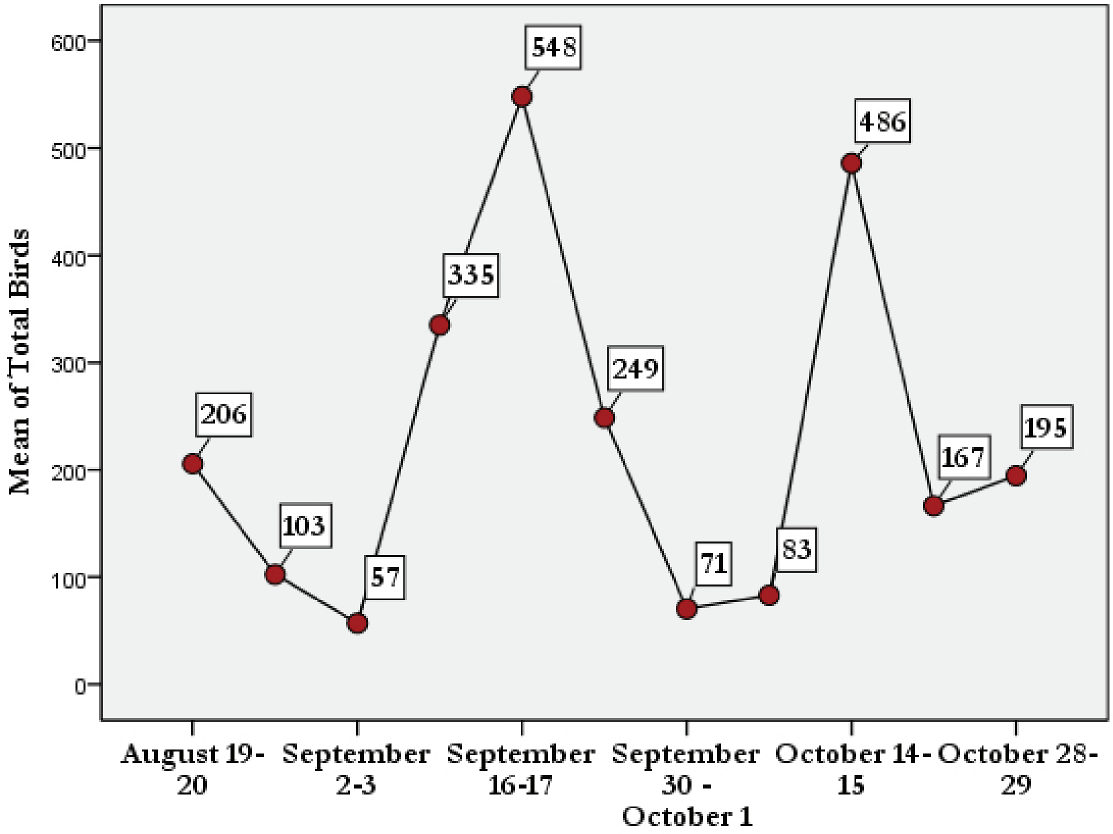


Figure 17: Mean Total Species on Stop-over Transects by Count Period in the Autumn

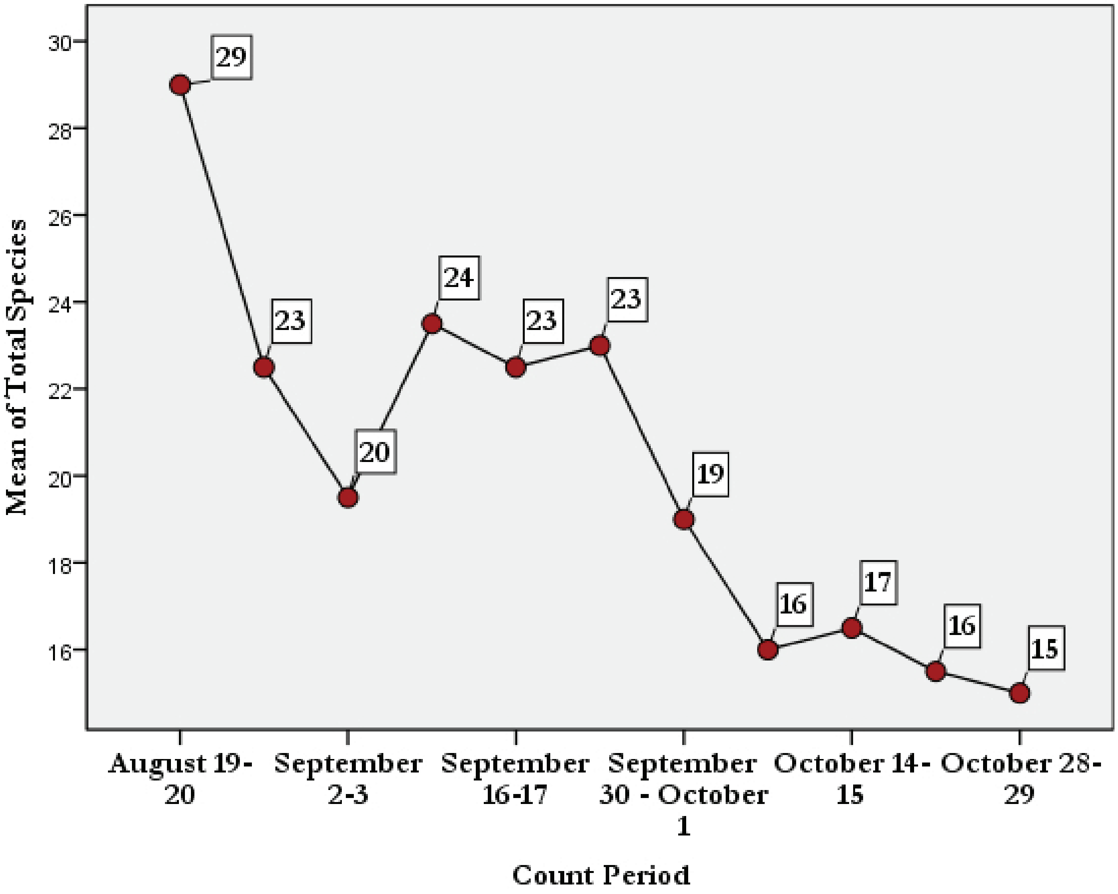
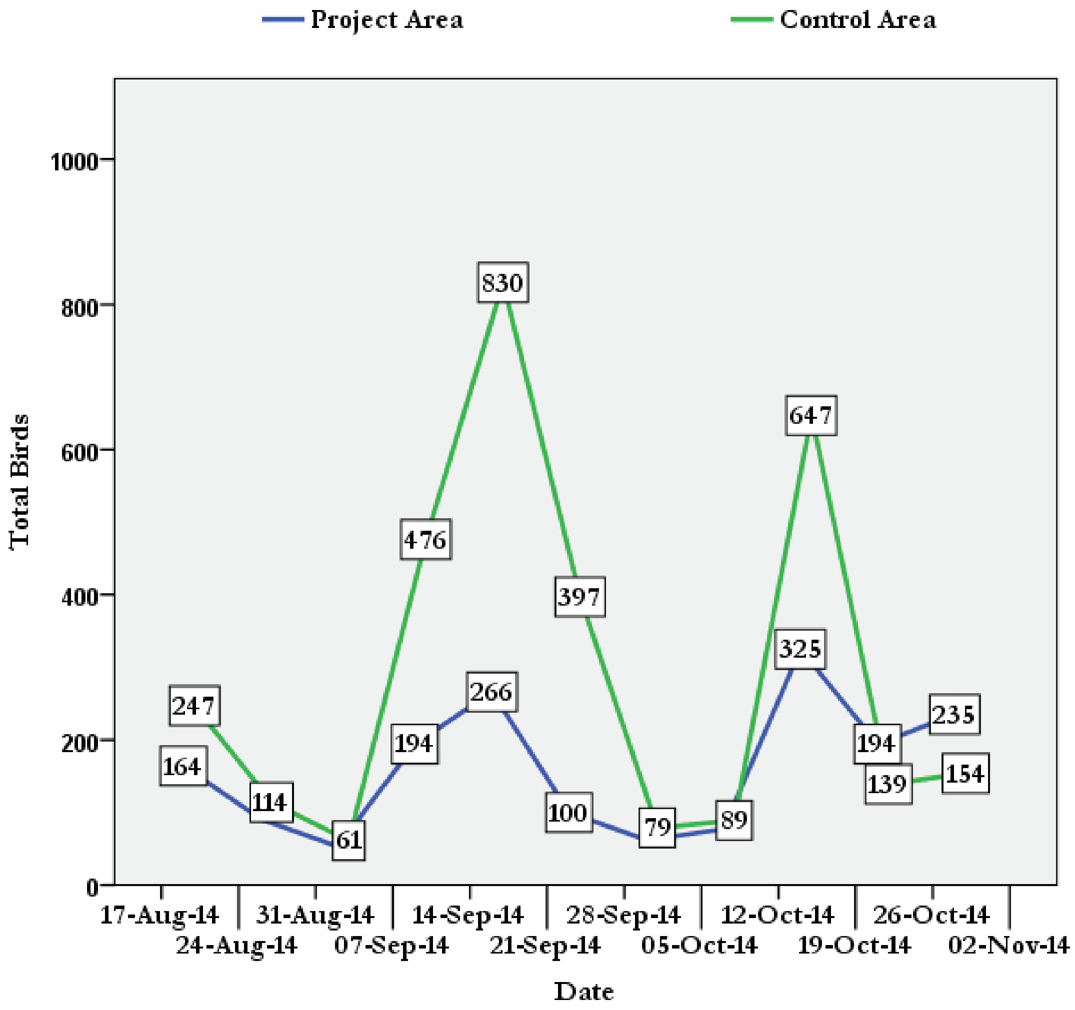


Figure 18: Total Birds per Transect by Date in the Autumn



of variance indicates seasonal difference in the mean number of species on the transects in the autumn. As seen in Figure 17, there is a sharp downward trend in the number of species in the month of October.

The total birds on each transect, one in the project area and one in the control area, is shown in Figure 18. The two transects follow a corresponding pattern with the control transect showing higher numbers during the two peak periods in mid-September and mid-October. Nonetheless, an independent T-test indicates that there is no statistically significant difference in the total birds occurring on the two transects.

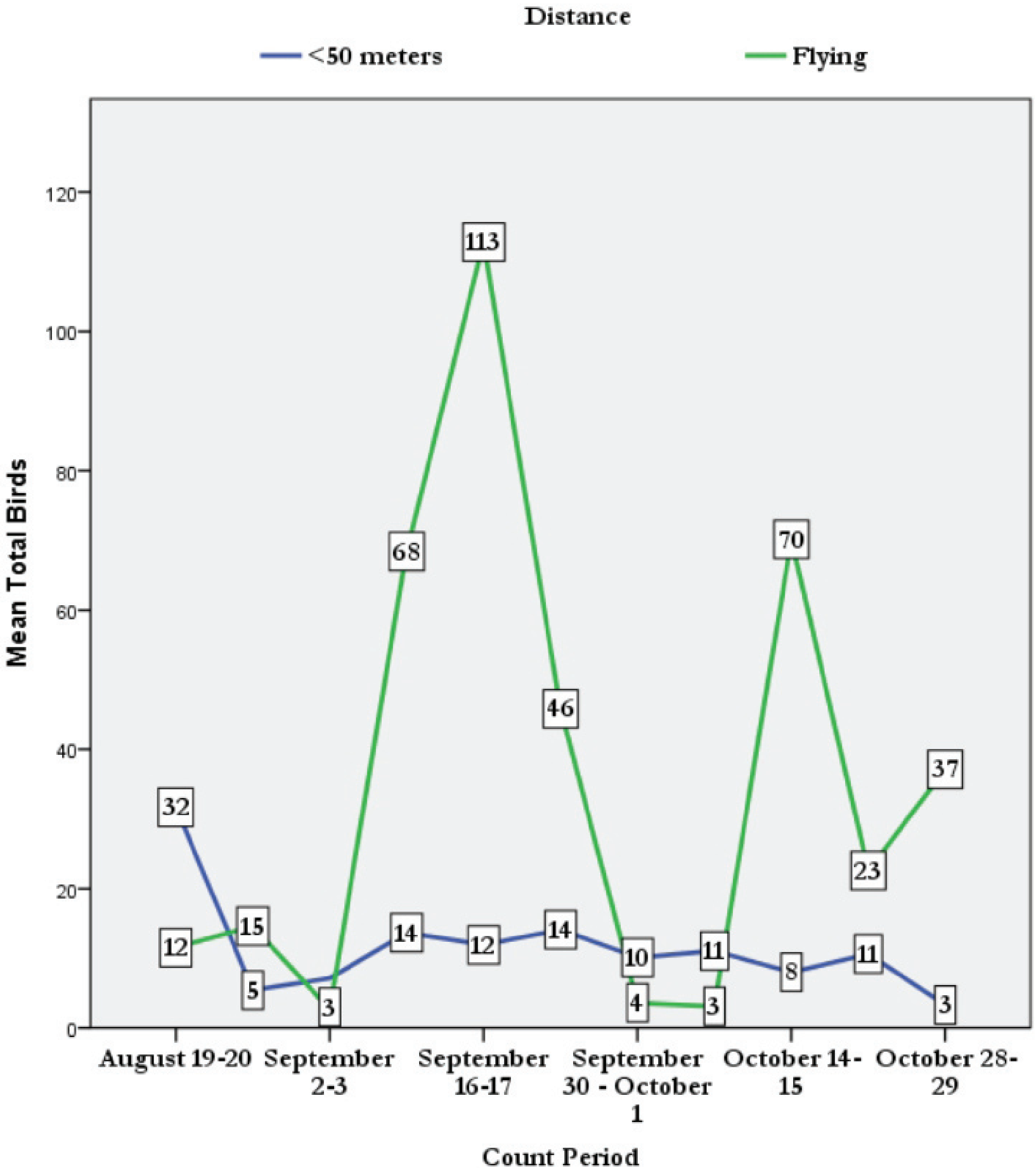
Table 9 lists the twenty most abundant birds on the stop-over transects in the autumn.

As in the spring migration, there is a statistically significant difference in the mean number of birds observed

Table 9: Twenty Most Abundant Species on Stop-over Transects

Species	Total
Common Grackle	1943
American Robin	483
Double-crested Cormorant	393
Blue Jay	277
Red-winged Blackbird	245
American Crow	236
Ring-billed Gull	168
White-throated Sparrow	136
European Starling	117
Black-capped Chickadee	110
Savannah Sparrow	96
Dark-eyed Junco	80
Common Yellowthroat	57
Ring-necked Pheasant	57
Yellow-rumped Warbler	52
Song Sparrow	49
Palm Warbler	49
Common Raven	46
Purple Fince	43
Magnolia Warbler	32

Figure 19: Mean Total Birds by Distance from Transect in the Autumn



from the transect at a distance of less than 50 meters compared to those birds seen flying over the transect. However, unlike the spring, and as seen in Figure 19, the number of birds flying over the transects is much greater than those on the ground or in the trees within 50 meters. The mean number of birds within 50 meters is 46.45 and for flying birds it is 147.09. This could indicate a high degree of diurnal passage at the time the transect lines are walked as discussed in the next section.

DIURNAL PASSAGE

Diurnal migration was much more apparent in the autumn than in the spring. Compared to a total of 26 diurnal migrants seen in the spring, there were 3,918 birds counted flying during day in the autumn. Figure 20 displays the heading of these birds. The dominant heading is northeast with 1,930 birds flying in that direction. The secondary heading is southwest with 844 birds. However a large number of these diurnal observations included Common Grackles and Red-

Figure 20: Heading of All Birds Flying during the Day in the Fall; N=3918

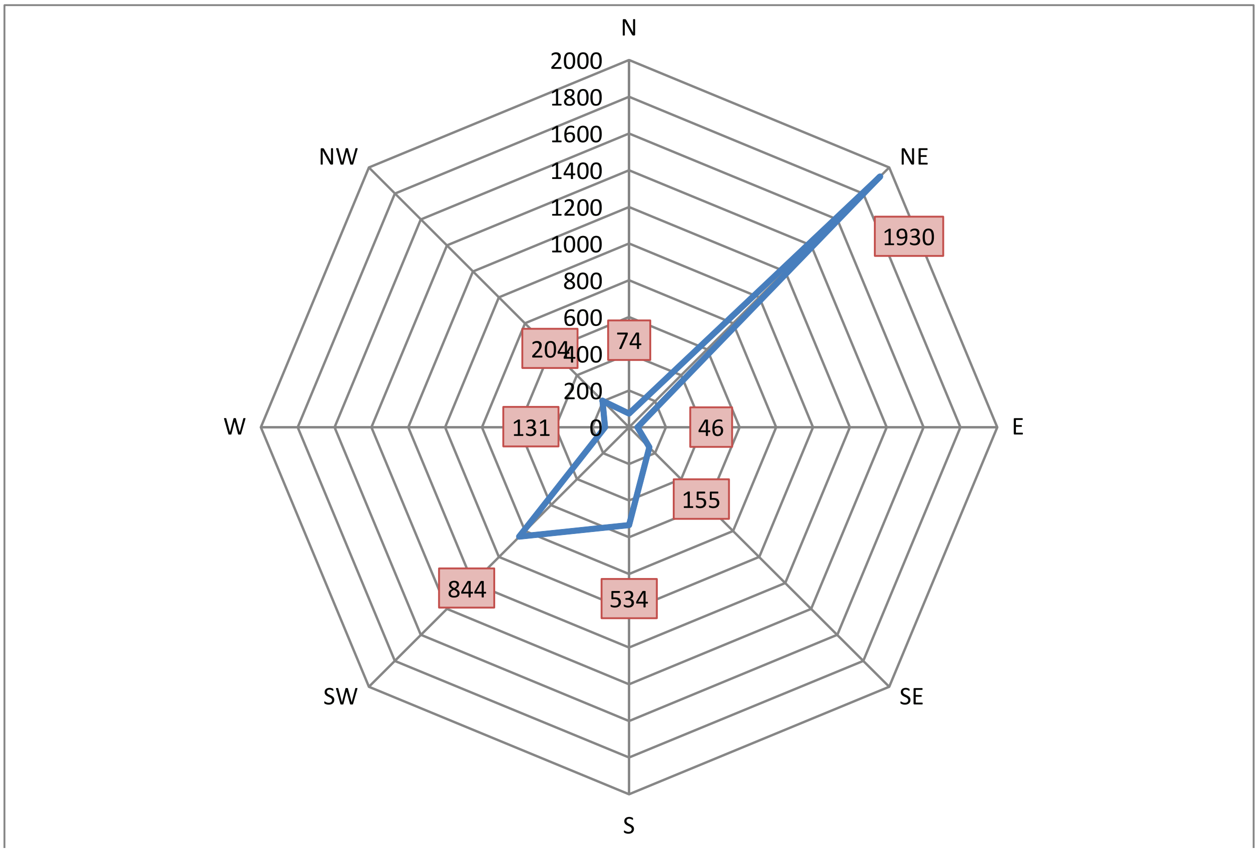


Figure 21: Heading of Diurnal Migrants in the Fall; N=675

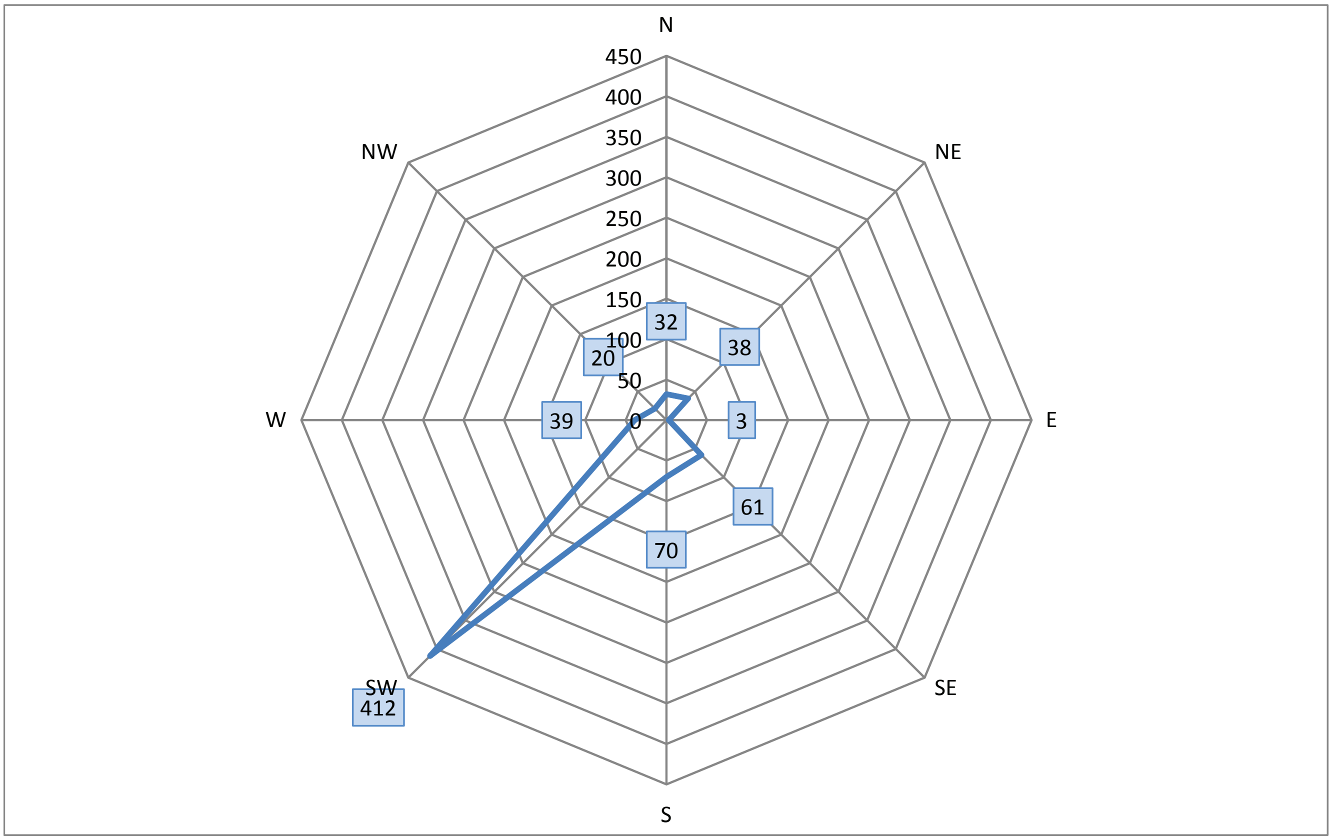
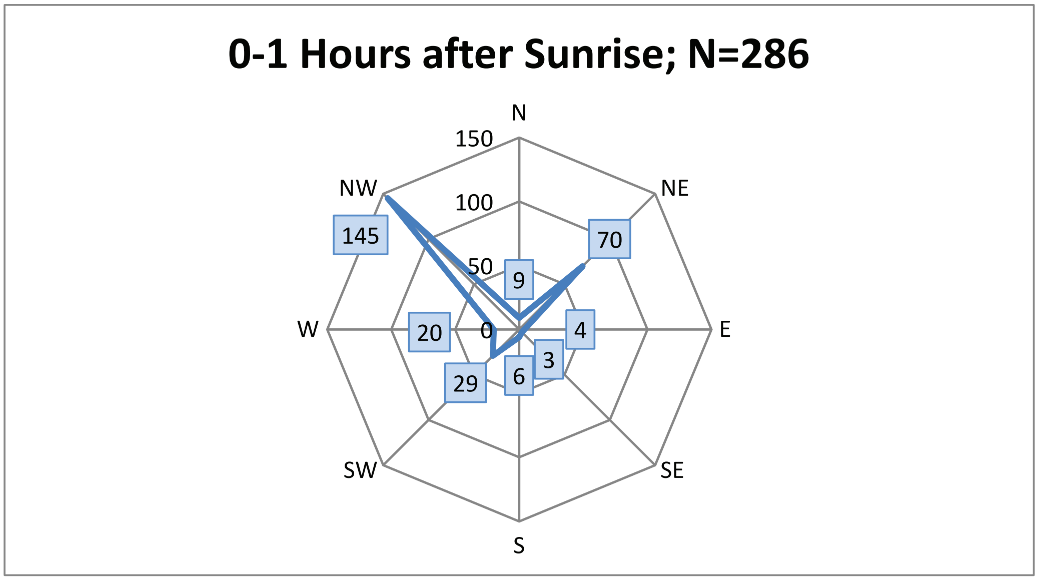
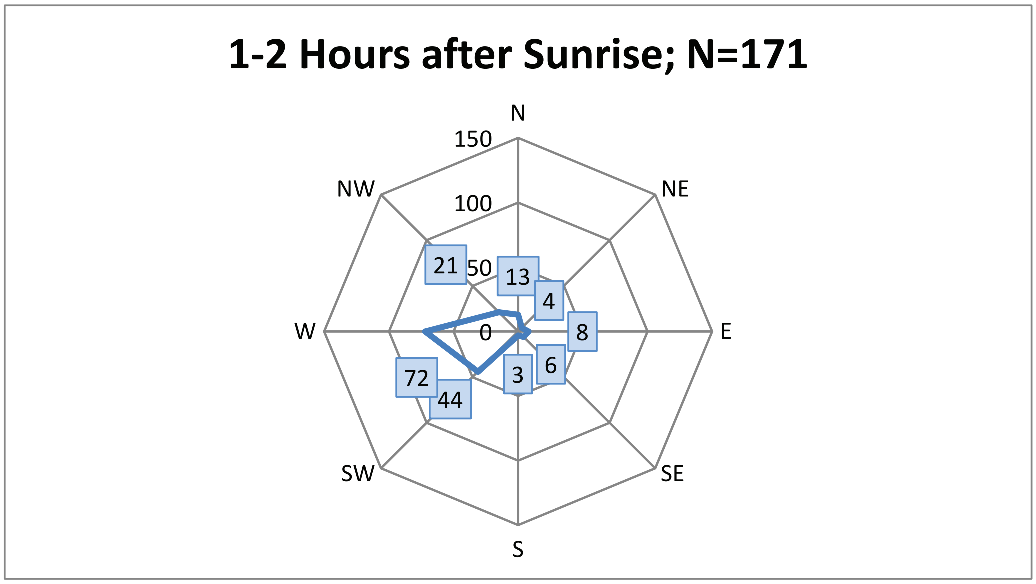
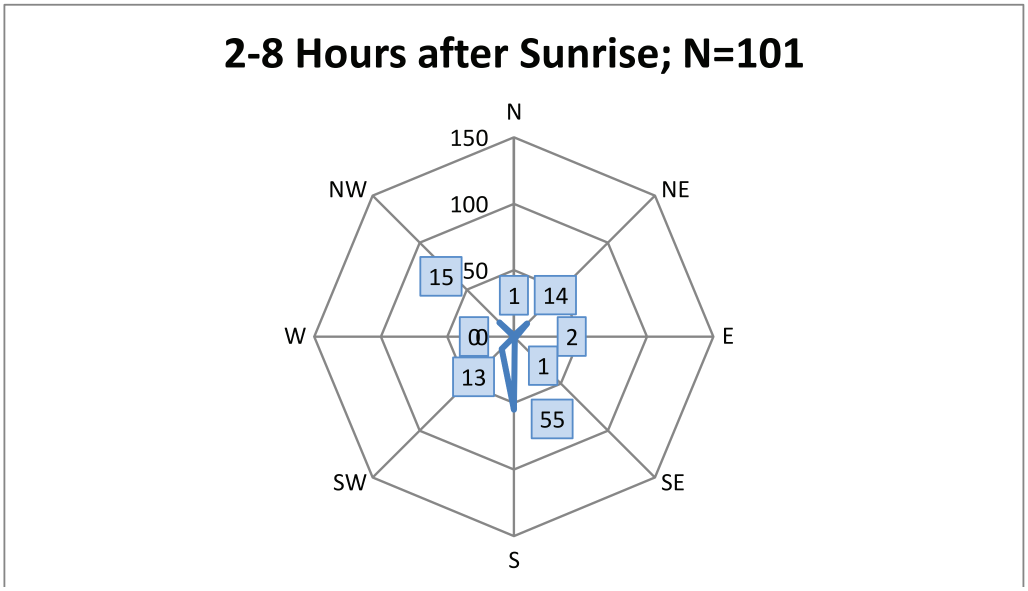


Figure 22: Heading of Nocturnal Migrants by Time of Day in the Autumn







winged Blackbirds. Although these two species are diurnal migrants, their movements largely to the northeast in the early morning suggests that they were moving from a night time roost in the Amherst marshes to feed in agricultural lands in the surrounding areas. A further factor to consider is the number of birds that are nocturnal migrants that are terminating or re-orienting their flights in the early morning hours.

Table 10: Summary of Altitudinal Observations

Turbine Area*	Number of Observations	Altitude Category**	Number of Observations	Number of Birds
No	56	1	33	918
		2	23	160
		3	0	0
Yes	31	1	17	87
		2	13	76
		3	1	2
Total	87		87	1,243

* No means greater than 250 meters from proposed turbine location

** 1=Less than 40 meters; 2=40-120 meters; 3=greater than 120 meters

Figure 21 shows the flight heading of those species of birds that are primarily diurnal migrants and excludes blackbirds and nocturnal migrants from the analysis. Here the pre-dominant direction is southwest; a heading appropriate for diurnal migration in the autumn.

Figure 22 displays the heading of nocturnal migrants by time of day. In the first hour after sunrise, the primary heading is northwest, in the second hour it is west, and for the next 7 hours it is south. There is a corresponding decrease in the number of nocturnal migrants seen during those time categories from 286 to 171 to 101. This pattern indicates an early morning re-orientation of nocturnal migrants to the northwest, backing in the next hour to west and southwest.

Table 10 summarizes the altitudinal data available. These data were collected through systematic observations on the transects and at the observation stations (See Figure 6). Most birds were flying below blade height (less than 40 meters) while 19% were at blade height (40-120 meters). Systematic observations at Station #1, where there is the most direct view of the proposed turbine locations, yielded the same result with 18% of birds observed at blade height.

Table 11: Ten Most Abundant Species in Diurnal Passage in the Autumn

Species	Number
American Robin	419
Double-crested Cormorant	393
Blue Jay	195
Passerines unspecified	56
Finches unspecified	32
Bobolink	26
Purple Finch	18
Cedar Waxwing	14
Yellow-rumped Warbler	14
Canada Goose	9

It is important to note, however, that the altitudinal data collected through systematic observation always commenced after the completion of the stop-over transects. This means that the observations do not include data for the first 1.5 to 2 hours after sunrise when diurnal migration was the most intense. Random notes on flight altitudes during the first 1.5 hours after sunrise show two flocks of grackes, one of 180 birds and another of 670 birds, flying at 40-120 meters on September 16 and 17 respectively. Another common diurnal migrant in the early morning, the Double-crested Cormorant would also fly at the 40-120 meter altitude category.

Table 11 lists the ten most abundant species in diurnal passage (excludes local non-migrating birds)

NOCTURNAL PASSAGE

The nocturnal passage data was processed for one of the two recording stations for this preliminary report. This was the same station as in the spring, Station #1. A total of 6,862 night flight calls were recorded. The breakdown by families is shown in Table 12. Warblers were the most common family with 4,296 calls followed by sparrows (1,184), and thrushes (982). Table 13 lists the twenty most abundant birds identified to the species level in the recordings of nocturnal passage. Savannah Sparrow, Swainson's Thrush, and Magnolia Warbler all had over 600 night flight calls detected.

Table 12: Number of Night Flight Calls by Family in the Autumn

Family	**Calls**
Warblers	4,296
Sparrows	1,184
Thrushes	982
Sandpipers	113
Unknown	94
Ducks & Geese	74
Sandpipers	44
Kinglets	42
Buntings	13
Blackbirds	11
Chickadees	3
Flycatchers	3
Herons	2
Gulls	1
Total	**6,862**

Table 13: Twenty Most Abundant Species Detected in Nocturnal Passage

Species	Calls
Savannah Sparrow	**667**
Swainson's Thrush	**660**
Magnolia Warbler	**618**
Blackpoll Warbler	**477**
Common Yellowthroat	**356**
American Redstart	**338**
Ovenbird	**270**
White-throated Sparrow	**254**
Black-throated Green Warbler	**245**
Hermit Thrush	**240**
Chestnut-sided Warbler	**230**
Northern Parula	**188**
Yellow-rumped Warbler	**162**
Bay-breasted Warbler	**150**
Black-and-White Warbler	**110**
Yellow Warlber	**86**
Song Sparrow	**82**
Cape May Warbler	**72**
American Woodcock	**66**
Canada Warbler	**65**

Figure 22 plots the number of night flight calls per night with the counts of total birds on the stop-over transects. There is a similar pattern in the number of flight calls to birds on the ground up until the beginning of October. The lack of correspondence in October may be due to the high number of diurnal migrants at that time. The same could be true for the mid-September spike when migrant and non-migrant flying birds dominated transect counts.

Figure 23 plots the number of night flight calls per night with counts of Savannah Sparrow on the stop-over transects. A possible interpretation of the graph is that breeding Savannah Sparrow departed in the third week of August. From early September to mid-October, Savannah Sparrows were arriving and leaving stop-over habitat. After mid-October, there is a

Figure 22: Comparison of Night Flight Calls with Birds on Stop-over Transects by Day in the Autumn

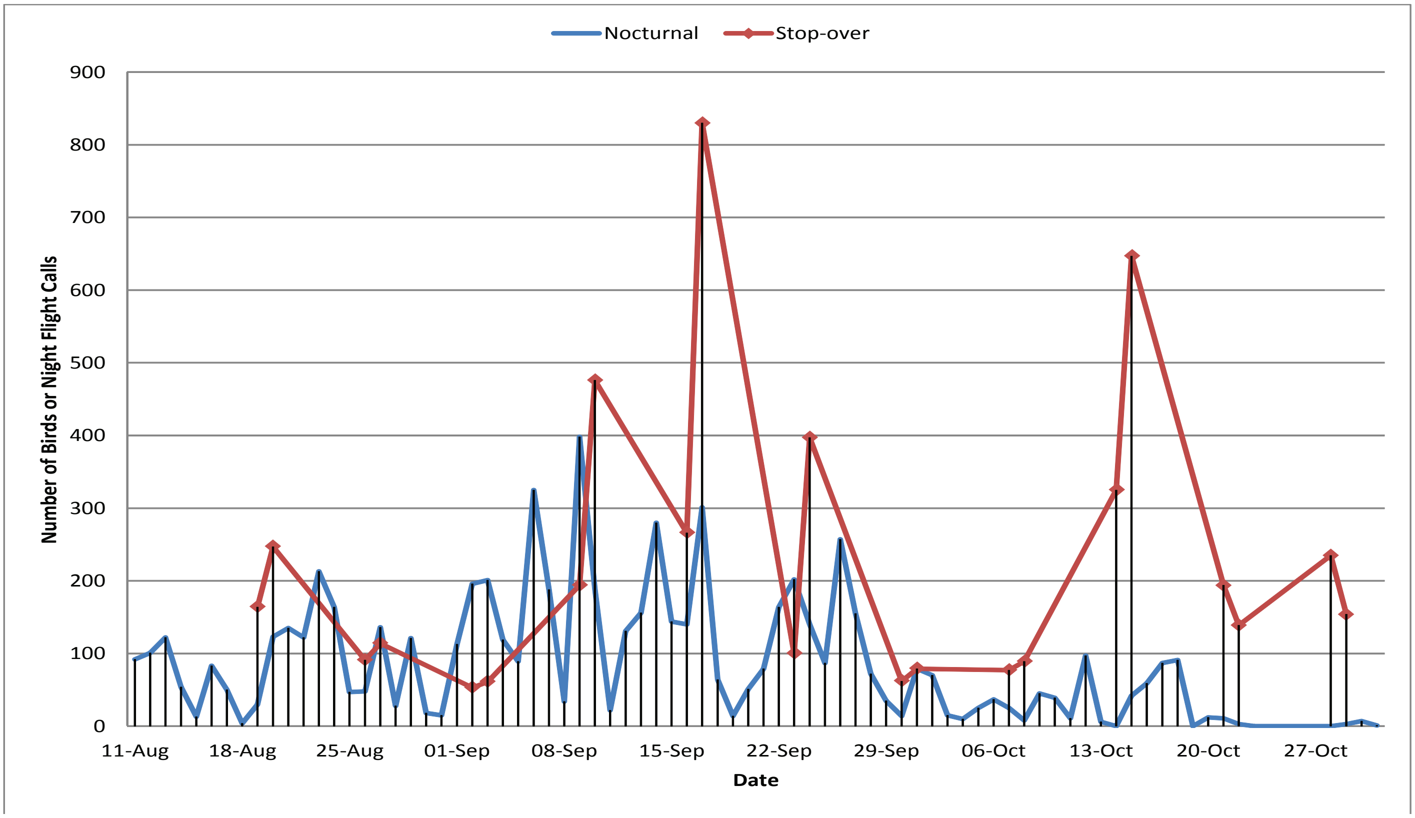


Figure 23: Comparison ot Night Flight Calls with Birds on Stop-over Transect for Savannah Sparrow in the Autumn

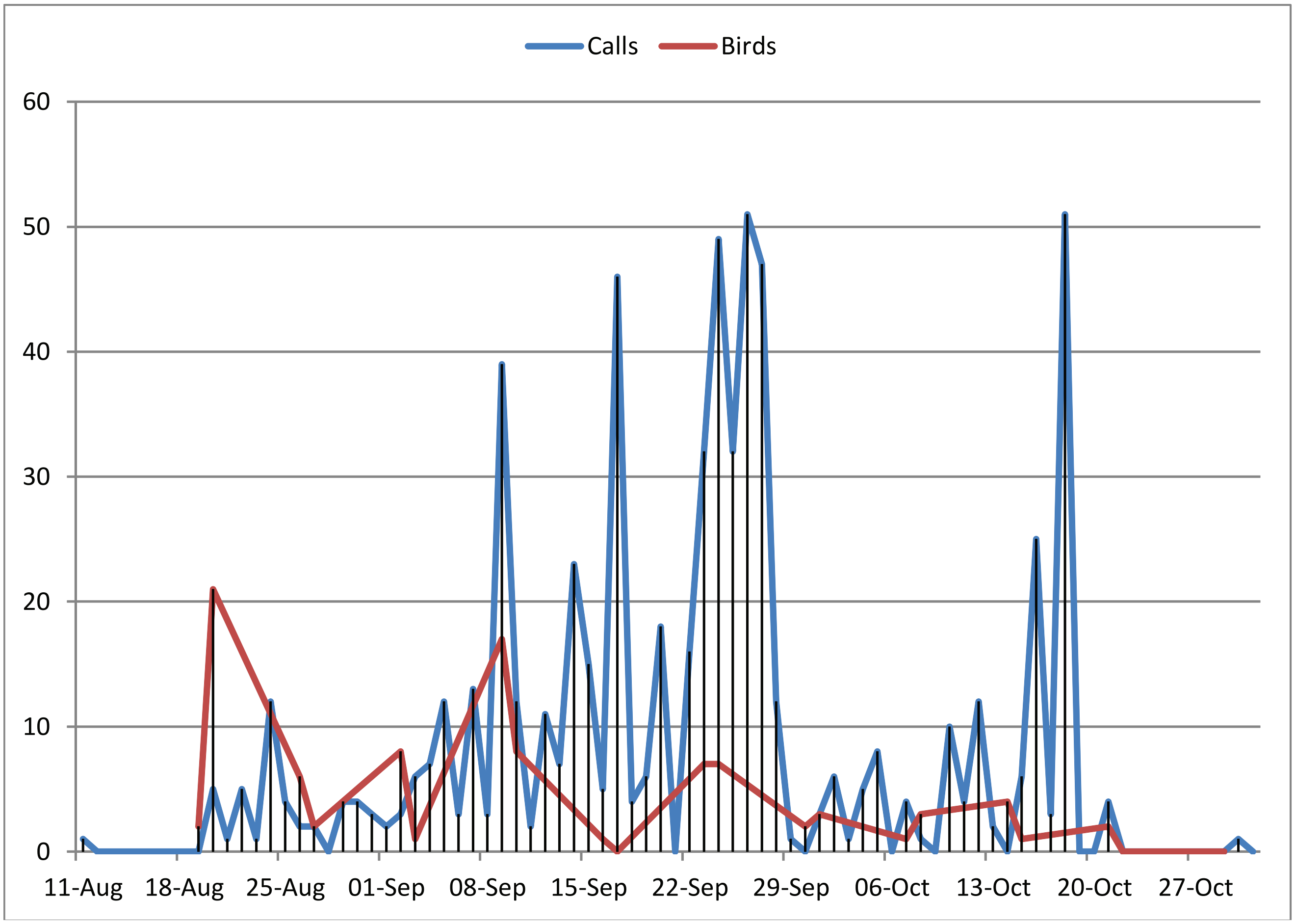
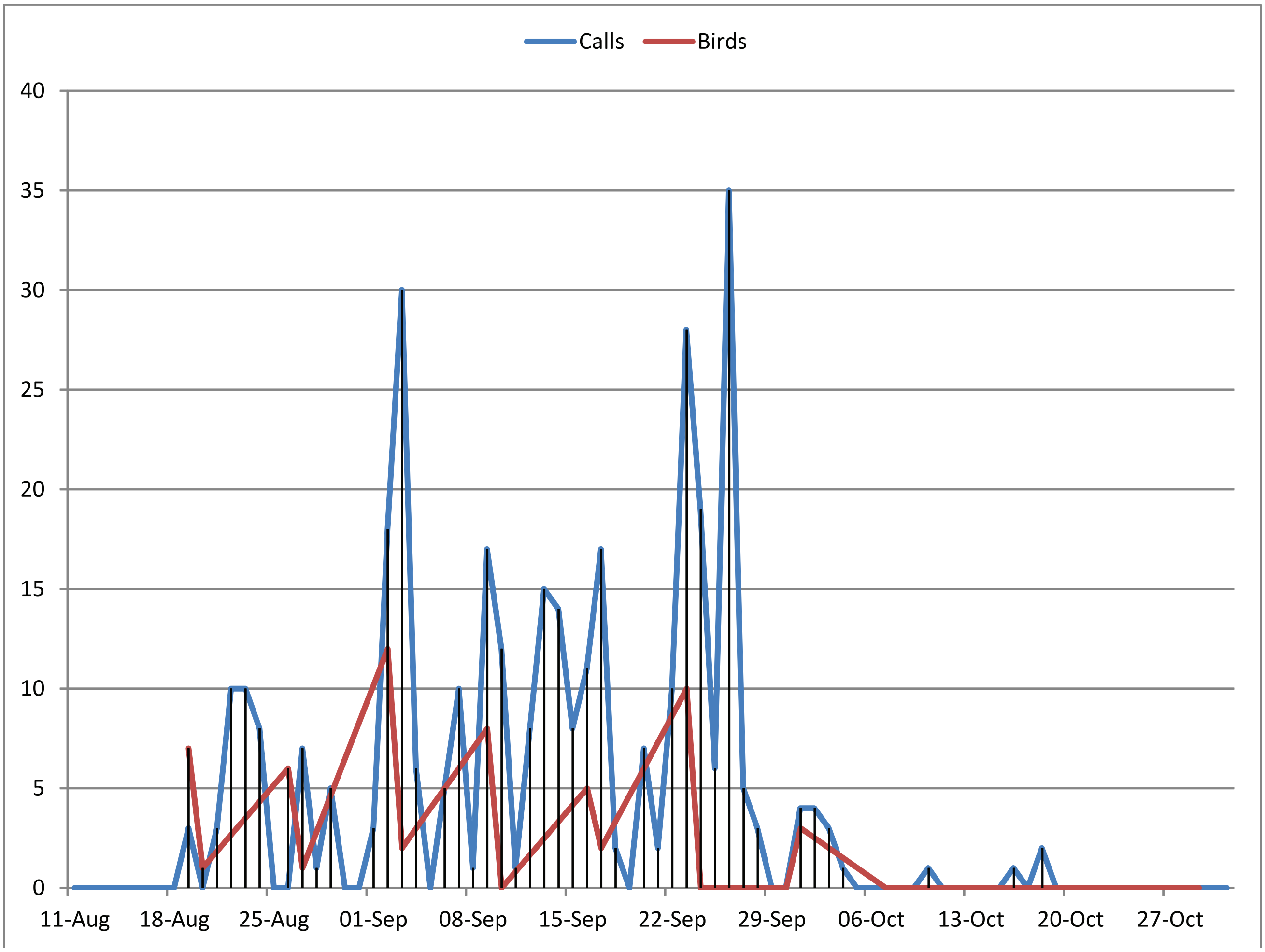


Figure 24: Comparison ot Night Flight Calls with Birds on Stop-over Transect for Common Yellowthroat in the Autumn



general exodus of these sparrows. In Figure 24, this pattern is also evident in the warbler species, Common Yellowthroat, with spikes in the number of night flight calls corresponding with arrivals or departures in stop-over.

Species of Conservation Concern

An annotated list of all the species of conservation concern recorded in the study area in 2014 is given in Table 14. A total of 32 species of conservation concern were detected through field studies or acoustic monitoring. All birds listed as “endangered”, “threatened”, or “vulnerable” under the Species at Risk Act, by the Committee on the Status of Endangered Wildlife in Canada, or by the Province of Nova Scotia are treated further in the discussion section that follows.

Table 14: An Annotated List of Species of Conservation Concern Recorded in the Study Area

Species	NSDNR Rank	SARA Schedule 1	COSEWIC Listed	COSEWIC Priority Candidates	Annotation
Common Loon	May be at Risk				1 bird flying over the project area on October 28 and 1 over the control area on October 29
Turkey Vulture	Sensitive				1 over the project area on September 30
Killdeer	Sensitive			Low	Recorded acoustically over project area; 1 on August 11, 8 on September 9, and 6 on October 10
Greater Yellowlegs	Sensitive				Recorded acoustically over project area; 3 on September 12 and 9 on October 17
Whimbrel	Sensitive				Heard flying over project area on August 27
Wilson`s Snipe	Sensitive				Recorded acoustically over the project area; 1 on September 27
Common Nighthawk	Threatened	Threatened	Threatened		Recorded acoustically over project area; 1st on June 10 then heard regularly in one hour after sunset and one hour before sunrise in early August. See text in discussion section
Belted Kingfisher				High	1 seen in project area on August 26 and September 9
American Kestrel				Mid	1-2 birds seen regularly in project area near Pumping Station Road in the spring, 1 seen in control area on September 3
Olive-sided Flycatcher	Threatened	Threatened	Threatened		1-2 birds as possible breeders in project area (see text in discussion section)
Yellow-bellied Flycatcher	Sensitive				1 in project area during breeding season
Great Crested Flycatcher	May be at Risk				2 calls of a Myiarchus flycatcher, possibly this species recorded acoustically on September 18
Gray Jay	Sensitive				1 seen in project area on May 14 and 29 and 2 in control area on May 12; these probably represent breeding birds. In the autumn, 3 were in the project area on August 9 and October 14, 2 on August 26 and 1 on September 23 and 30. 2 were in the control area on September 24
Tree Swallow	Sensitive				2 were in the project area on June 16 and thus possible breeders
Barn Swallow	Endangered		Threatened		7 were flying over project area on August 26. See text in discussion section
Boreal Chickadee	Sensitive				2 in project area on May 6; 1 in project area on September 9 and 23, and October 14. 1 recorded acoustically on September 22 over project area.
Golden-crowned Kinglet	Sensitive				One in project area on June 17 thus possible breeder. 1 in project area on 22 April. 2 in control area on October 15, and 1 on September 10 and October 22 and 29. Recorded acoustically in project area from August 11 to October 12 on 15 nights with peak call count at 12 on August 21.

Species	NSDNR Rank	SARA Schedule 1	COSEWIC Listed	COSEWIC Priority Candidates	Annotation
Ruby-crowned Kinglet	Sensitive				1 in project area during breeding season on June 19
Wood Thrush	Undetermined		Threatened		1 recorded acoustically in project area on September 2. See text in discussion section
Tennessee Warbler	Sensitive				Recorded acoustically in project area on 7 nights from September 2-17 with a maximum of 2 calls per night on September 4
Cape May Warbler	Sensitive				1 seen in control area on May 27. Recorded acoustically in project area on 23 nights from August 11 to September 25. A total of 72 calls with a maximum of 11 in a night on September 12
Bay-breasted Warbler	Sensitive				1 seen in control area on May 12. Recorded acoustically in project area in the spring on June 2. Recorded acoustically in the project area in the autumn on 41 nights from August 11 to September 28. Maximum call count of 12 on September 14.
Blackpoll Warbler	Sensitive				3 seen in project area on September 16 and 2 on September 23. 1 seen in control area on May 27, September 9, and October 1. Recorded acoustically in project area in spring on 4 nights from May 25 to June 3 with a maximum of 2 calls on June 3. Recorded acoustically in the project area in autumn from August 16 to October 10 with a total of 477 flight calls with the maximun of 56 calls on September 14
Canada Warbler	Endangered	Threatened	Threatened		Recorded acoustically in the project area in the autumn on 22 nights from August 11 to September 17 with a total of 65 calls and a peak of 11 calls on August 23. See text in discussion section
Wilson's Warbler	Sensitive				1 seen in the control area on September 3. Recorded acoustically in the project area in the spring with on 1 call on June 3 and on 14 nights in the autumn from August 16 to September 27 with a peak call count of 5 on August 23
Vesper Sparrow	May be at Risk				Recorded acoustically in the project area on September 10 and 17 with 1 call each night
Rose-breasted Grosbeak	Sensitive				1 seen in the control area on May 27. Recorded acoustically in the project area in the autumn with one call on six nights from September 1 to 23.
Indigo Bunting	Undetermined				Recorded acoustically in the project area with one call on the nights of August 21 and October 22

Species	NSDNR Rank	SARA Schedule 1	COSEWIC Listed	COSEWIC Priority Candidates	Annotation
Bobolink	Vulnerable		Threatened		Seen flying over the project area during the day on 5 ocassions from August 19 to 27 and once over the control area on August 19. 21 were seen in stop-over in the project area on August 26. Recorded acoustically in the project area in the autumn on 5 nights from August 20 to September 15 with a maximum of 5 calls on August 29. See text in discussion section
Pine Grosbeak	May be at Risk				1 seen in diurnal passage on October 21 in the project area and 4 in the control area on October 29
Pine Siskin	Sensitive				1 seen in diurnal passage in the spring in the project area on May 29 and 1 to 5 birds seen in diurnal passage in the autumn in the project and control areas from October 7 to 15
Evening Grosbeak				High	1 seen in diurnal passage in the spring in the control area on May 12. 1 to 7 birds seen in diurnal passage in the project and control areas in the autumn from October 14 to 29

Discussion

The proposed Amherst Community Wind Farm is located in a highly industrialized setting. These industries include forestry, agriculture, energy, telecommunications, and recreation. A small wind energy facility would not have a major impact on the level of disturbance on bird habitat that already exists. Nonetheless, there are species, including species of conservation concern, that can take advantage of this disturbance. The two SARA listed species detected during the course of the baseline study are such opportunists. The Common Nighthawk takes advantage of clearings created by agriculture and forestry, and the Olive-sided Flycatcher is frequently heard on territory in very recent clearcuts.

Both of these species are aerial insectivores, but only the Common Nighthawk would regularly feed near blade height. No data can be found on the impact of wind turbines on the Common Nighthawk. However extensive studies at communications towers report very low mortality for Common Nighthawk (Stevenson and Anderson 1994).

While Olive-sided Flycatchers are attracted to recent clearcuts for nesting, there is evidence that this forestry practice is an ecological trap for this species. Studies indicate low breeding success rates for this species in clearcuts (Robertson and Hutto 2007). While a clearcut may resemble a forest disturbed by burning, the number of predators in a clearcut is likely much higher and a possible factor in the low breeding success rates for this species of flycatcher.

There is suitable habitat in the project area for a species listed as “threatened” by COSEWIC (Committe on the Status of Endangered Wildlife in Canada) and as“vulnerable” by the Province of Nova Scotia, the Bobolink. Area searches for Bobolinks were conducted several times in the hay fields of the project area but none were found. These fields did provide stop-over habitat in the autumn migration, with a flock of 21 of these birds seen on August 26. Small numbers of Bobolinks were also detected in diurnal and nocturnal passage in late August to mid-September.

There is suitable habitat for another species listed as “endangered” by the Province of Nova Scotia and “threatened” by COSEWIC, the Barn Swallow. Area searches turned up no Barn Swallows during the breeding season for this species in the project or control area. A flock of seven Barn Swallows was seen flying over the study area in the autumn on August 26.

Table 15: Total Canada Warbler Night Flight Calls during the Autumn at Eight Existing or Proposed Wind Energy Sites in Nova Scotia

Location	Canada Warbler Night Flight Calls
Gulliver's Cove	53
Amherst	64
Glasgow Head	7
Spinney Gully	5
Browns Mountain-Weaver Mountain	46
Browns Mountain	37
Nuttby Mountain	4
Loganville Ridge	6

The acoustic monitoring of nocturnal passage recorded one Wood Thrush flying over the project area on September 2. This species is listed as “threatened” by COSEWIC.

The Canada Warbler, a SARA listed “threatened” species was recorded in relatively high numbers during the course of acoustic monitoring during the autumn migration. Table 15 lists the number of night flight calls of Canada Warbler recorded at eight existing or proposed wind energy sites in Nova Scotia. The proposed Amherst site had the highest numbers of calls of this species.

Table 16: Total High Frequency Night Flight Calls Recorded during the Spring at Nova Scotia Locations

Location	**Year**	**Total**
Glasgow Head, Guysborough Co.	2013	596
Brown's Mountain, Antigonish Co.	2012	404
Spinney Gully, Guysborough Co.	2013	361
Loganville, Pictou Co.	2012	355
Weaver Mountain, Pictou County	2012	352
Amherst, Cumberland Co.	2014	323
Digby Neck, Digby Co.	2012	321
Nuttby Mountain, Colchester Co.	2012	263
Total		**2,975**

There was light diurnal and nocturnal passage in the study area during the spring. Table 16 compares the total high frequency (sparrow and warblers) night flight calls recorded at the study area compared to seven other existing or proposed wind energy sites in Nova Scotia during the spring period. Totals at Amherst are among the lowest. On the other hand, as shown in Table 17, spring stop-over counts were higher than other sites except for Digby Neck. These relatively high counts at Amherst are likely due to the presence of birds that prefer edge and disturbed habitats. The three most common species in stop-over at Amherst in the spring were species that seek disturbed habitats; American Robin, White-throated Sparrow, and Palm Warbler.

Table 17: Mean Total Birds Counted on Spring Stop-over Transects at Six Wind Energy Sites in Nova Scotia

Site	**Years**	**Transects**	**Repetitions**	**Mean**
Digby	2012	2	16	128.50
Amherst	2014	2	13	117.85
Glen Dhu	2008-2012	5	75	102.99
Canso	2013	4	21	88.76
Fairmont	2013	1	6	87.00
Nuttby	2011-2012	4	33	79.67

In contrast to the spring, the number of birds in all three components of the autumn migration surveys was high; stop-over, nocturnal passage, and diurnal passage. Table 18 compares stop-over counts and nocturnal passage recordings at eight existing or proposed wind energy sites in Nova Scotia. The stop-over counts in Amherst approached the high counts at Digby Neck in mean total birds and were on a par with that location for the percentage of birds that were in flight in the morning. For nocturnal migration, Amherst was in the middle range of total and mean number of high frequency night flight calls.

Table 18: Comparison of Stop-over Counts and High Frequency Night Fligh Call Counts at Eight Sites in Nova Scotia

			Stop-over Transects			Acoustic Recordings		
Location	County	Distance from Coast	Mean Birds/Day	% Flying	Year	Calls/ Season	Mean/ night*	Year
Gulliver's Cove	Digby	<1 km	286	65	2012	10,002	213	2011
Amherst	Cumberland	7 km	227	65	2014	5,504	85	2014
Glasgow Head	Guysborough	<1 km	107	34	2013	2,016	94	2013
Spinney Gully	Guysborough	<1 km				1,383	21	2013
Browns Mountain-Weaver Mountain	Antigonish-Pictou	12-16 km	79	21	2008	7,899	152	2011
Browns Mountain	Antigonish	12 km	54	11	2011-2012	4,529	-	2011
Nuttby Mountain	Colchester	20 km	48	14	2011-2012	1,271	-	2011
Loganville Ridge	Pictou	14 km	-	-	2011	2,095	-	2011

* September 2 to October 15

The large number of birds in the air over the Amherst site in first two hours of the day consisted of three components; true diurnal migrants, re-orienting nocturnal migrants, and non-migratory movements to local feeding areas. The inappropriate direction of the nocturnal migrants in the early morning is consistent with the reports of Van Doren et al. (2014) and support the view of re-orientation over the study area. The American Robin was dominant in this group. The non-migratory movements were primarily large flocks of Common Grackles and Red-winged Blackbirds. Some of these flocks could also have been engaged in diurnal passage. Most diurnal migration was represented by Double-crested Cormorants, Blue Jays, and winter finches.

Towards a Final Report

The final report will include an analysis of the use of habitats within the study area by birds during the breeding season and during migration stop-over. In addition the effects of weather on stop-over, diurnal passage, and nocturnal passage will be examined using weather data collected at the wind energy site by the proponents, Mi'Kmaq Wind4All, and data available through Environment Canada.

It will be useful in the final report to include a further analysis of bird flights in the first two hours of the autumn mornings, incorporating radar and weather data. In addition, a combined radar and acoustic study in the spring of 2015 would fill an existing gap in the baseline study.

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Acknowlegements

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Fall Radar Study Report – Amherst NS

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DRAFT DOCUMENT

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Abstract

Here we present nocturnal results from a fall migration study conducted in Amherst NS. Two 12.5 kW Furuno radars modified to record bird migration were operated from late August to present at two locations adjacent to the proposed Amherst Community Wind Farm. This report presents data collected from late August to mid-October for both sites. A full report including the rest of late fall migration and a more detailed analysis of diurnal migration will follow at a later date; however, data presented here likely represents the bulk of migration in this area.

Introduction

We recorded the movement of biological targets (likely primarily birds) in the airspace in and around a proposed wind farm in the Amherst area of Nova Scotia. We collected data continuously from two modified marine radars over the fall of 2014, and have analysed these data to describe the volume, direction, and altitude of migration of presumed bird targets, and the relationship between those variables and weather. Our focus is on nocturnal migrants, and as such, we have primarily analyzed data collected between the hours of sunset and sunrise. However, we do provide some assessment of diurnal movement during times identified through stopover surveys.

Further, to provide additional information about species specific passage rates, we also correlate radar data with data collected from acoustic sensors (collected and processed by John Kearney).

Finally, we interpret these data in light of possible movements through the site of the proposed wind farm project area, and provide our view of the relative risk of the proposed development to bird migration in the area.

Selection of the study area

Due to logistical constraints (lack of electricity and site security) it was impossible to operate the radars immediately at the project site. However, two private homes close to the proposed wind farm site were chosen due to proximity to the site and support of homeowners. House 1, situated on NS Highway 6 (45.846173°, -64.154015°), is approximately 1.4 km from the closest proposed turbine location and House 2, located on Pumping Station Road (45.824016°, -64.135886°), is approximately 1 km from the closest proposed turbine location. The proximity of these two sites to the proposed wind farm location provides excellent information on the general pattern of migration in the area and can be used to infer the pattern of passage at the project site itself (Figure 1). Furthermore, the sweep of the radar at House 1 covers a portion of the airspace above the project area.

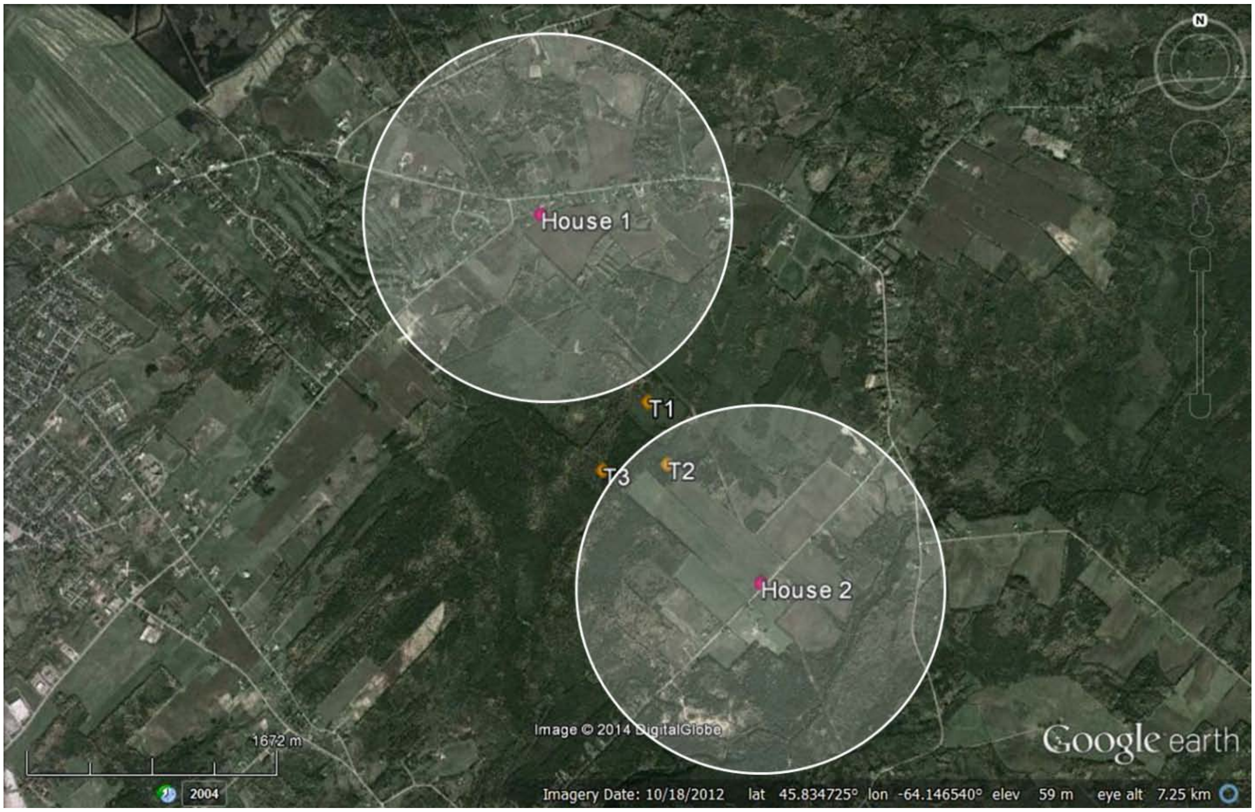


Figure 1. Map of the study area showing radar location, coverage (~ 1.2 km radius), and turbine placement.

Methods

Equipment

Two Furuno 1954C-BB (Camas, Washington, USA) X-band (3-cm wavelength) marine radars were set-up in late summer 2014. The radar antennas made a complete 360° revolution (a scan) every 2.4 sec. At both sites, for most of the season, the radars were set at a fixed angle of 25°. All output from the radar was processed using a digitizing card (Sigma Sd, Rutter Technologies Inc., NL) and recorded using radR, an open source, R-based platform (www.radr-project.org, Taylor et al. 2010). All data (date, time, and location in space) on targets ("blips") detected by the radar were stored in blip movie files for later processing (see Taylor et al. 2010 for details).

Data filtering and processing:

All recorded movies were filtered to remove clutter (e.g. spurious information from incoming radar signals, reflections due to rain, and backscatter from surrounding vegetation) using program radR (see http://radr-project.org; Appendix 1). We also employed radR's declutter filter to develop site specific declutter files and applied them using a threshold occupancy value of 0.03, to remove the persisting ground clutter.

Following clutter removal a multi-frame correspondence tracking algorithm (MFC tracker; Shafique and Shah 2005) implemented in radR (Taylor et al. 2010) was used to link successive detections of the same target to create ‘tracks’. Tracks provide information on the direction of travel and speed of targets.

Typically, small marine radars with a 3 cm wavelength detect insects as well as birds. However, examination of radar cross section and flight speed (commonly used for filtering out insects) did not show any obvious clustering that would allow for easy separation of the two types of biological targets. As such, we did not employ additional filtering to remove insect tracks and so it should be recognized that some of the targets recorded by the radar are likely from insects.

Weather data (wind speed and direction, pressure, temperature, and humidity) were acquired from the tower at the proposed project site (Natural Forces).

Data Analysis

Data were first summarized by grouping by one or more of four variables: location, time of night, season, and altitude, depending on the focus of the analyses. To examine the general direction of movement and variability in movement at the two sites, data were grouped based migratory direction and split based on time of year. We split the season into early (start of recording – 24 September) and late (25 September – end of recording) because it provides a logical break between groups of species that tend to migrate ‘early’ or ‘late’ (Calvert et al 2009). To examine fine scale decisions data were grouped based on altitude (100 m bins) and time (30 min bins) and plotted using arrow plots. For each of these groups we calculated the circular mean and variance in direction of movement. Finally, we correlated nightly counts of targets from radar with counts from the acoustic study.

The effect of weather (tailwind assistance, pressure, change in pressure and humidity) on log of the number of targets detected, and variance in heading was modelled using generalized linear models. Temperature was not included in these models as it was correlated with date (-0.740; temperature decreased across the season). Model support was assessed using Akaike's Information Criterion (package MuMIn; Barton 2012) and relative variable importance (on a scale of 0 to 1) and full model-averaged coefficients were calculated using functions in AICcmodavg (Mazerolle 2012). This type of approach is useful when dealing with potentially large number of multi-way interactions in a model (Crawley 2007). Model-averaged coefficients show the relative strength of the relationship between the weather variable and the response, and the variable importance provides information on the amount of evidence that a particular variable has some effect on the response.

All analyses were conducted using program R (R Statistical Core team; V 3.02).

Results

Migration timing

The bulk of fall migration activity occurred between 27 September and the 3 October at both sites. There also was a smaller peak in early September and mid-October. There was a strong, positive correlation between migratory activity at both sites (Spearman’s rho; 0.94, $p < 0.001$).

Furthermore, approximately 50% of the total number of targets detected occurred on only 8 nights (or 17% of the nights at house 1 and 16% of the nights at house 2).

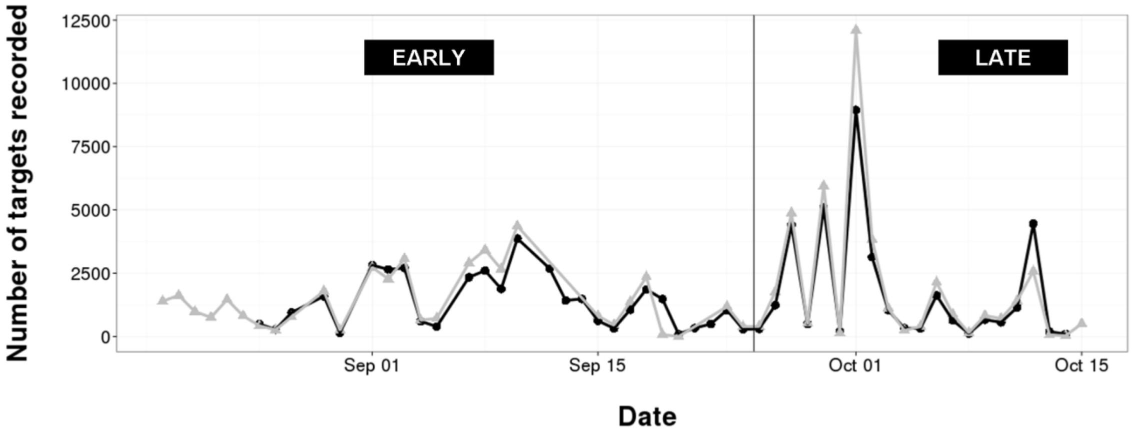
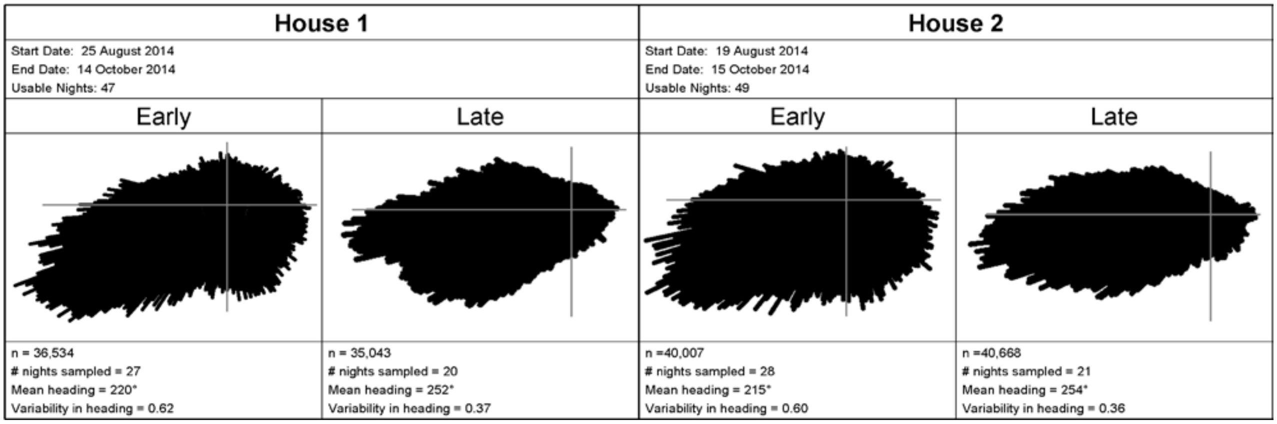


Figure 2. Number of tracks detected over the fall season at each site (black = house 1, grey = house 2). Days with missing points represent nights with no migration or nights with rain when we were not able to assess migration.

Direction of movement and variability through the night

In total, we detected approximately the same number of targets in the early and late seasons, at both sites. The mean direction of tracks was similar at both sites in the early season (220° and 215°) and shifted to the west in the late season (251° and 254°). The variance in headings differed considerably between seasons, with a large decrease in heading variance in the later season (0.37 and 0.36 vs. 0.62 and 0.60; Figure 3). The large variance early in the season shows that many targets are moving in all directions, with modal directions to the SW and to the SE.



House 1
Start Date: 25 August 2014
End Date: 14 October 2014
Usable Nights: 47

House 2
Start Date: 19 August 2014
End Date: 15 October 2014
Usable Nights: 49

n = 36,534	n = 35,043	n =40,007	n =40,668
# nights sampled = 27	# nights sampled = 20	# nights sampled = 28	# nights sampled = 21
Mean heading = 220°	Mean heading = 252°	Mean heading = 215°	Mean heading = 254°
Variability in heading = 0.62	Variability in heading = 0.37	Variability in heading = 0.60	Variability in heading = 0.36

Figure 3. Circular heading plot of mean heading and variability in heading of tracks across the fall migration season at the camp and house.

Nocturnal migrants initiate migration shortly after sunset and cease migrating at some point before sunrise. To examine the how these behaviours influence movement at these sites, we examined the periods separately by splitting all of the nights into 3 periods: 2 h after sunset (migration initiation) 2 h before sunrise (migration cessation) and the remainder of the night.

At both sites in the early and late seasons, the number of tracks per hour was highest at night and sunset and lowest at sunrise, and the variability in heading always increased across the night (Table 1 and 2). However, the variability in heading is at sunrise is much higher than at sunset and night in the late season, whereas in the early season, the variance was much more constant across the night.

Table 1. Number of tracks, mean heading, and variability in heading of tracks during each time bin (sunset, night sunrise) across the early (late August – 24 September) fall migration season at both sites.

Early Season	**House 1**			**House 2**		
	Sunset	Night	Sunrise	Sunset	Night	Sunrise
n	11,553	23,003	1,978	12,547	24,744	2,716
Mean Heading	227°	218°	161°	220°	215°	173°
Variability in Heading	0.57	0.63	0.74	0.55	0.60	0.73

Table 2. Number of tracks, mean heading, and variability in heading of tracks during each time bin (sunset, night sunrise) across the late (25 September – mid October) fall migration season at both sites.

Late Season	**House 1**			**House 2**		
	Sunset	Night	Sunrise	Sunset	Night	Sunrise
n	6,044	27,431	1,568	6,898	32,206	1,564
Mean Heading	243°	255°	218°	243°	257°	204°
Variability in Heading	0.33	0.35	0.75	0.31	0.35	0.68

Within night variability

Further insight into the patterns of movement can be obtained by examining particular nights with relatively high amounts of migratory activity. In Figure 4 we present a selection of these that show how that pattern can vary considerably across nights.

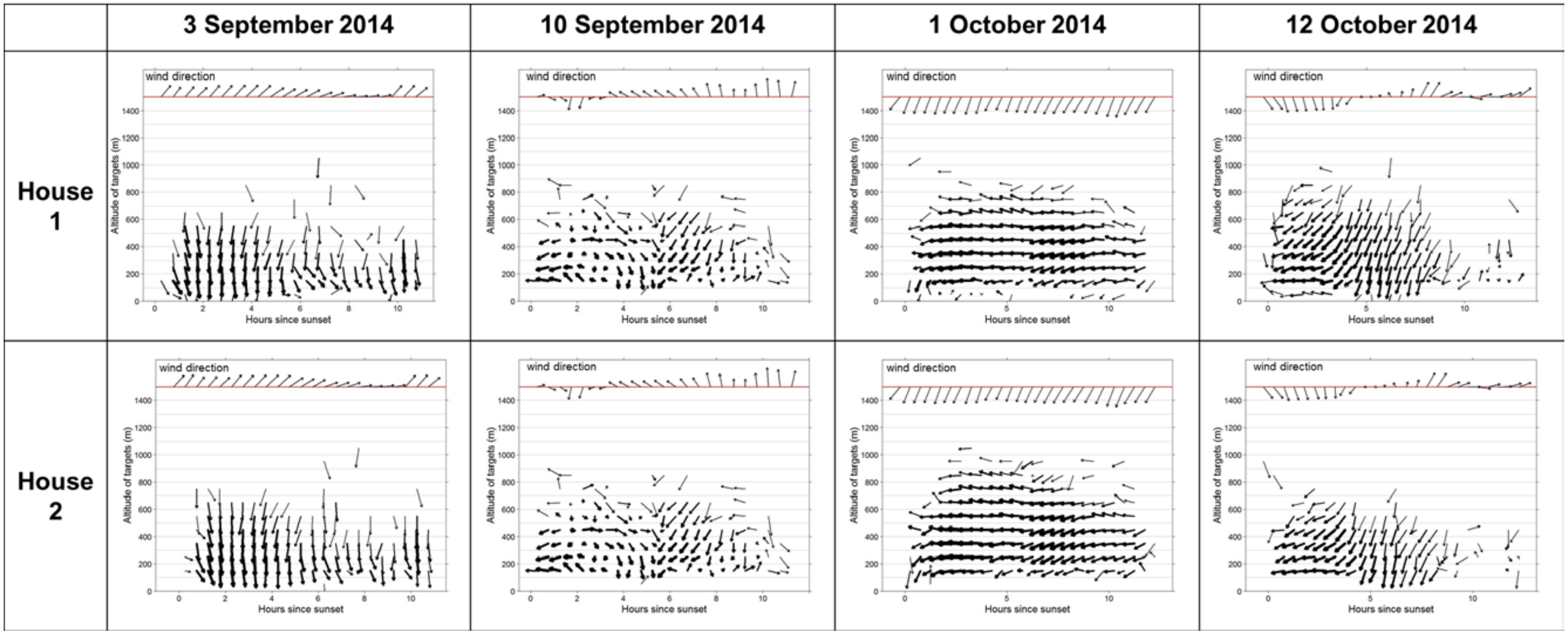


Figure 4. Arrow plots showing select nights with large numbers of tracks detected during fall migration. Plots show the number of targets (darkness of arrow; on a log scale), their mean direction (direction of arrow) and variability in direction (shorter arrows show more variability) for 30 minute time bins and 100 m altitude bins.

The night of 3 September shows a night with a large number of targets early in the season. The majority of targets on this night are traveling south early in the night at a variety of altitudes. The mean directions shifts to the E later in the night and after that, most targets are detected only at lower altitudes. The wind direction remains somewhat consistent throughout the night in both speed and direction (N, a headwind). The majority of detections on the acoustic microphone on this night were warblers including Common Yellowthroats, Magnolia Warblers, and Blackpoll Warblers.

The night of September 10 shows how birds behave when there is a shift in wind direction through the night. At sunset, the wind is very light and targets are moving to the SW. Around 2 h after sunset, the wind speed increases and begins to flow from the NE (a headwind). There is an obvious period of change when targets shift their direction S and then readjust to again move towards the SW at about 5.5 h after sunset. On this night the most common calls detected by the acoustic microphone were Swainson's Thrush, followed by Blackpoll Warblers, and Magnolia Warblers. All are long-distance tropical migrants that breed in the boreal/sub boreal.

The night of 1 October is the night with largest number of targets observed. The main direction of migration is SW and the number of targets detected remains consistent and high until just before sunrise. While there are likely many factors influencing this pattern, one may be that the wind is in a favourable (SW) direction all night. Calls detected by the acoustic microphone on this night were dominated by Hermit Thrush and White-throated Sparrow, both short-distance temperate migrants that breed in the boreal.

The night of 12 October shows a strong consistency in migration direction throughout the night despite slight changes in wind direction to a headwind later in the night. On this night, migration starts shortly after sunset and is consistently in a SW direction. Migration abruptly ceases 8 h after sunset despite no change in wind direction and strength. Typical of later migration, the majority of calls detected by the acoustic microphone were thrushes (Hermit Thrush and American Robins) and sparrows (White-throated Sparrows, Song Sparrows, and Savannah Sparrows). All of these species are also short-distance boreal/sub boreal migrants.

Correlations between radar data and acoustic monitoring

The number of targets detected by the radar and the acoustic microphone do not appear to be highly correlated (Figure 5). In general, peaks in the radar data do not necessarily correspond with peaks in the acoustic data and vice versa.

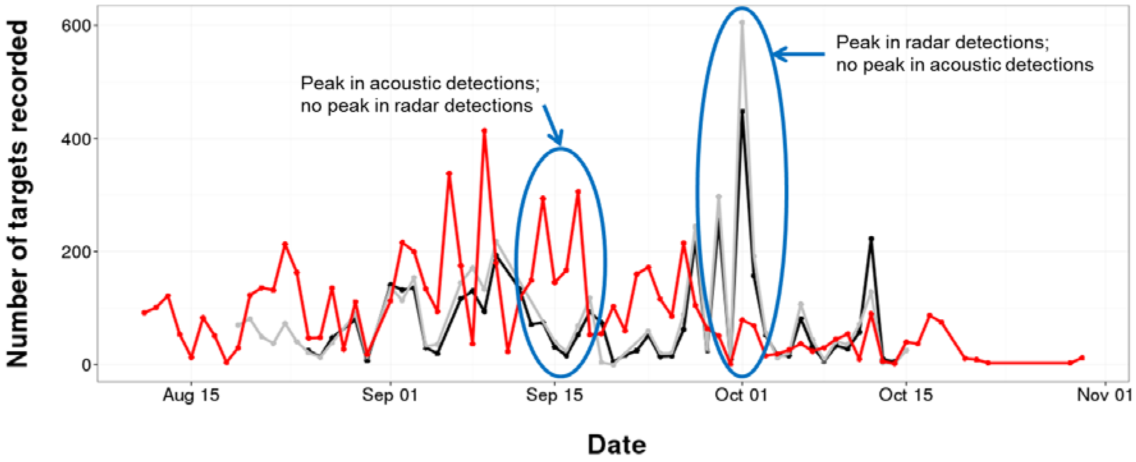


Figure 5. The number of tracks detected over the fall season at each site (black = house 1, grey = house 2, red = acoustic microphone). Radar data has been scaled by 20 to facilitate plotting.

Across all nights, there were only moderately weak correlations between the acoustic and radar data (Table 3). These correlations were higher when examining only the number of targets below 150 m that were detected by the radar, which is the estimated maximum detection range of the microphone. The correlations were slightly stronger at night than at sunset, but were very weak at sunrise. In spite of the lack of correlation, it is still likely that the suite of species detected on the acoustic microphone represents at least partially, the suite of species detected by the radar.

Table 3. Correlations between radar data and other monitoring data.

	Acoustic
All	0.311
> 150 m	0.300
< 150 m	**0.367**
Sunset (< 150 m)	0.520
Night (< 150 m)	0.493
Sunrise (< 150 m)	0.103

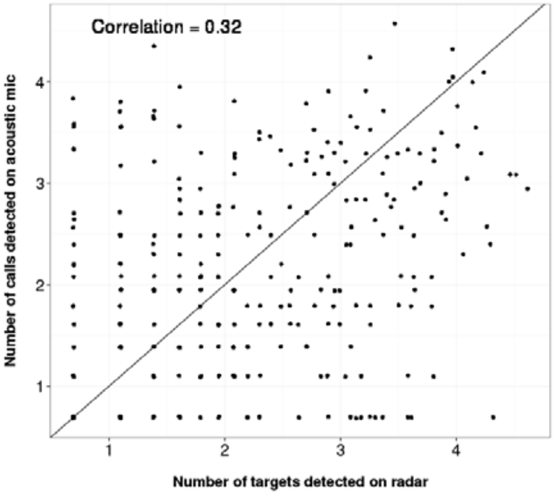


Figure 6. Relationships between the number of birds detected on the radar (< 150 m) and acoustic microphone.

Species-level inference and diurnal migration

A sample of some specific Radar-Ground Survey Comparisons:
On 17 September Kearney (pers. com) recorded large numbers of Common Grackles between 10:00 GMT and 11:00 GMT on stopover counts. The majority of these individuals were flying to the NE. A different pattern of movement was observed in the radar data. Few targets (n = 14) were detected on the radar at this time, and those that were, were traveling to the SE or NW. Later that same day the radar detected many more targets (n = 1558), many of which were moving to the NE. Further, the airspeed of these targets was low (<7 m/s) consisted with passerine migration.

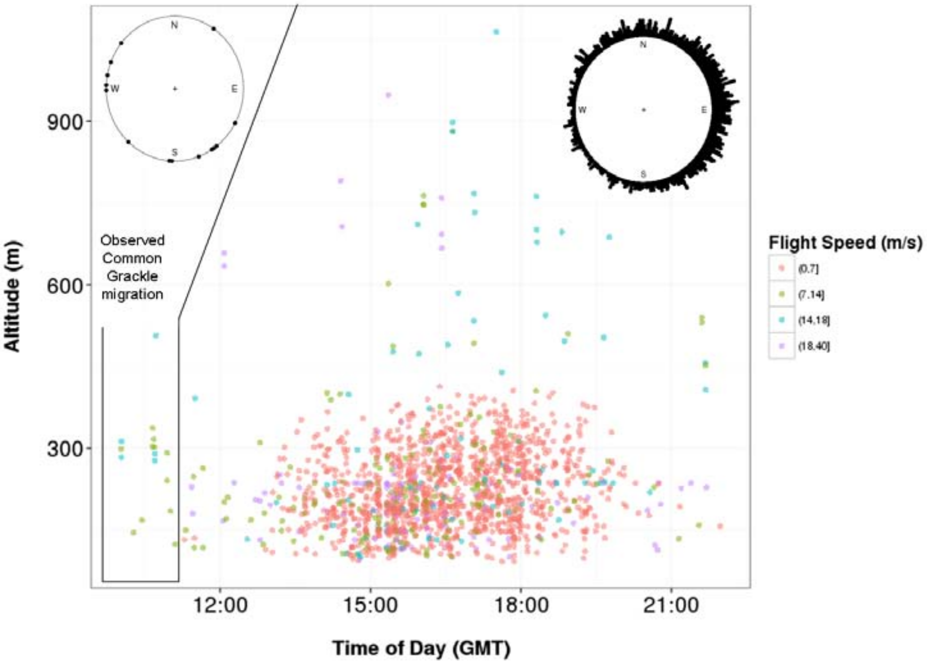


Figure 7. Radar data on the day of 17 September, identified by stopover surveys as a day with Common Grackle migration early in the morning. Radar results from this time are boxed off including a circular plot of heading. The remainder of the day's results are summarized in the second circular plot. Colour indicates wind speed.

On 14 October, Kearney (pers. com) recorded 164 American Robins on stopover counts between 10:36 GMT and 12:39 GMT. Most of these individuals (n = 156) had a westerly component to their heading (either SW, W or W). Again, we do not see the same pattern in the radar data. Few targets were detected between these times (or in fact during the entire day, n = 42), and over half (60%) of those detected had an easterly component to their heading.

Both of these results point to the importance of combining the two observational methods. Ground-based surveys are picking up movements at lower altitudes, and with the particular configuration of the radars that we had at this site, we are not well able to detect low-altitude movements.

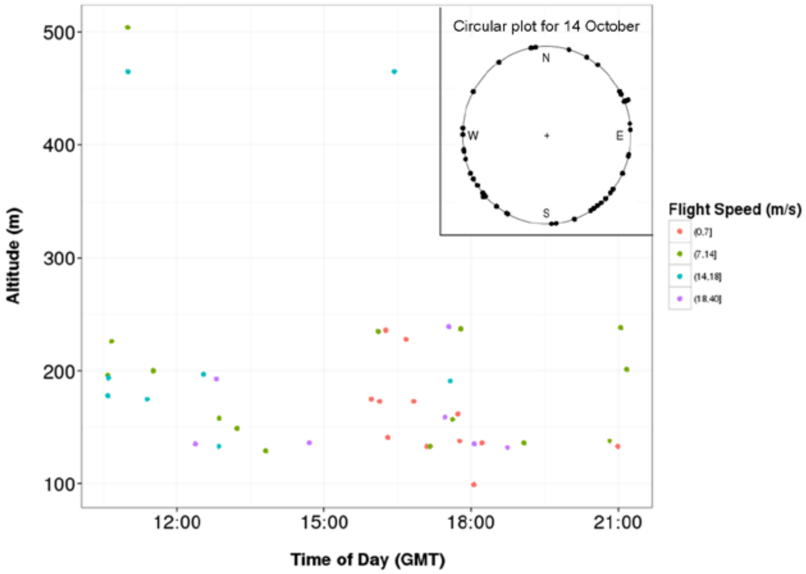


Figure 8. Radar data on the day of 14 October, identified by stopover surveys as a day with American Robin migration early in the morning.

Effects of weather on number of targets detected, heading and variability in heading

Number of targets detected (log). Some of the weather variables were quite important in explaining the number of targets detected at the two sites. In particular, in the early season there were important and strong positive relationships between humidity and the number of targets detected at sunset and night. There was also a moderately important and moderately strong positive relationship between tailwind assistance and the number of targets detected at night (Figure 9). In the late season, change in pressure, and tailwind assistance had strong positive relationships with the number of targets detected at night; these relationships were quite important in explaining the number of targets detected. At sunset and sunrise tailwind assistance was moderately important in explaining the number of targets detected; at sunset, as tailwind assistance increased number of targets detected increased whereas sunrise, as tailwind assistance decreased number of targets detected increased. Finally, humidity was moderately important in explaining the number of targets detected, as humidity decreased the number of targets detected increased (Figure 9).

Variance in heading. Weather was slightly more important in explaining variance in heading observed at the two sites. In the early season change in pressure was important in explaining variance at sunset and night. Both these relationships were negative (as change in pressure decreases, variance increases). Humidity was also important in explaining variance in heading; however this relationship was only weakly positive. Surprisingly tailwind assistance was positively correlated with variance, but only moderately important. In the late season only tailwind assistance and humidity were important in explaining variance, and only at night. Humidity had a strong positive relationship with variance (as humidity increased, variance increased). Whereas tailwind assistance had a strong negative relationship with variance (as tailwind assistance decreased, variance increased; Figure 9).

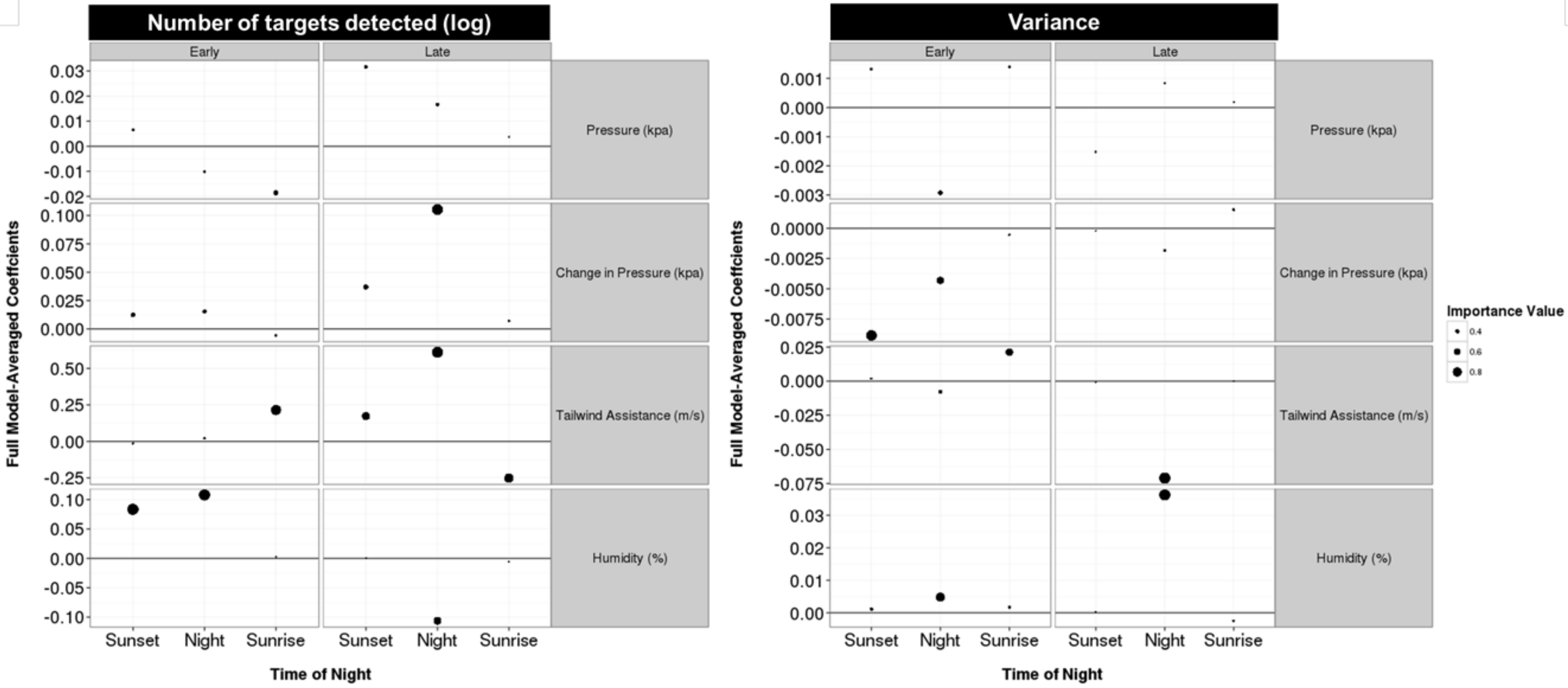


Figure 9. Full model-averaged coefficients from candidate models assessing the association of weather variables with number of targets detected (log), and variance in heading through at sunset, night, and sunrise. Size of the points is scaled on the importance value calculated from model averaging (on a scale of 0-1).

An unexpected result from the weather modeling was consistency of tailwind assistance in explaining the number of targets detected and the variability in heading. However, if we examine the main direction of wind in this area over the course of the season we observe that on 77% of the nights in the early part of the season and 69% of nights in the later part of the season, the wind is in an “inappropriate” direction (coming from the south) for seasonally appropriate movement, suggesting that many individuals may be migrating through the area in spite of unfavourable conditions, simply because they must.

Table 4. Mean wind direction at each time period for each night binned by direction.

	Early				Late			
	NW	NE	SE	SW	NW	NE	SE	SW
Sunset	2	5	6	21	0	8	7	16
Night	5	3	6	20	2	8	5	20
Sunrise	5	3	3	21	5	8	6	15
Total	12	11	15	62	7	24	18	51

Discussion

Migration timing

We observed similar distributions and density of targets at the two sites and the peaks in migration occurred on the same nights The small differences in numbers of targets likely are related to slight differences in the equipment used (e.g. slight variation in magnetron strength), by-products of the methods of target detection and extraction or they could be biological. Despite the effort to place the radars at the highest points in the areas, these two sites are separated by a slight ridge which could result in slight differences in the number of targets in the area. The similarity of the patterns at the two sites validates that we can make inference about the specific project areas by examining the two peripheral sites together.

Across the season the pattern of migration was moderately consistent with approximately 50% of migration occurring on 16% (house 1) and 17% (house 2) of nights monitored. This is higher than early work; Dury and Keith (1962) found that 60% of migration occurred on only 9% of nights monitored, Peckford (2006) found that 45% of migration occurred on 12% of nights monitored, and results from a study in 2010 found that ~50% migration occurred on between 11% and 15% of nights monitored (Lightfoot 2013; Appendix 2). The higher percent of targets that we observed here may be simply due to different population levels in species that move later versus earlier in the season. The pattern also suggests that the time window that we have reported on here contains the peak of fall migration for songbirds.

In early fall we detected a relatively consistent number of targets across all nights. In late fall, there were several nights with larger numbers of targets. These results suggest that early fall migration is strong and consistent, whereas late fall migration is more punctuated. Overall, these results are consistent with the general patterns of movement of migrant birds in NE North America and more locally consisted with a radar study conducted in the Gulf of Maine region in 2010 (Appendix 2).

Our ability to directly compare or rank the number of targets (Appendix 2) detected to what has been observed at other sites (in Nova Scotia or elsewhere) is limited. The angle of the radars for this project were deliberately set low to enhance the ability to detect targets closer to the ground. This compromises our ability to obtain data on targets at higher altitudes, making comparisons difficult. In addition, different track forming and filtering parameters were used in this project compared to the work in 2010, which influences the number of targets detected in unknown ways.

Furthermore, direct comparisons of data from any radar is dependent upon calibrating radars in a way that observers can calculated how probability of detection varies with distance from the beam. As such, even comparisons between the two sites in this study are not completed without caution. As part of ongoing research, we are investigating ways to undertake these calibrations, but we have not yet determined a method that can be readily put in to practice.

Direction of movement and variability in heading through the night

Circular plots of direction of movement for the early season show high variability in movement at both sites. Although there is a strong movement SW, there are also a high number of targets move SE and a moderate amount moving in “seasonally inappropriate” directions, NE and NW. Late in the season there is far less variability in heading with the majority of targets moving SW. Migration to the SW is consistent with movement from areas further north including Cape Breton and Newfoundland, following the general North America coastline. Migration to the SE direction is consistent with a more direct route to overwintering grounds in South America. Earlier radar studies in the region show some migration to the SE, and it is generally thought that this comprises shorebirds and Blackpoll Warblers (both which are known to take overwater routes to South America), and strong migration to the SW, thought to be passerines (Nisbet et al. 1995, Richardson 1972, 1978). These results are similar to some of the data from the radar study in 2010 (e.g. Lorneville and Petit Manan Point); however, greatly vary from data collected at Kent Island and Sandy Cove, where it was hypothesised that movement at these coastal sites was strongly influenced by local topography and encountering large expanses of open water (Lightfoot 2013; Appendix 3).

The variability in direction that we observed in the early part of the fall was exceptionally high compared to that observed in the late fall, and compared to other locations (e.g. Lightfoot 2013). High variability in the early season is consistent with the hypothesis that birds are less urgent to migrate and is also is influenced by a high proportion of targets moving in the SE direction. In addition, the low percent of nights with favorable wind conditions likely contribute to high variability. Individuals may not be moving in ‘appropriate’ migratory directions simply because they are undertaking post-fledging exploration of the landscape, or seeking suitable habitat for moulting. The lack of variability in the late fall is consistent with the hypothesis that birds are moving quickly through the site later in the season, a behavior we have observed at other locations in the region (Appendix 3). Furthermore, many of the individuals on fall migration on the east coast are hatch year birds move south for the first time (Leppold 2009, 2010, Ralph 1981,); this lack of experience may explain the lack of urgency in the early part of the season.

Closer examination of variability in heading shows an increase throughout the course of the night (Tables 1 and 2) in both the early and late season. This pattern is consistent with bird behaviour. Shortly after sunset individuals are initiating migration, at “night” the radar detects a combination of individuals in the middle of migration and ceasing migration (contributing to a slight increase in variability) and then at sunrise the radar detects individuals ceasing migration. Compared to other sites, arrow plots from these two sites shows consistency across altitudes suggesting similar migratory strategies are being employed at the altitudes sampled.

Correlations between radar data and acoustic monitoring

Correlation between radar data and acoustic data were lower than we have observed at the single other site where we have done this (Lightfoot and Taylor 2013). In the present study, the radar was set to scan at a higher angle (to avoid nearby clutter) which means that we are detecting fewer targets at lower altitudes. Other reasons for the lack of correlation are more likely, but difficult to ascertain. These include mostly biological effects – e.g. species composition varies (will discuss with Kearney for final report), individual birds have very different calling patterns at the two sites.

Species-level inference and diurnal migration

Neither of the two mornings identified by Kearney as having strong diurnal movement were well sampled by the radar. It is likely that these observed movements were occurring at an altitude below that which we were detecting targets by the radar. However, interestingly on the 17th, there seems to be a period of high activity later in the afternoon after Kearney’s surveys in a direction consistent with his early morning observations. It is possible that this is an extension of the diurnal migration he observed; however, there is a gap in time between his migrations and this period of high activity. In the final report we will more fully examine daytime radar data to more explicitly assess patterns of diurnal movement at the site.

Effects of weather on number of targets detected and variability in heading

The results from weather modelling in this study support previous work suggesting that weather affects migration in variable and complex ways (Richardson 1978, 1990). Overall relationships between weather variables and the number of targets detected were more important in the late season and for some variables (change in pressure and tailwind assistance) stronger. In the early season humidity is most important in explaining the number of targets detected; whereas in the late season tailwind assistance is more important. Weather relationships with variance were slightly stronger and more important in the early season compared to the early season. These results are similar from previous work (e.g. Peckford 2006, Thurber 2010, Matcovitch 2011, Lightfoot 2013, Lightfoot and Taylor 2013). In these studies, weather (tailwind assistance in particular) was shown to have an important relationship with the number of targets detected by the radar.

Although the relationship between tailwind assistance and the number of targets is not consistent, many of the relationships are biological correct. Because tailwind assistance was important in explaining the number of targets detected (positive relationship at night in the late season), this suggests that birds are taking advantage of the few nights with favourable winds. Furthermore, tailwind assistance is important in explaining variance in the late season at night (negative relationship). This suggests that birds are still moving on nights with headwinds, likely because so few nights have favourable winds, but the directions they are traveling on these nights are highly variable.

Assessment of risk

Assessments of risk of collisions using radar data are difficult, and have not been proven to be that effective. In general, mortality associated with windfarms is thought to be low, relative to the effects of other human infrastructure (Zimmerling *et al.* 2013).

Risk may be correlated with volume of migration, but without multiple, standardized radar studies from a broader region, it is difficult to make firm statements about whether the volume of migrants at the site is more or less than what might be expected elsewhere. In the present case, we have no data from other nearby sites that has been collected in a comparable way, and so are unable to compare the volume of migrants observed here to other places.

Risk may also be correlated with unusual patterns of movement, which can occur during periods of take-off and landing or during periods when individuals are re-orienting, and thus perhaps at higher risk because they are more likely to be stressed, tired or perhaps subject to some external force (e.g. fog) that leads to unusual patterns of movement. To our knowledge, such correlations have never been established, and so must be considered only as plausible hypotheses. The patterns of variability in orientation observed at this site, particularly in the early fall suggest that there may be more risk during that period than during late fall, although basing this conclusion on a single year's data is tenuous. However, it is our view that much of this variability may be due to biological variation that is not due to 'disorientation' but rather, likely due to landscape-scale stopover movements, post-fledging movements, or simply from different species groups (e.g. shorebirds vs. songbirds). A fuller analysis of these data is necessary to properly test this hypothesis.

The risk of mortality associated with wind farms may be associated with periods of extreme weather. In particular, patterns of fall movement in coastal Nova Scotia are highly dependent on weather (Mclaren et al 2000) and, in particular, with hurricanes or their remnants. The fall of 2014 had only six hurricanes, two tropical storms, and one tropical depression, more storms than 2013 but fewer than the previous three years (http://en.wikipedia.org/wiki/2013_Atlantic_hurricane_season) which should be taken in to account when considering these results and our interpretation.

Assessments of risk of wind turbine developments to migratory birds would benefit from broader, regional-scale studies that attempted to put into context patterns of migration as they relate to both local and regional-scale patterns of geography and weather. Further, such assessments would also benefit from rigorous, controlled, before-after studies that correlated post-construction mortality with pre-construction assessments of risk.

Future Work

In the coming weeks we will be processing and including the rest of fall migration (mid-October though late November) in analyses. In addition, we will be taking a closer look at diurnal movement at these sites. Finally we also hope to include an assessment of bat detections relative to radar detections.

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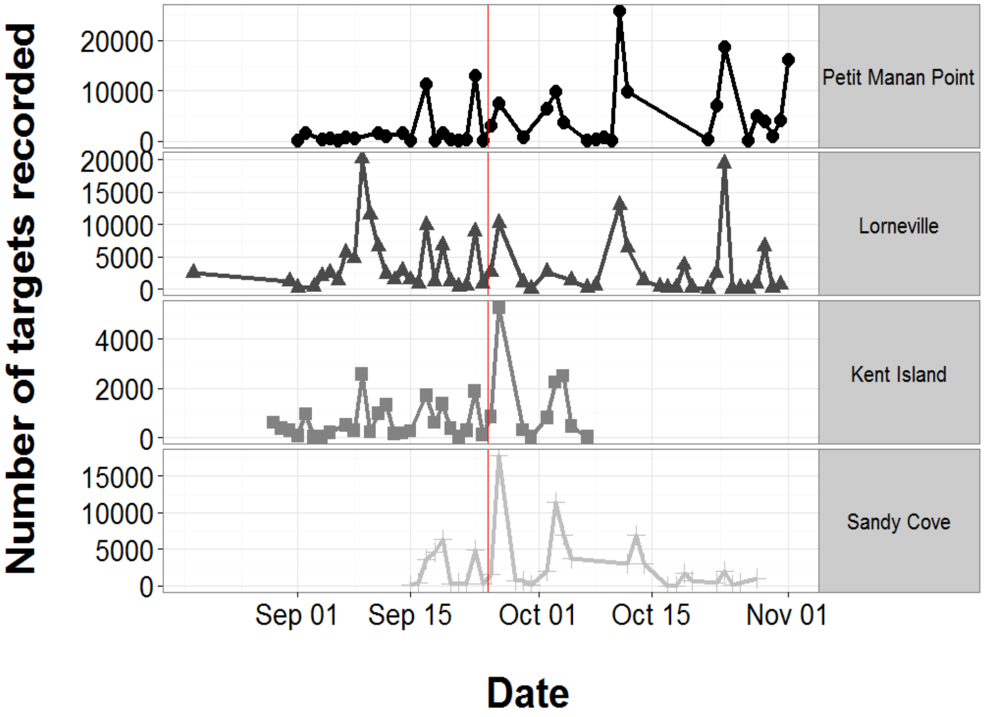
Appendix 1: Blip filtering settings used to remove clutter.

Location	Blip Area		# of Samples		Angular Span		Radial Span		Expression
	Min	Max	Min	Max	Min	Max	Min	Max	
House 1	150	20000	5	5000	1	-1	1	-1	int < 0.5
House 2	150	20000	5	5000	1	-1	1	-1	int < 0.5

Appendix 2: Number of tracks detected over the 2010 fall season at each site



Appendix 3: Circular plots at each site surveyed during the 2010 fall season.

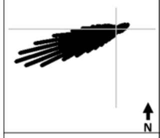
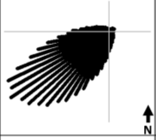
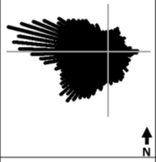
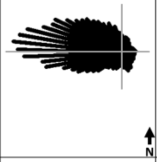
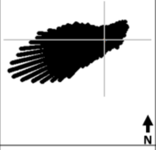
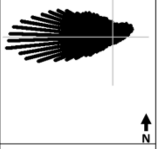
Petit Manan Point 		**Lorneville** 		**Kent Island** 		**Sandy Cove** 	
Start date: 01 Sep 2010 **End date:** 02 Nov 2010 **Usable nights:** 40		**Start date:** 19 Aug 2010 **End date:** 02 Nov 2010 **Usable nights:** 51		**Start date:** 29 Aug 2010 **End date:** 07 Oct 2010 **Usable nights:** 34		**Start date:** 15 Sep 2010 **End date:** 02 Nov 2010 **Usable nights:** 31	
Early	**Late**	**Early**	**Late**	**Early**	**Late**	**Early**	**Late**
							
# of Nights: 19 **Mean heading =** 250° **Circular var =** 0.31	**# of Nights:** 21 **Mean heading =** 247° **Circular var =** 0.12	**# of Nights:** 25 **Mean heading =** 217° **Circular var =** 0.65	**# of Nights:** 26 **Mean heading =** 231° **Circular var =** 0.22	**# of Nights:** 25 **Mean heading =** 258° **Circular var =** 0.57	**# of Nights:** 9 **Mean heading =** 279° **Circular var =** 0.32	**# of Nights:** 10 **Mean heading =** 261° **Circular var =** 0.53	**# of Nights:** 31 **Mean heading =** 282° **Circular var =** 0.44

Table 1: Warren Wind Project, Winter Bird Survey Detailed Results

Date	Transect Number	Transect Start (Easting)	Transect Start (Northing)	Start Point Habitat	Transect End (Easting)	Transect End (Northing)	End Point Habitat	Conditions				Time	Common Name	Number Observed	Distance to Observer (m)	Notes
								Wind Speed and Direction	Temperature °C	Sky	Precipitation					
February 27/2014	1	411779	5075082	Agricultural field	411561	5075281	Agricultural field with spruce hedge	<5 km/h S	-10	Overcast	None	7:09 AM	American Crow	2	100+	...
...	...	...	...	...	...	...	...	...	...	...	...	...	American Crow	3	50-100	...
...	...	...	...	...	...	...	...	...	...	...	...	...	American Goldfinch	2	50-100	...
...	...	...	...	...	...	...	...	...	...	...	...	...	Common Raven	1	100+	...
...	...	...	...	...	...	...	...	...	...	...	...	...	Snow Bunting	1	0-50	...
...	2	411561	5075281	Agricultural field with spruce hedge	411347	5075486	Agricultural field with spruce hedge	<5 km/h S	-10	Overcast	None	7:18 AM	American Crow	2	100+	...
...	...	...	...	...	...	...	...	...	...	...	...	...	Common Raven	1	100+	...
...	...	...	...	...	...	...	...	...	...	...	...	...	Common Raven	1	50-100	...
...	3	411347	5075486	Agricultural field with spruce hedge	411071	5075611	Mature softwood along agricultural field	<5 km/h S	-10	Overcast	None	7:25 AM	American Crow	2	100+	...
...	...	...	...	...	...	...	...	...	...	...	...	...	Blue Jay	1	50-100	...
...	...	...	...	...	...	...	...	...	...	...	...	...	Blue Jay	1	100+	...
...	...	...	...	...	...	...	...	...	...	...	...	...	Red Crossbill	2	FO	W
...	4	411071	5075611	Mature softwood along agricultural field	410852	5075700	Mature mixedwood along small stream	<5 km/h S	-10	Overcast	None	7:35 AM	Black-capped Chickadee	4	0-50	...
...	...	...	...	...	...	...	...	...	...	...	...	...	Blue Jay	1	50-100	...
...	...	...	...	...	...	...	...	...	...	...	...	...	Gray Jay	2	0-50	...
...	...	...	...	...	...	...	...	...	...	...	...	...	Pileated Woodpecker	1	100+	...
...	...	...	...	...	...	...	...	...	...	...	...	...	Purple Finch	2	FO	N
...	...	...	...	...	...	...	...	...	...	...	...	...	Red-breasted Nuthatch	1	0-50	...
...	5	410852	5075700	Mature mixedwood along small stream	410810	5075970	Mature softwood	<5 km/h S	-10	Overcast	None	7:50 AM	American Crow	2	100+	...
...	...	...	...	...	...	...	...	...	...	...	...	...	Black-capped Chickadee	6	0-50	...
...	...	...	...	...	...	...	...	...	...	...	...	...	Purple Finch	1	0-50	...
...	...	...	...	...	...	...	...	...	...	...	...	...	Red-breasted Nuthatch	1	0-50	...
...	6	410810	5075970	Mature softwood	411082	505983	Recent cutover	<5 km/h S	-10	Overcast	None	8:06 AM	American Crow	1	100+	...
...	...	...	...	...	...	...	...	...	...	...	...	...	Black-capped Chickadee	1	50-100	...
...	...	...	...	...	...	...	...	...	...	...	...	...	Common Raven	1	0-50	...
...	...	...	...	...	...	...	...	...	...	...	...	...	Purple Finch	2	0-50	...
...	7	411082	505983	Recent cutover	411029	5076267	Mixed shrub growth	<5 km/h S	-10	Overcast	None	8:24 AM	None Observed	N/A	N/A	...
...	8	411029	5076267	Mixed shrub growth	410862	5076510	Young hardwoods adjacent to recent cutover	<5 km/h S	-8	Overcast	None	8:34 AM	None Observed	N/A	N/A	...
...	9	410862	5076510	Young hardwoods adjacent to recent cutover	410650	5076645	Young spruce adjacent to recent cutover	<5 km/h S	-8	Overcast	None	8:44 AM	American Crow	1	100+	...
...	...	...	...	...	...	...	...	...	...	...	...	...	Common Raven	1	100+	...
...	10	410650	5076645	Young spruce adjacent to recent cutover	410394	5076790	Young spruce	<5 km/h S	-8	Overcast	None	8:57 AM	American Crow	1	50-100	...
...	...	...	...	...	...	...	...	...	...	...	...	...	American Crow	1	100+	...
...	...	...	...	...	...	...	...	...	...	...	...	...	American Crow	5	FO	NW
...	...	...	...	...	...	...	...	...	...	...	...	...	Red-winged Crossbill	2	FO	N
...	11	410394	5076790	Young spruce	410195	5076973	Mixed shrub growth along access road	<5 km/h S	-8	Overcast	None	9:08 AM	American Crow	1	100+	...
...	...	...	...	...	...	...	...	...	...	...	...	...	Brown Creeper	1	0-50	...
...	...	...	...	...	...	...	...	...	...	...	...	...	Purple Finch	1	FO	E
...	12	410311	5076866	Young mixedwoods along access road	410587	5076983	Young to mid-aged softwood along access road; close to shrub swamp	<5 km/h S	-8	Overcast	None	9:20 AM	American Crow	2	100+	...
...	...	...	...	...	...	...	...	...	...	...	...	...	Black-capped Chickadee	4	0-50	...
...	13	410587	5076983	Young to mid-aged softwood along access road; close to shrub swamp	410836	576847	Mid-aged softwood along powerline corridor	<5 km/h S	-8	Overcast	None	9:39 AM	None Observed	N/A	N/A	...
...	14	410836	576847	Mid-aged softwood along powerline corridor	411030	5076657	Mid-aged softwood along powerline corridor	<5 km/h S	-8	Overcast	None	9:48 AM	Black-capped Chickadee	4	0-50	...
...	...	...	...	...	...	...	...	...	...	...	...	...	Red-breasted Nuthatch	1	0-50	...
...	15	411030	5076657	Mid-aged softwood along powerline corridor	411211	5076453	Mid-aged softwood along powerline corridor	<5 km/h S	-8	Overcast	None	9:57 AM	Common Raven	1	100+	...
...	16	411211	5076453	Mid-aged softwood along powerline corridor	411315	5076224	Regenerating softwoods	<5 km/h S	-8	Overcast	None	10:07 AM	American Crow	2	100+	...
...	17	411315	5076224	Regenerating softwoods	411374	5075971	Shrub hardwoods along recent cutover and mid-aged mixedwood	<5 km/h S	-5	Overcast	None	10:17 AM	American Crow	1	100+	...
...	...	...	...	...	...	...	...	...	...	...	...	...	Black-capped Chickadee	9	0-50	...
...	18	411374	5075971	Shrub hardwoods along recent cutover and mid-aged mixedwood	411491	5075725	Edge of agricultural field and recent cutover	<5 km/h S	-5	Overcast	None	10:31 AM	American Crow	2	100+	...
...	...	...	...	...	...	...	...	...	...	...	...	...	Black-capped Chickadee	2	50-100	...
...	...	...	...	...	...	...	...	...	...	...	...	...	Ring-necked Pheasant	2	0-50	...
...	19	411491	5075725	Edge of agricultural field and recent cutover	411684	5075555	Edge of agricultural field and recent cutover	<5 km/h S	-5	Overcast	None	10:41 AM	None Observed	N/A	N/A	...

Table 1: Warren Wind Project, Winter Bird Survey Detailed Results

Date	Transect Number	Transect Start (Easting)	Transect Start (Northing)	Start Point Habitat	Transect End (Easting)	Transect End (Northing)	End Point Habitat	Conditions				Time	Common Name	Number Observed	Distance to Observer (m)	Notes
								Wind Speed and Direction	Temperature °C	Sky	Precipitation					
...	20	411684	5075555	Edge of agricultural field and recent cutover	411866	5075384	Edge of agricultural field, along narrow shrub hedge	10-15 km/h S	-5	Overcast	None	10:47 AM	American Crow	1	100+	...
March 12/2014	1	411779	5075082	Agricultural field	411561	5075281	Agricultural field with spruce hedge	10-15 km/h SE	-6	Overcast	None	7:28 AM	American Crow	3	100+	...
...	...	...	...	...	...	...	...	...	...	...	...	...	American Crow	5	FO	WSW
...	...	...	...	...	...	...	...	...	...	...	...	...	Common Raven	1	100+	...
...	2	411561	5075281	Agricultural field with spruce hedge	411347	5075486	Agricultural field with spruce hedge	10-15 km/h SE	-6	Overcast	None	7:35 AM	None Observed	N/A	N/A	...
...	3	411347	5075486	Agricultural field with spruce hedge	411071	5075611	Mature softwood along agricultural field	10-15 km/h SE	-6	Overcast	None	7:42 AM	Black-capped Chickadee	3	0-50	...
...	...	...	...	...	...	...	...	...	...	...	...	...	Blue Jay	1	100+	...
...	...	...	...	...	...	...	...	...	...	...	...	...	Common Raven	1	50-100	...
...	...	...	...	...	...	...	...	...	...	...	...	...	Pileated Woodpecker	1	100+	...
...	4	411071	5075611	Mature softwood along agricultural field	410852	5075700	Mature mixedwood along small stream	10-15 km/h SE	-6	Overcast	None	7:53 AM	Hermit Thrush	1	100+	...
...	...	...	...	...	...	...	...	...	...	...	...	...	Purple Finch	2	0-50	...
...	...	...	...	...	...	...	...	...	...	...	...	...	Red-breasted Nuthatch	1	50-100	...
...	5	410852	5075700	Mature mixedwood along small stream	410810	5075970	Mature softwood	10-15 km/h SE	-6	Overcast	None	8:06 AM	American Crow	2	100+	...
...	...	...	...	...	...	...	...	...	...	...	...	...	Pileated Woodpecker	1	100+	...
...	6	410810	5075970	Mature softwood	411082	505983	Recent cutover	10-15 km/h SE	-6	Overcast	None	8:16 AM	American Crow	1	100+	...
...	...	...	...	...	...	...	...	...	...	...	...	...	American Goldfinch	1	FO	E
...	...	...	...	...	...	...	...	...	...	...	...	...	Hairy Woodpecker	1	100+	...
...	...	...	...	...	...	...	...	...	...	...	...	...	Purple Finch	1	50-100	...
...	7	411082	505983	Recent cutover	411029	5076267	Mixed shrub growth	10-15 km/h SE	-6	Overcast	None	8:25 AM	Common Raven	1	100+	...
...	8	411029	5076267	Mixed shrub growth	410862	5076510	Young hardwoods adjacent to recent cutover	10-15 km/h SE	-2	Overcast	None	8:32 AM	American Crow	1	FO	N
...	...	...	...	...	...	...	...	...	...	...	...	...	American Crow	2	100+	...
...	9	410862	5076510	Young hardwoods adjacent to recent cutover	410650	5076645	Young spruce adjacent to recent cutover	10-15 km/h SE	-2	Overcast	None	8:42 AM	American Crow	9	FO	E
...	...	...	...	...	...	...	...	...	...	...	...	...	American Crow	1	50-100	...
...	...	...	...	...	...	...	...	...	...	...	...	...	American Goldfinch	1	50-100	...
...	...	...	...	...	...	...	...	...	...	...	...	...	American Goldfinch	1	FO	NE
...	...	...	...	...	...	...	...	...	...	...	...	...	Hairy Woodpecker	1	0-50	...
...	10	410650	5076645	Young spruce adjacent to recent cutover	410394	5076790	Young spruce	15-20 km/hSE	-2	Overcast	None	8:58 AM	Purple Finch	1	FO	N
...	11	410394	5076790	Young spruce	410195	5076973	Mixed shrub growth along access road	15-20 km/hSE	-2	Overcast	None	9:05 AM	American Crow	1	FO	W
...	...	...	...	...	...	...	...	...	...	...	...	...	American Crow	2	100+	...
...	...	...	...	...	...	...	...	...	...	...	...	...	Black-capped Chickadee	3	0-50	...
...	...	...	...	...	...	...	...	...	...	...	...	...	Black-capped Chickadee	1	50-100	...
...	...	...	...	...	...	...	...	...	...	...	...	...	Purple Finch	2	0-50	...
...	12	410311	5076866	Young mixedwoods along access road	410587	5076983	Young to mid-aged softwood along access road; close to shrub swamp	15-20 km/hSE	-2	Overcast	None	9:21 AM	Black-capped Chickadee	2	0-50	...
...	...	...	...	...	...	...	...	...	...	...	...	...	Common Raven	1	50-100	...
...	...	...	...	...	...	...	...	...	...	...	...	...	Ring-billed Gull	1	FO	N
...	13	410587	5076983	Young to mid-aged softwood along access road; close to shrub swamp	410836	576847	Mid-aged softwood along powerline corridor	15-20 km/hSE	-2	Overcast	None	9:31 AM	Black-capped Chickadee	1	50-100	...
...	...	...	...	...	...	...	...	...	...	...	...	...	Purple Finch	1	0-50	...
...	14	410836	576847	Mid-aged softwood along powerline corridor	411030	5076657	Mid-aged softwood along powerline corridor	15-20 km/hSE	-2	Overcast	None	9:37 AM	American Crow	2	100+	...
...	...	...	...	...	...	...	...	...	...	...	...	...	Black-capped Chickadee	1	50-100	...
...	15	411030	5076657	Mid-aged softwood along powerline corridor	411211	5076453	Mid-aged softwood along powerline corridor	15-20 km/hSE	-2	Overcast	None	9:43 AM	Black-capped Chickadee	8	0-50	...
...	...	...	...	...	...	...	...	...	...	...	...	...	Red Crossbill	1	0-50	...
...	...	...	...	...	...	...	...	...	...	...	...	...	Red-breasted Nuthatch	1	0-50	...
...	...	...	...	...	...	...	...	...	...	...	...	...	Red-breasted Nuthatch	1	50-100	...
...	16	411211	5076453	Mid-aged softwood along powerline corridor	411315	5076224	Regenerating softwoods	15-20 km/hSE	-2	Overcast	None	9:58 AM	Dark-eyed Junco	1	0-50	...
...	17	411315	5076224	Regenerating softwoods	411374	5075971	Shrub hardwoods along recent cutover and mid-aged mixedwood	15-20 km/hSE	-2	Overcast	None	10:05 AM	American Crow	2	100+	...
...	...	...	...	...	...	...	...	...	...	...	...	...	American Robin	1	100+	...
...	18	411374	5075971	Shrub hardwoods along recent cutover and mid-aged mixedwood	411491	5075725	Edge of agricultural field and recent cutover	15-20 km/hSE	-2	Overcast	None	10:22 AM	Bald Eagle	1	100+	Sitting adjacent to nest
...	19	411491	5075725	Edge of agricultural field and recent cutover	411684	5075555	Edge of agricultural field and recent cutover	15-20 km/hSE	-2	Overcast	None	10:31 AM	Ring-necked Pheasant	1	50-100	...
...	...	...	...	...	...	...	...	...	...	...	...	...	Ring-necked Pheasant	1	0-50	...
...	20	411684	5075555	Edge of agricultural field and recent cutover	411866	5075384	Edge of agricultural field, along narrow shrub hedge	15-20 km/hSE	-2	Overcast	None	10:38 AM	Ring-necked Pheasant	2	0-50	...

Table 2: Warren Wind Project, Winter Bird Survey Summarized Results **Job # 14-4969**

Common Name	Scientific Name	SARA Status	NSESA Status	COSEWIC Status	NSDNR Status	Number of Observations	Individuals Observed
American Crow	*Corvus brachyrhynchos*	Not Listed	Not Listed	Not Listed	Green	28	60
American Goldfinch	*Spinus tristis*	Not Listed	Not Listed	Not Listed	Green	4	5
American Robin	*Turdus migratorius*	Not Listed	Not Listed	Not Listed	Green	1	1
Bald Eagle	*Haliaeetus leucocephalus*	Not Listed	Not Listed	Not at Risk	Green	1	1
Black-capped Chickadee	*Poecile atricapillus*	Not Listed	Not Listed	Not Listed	Green	14	49
Blue Jay	*Cyanocitta cristata*	Not Listed	Not Listed	Not Listed	Green	4	4
Brown Creeper	*Certhia americana*	Not Listed	Not Listed	Not Listed	Green	1	1
Common Raven	*Corvus corax*	Not Listed	Not Listed	Not Listed	Green	10	10
Dark-eyed Junco	*Junco hyemalis*	Not Listed	Not Listed	Not Listed	Green	1	1
Gray Jay	*Perisoreus canadensis*	Not Listed	Not Listed	Not Listed	Yellow	1	2
Hairy Woodpecker	*Picoides villosus*	Not Listed	Not Listed	Not Listed	Green	2	2
Hermit Thrush	*Catharus guttatus*	Not Listed	Not Listed	Not Listed	Green	1	1
Pileated Woodpecker	*Dryocopus pileatus*	Not Listed	Not Listed	Not Listed	Green	4	4
Purple Finch	*Carpodacus purpureus*	Not Listed	Not Listed	Not Listed	Green	9	13
Red Crossbill	*Loxia curvirostra*	Not Listed	Not Listed	Not Listed	Green	2	3
Red-breasted Nuthatch	*Sitta canadensis*	Not Listed	Not Listed	Not Listed	Green	6	6
Ring-billed Gull	*Larus delawarensis*	Not Listed	Not Listed	Not Listed	Green	1	1
Ring-necked Pheasant	*Phasianus colchicus*	Not Listed	Not Listed	Not Listed	Exotic	4	6
Snow Bunting	*Plectrophenax nivalis*	Not Listed	Not Listed	Not Listed	Green	1	1
Total						**95**	**171**

Appendix C:

Bat Activity Survey

Characterization of the magnitude of bat activity at the proposed Amherst Community Wind Farm Project, Cumberland County, NS

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Context

Project Background

Natural Forces is proposing to install three wind turbines to generate electricity near the community of Amherst, Cumberland County, Nova Scotia. The project is in an early phase with wind monitoring on site with a measurement tower (MET tower) and Sonic detection and ranging (SODAR) unit.

Commercial scale wind energy production is one of the fastest growing sectors of the global energy industry as the demand for renewable energy sources for electricity generation continues to increase (Nelson 2009). This demand, combined with recent advances in wind turbine technology that have improved the cost-competitiveness of wind energy, has led to a global increase in the number of wind energy installations. In Canada, energy production and regulation falls under provincial jurisdiction and thus most renewable energy targets are set at the provincial level. In the province's Renewable Electricity Plan, the Provincial Government of Nova Scotia has set an aggressive target of 40% of the province's electricity needs to be met by renewable energy by the year 2020 (Nova Scotia Department of Energy 2010). Of this amount, 25% has been set as coming from made-in-Nova Scotia sources by 2015, and the wind energy sector is anticipated to be the largest contributor in meeting these goals. As of 2014, Nova Scotia power estimates that close to 10% of current electricity needs are met by wind energy (NSP 2014). The Amherst Community Wind Farm project is part of the Community Feed-In Tariff program (COMFIT) of the Renewable Electricity Plan which facilitates small-scale, local renewable projects that involve community groups.

Despite the many environmental benefits of electrical generation via wind energy, the rapid global growth of the wind energy sector has raised concerns regarding the impacts of these developments on both resident and migratory populations of wildlife (Arnett et al. 2008b). Large numbers of bat fatalities have occurred at wind energy facilities (Johnson 2005a) and this is gaining considerable global attention. As a result, fatalities of bats have become a primary environmental concern associated with wind energy development.

Efforts to minimize conflicts between wildlife and wind energy have focused mainly on two areas: risk avoidance and impact mitigation (Weller and Baldwin 2012). Impact mitigation refers to those efforts focused on developing methods to reduce wildlife fatalities at operational wind facilities and does not apply to this project at this time. Risk avoidance involves conducting surveys prior to construction to avoid sites, or areas within sites, with high levels of usage by wildlife. The assumption of this approach is that low indices of activity prior to construction should result in low fatality rates post-construction since there should be fewer animals 'available' to be killed. This further assumes that bats are not attracted to the infrastructure once built (Baerwald and Barclay 2009). As the planning phase proceeds for the development of the project, surveys of the wildlife at the proposed site are being undertaken to address any potential wildlife issues related to the development of the site. This document provides a summary of the echolocation survey undertaken for bats at the Amherst Community Wind Farm Project in 2014.

Regulatory Context

The following legislation and policy were considered in relation to the proposed survey at the Amherst Community Wind Farm Project:

- Federal Species at Risk Act (http://laws-lois.justice.gc.ca/eng/acts/S-15.3/page-1.html)
- Nova Scotia *Wildlife Act* (http://nslegislature.ca/legc/statutes/wildlife.pdf)
- Nova Scotia *Endangered Species Act* (http://www.novascotia.ca/legislature/legc/statutes/endspec.htm)

Additional resources that are relevant to the proposed surveys used include:

- Atlantic Canada Conservation Data Centre (http://www.accdc.com/)
- Wild Species: The General Status of Species in Canada (http://www.wildspecies.ca/home.cfm?lang=e)
- Global Species Rankings (http://www.natureserve.org/explorer/)

Study Objectives

The objectives of this project were to:

(1) Provide information on the occurrence and relative magnitude of bat activity in the proposed development area, based on analysis of echolocation survey results;

(2) Provide relevant information on the resource requirements of local bat species that may be useful for the decision-making process on the proposed development; and

(3) Make relevant recommendations based on the results of this project and recent developments in the field of bats and wind energy.

Review of Key Issues

Background

As of July (2014) in Nova Scotia, there are >150 wind turbines in operation with a total capacity of approximately 335 MW (CanWEA 2014). As of yet, we are not aware of any incidents of major mortality, though bats have been killed. For context and qualification, most of these turbines have been in operation for only a short period of time (months to less than 10 years) and it is not known how thoroughly all existing operational turbines have been surveyed for bat fatalities, or how well documented and reported the findings are. In the following sections we discuss the various means by which bats may be impacted by wind energy developments, including direct mortality, changes to habitat availability, and disruption of movement patterns (e.g., foraging, mating, migrations, or abandonment of sites).

Direct Mortality

Proximate causes of bat fatalities at wind energy developments may be due to direct strike by rotating turbine blades, collision with turbine towers, barotrauma or any combination of the three. Barotrauma involves tissue damage to the lungs due to rapid or excessive air-pressure reduction near moving turbines blades (Baerwald et al. 2008, Cryan and Barclay 2009). The discussion of the relative role of barotrauma in the death of bats at wind energy developments remains on-going (Grodsky et al. 2011, Capparella et al. 2012, Rollins et al. 2012). In North America, significant bat fatality events at wind energy developments occur primarily in the late summer and early fall, peaking during the period that coincides with fall migration (Johnson 2005b, Cryan and Brown 2007, Arnett et al. 2008a). These trends have led researchers to believe that migration plays a key role in the susceptibility of certain bat species to wind turbine fatalities (Cryan and Barclay 2009). Although some fatality has also been documented during the spring (Brown and Hamilton 2006, Arnett et al. 2008a), numbers are much lower, and are thought to be a result of more scattered migratory behaviour, or possibly the use of different routes compared to fall migration.

The species that have the largest number of kills at wind farms are the long-distance migratory bats, including the hoary bat (*Lasiurus cinereus*), the eastern red bat (*L. borealis*), and the silver-haired bat (*Lasionycteris noctivagans*). In North America, these species make up about 75-80% of the documented fatalities at wind energy developments, with the hoary bat alone comprising almost half (Kunz et al. 2007, Arnett et al. 2008a). The cumulative impacts of current mortality rates as a result of wind turbines on these affected species could have long-term population effects (Kunz et al. 2007). With mortalities at wind turbines in Europe from a large catchment area, including resident and migrating individuals, (Voigt et al. 2012, Lehnert et al. 2014), these effects could be having large scale impacts on these species. Bat fatalities in North America have also been reported for resident hibernating bat species, including the big brown bat (*Eptesicus fuscus*), the little brown bat (*Myotis lucifugus*), the northern long-eared bat (*M. septentrionalis*), and the tri-colored bat (*Perimyotis subflavus*) (Nicholson 2003, Johnson 2005b, Jain et al. 2007, Arnett et al. 2008a). At some sites in the eastern United States high numbers of fatalities of these resident, hibernating species have been reported (Kunz et al. 2007).

Various explanations for the high incidence of bat fatalities at wind energy developments have been proposed (Johnson 2005b, Kunz et al. 2007, Arnett et al. 2008a, Cryan and Barclay 2009). Estimates of the number of bat fatalities vary widely from less than 3 bats/turbine/year (Johnson et al. 2003, Johnson et al. 2004) to upwards of 50 bats/turbine/year (Nicholson 2003, Kerns et al. 2005, Jain et al. 2007). Given the considerable variability in species composition and rates of bat fatalities among wind energy facilities, it is likely that location-specific qualities of individual facilities are important (e.g., located along migration routes or other flight corridors). It has also been proposed that the use of turbines with increasing height has extended developments further into the flight space used by migrating bats (Barclay et al. 2007). However, behavioural observations of bats around wind turbines shows flight patterns typical of foraging activity prior to collisions with turbines which may put bats at increased risk for collisions or interactions (Horn et al. 2008). Recent work has demonstrated that many bats are actively foraging during migration (Reimer et al. 2010, Valdez and Cryan 2013). Others have hypothesized that collisions may result from bats being attracted to turbines out of curiosity, misperception (failure to avoid a detected obstacle or interference with perception of an obstacle), or as potential feeding, roosting, and mating opportunities (reviewed in Cryan and Barclay 2009). New work using thermal imaging cameras found bats closely approached turbine structures (monopoles, nacelles and turbine) as well as made flight loops, dives, and hovering behaviours , and chased other bats around structures (Cryan et al. 2014). The authors suggest that bats are attracted to these structures, perhaps to roost, forage around or seek mates, but to date, the cause(s) of bat fatalities at turbines remains unclear and is an active area of research.

As mortalities may be the result of site-specific and design-specific characteristics and conditions, it is important to conduct site-specific monitoring studies to make reliable inferences on the potential impacts of a wind energy development on local bat populations (American Society of Mammalogists 2008).

Habitat Availability

In forested landscapes, habitat availability for bats may be impacted by the alteration or removal of vegetation to accommodate roads and wind turbine installations. This may include the direct loss of resources (e.g., roost trees), fragmentation of habitat components (e.g., foraging and roosting areas), or other disturbance that may cause bats to vacate certain areas. Together these can act to degrade the local environment for bat colonies/populations that reside in the area during the summer. This negative impact of new wind energy developments is likely to occur, and will contribute to the cumulative effect of habitat loss that is occurring throughout the range of most bat species (Altringham 2011).

At the site level, small-scale clearings in forested landscapes have been shown to attract certain bat species, which use these areas for foraging (Grindal and Brigham 1998, Hayes and Loeb 2007). Removal of vegetation can create edges and small clearings which can act to concentrate prey for bats. The extent to which this loss of vegetation can be perceived to be beneficial to bats is not known. Further, the extent of fragmentation varies from site to site, as there must be a balance between the availability of suitable roosting resources with the availability of suitable foraging areas within commuting distance to provide conditions that favour the occupancy of resident bat species (Henderson and Broders 2008). Differential effects of forest fragmentation are known for different species of a bat community (Patriquin and Barclay 2003, Segers and Broders 2014) thus necessitating the need for bat species considerations in managements plans, not just broad level management plans for bat communities.

Movement Patterns

From the perspective of bat movement, resident bats may be affected by wind energy developments through alterations to foraging areas and possible disruption of commuting movements between roosting and foraging areas. There is some genetic evidence to suggest that bat movements can be impeded by fragmentation of habitat, which can scale up to population or distributional level effects (Kerth and Petit 2005, Meyer et al. 2009). However, this is not well understood for most species.

Little is known about the dynamics of movement (e.g., altitude, travel routes, frequency of visitation) of resident, hibernating bats to and from hibernation sites. Anecdotal evidence suggests that bats likely use ridges and other linear landscape elements (e.g., riparian corridors) as travel routes, depending on the landscape (Arnett 2005, Lausen 2007, Furmankiewicz and Kucharska 2009). In the late summer and early autumn large numbers of bats congregate at the entrances to underground hibernacula in an activity referred to as 'swarming' (Davis and Hitchcock 1965, Fenton 1969, Thomas and Fenton 1979, Glover and Altringham 2008). During the swarming period bats do not roost in hibernacula; research being conducted in Nova Scotia indicates that resident bats are 'on the move', roosting transiently on the landscape (Lowe 2012), though we do not have a full understanding of the dynamics of these behaviours. Swarming may serve several functions, including courtship, copulation, and orienting young-of-the-year to over-wintering sites (Fenton 1969, Thomas and Fenton 1979).

Movement data from Ontario and Manitoba suggests that resident bats may move up to at least 120 km between hibernacula within a year, and up to at least 500 km between years (Fenton 1969, Norquay et al. 2013). In New England, there are records of bats moving 214 km between hibernacula within one year, with one female moving 128 km in only three nights during spring emergence from hibernation (Davis and Hitchcock 1965). Thus these resident hibernating species are at least capable of large scale migratory movements on the order of hundreds of kilometers. It is not known whether flight behaviour (e.g., height, routes, etc.) during this time differs from when resident species are in their summering area; the paucity of information on this aspect of their biology would appear to be one of the largest impediments in accurately predicting the impact of wind energy developments on local bat populations (Weller et al. 2009).

Bats in Nova Scotia

Nova Scotia Bat species

In Nova Scotia there are occurrence records for six species of bats (Table 1; van Zyll de Jong 1985, Broders et al. 2003, Segers et al. 2013), and each have been documented to have experienced fatalities at wind turbine sites (Arnett et al. 2008a). There are three species of long-distance migratory bats recorded in the province, the hoary bat, the eastern red bat, and the silver-haired bat. These three species have extensive distributional ranges throughout North America, with Nova Scotia at or near their northern range limit (van Zyll de Jong 1985). Low numbers of echolocation recordings of the long-distance migratory species in Nova Scotia by Broders (2003), other unpublished work, and recent compilation of sighting records (Lucas and Hebda 2011), suggests that there are no significant populations or large scale migratory movements of these species in the province. However, they do occur regularly and are often associated with coastal or off-shore autumn occurrences (Cryan and Brown 2007, Czenze et al. 2011, Segers et al. 2013). Two species of bats in the genus *Myotis*, the little brown bat and the northern long-eared bat, are the only abundant and widely distributed bats in Nova Scotia (Broders et al. 2003, Henderson et al. 2009). These 5–8 g insectivorous bats are sympatric over much of their range (Fenton and Barclay 1980, van Zyll de Jong 1985, Caceres and Barclay 2000). A third species, the tri-coloured bat, has a significant population in the province, however they are likely restricted to southwest Nova Scotia (Broders et al. 2003, Rockwell 2005, Farrow and Broders 2011). These three species are gregarious species that over-winter in caves and abandoned mines in the region (Moseley 2007, Randall and Broders 2014). There is only one unconfirmed observation of the big brown bat, also a gregarious species, hibernating at a cave in central mainland Nova Scotia (Taylor 1997).

Ecology of Resident Species

Northern long-eared, little brown and tri-coloured bats are expected to be the most likely species to occupy the proposed development area. The life history of these species is typical for temperate, insectivorous bats. Their annual cycle consists of a period of activity (reproduction) in the summer, and a hibernation period in the winter. Females of the three species bear the full cost of reproduction in the summer, from pregnancy to providing sole parental care to juveniles (Barclay 1991, Hamilton and Barclay 1994, Broders 2003).

The northern long-eared bat is a forest interior species that primarily roosts and forages in the interior of forests (Broders 2003, Jung et al. 2004, Henderson and Broders 2008). Females form maternity colonies, roosting in coniferous or deciduous trees, depending on availability (Foster and Kurta 1999, Broders et al. 2006, Garroway and Broders 2008). Males typically roost solitarily in either deciduous or coniferous trees (Lacki and Schwierjohann 2001, Jung et al. 2004, Ford et al. 2006). The little brown bat is a generalist species that is associated with forests, as well as human-dominated environments (Barclay 1982, Jung et al. 1999). This species has been found to forage over water and in forests (Anthony and Kunz 1977, Fenton and Barclay 1980), and both males and females (i.e., maternity colonies) have been documented roosting in both buildings and trees (Crampton and Barclay 1998, Broders and Forbes 2004). During the summer, it appears that most of the commuting and foraging activity of northern long-eared and little brown bats occurs close to the ground (Broders 2003). Nonetheless, our ability to survey bat activity at high altitudes is extremely limited, and therefore our ability to make inference on the vertical distribution of bats is also limited.

The third species that occurs year-round in Nova Scotia is the tri-colored bat, is not likely to occur in the proposed development area as it is locally abundant in southwest Nova Scotia (Farrow and Broders 2011). In Nova Scotia, work that we have done in Kejimkujik National Park suggests that this species roost in *Usnea* lichen species and forages over waterways (Poissant et al. 2010).

White Nose Syndrome

In 2012, three species of bats found in Nova Scotia were listed by COSEWIC as Endangered, and in 2013 were listed as Endangered by the Province of Nova Scotia. This is primarily due to the spread of an emerging infectious disease known as White Nose Syndrome (WNS) that is responsible for unprecedented mortality in hibernating bats through much of eastern North America (Blehert et al. 2009, United States Fish & Wildlife Service 2012). The condition is caused by *Pseudogymnoascus destructans* (formerly *Geomyces destructans)*, a cold-loving fungus that thrives in cave conditions and as such, impacts bat population directly during the winter hibernation period (Lorch et al. 2011, Blehert 2012, Minnis and Lindner 2013). It is thought to disrupt patterns of torpor which results in death by starvation or dehydration (Cryan et al. 2010, Reeder et al. 2012, Warnecke et al. 2013). First documented in New York State in 2006 (Blehert et al. 2009), WNS spread rapidly to 22 states and five Canadian provinces by 2013 and is thought to be responsible for the death of more than 5.5 million bats (United States Fish & Wildlife Service 2012). White Nose Syndrome has been confirmed among populations of seven species of bats. The little brown bat, the most abundant species in the region currently affected by WNS, has experienced the most dramatic population declines (Frick et al. 2010). Some hibernacula have seen mortality rates of 90 to 100 percent of resident hibernating bats as a result of infection with WNS (United States Fish & Wildlife Service 2012), leading researchers to believe that WNS could lead to local extinctions of the little brown bat, as well as other species (Frick et al. 2010).

White Nose Syndrome was first documented in Nova Scotia in April 2011 and declines of 80% to 100 % have since been recorded in winter populations (Broders and Burns, unpublished data). A similar magnitude of decline in summer activity was also observed from 2012 to 2013, following the first full winter WNS was documented in the province (Segers and Broders 2014). Therefore, it would be prudent to protect any surviving animals that may be genetically predisposed to surviving the infection. Even prior to WNS, bats were increasingly recognized as a conservation priority in North America. Now, in consideration of the sharp declines and rapid spread of WNS, serious concerns have been raised about the impact of WNS on the population viability of affected bat species, consequently impacting the conservation status of bat species at the local, national and global level (Table 1). Given that hibernacula represent one of the more critical resources for bats, as they allow successful over-wintering, they are important to protect.

Proximity to Hibernacula

The Nova Scotia Proponent's Guide to Wind Power Projects (Nova Scotia Environment 2012) states that wind farm sites within 25 km of a known bat hibernacula have a 'very high' site sensitivity. There are no known hibernacula within 25 km of the Amherst Community Wind Farm Wind Project area (Moseley 2007, Randall and Broders 2014). The closest known bat hibernacula to the site occur in New Brunswick with Underground Lake Cave located at 41.4 km W, Whites Cave at 42.4 km WNW and Berryton Cave, the historically largest known bat hibernaculum in NB at 56.9 km W (McAlpine 1983, Vanderwolf et al. 2012). The nearest known bat hibernaculum, in Nova Scotia is Lear shaft which is located approximately 54.8 km SE from the proposed development area. Other hibernacula include Minasville at 68.1 km SSE, Cheverie Cave at 75.1 km S and Hayes Caves, the largest known historical hibernaculum at 81.0 km SE.

Table 1. Over-wintering strategy and conservation status of bat species recorded in Nova Scotia.

Species	**Overwintering Strategy**	**Global Ranking**[1]	**COSEWIC Status**	**ACCDC status**[3]	**NSESA**[4]
Little brown bat	Resident hibernator	G3	Endangered[2]	S1	Endangered
Northern long-eared bat	Resident hibernator	G2G3	Endangered[2]	S1	Endangered
Tri-coloured bat	Resident hibernator	G3	Endangered[2]	S1	Endangered
Big brown bat	Resident hibernator	G5	Not assessed	N/A	Not listed
Hoary bat	Migratory	G5	Not assessed	S1	Not listed
Silver-haired bat	Migratory	G5	Not assessed	S1	Not listed
Eastern red bat	Migratory	G5	Not assessed	S1	Not listed

[1] Global Ranking based on the NatureServe Explorer: G1 = Critically Imperiled, G2 = Imperiled, G3 = Vulnerable, G4 = Apparently Secure, G5 = Secure. All the above species were reassessed in July 2012.

[2] Assessed by COSEWIC and designated in an emergency assessment on February 3, 2012.

[3] Atlantic Canada Conservation Data Centre ranking, based on occurrence records from NB and NS: S1 = Extremely rare: May be especially vulnerable to extirpation (typically five or fewer occurrences or very few individuals).

[4] Listing status under the Nova Scotia Endangered Species Act: Endangered = a species facing imminent extirpation or extinction; species were reassessed in July 2013.

Methods

Study Area

The project area is approximately 5 km from the town of Amherst (population ≈ 9500) in Cumberland County. This area is within Northumberland Plain district of the Carboniferous Lowlands Theme Region (Davis and Browne 1996) and is in the Maritime Lowlands Ecoregion (Webb and Marshall 1999). Coniferous and mixedwood forests dominate this area composed of red spruce, balsam fir, red maple and eastern white pine with sugar maple and yellow birch found on higher slopes. Interspersed among forests are agricultural lands and old fields.

Ultrasonic Surveys

We used four automated bat detectors (3x model Song Meter SM2Bat+, Wildlife Acoustics, Concord, MA; 1x Anabat, Titley Scientific, Columbia, MO) to sample at four locations within the proposed development area (Table 2, Figure 1). One detector was placed on the edge of the forest near the entrance to the site, and a second was placed at the measurement tower with microphones recording at 2 m and at ≈ 33 m AGL mounted on the MET tower. The third and fourth detectors were placed on forest edges (Table 3). Microphones on the SM2Bat+ units were oriented slightly down to shed rain. The seasonal timing of sampling likely corresponded to the end of the summer residency period, through to the autumn movements of resident species to local hibernacula, and autumn migration by migratory species. Detectors were programmed to turn on ½ hour before and after sunset and were reprogrammed throughout the season to adjust for increasing night length.

Identification of many bat species is possible because of the distinctive nature of their echolocation calls (Fenton and Bell 1981, O'Farrell et al. 1999). Species were quantitatively identified using Kaleidoscope^{TM} software (Wildlife Acoustics) which compares recorded sequences to known echolocation call sequences supplied to the company. We used the “Bats of North America 2.1.0” classifier of the program with the region set as Eastern Canada, and only included the 7 species with records for the province. Following the automatic classification by this program, we manually inspected all call spectrograms and assigned/confirmed call sequence identification. In the case of species in the genus *Myotis* (northern long-eared and little brown bat), we did not identify sequences to the species level for two reasons. First, the Kaleidoscope program uses reference calls from other regions of the species ranges and thus a regional-specific call library is not available for these species. Second, since the calls of the two species can be quite similar depending on the spatial context (Barclay 1999, Broders et al. 2004b), they cannot often not be reliably separated and we had some calls that were clearly *Myotis* species but not auto-identified by the program to one species or another. Recordings from both detector types (SM2Bat+ and Anabat) were subject to the same identification process with manual verification for Anabat files in AnalookW. We used the number of recorded echolocation files as the unit of bat activity, which approximates an echolocation call sequence, defined as a continuous series of greater than two calls (Johnson et al. 2004). Because an individual bat may be recorded making multiple passes, the data presented represent a measure of bat activity, and cannot be used as a direct measure of the number of bats within or passing through an area.

Differences in bat call sequence detections, call quality and ultimately species identifications are known among different models of bat detectors. Recent comparisons have shown that Wildlife Acoustics SM2Bat units record more bat call sequence files than Anabat units (Allen et al. 2011, Adams et al. 2012) and these differences must be incorporated into the interpretations and inferences of data when using both detectors.

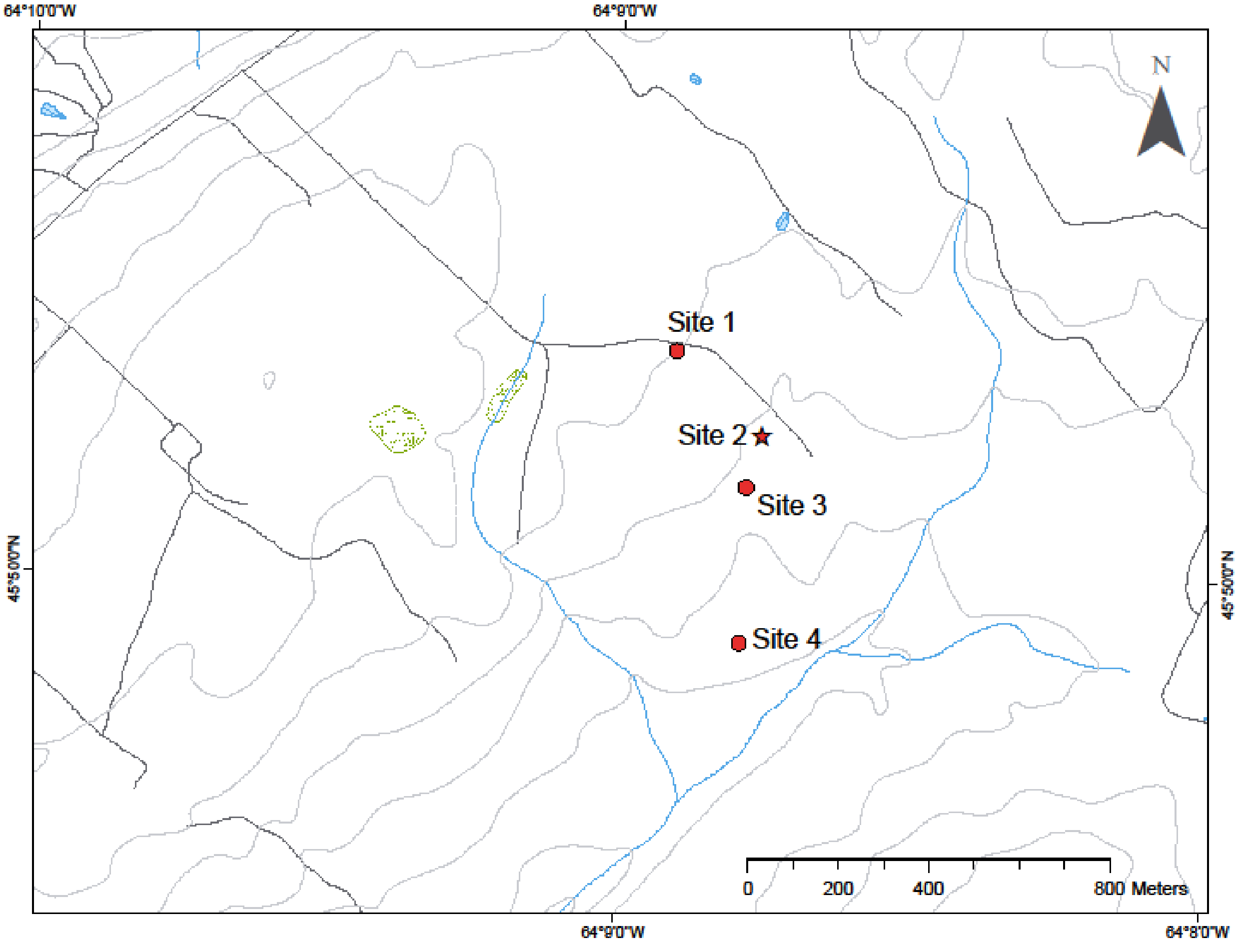

Figure 1. Locations of bat detectors used to sample for bat activity the Amherst Community Wind Farm Project, August to October 2014. GIS data supplied by Service Nova Scotia and Municipal Relations. The star indicates the MET tower that the detector had a high microphone placed on at Site 2.

Table 2. Locations of ultrasonic survey sites for the 2014 survey of bat activity at the proposed Amherst Community Wind Farm Project, Cumberland County, Nova Scotia. Coordinates are NAD83 UTM Zone 20.

Site	**Location**	**Detector type**	**Coordinates**		**Deployed**	**Retrieved**
1	Forest edge	Anabat	410822 E	5076671 N	21 Jul 2014	04 Nov 2014
2	MET tower	SM2Bat+	411009 E	5076486 N	21 Jul 2014	04 Nov 2014
3	Forest edge	SM2Bat+	410975 E	5076369 N	21 Jul 2014	04 Nov 2014
4	Forest edge	SM2Bat+	410958 E	5076025 N	21 Jul 2014	04 Nov 2014

Table 3. Site descriptions for ultrasonic survey sites for the 2014 survey of bat activity at the Amherst Community Wind Farm Project, Cumberland County, Nova Scotia.

Site	Description
1	Located along forest edge oriented into a clearing deployed at ground level
2	Detector at MET tower with one microphone at 2 m and a second microphone on the tower at ≈33 m AGL
3	Located along a forest edge with microphone oriented out into the clearing, microphone at 2 m AGL
4	Located along a forest edge, microphone oriented out into the clearing, microphone at 2 m AGL

Assessment of Potential for Hibernacula

To assess the potential for hibernacula to occur in proximity to the project area, we examined the available literature and the Nova Scotia Abandoned Mine Openings (AMO) Database (Fisher and Hennick 2009). To assess the AMO, database location and attribute data were imported into a Geographic Information System (GIS; ArcMap 10.2, ESRI, Redlands, California). We estimated the centre of the Amherst Community Wind Farm project area and buffered the surrounding landscape to 25 km since wind farm sites within 25 km of a known bat hibernacula are to be considered to have a 'very high' site sensitivity (Nova Scotia Environment 2012). Records of underground abandoned mine openings occurring within the buffer were then exported into a spreadsheet where we subsequently excluded specific AMO's as being unlikely hibernacula based on four sequential attribute criteria (Table 4).

Table 4. Attributes of fields used from the Nova Scotia Abandoned Mine Openings Database used to exclude openings from the list of unexplored potential hibernacula for bats near the Amherst Community Wind Farm Project Area, Cumberland County, Nova Scotia.

Ordering	Field Heading	Criteria used for exclusion
1	Origdepth	≤19 m in depth
2	Flooded	attribute = T (true)
3	Protection	those that are backfilled, excavated and backfilled, filled or sealed
4	Plug	those containing a plug of rock, rock & vegetation, rock & garbage, garbage (and where field "Landuse"= municipal garbage dump site)

Results

The Anabat detector and two SM2Bat+detectors (Sites 2 & 3) were deployed from 21 July to 04 November and continuously recorded during this time. The SM2Bat+ detector at site 4 was vandalized sometime after 12 September and before 26th of September. We can only validate it was fully operational and recording from the period 21 July to 11 September 2014 based on recordings and our site visit to download data. A total of 477 detector nights were sampled where one bat detector running continuously from sunset to dawn is considered as 1 detector night.

Within the proposed wind energy development area there were 2047 acoustic files recorded on the 4 detectors. A total of 1028 of these were classified as bat-generated ultrasound files and the remaining classified as extraneous noise (Table 5). Of the 1028 echolocation sequences, 16 were recorded at site 1 (Anabat), 58 were recorded at site 2 on the low microphone, 80 were recorded at site 2 on the high microphone, 27 were recorded at site 3 and 847 were recorded at site 4. The vast majority of call sequences (955/1028; 92.9 %) were classified as hoary bat call sequences. This was followed by 4.7 % (48/1028) classified as *Myotis* species (i.e., includes northern long-eared and little brown bats); as stated above no attempt was made to identify these call sequences to the species. We also detected 18 call sequences as silver-haired bat sequences representing 1.7 % of the total bat call sequences. The calls of big brown and silver-haired bats can be difficult to distinguish between (Betts 1998). However, based on our knowledge of bats in Nova Scotia where only one, unverified record occurs of the big brown bat, we believe these sequences are silver-haired bat sequences. Lastly we classified 7 sequences as belonging to red bats representing 0.7 % of the total recorded bat call sequences. Two of these sequences were of short duration making them of lower quality to identify (detected on Aug 8 and September 12 at site 2 on the high microphone). However, the characteristics of the call pulses within the sequences files (e.g., minimum frequency, slope) were consistent with red bat calls.

The average number of recorded bat call sequences per night (averaged over all detectors at all four sites together) in the proposed development area was 2.16 (SD =21.1) during the sampling period. To place the relative magnitude of activity recorded in the study area into context, in 129 nights of monitoring along five forested edges in the Greater Fundy National Park Ecosystem from June to August 1999, the average number of sequences per night was 27 (SD = 44; Broders unpublished data). In 650 nights of monitoring at river sites in forested landscapes in southwest Nova Scotia from June to August of 2005-2006, the average number of sequences per night was 128 (SD = 232; Farrow unpublished data), though note that rivers act to concentrate bat activity, as they are used as foraging and commuting corridors (Laval et al. 1977, Fenton and Barclay 1980, Krusic et al. 1996, Zimmerman and Glanz 2000, Lacki et al. 2007). Both of these previous comparisons were conducted prior to the emergence of white nose syndrome and therefore are likely not directly comparable. In a forested landscape in Colchester County, Nova Scotia, an approximate 99% decrease in bat echolocation activity was detected after significant mortality was noted in Nova Scotia following the arrival of white nose syndrome to the province. In that study the average number of bat call sequences recorded at forested and riparian areas, per night, dropped from 111.22 (SD 163.54) in 2012 to 0.95 (SD=1.84) in 2013 (Segers and Broders 2014).

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Table 5. Number of echolocation bat call sequence files recorded per night for the 2014 survey of bat activity at the proposed Amherst Community Wind Farm Project, Cumberland County, Nova Scotia. LAB= *Lasiurus borealis,* LAC= *Lasiurus cinereus,* MYO = *Myotis* species, LAN = *Lasionycteris noctivagans*.

	Site 1			Site 2 low mic				Site 2 high mic				Site 3			Site 4				Nightly
Night of	LAB	LAC	MYO	LAB	LAC	LAN	MYO	LAB	LAC	LAN	MYO	LAC	LAN	MYO	LAB	LAC	LAN	MYO	Total
21-Jul-14	0	0	0	1	3	3	3	0	7	0	0	2	0	1	0	122	0	0	142
22-Jul-14	0	0	0	0	2	0	0	0	4	0	0	1	0	0	0	263	0	0	270
23-Jul-14	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	357	0	0	360
24-Jul-14	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	6	0	0	10
25-Jul-14	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	25	0	0	28
26-Jul-14	0	2	0	0	1	0	0	0	1	0	0	0	0	0	0	4	0	1	9
27-Jul-14	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	8
28-Jul-14	0	2	0	0	0	0	0	0	0	0	0	0	0	1	0	15	0	1	19
29-Jul-14	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	8	0	1	10
30-Jul-14	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	2
31-Jul-14	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	2	0	1	5
1-Aug-14	0	0	1	1	0	0	12	0	0	0	0	0	0	1	0	0	0	2	17
2-Aug-14	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2
3-Aug-14	0	1	0	0	2	0	0	0	5	0	0	1	0	1	0	2	0	0	12
4-Aug-14	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	3
5-Aug-14	0	0	0	0	21	0	0	0	28	0	0	1	0	0	1	0	0	0	51
6-Aug-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7-Aug-14	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	4
8-Aug-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9-Aug-14	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	3
10-Aug-14	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
11-Aug-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12-Aug-14	0	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	3
13-Aug-14	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1

	Site 1			Site 2 low mic				Site 2 high mic				Site 3			Site 4				Nightly
Night of	LAB	LAC	MYO	LAB	LAC	LAN	MYO	LAB	LAC	LAN	MYO	LAC	LAN	MYO	LAB	LAC	LAN	MYO	Total
14-Aug-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15-Aug-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16-Aug-14	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	2
17-Aug-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18-Aug-14	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
19-Aug-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20-Aug-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21-Aug-14	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2
22-Aug-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23-Aug-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
24-Aug-14	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
25-Aug-14	0	0	0	0	1	0	0	0	1	0	0	1	0	0	0	0	0	1	4
26-Aug-14	0	0	0	0	0	0	1	0	1	0	0	1	1	0	0	1	0	0	5
27-Aug-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
28-Aug-14	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	2
29-Aug-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30-Aug-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	1	0	10
31-Aug-14	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
1-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2-Sep-14	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	2
3-Sep-14	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	2
4-Sep-14	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0	6	2	0	11
5-Sep-14	0	0	0	0	0	1	0	0	1	1	0	3	0	1	0	1	2	0	10
6-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
8-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
10-Sep-14	0	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	3

	Site 1			Site 2 low mic				Site 2 high mic				Site 3			Site 4				Nightly
Night of	LAB	LAC	MYO	LAB	LAC	LAN	MYO	LAB	LAC	LAN	MYO	LAC	LAN	MYO	LAB	LAC	LAN	MYO	Total
11-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12-Sep-14	0	0	0	0	0	0	0	1	0	0	1	0	0	1	-	-	-	-	3
13-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	0
14-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	2	-	-	-	-	2
15-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	0
16-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	0
17-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	0
18-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	0
19-Sep-14	0	0	0	0	0	0	0	0	1	0	0	0	0	0	-	-	-	-	1
20-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	0
21-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	0
22-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	0
23-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	0
24-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	0
25-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	0
26-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	0
27-Sep-14	0	0	0	0	0	0	1	0	0	0	0	0	0	0	-	-	-	-	1
28-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	0
29-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	0
30-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	0
1-Oct-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	0
2-Oct-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	0
3-Oct-14	0	0	0	0	0	0	0	0	0	0	0	0	0	1	-	-	-	-	1
4-Oct-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	0
Data not shown from 5-Oct-14 to 03-Nov-14 when no bat call sequences were recorded																			
Site totals	1	11	4	2	32	5	19	2	69	6	3	11	2	14	2	832	5	8	1028
Project Ave																			2.16
Num nights																			106

The symbol “– “means the detector was not validated as recording on that night

According to the Nova Scotia Abandoned Mine Openings Database (Fisher and Hennick 2009), there are 366 underground abandoned mine opening records in the vicinity of the Amherst Community Wind Farm Project (within 25 km). Following our exclusion analysis, 56 of the AMO records remain that could potentially act as bat hibernacula (Appendix 1) where to our knowledge they have never been surveyed for bats before.

Discussion

In our work at the Amherst Community Wind Farm Project, we have recorded high bat species richness where 5-6 species were detected that includes resident and migratory species. Hoary bats were recorded at high activity levels with the species detected on 28 nights, the most we have detected in any of our previous projects in Atlantic Canada.

Hoary bats were detected during the residency portion of the survey with sequences recorded on 17 of 20 nights sampled prior to 10 August; an approximate date of when migration activity begins to increase. The majority of the hoary bat call sequences were temporally and spatially clustered with 97.8 % of the total hoary bat call sequences recorded at site 4 from July 21 to August 4th. On the three nights with the highest number of sequences recorded, they were recorded from approximately 21:30 to 04:30. The high levels of activity (i.e., the total call sequences recorded and high number of nights recorded on), and the clustering of activity early on in the survey period may suggest the presence of resident hoary bats that summer around the area. Typically, sightings/recordings of hoary bats in the province are rare and occur most often in the late summer/early autumn migratory period. We cannot make inference on the number of individual hoary bats in the area that made the calls because an individual bat may be recorded making multiple passes. High activity can thus result from just a few individuals that are foraging nearly continuously around a particularly rich and available prey source or from many individuals using the same area. In this case the exceptionally high magnitude of activity of this species was concentrated at just 1 of four detector sites (site 4), suggesting that high activity was not widespread. Regardless, more intensive surveys earlier, and throughout the summer would be required to assess the full extent to which hoary bats are resident in the area.

Collectively, call sequences of the other migratory species (red and silver-haired bats) represented only 2.5% of the total calls recorded. The low number of call sequences attributed to the red and silver-haired bat, suggests that there are no large populations or significant migratory movements of these species at the study area. This fits with our current knowledge of the status of this species in the province where sightings are rare and often occur in the late summer/early autumn on the coast or offshore (Broders et al. 2003, Czenze et al. 2011, Lucas and Hebda 2011, Segers et al. 2013). However, occurrences do occur regularly, albeit in low frequency, and these species, along with hoary bats, are especially vulnerable to wind facilities. All three migratory species are generally solitary, tree-roosting species with extensive distributional ranges throughout North America (van Zyll de Jong 1985, Naughton 2012). These species have received the greatest attention with regards to wind energy developments because they make up the large majority of documented fatalities at existing developments in North America. Any mortality of hoary, red or silver-haired bats would be significant to Nova Scotia given there low numbers in the region. Significant bat fatality events at wind energy developments occur primarily in the late summer and early fall, peaking during the period that coincides with the long-distance fall migration of these species (Johnson 2005b, Cryan and Brown 2007, Arnett et al. 2008a). This has led researchers to believe that migration plays a key role in the susceptibility of certain bat species to wind turbine fatalities (Cryan and Barclay 2009). It has been proposed that this may be because these species travel at a height that puts them at increased risk of collisions with rotating turbine blades (Barclay et al. 2007, Arnett et al. 2008a).

For the *Myotis* spp., interpretation of these data are problematic for assessing relative risk to bats at the proposed development given our knowledge of the devastating impacts that white nose syndrome has had, and is having, on local bat populations. The disease is now confirmed in nine counties in mainland Nova Scotia and three counties in Cape Breton including the county where the project area is located. Elsewhere, white nose syndrome significantly reduced the summer *Myotis* bat activity by as high as 75% (Dzal et al. 2011, Jachowski et al. 2014). In the winter of 2012-2013, there were hundreds of fatalities recorded at several known hibernacula in the province and annual monitoring counts of bats at such hibernacula were down, on average, by 94% (Broders and Burns, unpublished data). These observations are suggestive of a major mortality event in the area, likely decreasing the magnitude of bat activity in many areas in the summer. This is supported by other work we are conducting in the region suggesting a >99% reduction in the magnitude of echolocation activity in 2013, relative to 2012 (Segers and Broders 2014), and decimation of a number of maternity colonies in the region. For these reasons this dataset must be interpreted with caution.

After the hoary bat call sequences, the majority of the identified echolocation sequences recorded for this project were attributable to the two species of *Myotis* bats known to occur in Nova Scotia, the little brown bat and the northern long-eared bat. This was expected as they were the only abundant and widely-distributed species in the province, and are two of only three species that had large numbers in the province (Broders et al. 2003). Although we did not distinguish the calls of *Myotis* species, the majority of the recorded sequences likely represent the little brown bat, as this species is known to forage in open areas and over water. The northern long-eared bat is a recognized forest interior species (Jung et al. 1999, Henderson and Broders 2008), and is less likely to use open areas for foraging and commuting (Henderson and Broders 2008). Additionally, the northern long-eared bat has lower intensity echolocation calls and is thus not recorded as well as the little brown bat (Miller and Treat 1993, Broders et al. 2004a).

Myotis species are relatively new to the list of species among fatalities at wind turbines sites. This may be due to the fact that the first large scale wind developments were located primarily in western North America, typically in agricultural and open prairie landscapes (reviewed in Johnson 2005b). Fatalities of these resident, non-migratory species were largely absent from these sites, likely due to the association of these species with forested landscapes. More recently, evidence of *Myotis* fatalities resulting from collisions with wind turbines have been noted at sites in eastern North America (reviewed in Johnson 2005b, Jain et al. 2007, Arnett et al. 2008a). Although there are fewer documented fatalities of *Myotis* bats compared to long-distance migratory species, there is still a risk of direct mortality.

Other than direct bat mortality as a result of collisions with turbines, there is also the potential that disruption of the forest structure (e.g., removal of trees and fragmentation of forest stands for roads and clearings) will degrade the local environment for colonies/populations of *Myotis* bats that reside in the area during the summer. This can occur by the elimination of existing roost trees, the isolation of trees left standing, as well as the elimination or degradation of foraging areas for bats.

Additionally, resident bat species make what are generally considered to be short distance migrations (range of tens to hundreds of kilometres) from their summering areas to underground sites where they hibernate. Little is known about the flight behaviour and dynamics of these movements (i.e., height of travel, and routes); therefore, it is difficult to predict the specific effects that wind developments will have on the movements of local populations of bats in the spring or fall from summering sites to hibernation sites.

Given the context of white-nose syndrome, as discussed above, there was no acoustic evidence of a significant movement of *Myotis* bats through the area investigated during this pre-construction survey of bat activity. The overall magnitude of activity was low compared to baseline levels (collected prior to 2007), and more comparable to levels recorded in 2013 (following white nose syndrome) that one would expect in a forested ecosystem in the region. Although we cannot rule out the possibility that mortality events associated with this development will occur, we have found no evidence to suggest that the proposed project will cause large numbers of direct mortality of bats. That being said, in light of white nose syndrome and the recent listing of the several resident species as endangered, the significance of any mortality is much greater than it would have been just a couple of years ago. However, this study recorded the highest concentration of hoary bats that we have recorded in Atlantic Canada. This activity was greatest in the early part of our survey (late July) and may indicate resident bats in the area. Further, as discussed above, any mortality of hoary bats (or the other migratory species) would also be significant to the province given their low numbers in the province.

Recommendations

1. *Pre-construction monitoring* – Given the findings of high hoary bat activity during the summer residency period in this study (2014), we recommend follow up monitoring to make better inference on the use of the site as summer habitat.

2. *Post-construction monitoring* – A rigorous post-construction monitoring program, appropriately designed to account for searcher efficiency and scavenger rates, needs to be established to quantify bat fatality rates. These surveys should be conducted over an entire season (April to October), but especially during the fall migration period (mid-August to late-September) for at least two years. Should fatalities occur, they should be investigated with respect to their spatial distribution relative to wind turbines, turbine lighting, weather conditions, and other site specific factors. Should trends be identified, operations should be adjusted in an adaptive management framework whereby mitigation can be focused on any identified high risk areas/infrastructure to minimize future fatalities. These data are essential for assessing potential risks at future developments in the region via assessment of cumulative effects; therefore it is critical that the results of these surveys be appropriately reported.

3. *Retain key bat habitat* – Key bat habitat should be identified in the project area (e.g., wetlands, riparian areas, mature deciduous-dominated forest stands) and retained to continue to support any existing summer colonies and or potential fall movement corridors of bats. Forested wetlands/riparian areas may be used by bats during migratory phases which would be important to retain as some bats do make migratory stopovers to feed and/or roost (McGuire et al. 2012). In this case, as much of the remaining forest and forest patches should be maintained as these will provide roosting and foraging habitat for resident bats. The forest-clearcut edges also

provide foraging habitat for bats. Retention of these bat habitat resources should be in a spatial manner that provides connectivity in the project area and with the larger landscape to ensure foraging and roosting areas remain well connected. Consideration of the potential for fragmentation of bat habitat resources should also be taken with regards to the development of road networks and transmission lines in the project area.

4. *Return to pre-project state upon decommissioning* – The project area should be returned to the state that existed prior to the development of the site once the project is decommissioned. This should include planning to ensure the continuity of forest stand succession to provide and maintain appropriate roosting areas well into the future as existing roost trees die off. Retention of forest stands of a range of ages will provide mature trees for bat roosting resources in the future.

5. *Develop an operations fatality mitigation plan* – Recent experimental case studies in Alberta and the United States have demonstrated dramatic reductions in bat fatalities at operational wind energy facilities can be made by changing operational parameters during the peak fatality period (Baerwald et al. 2009, Arnett et al. 2010). These include changes to when turbine rotors begin turning in low winds via alterations to wind-speed triggers and blade angles to lower rotor speed. These studies have found decreases in bat mortalities ranging from 44% to as high as 93% reductions on a nightly basis at relatively low cost to annual power production loss, at approximately ≤ 1%. This plan should be adaptive as operations continue through time and be in place prior to operations commencing such that if any bat mortalities be observed at the site once operational, the plan can be implemented immediately.

6. *Remain up to date with current research* –There is presently an abundance of on-going research aimed at determining the impacts of wind energy developments on populations of bats. Other studies are focusing on investigating the efficacy of potential mitigation measures, including the effects of weather on bat activity patterns and collisions with wind turbines, and possible bat deterrents (including acoustic (Arnett et al. 2013)and radar emissions). As these are active areas of research, it is essential that the most current studies and guidelines are used to guide management decisions and development plans for wind energy projects.

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Appendix 1. Identified abandoned mine openings (AMO's) from the Nova Scotia AMO Database that are located within 25 km of the Amherst Community Wind Farm Project and have the potential to be bat hibernacula.

Shaft ID	Location (as listed in the database)	Original Depth (m)	Land ownership
RIV-2-197	RIVER HEBERT	24	Private
SST-1-004	SALTSPRINGS STATION	30	Private
JMA-2-106	MACCAN	32	Private
RIV-2-204	RIVER HEBERT EAST	40	Private
RIV-2-221	RIVER HEBERT	41	Private
RIV-2-067	RIVER HEBERT EAST	50	Private
RIV-2-053	RIVER HEBERT	54	Private
RIV-2-200	RIVER HEBERT	60	Private
RIV-1-324	RIVER HEBERT	60	Private
RIV-2-066	RIVER HEBERT EAST	68	Private
RIV-2-078	RIVER HEBERT EAST	70	Private
RIV-2-079	RIVER HEBERT EAST	70	Private
RIV-2-209	RIVER HEBERT	70	Private
SCD-1-039	SPRINGHILL	72	Private
RIV-2-049	RIVER HEBERT	80	Private
RIV-2-238	RIVER HEBERT EAST	90	Private
RIV-2-076	RIVER HEBERT EAST	90	Private
RIV-2-215	RIVER HEBERT EAST	90	Private
RIV-2-062	RIVER HEBERT EAST	90	Private
RIV-2-205	RIVER HEBERT EAST	90	Private
RIV-2-237	RIVER HEBERT EAST	95	Private
RIV-2-235	RIVER HEBERT	98	Private
RIV-2-075	RIVER HEBERT EAST	110	Private
RIV-2-041	RIVER HEBERT	120	Private
RIV-2-321	RIVER HEBERT EAST	130	Private
RIV-2-060	RIVER HEBERT EAST	130	Private
RIV-1-028	RIVER HEBERT	160	Private
RIV-2-040	RIVER HEBERT	160	Private
RIV-2-035	RIVER HEBERT	165	Private
RIV-2-070	RIVER HEBERT EAST	165	Private
RIV-2-214	RIVER HEBERT EAST	170	Private
RIV-2-061	RIVER HEBERT EAST	188	Private
RIV-1-233	RIVER HEBERT	190	Private
RIV-2-216	RIVER HEBERT EAST	200	Private
RIV-2-048	RIVER HEBERT	205	Private

Shaft ID	Location (as listed in the database)	Original Depth (m)	Land ownership
RIV-1-029	RIVER HEBERT	210	Private
RIV-2-045	RIVER HEBERT	225	Private
RIV-2-046	RIVER HEBERT	225	Private
RIV-2-042	RIVER HEBERT	235	Private
RIV-2-077	RIVER HEBERT EAST	260	Private
RIV-2-054	RIVER HEBERT	265	Private
RIV-2-239	RIVER HEBERT EAST	340	Private
RIV-2-080	RIVER HEBERT EAST	340	Private
RIV-2-068	RIVER HEBERT EAST	380	Private
RIV-2-073	RIVER HEBERT EAST	384	Private
RIV-2-203	RIVER HEBERT EAST	400	Private
RIV-2-038	RIVER HEBERT	488	Private
RIV-2-059	RIVER HEBERT EAST	488	Private
RIV-2-043	RIVER HEBERT	640	Private
RIV-2-074	RIVER HEBERT EAST	830	Private
RIV-2-032	RIVER HEBERT	920	Private
RIV-2-072	RIVER HEBERT EAST	1,000.00	Private
RIV-2-047	RIVER HEBERT	1,095.00	Private
RIV-2-033	RIVER HEBERT	1,120.00	Private
SCD-1-043	SPRINGHILL	584	Crown
SCD-1-007	SPRINGHILL	584	Crown

Appendix 2. Survey site photographs

Figure A1: Bat detector (Anabat) placement at site 1. Red rectangle shows placement of detector and inset shows a front view of the detector.

Figure A2. Bat detector (SM2Bat+) placement at site 2 showing the low microphone on the 2x2 (2 m AGL). Red rectangle shows the high microphone position on the MET tower (≈33 m AGL).

Figure A3. Bat detector (SM2Bat+) placement at site 3 along a forest edge.

Figure A4. Bat detector (SM2Bat+) placement at site 4 along a forest edge.

Appendix D:

Archaeological Resource Impact Assessment

Amherst Wind Project

Archaeological Resource Impact Assessment

Heritage Research Permit A2014NS041

November 2014

Davis MacIntyre & Associates Limited
109 John Stewart Drive, Dartmouth, NS B2W 4J7

Amherst Wind Project
Archaeological Resource Impact Assessment

Heritage Research Permit A2014NS041

Davis MacIntyre & Associates Limited
Project No. 14-015.2

November 2014

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Cover Image: The meteorological tower for the Amherst Wind Project, looking southeast.

Executive Summary

Davis MacIntyre & Associates Limited was contracted by Natural Forces to conduct an archaeological resource impact assessment of the proposed Amherst Wind Project in Cumberland County. The purpose of the assessment was to determine the potential for archaeological resources within the study area and to provide recommendations for mitigation, if necessary. The assessment included a historic background study and reconnaissance. An initial reconnaissance of a preliminary layout was conducted in June 2014. A second reconnaissance of the final layout was conducted in November 2014.

The results of the archaeological resource impact assessment indicates that the study area is of low potential for First Nations resources. Furthermore, no historic period archaeological resources were identified within the impact area during the assessment. The only cultural activity that was observed during the reconnaissance was modern, mainly logging and active agriculture. Therefore, no further mitigation is recommended. However, should development plans change so that areas not assessed during this investigation are to be impacted (by access roads or turbine sites), it is recommended that those areas be subject to an archaeological assessment.

Finally, in the unlikely event that archaeological resources are encountered during ground disturbance activities, it is required that all activity cease and the Coordinator of Special Places (902-424-6475) be contacted immediately.

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1.0 Introduction

In May 2014, Davis MacIntyre & Associates Limited was contracted by Natural Forces to conduct an archaeological resource impact assessment of a proposed wind project near Amherst, Cumberland County. The purpose of the assessment was to determine the potential for archaeological resources within the impact area, and to provide recommendations for further mitigation if necessary.

The assessment was conducted under Category C Heritage Research Permit A2014NS041 (Appendix A). This report conforms to the standards of the Nova Scotia Department of Communities, Culture and Heritage and the Heritage Research Permit requirements as per the Special Places Protection Act (*R.S., c. 438, s. 1.).*

2.0 Study Area

The study area is located approximately 3.0 kilometers east of Amherst in Cumberland County, on John Black Road. Natural Forces proposes to construct a 6.0 MW wind farm that will include three turbines and necessary access roads. In June 2014, an initial layout was provided for access roads and the three turbine candidate sites. The layout was revised, however, in November 2014 (Figure 2.0-1). The foundation excavation for each turbine will be approximately 2 meters deep and 15 meters in diameter. Access roads will be 6 metres wide, with a maximum width of 12 metres. There is an existing road within the study area, which leads to toward turbine candidate site #1 and currently terminates at the data collector. The existing road will likely be upgraded and a new access road constructed where necessary.

A buffer of 80 metres was established around the turbine candidate sites. The purpose of the buffers was to provide a possible impact area to be examined during field reconnaissance with the understanding that if any impact is subsequently planned for outside of the 80 metre buffer areas, additional field reconnaissance will be required.

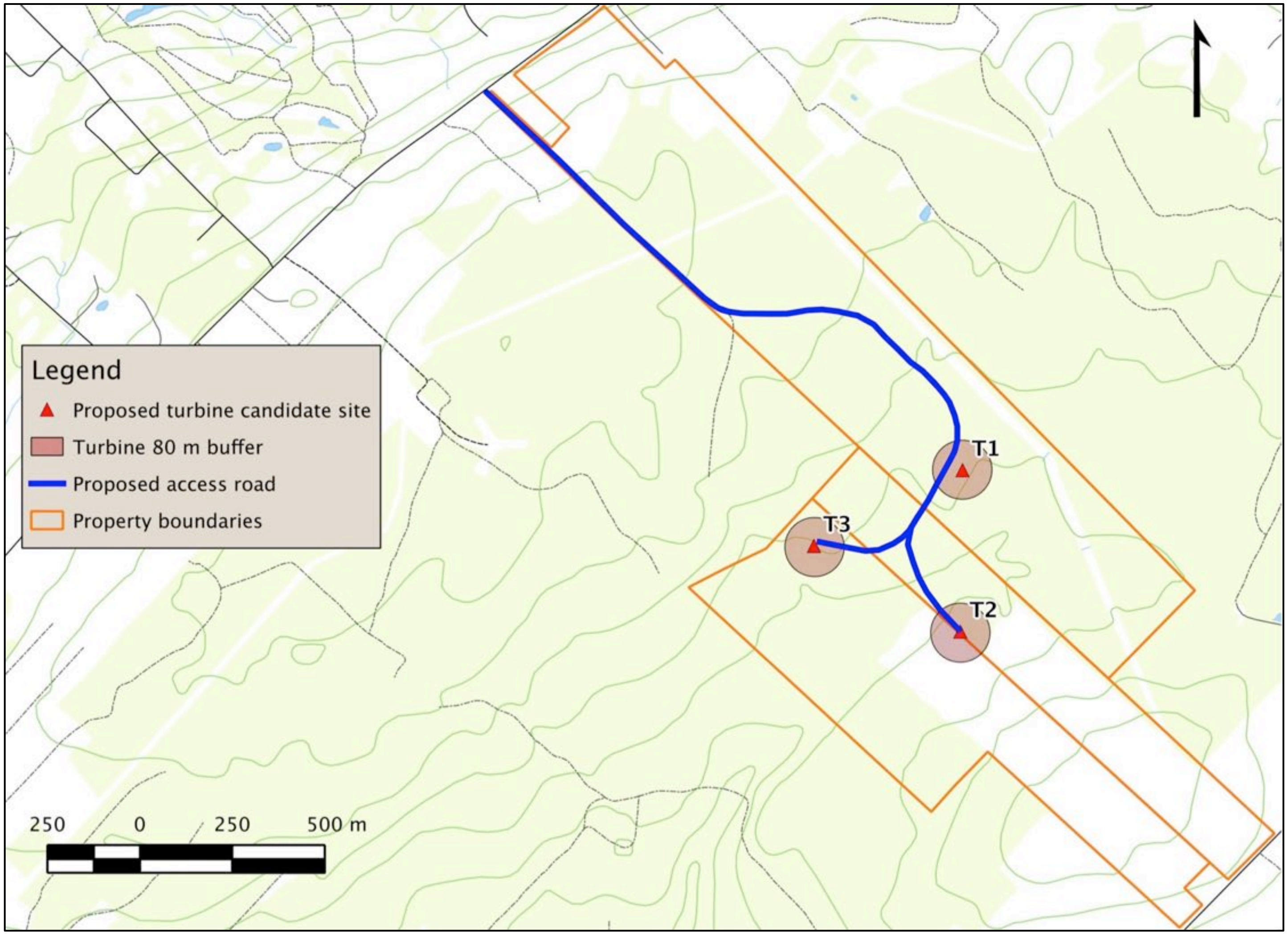

Figure 2.0-1: Map of the proposed Amherst wind project development showing the November 2014 layout (Data courtesy of Natural Forces).

Amherst is located in theme region #521a, the Northumberland Strait sub-Unit of the Northumberland Plain theme region (Figure 2.0-2). This region covers the area from Cumberland Basin to Pictou and contains an anticline that runs from Pugwash Harbour to Nappan and Amherst Point. The area contains fine red sandstones. The region has a dendritic drainage pattern and mainly drains into the Northumberland Straith, although the southwest area, including the Nappan River, drains into the Cumberland Basin. The soil ranges from sandy loam to sandy clay loam and is derived from sandstone and shales which underlie the entire area. The subsoil tends to be compacted and impermeable and the soils are usually imperfectly drained.

The forests tend to be dominated by Black Spruce, Jack Pine, White Spruce, Red Spruce and Red Maple with some Eastern Hemlock and White Pine. However, much of the area is oldfields or is still actively farmed, creating a significant amount of active and abandoned farmland. The region is home to animals such as coyotes, muskrat, mink, racoon and red fox. The waterways are productive, containing some River Otter, and Atlantic Salmon, Gaspereau, Brown Trout and Brook Trout.[1]

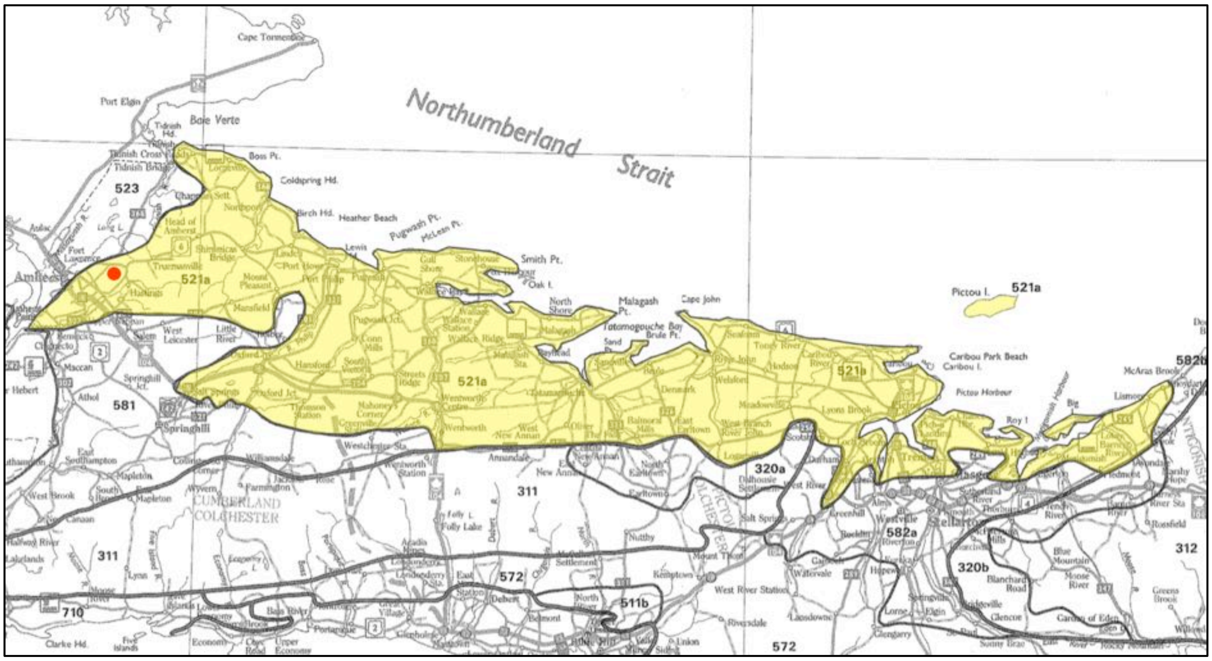

Figure 2.0-2: Natural Theme Regions of Nova Scotia, showing region #521a (highlighted in yellow) – Northumberland Plain, Northumberland Strait, sub-Unit.[2] The approximate location of the study area is indicated in red.

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[1] Davis and Browne, 1996: 108-111.

[2] Adapted from Davis and Browne, 1996.

3.0 Methodology

A historic background study was conducted by Davis MacIntyre & Associates Limited in June 2014. Historical maps and manuscripts and published literature were consulted as well as previous archaeological assessments in the general vicinity. The Maritime Archaeological Resource Inventory, a database of known archaeological resources in the Maritime region, was searched to understand prior archaeological research and known archaeological resources neighbouring the study area. Finally, a field reconnaissance was conducted in order to further evaluate the potential for archaeological resources. An initial reconnaissance was conducted in June 2014 of the preliminary access road and turbine site layout. The details of this reconnaissance can be found in appendix B. A reconnaissance of final layout was conducted in November 2014.

3.1 Maritime Archaeological Resource Inventory

The Maritime Archaeological Resource Inventory was consulted in June 2014 in order to determine if known archaeological sites or resources exist within or near the study area. Ten sites were found in the general area of Cumberland County, although none were found in close proximity to the study area.

A cluster of known sites is located approximately 9 kilometers northwest of the proposed Amherst wind project. These sites include the Acadian village of Beaubassin (BlDb-07 and BlBd-20), the British Fort Lawrence (BlBd-08), the Amherst terminus of the Chignecto Marine Transport Railway (BlBd-09) and an isolated First Nations find (BlBd-17). The isolated find was an Adena celt preform found during construction activities of the Fort Lawrence reconstruction.

Seven additional known sites are located within 10 to 15 kilometers of the study area. These sites include four precontact First Nations resources. Two late Archaic/ early Ceramic period sites (c. 2500 years ago) were recorded near Harrison Lake (BkDb-01, BkDb-02), an isolated late Archaic artifact was found near Amherst Point (BkDb-04) and an isolated find dating to the Archaic period (9000 to 2500 years ago) was recorded near Nappan (BkBd-06).

Two 19th century cellar depressions were recorded on Amherst Point (BkDb-03) and six 19th or 20th century cellar depressions were recorded on Minudie Marsh (BkDb-05 and BkDc-01) as part of a larger historic village site.

The lack of recorded archaeological resources in close proximity to the study area is likely an indication of a lack of detailed archaeological surveys being completed in the area, rather than a lack of archaeological resources, especially considering the large amount of known historic and First Nations occupation in the area.

3.2 Historic Background

3.2.1 The Precontact Period

The history of human occupation in Nova Scotia has been traced back approximately 11,000 years ago, to the Palaeo-Indian period or *Sa'qewe'k L'nu'k* (11,000 – 9,000 years BP). The only significant archaeological evidence of Palaeo-Indian settlement in the province exists at Debert/Belmont in Colchester County.

The *Saqiwe'k Lnu'k* period was followed by the *Mu Awsami Kejikawe'k L'nu'k* (Archaic period) (9,000 – 2,500 years BP), which included several traditions of subsistence strategy. The Maritime Archaic people exploited mainly marine resources while the Shield Archaic concentrated on interior resources such as caribou and salmon. The Laurentian Archaic is generally considered to be a more diverse hunting and gathering population.

The Archaic period was succeeded by the Woodland/Ceramic period or *Kejikawek L'nu'k* (2,500 – 500 years BP). Much of the Archaic way of subsistence remained although it was during this period that the first exploitation of marine molluscs is seen in the archaeological record. It was also during this time that ceramic technology was first introduced.

The Woodland period ended with the arrival of Europeans and the beginning of recorded history. The initial phase of contact between First Nations people and Europeans, known as the Protohistoric period, was met with various alliances particularly between the Mi'kmaq and French.

The Mi'kmaq inhabited the territory known as *Mi'kma'ki* or *Megumaage*, which included all of Nova Scotia including Cape Breton, Prince Edward Island, New Brunswick (north of the Saint John River), the Gaspé region of Quebec, part of Maine and southwestern Newfoundland (Figure 3.2-1). A portion of Nova Scotia and New Brunswick, including the Amherst region of Cumberland County, was known by the Mi'kmq as *Siknikt* meaning "drainage area".[3]

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[3] Confederacy of Mainland Mi'kmaq, 2007:11.

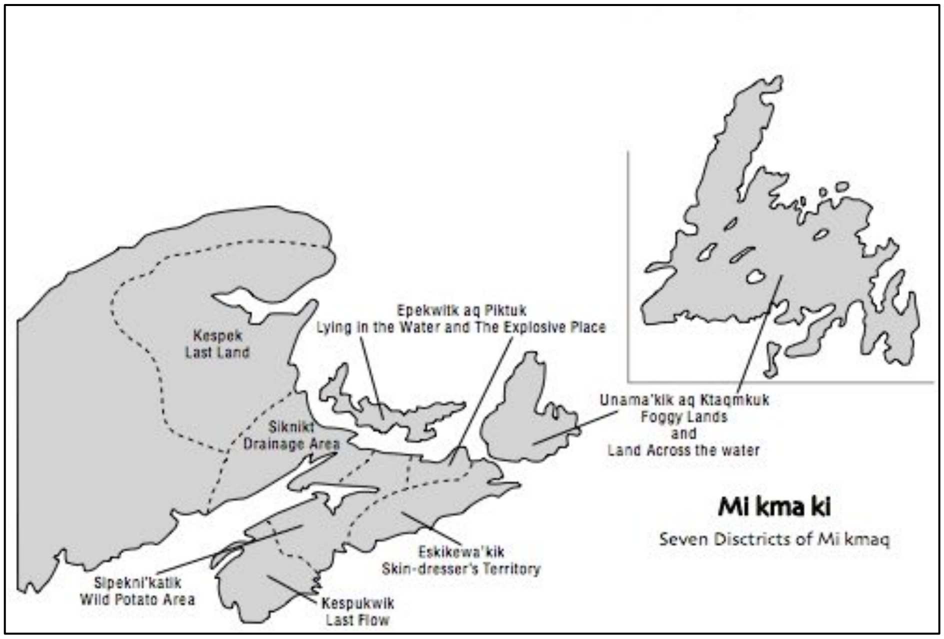

Figure 3.2- 1: Map of the Mi'kmaki territories.[4]

3.2.2 Historic Period

There is a long, rich history of settlement and agricultural land use within Amherst and the Cobequid area. The abundant marshlands provided resources for the Mi'kmaq, as well as for early Acadian settlers, who transformed otherwise unusable land into fertile farms with their well engineered and efficient dyke water systems. These systems have been re-established throughout history to provide rich farmland used by local farmers to this day.

The earliest residents of the Amherst area in the historical period would have been the Mi'Kmaq. Mi'kmaw encampments are known to have existed along the southern ridge above the marsh land at a village site named *Nemalooscudaagan*, and another further west called *Weehakage* on the Amherst point.[5] Found along the shores of the LaPlanche River, these encampments were presumably abandoned by the Mi'Kmaq in 1694 due to plague.[6] These sites would eventually be re-inhabited by the Acadians.

The Acadians were the first recorded Euro-Canadian settlers in the Amherst area.[7] They transformed the marshlands into agricultural goldmines and pastures, which gave them prominent resources thanks to their specialized dyke drainage systems.

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[4] Confederacy of Mainland Mi'kmaq, 2007:11.

[5] Furlong 2001:vii.

[6] Bird c. 1942:31.

[7] Bird c. 1942:2.

These provided an abundance of crops, such as wheat, hay, oats, rye, barley, corn, flax and hemp.[8]

The closest Acadian village to the study area was probably *La Planche*, located in the vicinity of East Amherst (Figure 3.1-2). Another village, *Ville La Butte* is thought to have been located in the present site of the town of Amherst. These villages were constructed as log homes overtop of the deserted Mi'kmaw encampments near the *La Planche* River, today known as the Laplanche River. *La Planche* River was given its name as the French had a 'great plank' which they used as a footbridge to cross the river at low tide. [9] This village was eventually burned due to raids in 1750. *La Butte* is noted to have stood until 1755 when it too was burned.[10]

Beaubassin, another Acadian village, was located on the Fort Lawrence Ridge. It was founded in 1671 by Jacques Bourgeois and five other families who moved from Port Royal.[11] The area expanded rapidly and by 1686 there were 22 houses on the ridge with the census recording 127 persons, as well as an abundance of livestock[12]. Beaubassin village thrived as the centre of a trading network for the Mi'kmaq and the people of Louisburg.[13]

Due to high tensions between the French and the English, these village sites were targeted areas of raiding for the New Englanders. Beaubassin eventually succumbed to these raids as the village was burned down in both the years 1696 and 1704. By 1750, the French population in the general area was approximately 2,500. [14] During the same year, Abbe Jean-Louis Le Loutre and "his Natives" forced the Acadians from Beaubassin to the French side of the Isthmus River and, once again, the homes and pastures of the village were set in flames.[15]

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[8] Jobb 2005::45-46
[9] Bird c. 1942:31.
[10] Nadon 1968:30,36.
[11] Jobb 2005:43.
[12] Acadian Census 1686.
[13] Davis MacIntyre & Associates Limited 2012:16.
[14] Jobb 2005:43.
[15] Jobb 2005:84.

***Figure 3.2- 2: Map of settlement in Nova Scotia in 1755, north at top. Note that the map does not depict* La Planche *or* La Butte *on the River La Planche (purple). The approximate study area is shown in red.*[16]**

In an attempt to gain military control of the area, Fort Lawrence was built in the fall of 1750 by Charles Lawrence, just north of *Beaubassin*. In retaliation, the French built Fort *Beausejour* on the present day, Aulac Ridge, west of Fort Lawrence. Fort *Beausejour* was attacked in a combined effort of British and New England forces from Fort Lawrence in 1755. The English were successful in capturing the fort, renaming it Fort Cumberland.[17]

After the deportation of the Acadians in 1755, settlement patterns came to a slow in the Amherst area and the Acadian dyke systems seemed to come to a fair amount of destruction in the years to come. A particularly rough storm hit the area in 1759, damaging the dykes. The damage was so extensive that the dykes were unusable, leaving barely any trace of them at all.[18]

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[16] Lewis 1755.

[17] Furlong 2001:vii, ix.

[18] Brebner 1937:60-61.

By the end of 1763, three British townships existed in the Chignecto area. Running across the Isthmus was Amherst, Cumberland and Sackville. The township of Amherst was named by Joseph Morse for Lord Jeffrey Amherst. Jeffrey Amherst was a British military hero for leading the final siege of Louisburg in 1758. He had never set foot in North America prior to the siege.[19]

After 1763, the populations began to grow as the new British township of Amherst was now granted to 42 families; each was given a woodlot, farm lot and marsh lot. The town was originally plotted by British engineers in the area of West Amherst. These lots were never used and the town grew further inland at its present site today.[20] The new British settlers were unable to renew the fertile dyked marshlands. Instead, farm lots were made on the southern slopes and they used the salt marshes only for pasturage and marsh hay. In some areas, Acadian prisoners were used to repair and instruct New Englanders on how to properly use the dyke systems. [21] These dyke lands were extremely fertile. Thus, they were kept and used to the most of their extent. Some of the families came to assist in the dyke maintenance, such as the Noiles, Bourque, and Gould families, who returned to Minudie and Nappan.[22]

The town of Amherst began to grow again after 1774. At this time, settlers from Yorkshire, England came to settle in the area. The Yorkshire peoples expanded the Tantramar marsh, which includes the Amherst marshes, by 80,000 acres through dyking.[23] This enabled the Chignecto and Tantramar farmers to become very prosperous off of the fertile marshland.

Although settlement was growing in Amherst, the study area itself appears to have been relatively devoid of cultural activity by 1779 (Figure 3.2-3). A 1779 map of the area shows settlement clustered along the rivers, including the Nappan and Laplanche rivers. However, the study area is located inland, between these two watercourses, where there is no depicted settlement.

By the 1850's, and into the early 1900's, early mechanized mowing and raking machines were beginning to come into use. Barns across the marshlands were built to store this rich marsh hay.[24] The hay was being exported to England and Newfoundland to feed workhorses, at a cost of $20 to $25 a tonne. [25]

In 1869, the Acadian dykes again succumbed to flooding due to a disastrous storm. The infamous Saxby Gale drove the tides over the dykes, causing hay and hay barns to float out into the Cobequid bay.[26]

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[19] Furlong 2001:x.

[20] Boomer 1937:43-45.

[21] Brebner 1937:43-45, 114.

[22] Boomer 1937:43-45.

[23] Cumberland County Museum and Archives n.d.:4.

[24] Boomer c. 1907:2,5.

[25] Cumberland County Museum and Archives n.d.:4.

[26] Boomer c. 1907:6.

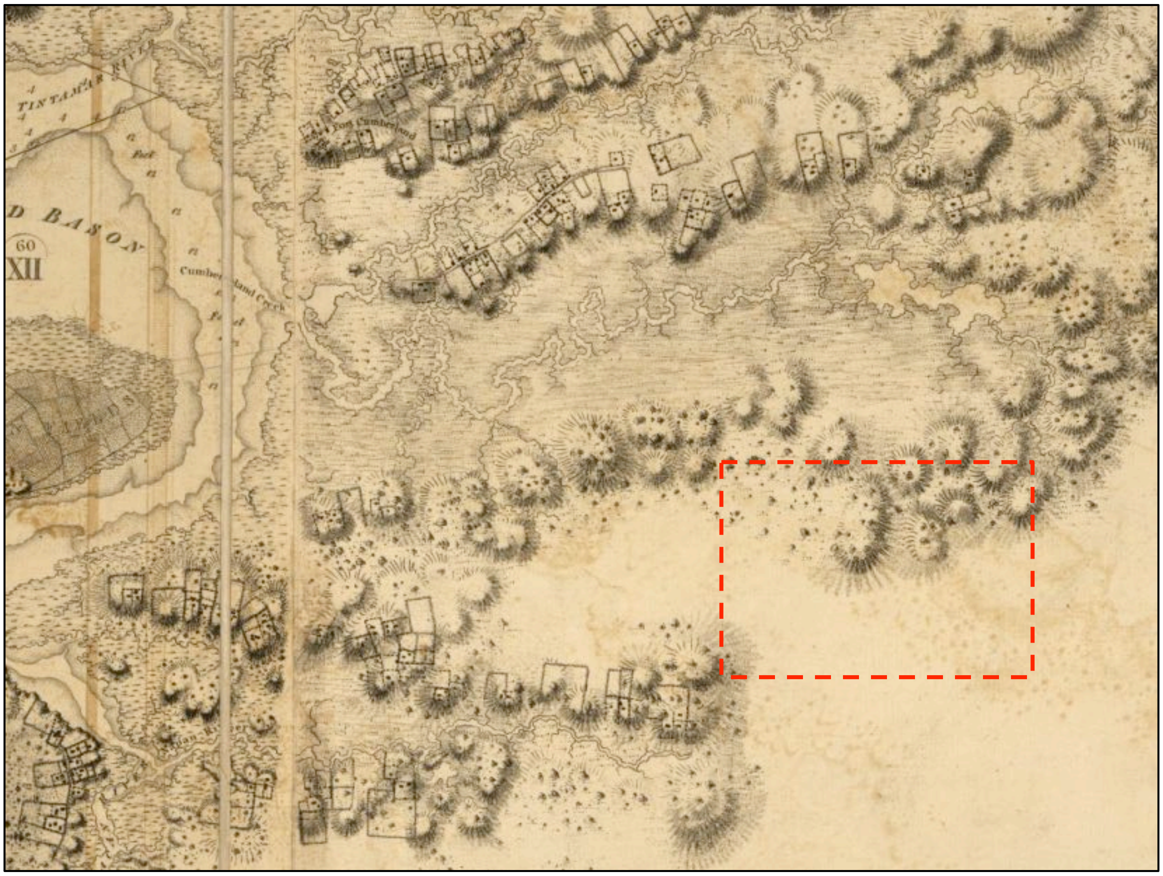

Figure 3.2- 3: 1779 map of the Amherst area showing settlement, north at the upper-right corner.[27] The approximate location of the study area is shown in red.

In 1888, the beginning of construction began for the Chignecto Marine Transport Railway. The engineer, Henry Ketchum, proposed the idea and his plans for the railway to the minister of Railways and Lands, Sir Charles Tupper. It was supposed to be a substitute for a canal between the Bay of Fundy and the Gulf of St. Lawrence over the Isthmus of 17 miles (27 km), from Tidnish to Fort Lawrence and the Cumberland Basin, with a dock at each end.[28] Work began in 1888, although the CMTC (Chignecto Marine Transport Company) ran out of money in 1891 and was unable to continue construction. The Canadian government refused to contribute more money, causing the project to be abandoned in 1893.[29] Remains of the railroad can still be seen today.

In 1900, the dykes were again damaged by an extreme high tide that swept over the Amherst marshes. A new dyke, 2 miles long and 6 feet high, was constructed to protect 13 acres of farmland. It had been maintained by the English and their

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[27] Des Barres 1779.

[28] Coll, n.d.:1; Underwood 1995:17.

[29] Coll n.d.:2-3.

descendants. This new dyke was also swept apart a year later. Another was built 7 feet high and 13 feet across its base. This one was noted to have lasted much longer than the others.[30]

Come the 1930's, the marsh hay market had crashed. To fuel the workforce, less hay was needed. This stifled the previously prosperous business of marsh hay sales, as farmers were lucky to receive $5 to $7 per tonne. This was barely enough to pay for labour and shipping, eventually leaving fields fallow and dykes unattended.[31]

During the Second World War, however, marsh hay was once again in demand. Marsh and dyke repairs were carried out between 1943 and 1947 and the Maritime Marshland Rehabilitation Administration was formed.[32] Large scale mechanical moving and upkeep of marsh soil eventually allowed for better draining. The long history of the Acadian dyke systems still contribute to the fertile marshlands of the Amherst area used by farmers to this day.

The Acadian settlements seem to appear mostly in the opposing direction of the study area or in the present location of the town of Amherst. Although the study area is mainly outside of any depicted settlement, the closest township to the location is the present area known as Hastings (Figure 3.2-4). Formerly known as Porter Town, its name was changed by provincial statue in 1864. Its present name honours the English statesman Warren Hastings. The area does not seem to include any significant European or Acadian settlements. However, a way office was established there in 1864 and a school was built in 1870.[33]

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[30] Boomer c. 1907:6.

[31] Cumberland County Museum Archives n.d.:5-7.

[32] Cumberland County Museum Archives n.d.:7-8.

[33] Fergusson 1967:283.

Figure 3.2- 4: The 1873 map of Cumberland County by A.F. Church, showing the approximate location of the study area (red)[34]. Note the clustering of cultural activity along the roads and lack of activity inland.

3.3 Field Reconnaissance

A reconnaissance of the initial June 2014 layout was conducted on 23 June 2014. The details of this reconnaissance can be found in appendix B. An archaeological field reconnaissance of the final November 2014 layout was conducted on 12 November 2014. The reconnaissance was facilitated by a hand-held GPS and GPS data supplied by the client. A total of approximately 2.5 kilometres of proposed access road was surveyed, including approximately 1.6 kilometres of access road located along an existing logging road. A buffer of approximately 20 metres on either side of the proposed access road was investigated. All three proposed turbines sites were also surveyed.

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[34] Church 1873.

The existing access road, probably originally a logging road, connects to Black John Road. From Black John Road, the access road crosses an area with a blueberry field on the southwest side (Plate 1) and a grass field on the northeast (Plate 2). After approximately 400 metres, the access road meets a gate and moves into a wooded area. The terrain around the access road shows indications of logging, including cut stumps and skidder tracks (Plate 3). The area to the northeast of the access road is wet. There are many exposed soils along the access road, which were examined but appeared to be culturally sterile (Plate 4).

The access road crosses part of a natural gas pipeline (Plate 5) and enters into an area that had been extensively clear-cut recently and contains young regrowth. After approximately 1.5 kilometres, the access road passes the meteorological tower, in the midst of recent clear-cut (Plate 6). The existing access road terminates at a data collector (Plate 7).

From here, the proposed access road passes through an area characterized by young regrowth of spruce, birch, and maple with a fern understory. A portion of the road runs along an old skidder trail that is wet. The terrain in general is rough and hummocky and several other skidder trails and cut stumps can be seen. This area has been cut in the last 20 years. The terrain at turbine candidate site #1 is much the same, though tamarack can also be seen, further evidence that this area is wet and the soil poorly drained. At the turbine site, there appears to have been more recent selective cutting in the last five years (Plate 8).

From here, the reconnaissance progressed along the access road to turbine candidate site #3. A significant portion of the access road passes through an expansive recent clear cut, much of which has been flagged as wetland (Plate 9). The clear cut is criss-crossed by a network of skidder trails. At the south end of the clear cut, the land gradually slopes down and the road then passes through a mature forest which is predominantly spruce with a moss and fern understory. A brook drains the clear cut wetland above. The brook is approximately 1 metre wide and 10 centimetres deep, on average (Plate 10). The terrain here along the access road to turbine candidate site #3 is relatively rough with no indications of past cultural activity.

Turbine candidate site #3 is located in the same mature forest. The immediate area is predominantly spruce, approximately 60 to 70 years old. The forest floor is moss covered, wet and hummocky (Plate 11). Again, there is no evidence of past cultural activity.

From here, the reconnaissance progressed along the northern edge of the mature forest (where it transitions into the expansive clear cut to the north), to turbine candidate site #2. The turbine site is located on the periphery between an active agricultural field to the southwest and a hay field to the northeast. A tree line between the two fields runs along a drainage ditch (Plate 12). With the exception of recent clear cutting and active agriculture, there was no evidence of cultural activity.

From turbine candidate site #2, the reconnaissance moved along the access road from the turbine site back to the north side of the expansive clear cut, where it meets the access road between turbine sites #1 and #3. The southern end of the access road to turbine candidate site #2 has been recently clear cut up to the agricultural fields. The road slopes down here to a small brook which is likely a tributary of the same brook encountered on the access road to turbine site #3 (Plate 13). The brook is draining from an area to the north that was previously dammed by a beaver. The dam appears to have been breached.

4.0 Results and Discussion

There is no evidence of historic cultural activity in the impact areas of the proposed access roads and turbine candidate sties. The only indications of cultural activity were found to be fairly modern, consisting of modern logging activity such as skidder trails, clear-cut, logging roads and cut stumps, modern agricultural activity, and a natural gas pipeline.

Although there was historic activity in the general vicinity of Amherst, historic maps and documents indicated there was little historic cultural activity in the study area itself. Additionally, the potential for First Nations archaeological resources in the impact area is low. The only noted watercourse is small and non-navigable. The study area is generally poorly drained and wet and the terrain rough and uneven. First Nations peoples are known have been in the general vicinity and may have taken advantage of the area for hunting and/or gathering. However, there is little reason for them to have settled here. Activity such as short-term forays into the area for hunting and/or gathering is unlikely to leave an archaeological footprint.

5.0 Conclusions and Recommendations

Avoidance is the preferred method of mitigation in all instances where archaeological resources are present. The results of the historic background study and archaeological reconnaissance indicate that the study area is of low potential for First Nations archaeological resources. Furthermore, no historic period archaeological resources were encountered during the reconnaissance. The only identified cultural activity consisted of modern logging and agricultural activity.

Should development plans change so that areas not previously assessed by archaeologists are to be impacted by access roads or turbine sites it is recommended that those areas be subjected to an archaeological assessment by a qualified archaeologist.

Finally, in the unlikely event that archaeological features are encountered during ground disturbing activities, it is required that all activity cease and the Coordinator of Special Places (902-424-6475) be contacted immediately regarding a suitable method of mitigation.

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PLATES

Plate 1: Looking northwest over the existing access road to John Black Road, with the blueberry field shown on the left of the road.

Plate 2: Looking southeast over the access road and grass field to the northeast of the road.

Plate 3: A view of cut stumps beside an overgrown skidder trail (right) located to the southwest of the access road, looking southwest.

Plate 4: Examination of exposed soils at the edge of the existing access road, looking northeast.

Plate 5: Looking west toward the existing access road along the natural gas pipeline.

Plate 6: The meteorological tower in recent clear-cut, looking southwest.

Plate 7: The data collector at the terminus of the access road, looking east.

Plate 8: Turbine candidate #1 site, looking west.

Plate 9: Looking southwest at the clear cut along the proposed access road to turbine candidate site #3.

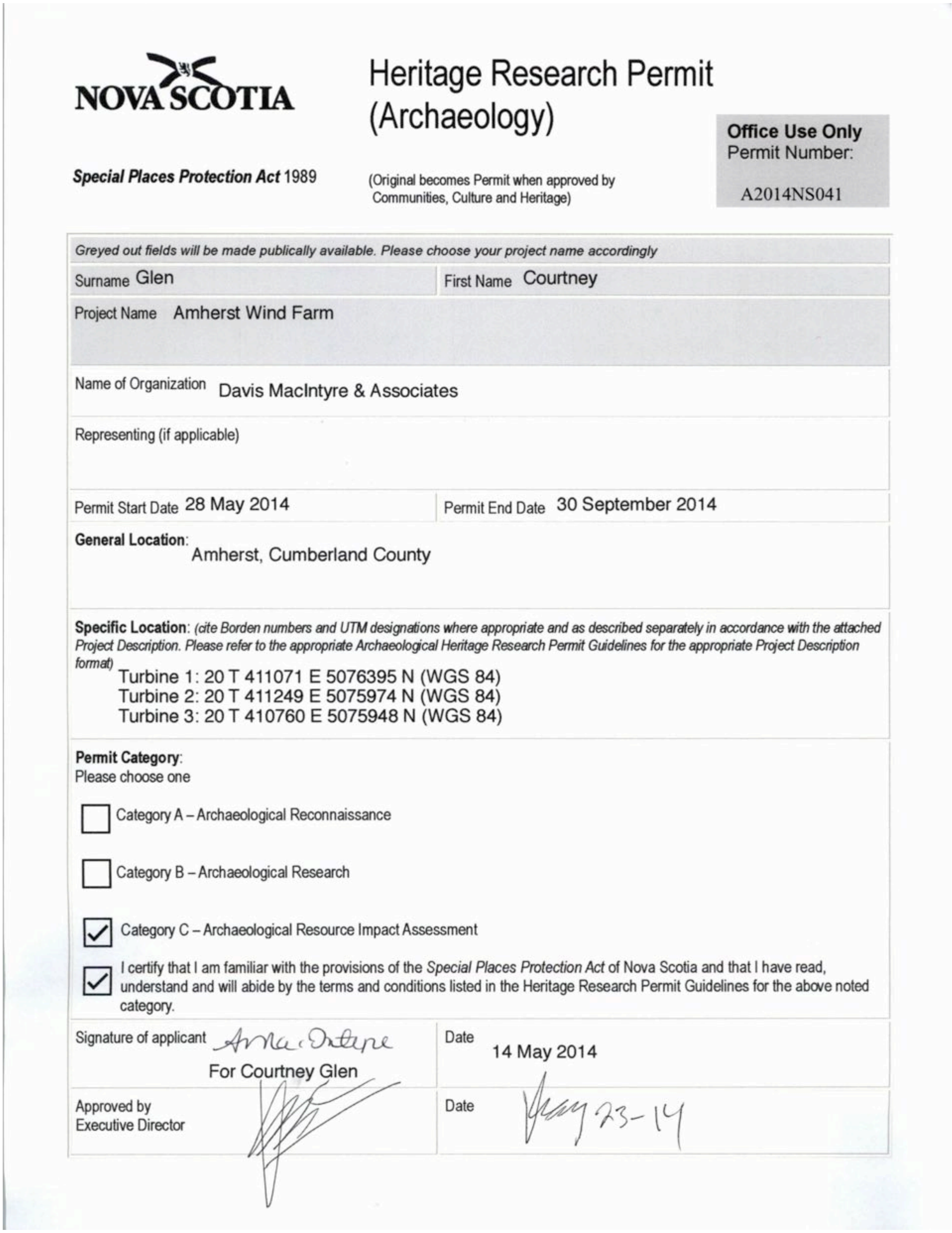
Plate 10: Brook along the access road to turbine candidate site #3, looking south.

Plate 11: Turbine candidate site #3, looking west northwest.

Plate 12: Looking east at turbine candidate site #2. The hay field can be seen in the background. The active agricultural field is to the photographer's left, out of frame. The tree line along the edge of the hay field runs along a drainage ditch.

Plate 13: Looking northwest at turbine site #2 with the access road on the photographer's right.

APPENDIX A:
Heritage Research Permit



NOVA SCOTIA

Heritage Research Permit (Archaeology)

Office Use Only
Permit Number:
A2014NS041

Special Places Protection Act 1989

(Original becomes Permit when approved by Communities, Culture and Heritage)

Greyed out fields will be made publically available. Please choose your project name accordingly

Surname Glen

First Name Courtney

Project Name Amherst Wind Farm

Name of Organization Davis MacIntyre & Associates

Representing (if applicable)

Permit Start Date 28 May 2014

Permit End Date 30 September 2014

General Location: Amherst, Cumberland County

Specific Location: *(cite Borden numbers and UTM designations where appropriate and as described separately in accordance with the attached Project Description. Please refer to the appropriate Archaeological Heritage Research Permit Guidelines for the appropriate Project Description format)*

Turbine 1: 20 T 411071 E 5076395 N (WGS 84)
Turbine 2: 20 T 411249 E 5075974 N (WGS 84)
Turbine 3: 20 T 410760 E 5075948 N (WGS 84)

Permit Category:
Please choose one

☐ Category A – Archaeological Reconnaissance

☐ Category B – Archaeological Research

☑ Category C – Archaeological Resource Impact Assessment

☑ I certify that I am familiar with the provisions of the *Special Places Protection Act* of Nova Scotia and that I have read, understand and will abide by the terms and conditions listed in the Heritage Research Permit Guidelines for the above noted category.

Signature of applicant
For Courtney Glen

Date 14 May 2014

Approved by Executive Director

Date May 23-14

APPENDIX B:
June 2014 Reconnaissance Letter

DAVIS
MACINTYRE
& ASSOCIATES
ARCHAEOLOGICAL CONSULTANTS

10 June 2014

Sean Weseloh McKeane
Coordinator, Special Places
Communities, Culture and Heritage
PO Box 456, STN Central
Halifax, NS B3J 2R5

CC:
Amy Pellerin
Natural Forces
1801 Hollis Street, Suite 1205
Halifax, NS B3J 3N4

Re: A2014NS041 – Amherst Wind Project

Dear Mr. McKeane,

This letter details the preliminary findings of the June 2014 field reconnaissance for the initial layout of the Amherst Wind project. During the June 2014 field reconnaissance, a large beaver dam was found at one of the proposed turbine locations, prompting the layout of the project to be revised. A reconnaissance of the revised layout was conducted in November 2014 and these findings, along with a historic background study of the area and any necessary recommendations for mitigation will be detailed in an archaeological resource impact assessment (ARIA) for HRP A2014NS041. This letter will be included in the ARIA report as Appendix B.

The June 2014 access road layout included approximately 1.6 kilometres of an existing road, which did not change from the initial layout to the revised November 2014 layout and will therefore be reported on in the forthcoming ARIA report. The June 2014 layout of the access road and turbine candidate sites is attached as Figure 1.

An archaeological field reconnaissance was conducted on 23 June 2014. The reconnaissance was facilitated by a hand-held GPS and GPS data supplied by the proponent. A buffer of 80 metres surrounding the June 2014 proposed access roads (approximately 1 kilometre in length) was surveyed. The three proposed turbine sites were also surveyed, although there was difficulty in accessing turbine site #2.

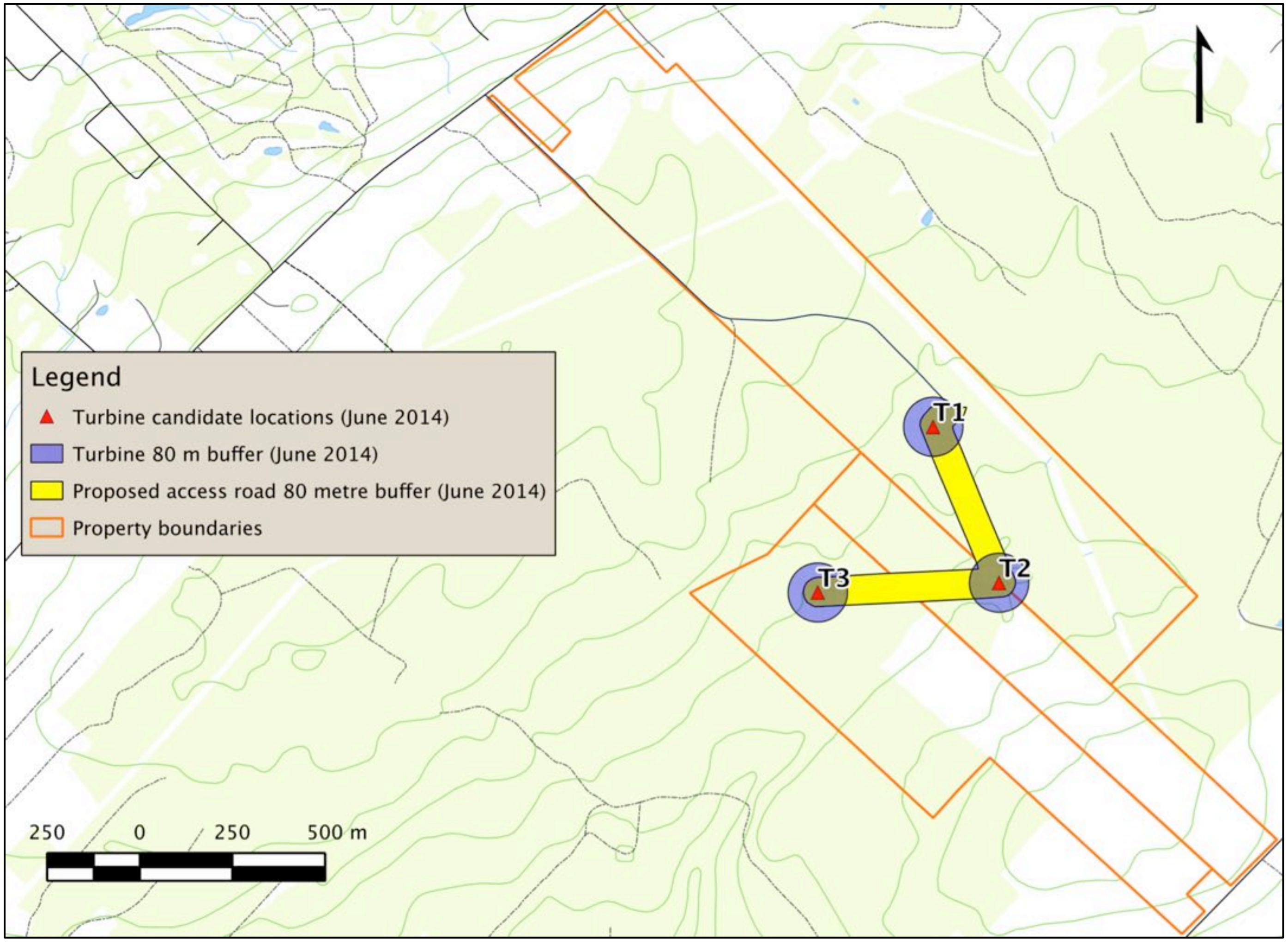


Figure 1: The June 2014 access road layout and proposed turbine candidate sites, with 80 metre buffers indicating the area that was surveyed.

The proposed turbine candidate site #1 is located in an area characterized by young regrowth of spruce and birch, with a fern understory (Plate 1). The terrain is rough and very uneven. The area showed signs of logging, including skidder trails and piles of dry logs.

Plate 1: Looking southwest over proposed turbine candidate site #1.

From turbine candidate site #1, the proposed access road will cut southeast to turbine candidate site #2. This portion of the proposed access road crosses an area of predominately young re-growth with some patches of mature trees (Plate 2). Again, the area shows signs of logging. After approximately 250 metres, the proposed access road enters an area of very recent clear-cut. The area is also very wet (Plate 3).

Plate 2: A view of the mature trees and young re-growth in the path of the proposed access road, looking south.

Plate 3: Looking south over the wet clear-cut area, including water-logged skidder tracks, along the proposed access road approximately 130 metres from turbine candidate site #2.

The area becomes progressively wetter towards turbine candidate site #2 and it became difficult to survey the area approximately 50 metres northwest from the turbine candidate site, where the team turned around to attempt to approach from another direction (Plate 4). Upon approaching the candidate site from the southwest, a large beaver dam was encountered. The dam is built up from the ground level, most likely taking advantage of an existing wetland (Plate 5). The dam is probably partially responsible for the inundation of turbine candidate site #2. The team was therefore unable to access turbine candidate site #2 and most of the 80 metre buffer surrounding it.

The northern edge of the proposed access road buffer from turbine candidate site #2 to turbine candidate #3 crosses the same area of recent clear-cut noted in plate 3. Although this clear-cut area is higher than the wetland around turbine candidate site #2, deep skidder tracks filled with ground water were noted across the entire clear-cut area.

Plate 4: A view of the wetland around turbine candidate site #2, looking southeast. Note the standing water.

Plate 5: A close-up of the beaver dam, looking east. Note how the dam has been built up from the ground.

The southern side of the proposed access road buffer cuts through a mature forested area. This mature forest was also encountered on the northern side of the proposed access road after approximately 330 metres. The mature forest is predominately spruce, with a moss and fern understory. There were few indications of cultural activity and these include an overgrown road that appeared to still be in use by recreational vehicles (Plate 6) and a hunting blind (Plate 7).

Plate 6: Looking east along an overgrown road within the proposed access road buffer.

Plate 7: A view of the hunting blind (blue) located in the proposed access road buffer, looking south. Note the mature forest surrounding the blind.

Several small watercourses were noted along this section of the proposed access road (Plate 8). These watercourses are shallow, non-navigable and are probably part of the drainage system for the wetland around turbine candidate site #2. The watercourses are less than 1 metre to 1.5 metres wide and less than 50 centimetres deep. Turbine candidate site #3 is located in an area of mature growth spruce and birch. The area is a little wet and the terrain is rough and uneven (Plate 9).

Plate 8: A small, non-navigable watercourse probably related to drainage of the area, looking west. This was typical of the watercourse encountered in the south end of the study area.

Plate 9: A view of the approximate location of turbine candidate site #3, looking south.

During the preliminary June 2014 reconnaissance, no areas of heightened archaeological potential were noted and no cultural features, aside from modern logging activities and a hunting blind, were noted. A large beaver dam and associated pond were identified at the edge of the 80 metre buffer for turbine candidate site #2 (Table 1). The June 2014 field survey identified no historic or First Nations archaeological resources within the impact area. The potential for First Nations or historic resources within the surveyed area is also low. The only identified cultural activity consisted of modern activities, such as logging and hunting.

***Table 1: Areas of cultural or notably natural activity with UTM coordinates (NAD83) identified in the preliminary June 2014 field reconnaissance*.**

Cultural or natural activity	Coordinates	Archaeological Significance
Hunting blind	20 T 410824 5075896	Low
Beaver dam and pond	20 T 411156 5075968	N/A

If Heritage staff find this letter acceptable, I would appreciate if a copy of your letter be forwarded to our client as follows:

Amy Pellerin
Natural Forces
1801 Hollis Street, Suite 1205
Halifax, NS B3J 3N4

Please do not hesitate to contact me if this letter is not acceptable or if more information is required.

Regards,

Courtney Glen
Senior Archaeologist

CC: A. Pellerin, Natural Forces

Appendix E:

Mi'kmaq Ecological Knowledge Study

Amherst Community Wind Farm
Mi’kmaq Ecological Knowledge Study

Prepared for: Natural Forces Inc.

Membertou
GEOMATICS SOLUTIONS

October 2014
Version 1

M.E.K.S. Project Team

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Prepared by:	Reviewed by:
______________________	______________________
Craig Hodder, Author	Jason Googoo, Manager

Executive Summary

This Mi'kmaq Ecological Knowledge Study, also commonly referred to as an MEKS or a Traditional Ecological Knowledge Study (TEKS), was developed by Membertou Geomatics Solutions (MGS) for Natural Forces Inc. (Natural Forces) for the proposed Amherst Community Wind Farm project.

This MEKS mandate is to consider land and water areas which the proposed project will utilize, and to identify what Mi'kmaq traditional use activities have occurred, or are currently occurring within, and what Mi'kmaq ecological knowledge presently exists in regards to the area. In order to ensure accountability and ethic responsibility of this MEKS, the MEKS development has adhered to the "Mi'kmaq Ecological Knowledge Protocol". This protocol is a document that has been established by the Assembly of Nova Scotia Mi'kmaq Chiefs, which speaks to the process, procedures and results that are expected of a MEKS.

The Mi'kmaq Ecological Knowledge Study consisted of two major components:

- **Mi'kmaq Traditional Land and Resource Use Activities**,
  both past and present,
- A **Mi'kmaq Significance Species Analysis**, considering the resources that are important to Mi'kmaq use.

The Mi'kmaq Traditional Land and Resource Use Activities component utilized interviews as the key source of information regarding Mi'kmaq use in the Project Site and Study Area. The Project Site is located approximately 3 km east of Amherst, Nova Scotia. The Study Area will consist of areas within 5 km of the proposed project's property boundary, and encompasses the communities of Amherst, East Amherst, Tyndal Road, Warren, Hastings, Brookdale and Upper Nappan.

Interviews were undertaken by the MEKS Team with Mi'kmaq hunters, fishers, and plant gatherers, who shared with the team the details of their knowledge of traditional use activities. The interviews took place in September 2014.

Informants were shown topographical maps of the Project Site and Study Area and then asked to identify where they undertake their activities as well as to identify where and what activities were undertaken by other Mi'kmaq. A total of twenty three informants agreed to provide any fishing, hunting, gathering information, or details of any other cultural activity in the area. Permission was requested of the interviewee(s) to have their information incorporated into the GIS data. These interviews allowed the team to develop a collection of data that reflected the most recent Mi'kmaq traditional use in this area, as well as historic accounts. **All interviewee's names are kept confidential and will not be released by MGS as part of a consent agreement between MGS and the interviewee to ensure confidentiality.**

The data gathered was also considered in regards to Mi'kmaq Significance. Each species identified was analyzed by considering their use as food/sustenance resources, medicinal/ceremonial plant resources and art/tools resources. These resources were also considered for their availability or abundance in the areas listed above, and their availability in areas adjacent or in other areas outside of these areas, their use, and their importance, with regards to the Mi'kmaq.

Project Site

Based on the data documented and analyzed, it was concluded that there is very little traditional use occurring directly on the project site. Activities found to have occurred were the gathering of blueberries, apples, flag root, cow lily, ground juniper, and princess pine. These areas were found to be located in the northwest corner of the Project Site.

Study Area

Based on the data documentation and analysis, it was concluded that the Mi'kmaq have historically undertaken traditional use activities in the Study Area, and that this practice continues to occur today. These activities primarily involve harvesting of fish, but also include harvesting of animal, plant, and tree species; all of which occurs in varying locations throughout the Study Area and at varying times of the year.

Trout and bass were found to be the most fished species in the Study Area. Deer and rabbit were found to be hunted in the Study Area. The harvesting of blueberries and apples were the most reported gathering activity found in the information recorded.

This MEKS <u>should not</u> be used for Consultation purposes by government and/or companies, nor should this report replace any Consultation process that may be required or established in regards to Aboriginal people. As well, this report cannot be used for the justification of the Infringement of S.35 Aboriginal Rights that may arise from the project.

Table of Contents

1.0 INTRODUCTION

1.1 Membertou Geomatics Solutions

Membertou Geomatics Solutions (MGS) is a Membertou First Nation company that was developed as a result of the 2002 Supreme Court Marshall Decision. MGS was established as a commercially viable company that could provide expertise in the field of GIS Services, Database Development, Land Use Planning Services and Mi'kmaq Ecological Knowledge Studies (MEKS). MGS is one of many companies established by the Membertou First Nation – Membertou Corporate Division and these companies provide employment opportunities for aboriginal persons and contribute to Membertou's efforts of growth and development. As well, Membertou's excellent management and accountability of their operations is further enhanced by their ISO 9001:2008 certification.

For the development of this MEKS, MGS brings to the table a team whose expertise and skills with land documentation have developed a sound MEKS. The team skills include expertise within the area of historical Mi'kmaq research, GIS data analysis, Mi'kmaq environmental knowledge, and Mi'kmaq community connections.

1.2 Amherst Community Wind Farm Project

Natural Forces is acting as the 'Developer' for the proposed Amherst Community Wind Farm project located in Amherst, Nova Scotia, which will be owned by an entity named 'Mi'Kmaq Wind4All Communities LP'.

The wind farm, located east of Amherst, Nova Scotia, will consists of the development of 3 wind turbines.

Natural Forces has contracted Membertou Geomatics Solutions (MGS) to undertake a Mi'kmaq Ecological Knowledge Study (MEKS) for the proposed Amherst Wind Farm Project.

2.0 MI'KMAQ ECOLOGOCAL KNOWLEDGE STUDY SCOPE & OBJECTIVES

2.1 Mi'kmaq Ecological Knowledge

The Mi'kmaq people have a long-existing, unique and special relationship with the land and its resources, which involves the harvesting of resources, the conservation of resources and spiritual ideologies. This relationship is intimate in its overall character, as it has involved collective and individual harvesting of the resources for various purposes, be it sustenance, medicinal, ceremonial and/or conservation. This endearing relationship has allowed the Mi'kmaq to accumulate generations of ecological information and this knowledge is maintained by the Mi'kmaq people and has been passed on from generation to generation, youth to elder, ***kisaku kinutemuatel mijuijij***.

The assortment of Mi'kmaq Ecological Information which is held by various Mi'kmaq individuals is the focus of Mi'kmaq Ecological Knowledge Studies (MEKS), also commonly referred to as Traditional Ecological Knowledge Studies (TEKS). When conducting a MEKS, ecological information regarding Mi'kmaq/Aboriginal use of specific lands, waters, and their resources are identified and documented by the project team.

Characteristically, MEKS have some similar components to that of an Environmental Assessment; yet differ in many ways as well. Among its purpose, Environmental Assessments seek to measure the impact of developmental activity on the environment and its resources. This is often done by prioritizing significant effects of project activities in accordance with resource legislation, such as the federal *Species at Risk* and the Nova Scotia Endangered Species Act.

Mi'kmaq Ecological Knowledge Studies are also concerned with the impacts of developmental activities on the land and its resources, but MEKS do so in context of the land and resource practices and knowledge of the Mi'kmaq people. This is extremely important to be identified when developing an environmental presentation of the Study Area as Mi'kmaq use of the land, waters and their resources differs from that of non-Mi'kmaq. Thus, the MEKS provides ecological data which is significant to Mi'kmaq society and adds to the ecological understandings of the Study Area.

2.2 Mi'kmaq Ecological Knowledge Study Mandate

Membertou Geomatics Solutions was awarded the contract to undertake a Mi'kmaq Ecological Knowledge Study, on behalf of Natural Forces, with regards to the proposed Amherst Community Wind Farm Project. This project will require the documentation of key environmental information in regards to the project activities and its possible impacts on the water, land and the resources located here. The MEKS must be prepared as per the **Mi'kmaq Ecological Knowledge Study Protocol** ratified by the Assembly of Nova Scotia Mi'kmaq Chiefs on November 22, 2007.

MGS proposed to assist with the gathering of necessary data by developing a MEKS which will identify Mi'kmaq traditional land use activity within the proposed project site and in surrounding areas within a 5 kilometer radius of the project site. The proposed MEKS would identify, gather, and document the collective body of ecological knowledge which is held by individual Mi'kmaq people. The information gathered by the MEKS team is documented within this report and presents a thorough and accurate understanding of the Mi'kmaq's use of the land and resources within the Project Site/Study Area.

MGS understands that this study could be included in the Environmental Assessment under the Nova Scotia Environmental Assessment Act that will be submitted to the Nova Scotia Department of Environment by Natural Forces, and will be used as an indicator identifying Mi'kmaq traditional land and resource use within the Study Area.

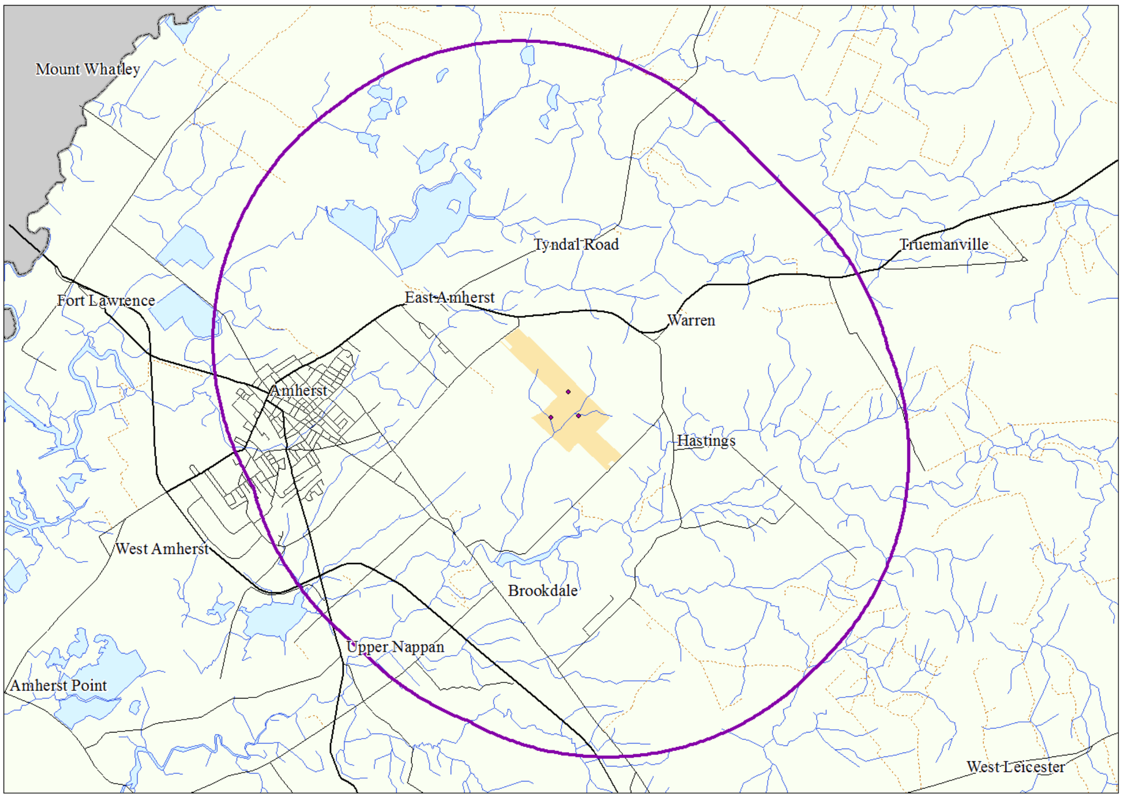
It must be stated, however, that this MEKS <u>should not</u> be used for Consultation purposes by government and/or companies, nor should this report replace any Consultation process that may be required or established in regards to Aboriginal people. As well, this report cannot be used for the justification of the Infringement of S.35 Aboriginal Rights that may arise from the project.

2.3 Mi'kmaq Ecological Knowledge Study Scope & Objective

This MEKS will identify Mi'kmaq ecological information regarding Mi'kmaq traditional land, water and resource use within the Project Site/Study Area. The data that the study will gather and document will include use from both the past and present time frame. The final MEKS report will also provide information that will identify where the proposed project activities may impact the traditional land and resource of the Mi'kmaq. If such possible impact occurrences are identified by the MEKS then the study will also provide recommendations that should be undertaken by the proponent. As well, if the MEKS identifies any possible infringements with respect to Mi'kmaq constitutional rights, the MEKS will provide recommendations on necessary steps to initiate formal consultation with the Mi'kmaq. Finally, through the development of this MEKS, Mi'kmaq ecological knowledge and traditional land, water and resource use will be identified for those parties that are considering the Amherst Community Wind Farm Project.

2.4 MEKS Study Area

This MEKS will focus on the Project Site, an area located approximately 3 km east of Amherst, Nova Scotia. The Study Area will consist of areas that fall within a 5 km radius of the Project Site.



Project Site (orange highlight) and Study Area (purple line)

3.0 METHODOLOGY

3.1 Interviews

As a first step to gathering traditional use data, the MEKS team initiated dialogue and correspondence with Mi’kmaq communities in close proximity of the Project Site: Sipekne’katik (Shubenacadie), Millbrook, Paq’tnkek, and Pictou Landing. Discussions occurred to identify individuals who undertake traditional land use activities or those who are knowledgeable of the land and resources. An initial list of key people is then developed by the team. These individuals were then contacted by the MEKS team members and interviews were scheduled.

For this MEKS, twenty four (24) individuals provided information in regards to past and present traditional use activities. Interviewees resided within or were from the communities of Sipekne’katik (Shubenacadie), Millbrook, Paq’tnkek, and Pictou Landing. All of the interviews that were completed following the procedures identified within the Mi’kmaq Ecological Knowledge Protocol (MEKP) document. Prior to each interview, interviewees were provided information about the MEKS, including the purpose and use of the MEKS, the non-disclosure of their personal information in any reports, and the future use of the traditional use information they provided.

Interviewees were asked to sign a consent form, providing permission for MGS to utilize their interview information within this MEKS. During each interview, individuals were provided maps of the Project Site/Study Area and asked various questions regarding Mi’kmaq use activities, including where they undertook their activities or where they knew of activities by others, when such activities were undertaken, and how that type of resource was utilized. When required, interviews were conducted in the Mi’kmaq language.

3.2 Literature and Archival Research

With regards to this MEKS, various archival documents, maps, oral histories and published works were reviewed in order to obtain accurate information regarding the past or present Mi'kmaq use or occupation relevant to the Project Site and Study Area. A complete listing of the documents that were referenced is outlined within the *Sources* section.

3.3 Field Sampling

Site visits to the Project Site took place in September, 2014 by MGS staff members, guided by a Mi'kmaq ecological knowledge holder over a period of three days. A member of Mi'kmaq Wind 4All Steering Committee also joined MGS staff members on one day during the site visit.

The site visits consisted of a site recon, and walkthroughs of the Project Site, noting and identifying any particular species in the area, plant and animal habitats, or other land/water features or areas that would be of importance to the Mi'kmaq. MGS staff and the Mi'kmaq ecological knowledge holder would either take note of observation points at set, and at irregular intervals, or whenever a species or observation was worth noting.

Site Visit Observations

Throughout the entire site visit, thirty five (35) various species of plants, trees, and animal were observed and recorded in seventy nine (79) observation points. The most common observations recorded during the site visit were birch trees (with 12 observation points—7 yellow birch and 5 white birch), 11 maple tree observations (including 4 red maple observations and 3 sugar maple), and 10 spruce trees (including 5 black spruce, and 3 red spruce observations).

Other plant species and/or animal signs observed were ferns, numerous bear signs (and calls), golden thread, labrador tea, balsum trees, partridge and pheasants, raccoon tracks, lady slipper, beech trees, alders, aspen trees, cherry tree, coyote track, larch, partridge berries, poplar, rabbit signs, snowberries, wood sorrel, mountain ash, a plum tree, moss, deer tracks, jack pine, dogwood, and raspberries.

Golden thread, found in a mossy, old growth portion of the site visit, along with some snowberries.

4.0 MI'KMAQ LAND, WATER AND RESOURCE USE

4.1 Overview

The Mi'kmaq Land, Water and Resource Use Activities component of the MEKS provides relevant data and analysis in regards to Mi'kmaq traditional use activities that are occurring or have occurred within the Study Area. It identifies what type of traditional use activities are occurring, it provides the general areas where activities are taking place and it presents an analysis regarding the significance of the resource and the activity as well.

The Mi'kmaq traditional use activities information that is provided by interviewees is considered both in terms of "Time Periods" and in regards to the "Type of Use" that the resource is being utilized. The Time Periods that the MEKS team differentiates traditional use activities by are as follows:

"Present" – a time period within the last 10 years
"Recent Past" – a time period from the last 11 – 25 years ago
"Historic Past" – a time period previous to 25 years past

The "Type of Use" categories include spiritual use, and sustenance use, such as fishing, hunting or medicinal gathering activities.

Finally, the study analyzes the traditional use data in consideration of the type of land and resource use activities and the resource that is being accessed. This is the Mi'kmaq Significant Species Analysis, an analysis which ascertains whether a species may be extremely significant to Mi'kmaq use alone and if a loss of the resource was to occur through project activities, would the loss be unrecoverable and prevent Mi'kmaq use in the future. This component is significant to the study as it provides details as to Mi'kmaq use activities that must be considered within the environmental understanding of the Project Site and Study Area.

By analyzing the traditional use data with these variables, the MEKS thoroughly documents Mi'kmaq traditional use of the land and resources in a manner that allows a detailed understanding of potential effects of project activities on Mi'kmaq traditional use activities and resources.

4.2 Limitations

By undertaking a desktop background review and interviews with Mi'kmaq participants in traditional activities, this study has identified Mi'kmaq Traditional Use activities that have occurred or continue to occur in the Study, and no uses within the Project Site. This has allowed the study to identify traditional use activities in a manner that the MEKS team believes is complete and thorough, as required by the MEKP. Historical documents within public institutions were accessed and reviewed and individuals from nearby Mi'kmaq communities were interviewed. The interviews were undertaken with key Mi'kmaq community people, identified initially by the MEKS team, who are involved and are knowledgeable regarding traditional use activities. Through the historical documentation review and the interview process, the MEKS team is confident that this MEKS has identified an accurate and sufficient amount of data to properly reflect the traditional use activities that are occurring in the Study Area.

The MEKS process is highly dependent on the information that is provided to the team. Because only some of the Mi'kmaq traditional activity users and not all Mi'kmaq traditional activity users are interviewed, there is always the possibility that some traditional use activities may not have been identified by the MEKS.

4.3 Historical Review Findings

Historic Review

The Project Site is approximately 5 km east of Amherst, Cumberland County, Nova Scotia. The site is adjacent an existing electrical transmission line and is bound in the north by John Black Road and in the south by Pump Station Road. The Project Site occupies high ground over the low LaPlanche River Valley and Amherst Marsh to the northwest with the Project Site being approximately 50m in elevation with some highpoints of 75m and 66m elevation adjacent the site. The Study Area encompasses an area that includes the Amherst Marsh, communities of Tyndale Road, Warren, Hastings, Brookdale, Upper Nappan and the Town of Amherst.

The high ground of the Project Site overlooks the expanse of lowland of the Chignecto Istmus to the north and northwest. The Chignecto Istmus has 3 low and elongated ridges in a northeast-southwest alignment on the Cumberland Basin side of the Isthmus and some islands of high ground.

The Natural History of Nova Scotia describes the Project Site high ground as the Northumberland Strait portion of the Northumberland Plain (521a). The Northumberland Plain is more specifically part of the Carboniferous Lowlands (500) of carboniferous sedimentary rock forming in this area a Coastal Plain (520), known as the Northumberland Plain (521) along this coast and specifically the Northumberland Strait coastal plain (521a). The Northumberland Strait coastal plain stretches from the Cumberland Basin to Merigomish Island and is described as being typically underlain by fine red sandstone that has been folded leaving two main anticlines (bump in the layered bedrock) that are partially eroded and exposing the sandstone layers to the subsurface. The difference in the erosion resistance of each layer left an undulating landscape of low ridges and valleys. The low valley of the LaPlanche River and the Amherst Marsh northwest of the Project Site are described as Tantramar Marshes (523), also of the Carboniferous Lowlands. *(1)*

The Northumberland Strait coastal plain (521a) has few lakes and what lakes there are elongated and shallow. With the exception of a small area east of Amherst and including the Project Site that drains southwest into the Nappan River and Cumberland Basin, the Northumberland Strait coastal plain drains north. *(1)*

The underlying sandstone and shale bedrock produced glacial tills of sandy loam to sandy clay loam that is impermeable in nature and developed imperfectly drained soils. These soils support a heterogeneous mixed forest with hardwoods dominating. The area is subject to high winds from the Northumberland Strait and trees tend to be leaning and stunted in some areas. The habitat found within the Northumberland Strait coastal plain supports bird breeding areas with some species breeding only within the Northumberland Strait coastal plain (521a). *(1)*

The Rock

The Project Site is entirely underlain by the Balfron Formation (lCpb) of the Pictou Group of the Carboniferous Period. The Balfron Formation consists of Fluvial Sandstone, Conglomerate, Mudstone and occasional Lacustrine Limestone and is approximately 305 Ma old. *(2)*The Carboniferous Period lasted from 359.2 to 299 Ma ago and was a time of warm and wet conditions on earth that produced abundant plant life that was the source of the carbon for coal found today. *(3)* It is not until the Cobequid Mountains approximately 25 km to the south and southeast are found bedrock that is suitable for tools and weapons that would have been of interest to early peoples. Suitable bedrock for tools and weapons may be found approximately 40km west of the Project Site and west of the Petitcodiac River are found volcanic bedrock of the Middle Neoproterzoic or Ediacaran period of 541 to 365 Ma in age. Some exposed outcrops along the shores of the Bay of Fundy, Minas Channel and Minas Basin are a source of raw material for tools and weapons. *(2)*

The Ice

Evidence from deep-ocean sediments indicate that there have been at least 16 glacial periods that lasted approximately 100 thousand years each. The last glacial period was the Wisconsin Glaciation which began 75 thousand years ago and ended between 12 and 10 thousand years ago. During this period, early glaciers from outside the region crossed over the Atlantic Region while later glaciers were formed locally within the region while being fed by the high amounts of precipitation. By 13 thousand years ago the ice sheets had receded to the approximate coastline of today and then only residual ice caps remained in highland areas at approximately 12 thousand years ago. *(4)*

Since the 1800's glacial theory for the Atlantic region consisted of two hypothesis with one being a large continental sheet centered near Hudson Bay and Quebec and the other being local confined ice sheets. Recently after extensive sampling in Nova Scotia, evidence indicates that successive glaciation had four distinct phases with different and shifting ice centers. *(4)*

The Phase 1 ice flows moved eastward across the region including Prince Edward Island and Cape Breton Island before shifting flow direction southeastward across the present-day Bay of Fundy, Mainland Nova Scotia and Cape Breton Island. The Ice flowed across the Project Site during this phase in a slight southeastward direction and then at some time shifted to a more southward flow direction. *(4)*

The Phase 2 ice center was located north of present day Prince Edward Island with flow direction south over mainland Nova Scotia and southeast over lower southeast portions of Cape Breton Island. The Phase 2 ice flow direction was southward over the Project Site and Study Area. *(4)*

The Phase 3 ice center was parallel to the present day Nova Scotia Atlantic Coast and extended on land from Cape Sable, through Cape Canso to offshore and approximately south of present day Louisbourg, Cape Breton Island. From this ice divide, ice flows moved northeast across eastern portions of Cape Breton Island, northwest across western portions of Cape Breton Island, northeast across northern portions of the mainland from Cape George to Minas Basin west to northwest across the present day Annapolis Valley. On the Atlantic side of the ice divide, all flow directions were in a southeast direction over the Scotia Shelf. Later in Phase 3, the ice center shifted west and north from the south shore through the Minas Basin and covering the Project Site with the western portion of the Chignecto Isthmus of today. The Ice sheet center during this phase was located approximately over the Project Site or just to the south. Flow direction in the early phase 3 over the project site was most likely in a northeast direction as the ice flowed from the northeast-southwest province wide ice divide. *(4)*

Phase 4 was a period when several remnant ice sheets were located throughout the province and advanced and receded in a radial direction from the ice centers. Cape Breton had two glaciers that were centered on the Highlands and another centered on the Bas d’Or Lakes. The Chedabucto Glacier filled the present day Chedabucto Bay and St. Georges Bay with a westward ice flow direction across the central portion the province into the Northumberland Strait, Minas Basin and the Atlantic. The Chignecto Glacier was centered near Baie Verte and Cape Tormentine and the South Mountain Ice Cap was centered between the Bay of Fundy and Atlantic Coast near present day Kejimkujik National Park. The radial ice sheet flow direction of the Chignecto Glacier was a southwest flow direction across the Chignecto Isthmus and over the Project Site as the ice flowed into the Bay of Fundy. *(4)*

Then all the material suspended in the ice sheet was either dropped or washed out of the melting ice and left a landscape of till and variable land forms. Surficial geology mapping shows no obvious drumlins on the Silty Till Plain present within the Project Site and surrounding Study Area. However, the mapping does indicate at least 4 ridges or elliptical hills having a northeast to southwest orientation across the Project Site. *(5)*

Between 11 and 10 thousand years ago there was an abrupt climate change with a cold period lasting approximately 200 years known as the Younger Dryas. During the

Younger Dryas Period previously colonized plants that followed the receding glaciers were covered in permanent snowfields and some large mammals became extinct. *(6)*

As the last remnant glaciers receded and the climate warmed again. The landscape was gradually colonized by tundra vegetation of willow shrubs and herbaceous plants between 10 and 7.5 thousand years ago and were gradually replaced by boreal vegetation such as fir, spruce and birch until 6 thousand years ago when pine and oak was prominent. *(7)* Temperatures were 2 degree Celsius warmer than today for period up until 4 thousand years ago and forests of hemlock mixed with beech and maple was the dominant vegetation. Gradual cooling to present day temperatures and increased moisture favoured spruce forests. *(8)*

It is also theorized that a terrestrial refuge for plants and animals existed near the edge of the continental shelf where arctic and boreal species survived the last ice age and eventually repopulated the newly exposed mainland landscape as the ice sheets receded and before the sea level rise. However, since the end of the last ice age the Chignecto Isthmus provided the land corridor for plants and animals to migrate into Nova Scotia as well as assisted airborne species migrations. *(9)*

People

The earliest evidence of peoples on the land was found at the foot of the south slopes of the Cobequid Mountains at present day Debert. The Debert Site is located on top of a sandy knoll south of the Cobequid Mountains and was occupied approximately 11,000 years ago by Paleo-Indian peoples. The campsite overlooked a caribou migration route through the Cobequid Mountains to what would have been tundra plain leading into present day Cobequid Bay. At 11,000 years B.P., there were remnant ice sheets centered on the Cobequid Mountains, another on South Mountain of the Annapolis Valley and an ice sheet centered in the highlands of Cape Breton Island. At 10,500 years B.P., the ice sheets advanced again during the 200 year cold Younger Dryas period. A corridor between the Cobequid Bay and the Gulf of St Lawrence may have existed during the cold period and a sandy knoll on a tundra landscape made a good campsite. *(10)* The cold period of the Younger Dryas may have pushed the Paleo-Indian people south with advancing ice sheets and permanent snowfields or they may have abandoned the region. *(11)*

Archaeological evidence is scarce for a period of 10 to 5 thousand years ago which is thought to be due to the rise in sea levels that since submerged former coastal sites. *(11)* Sea level rise on the Atlantic Coast was a combination of land rebound after ice sheets receded, rising ocean temperatures and water released by melting glaciers. *(12)* As heavily weighted ice sheet centers as was located in the Gulf of St Lawrence depressed the earth's mantel, the areas of the mantel at ice sheet margins rose slightly. As the weight of the ice sheets diminished with melting the depressed center areas rebounded and rose in elevation while the mantel of the margin areas lowered in elevation. *(13)*

The Archaic Period covers a time of 9 to 2.5 thousand years BP and is further sub divided into a periods of 5 to 3.5 thousand years BP referred to as the Maritime Archaic Period and 3.5 to 2.5 thousand years BP which was a period of Susquehanna cultural influence indicated by the artifacts found within archaeological sites. *(11)(14)* Tool manufacture techniques and materials indicate a connection between Archaic Period peoples within western Nova Scotia to the Susquehanna Tradition Culture (3500-2500 BP) which was centered in present day Mid-Atlantic States. *(11)*

The Period of 2.5 to 0.5 thousand years BP is referred to as the Ceramic Period or Maritime Woodland Period that saw the introduction of pottery and burial mounds in Nova Scotia. *(11)(14)* Coastal Maritime Woodland Period sites were not as impacted by rising sea levels as earlier periods but are currently impacted by coastal erosion of the glacial tills by successive storms and constant wave action.

While there are no archeological sites within the Project Site known to this study, there are several archaeological sites found within the surrounding area indicating a wide presence of early peoples living on the land within the Cumberland County area.

A possible Late Ceramic period site is located west of Oxford on an oxbow of the River Philip. Numerous flakes and a projectile point were found at this site. *(15)*

Prehistoric tools were unearthed at the Little River Site during bridge construction at the Little River Bridge at Oxford. The site located where the Little River and River Philip meet may be a Late Prehistoric site. *(15)*

Another site in area of where the Little River and River Philip meet is the Thompson Site located on the southeastern bank of the River Philip and opposite bank of the mouth of the Little River. 30 years of cultivation produced many unrecorded artifacts but the identifiable artifacts are dated Late Ceramic Period. *(15)*

The possible Late Archaic Period Site is located the eastern bank of River Philip and opposite Kobec, where a large biface and an adze blade where found eroding from the river bank. *(15)*

In 1971 a Copper Kettle Burial site was discovered eroding from the north bank of the mouth of the Shinimicas River at Northport, approximately 20 km west of Pugwash. Copper Kettle Burials are post contact Mi’kmaq (some Maliseet) burial sites that typically contain both European and Mi’kmaq artifacts can be well preserved by the cooper salts from overturned cooper kettles covering the upright burial. *(16)*

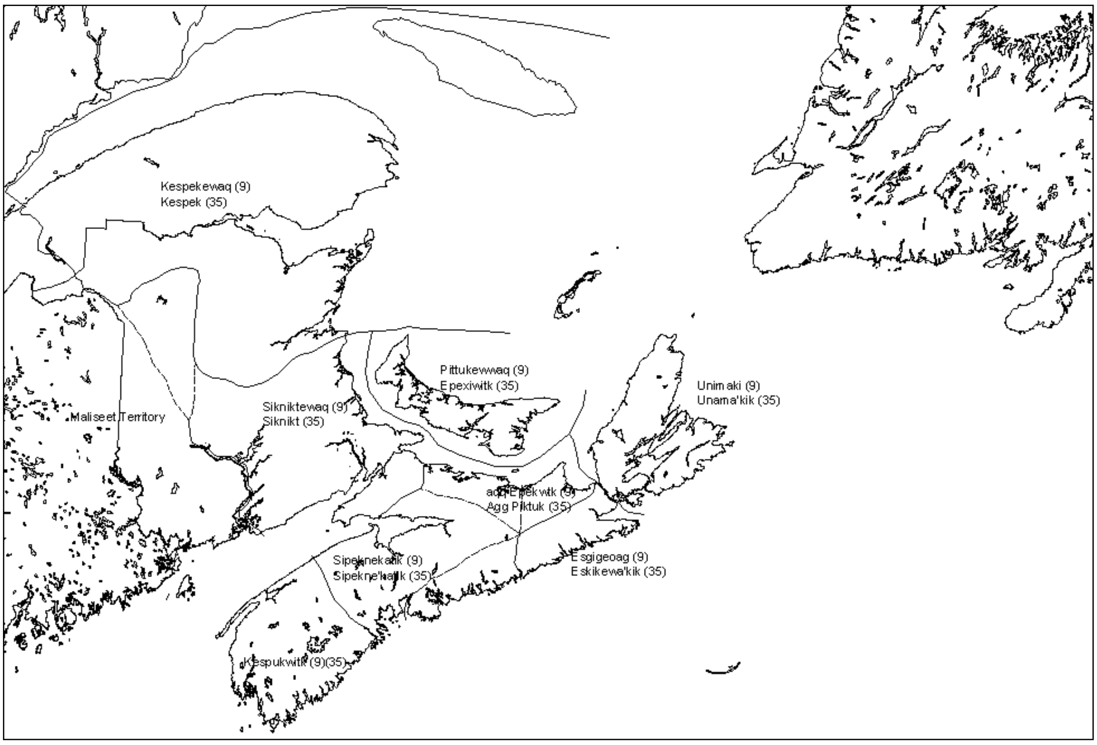
The Northport Site had four overturned copper kettles of various sizes under a layer of red ochre. The remains of the one body found was wrapped in birchbark and furs along with artifacts of jewelry of both shell and glass beads, leather wrist strap and copper armband bracelets. Tools were also found consisting of two iron axes, two iron knives and some stone tools. The field report made a preliminary assessment that the remains were of a young Mi’kmaq female. Further examination revealed additional tools for sewing, fishing as well as some possible squash seeds. This is one of the most poignant sites found in that the young women was obviously cared for as she was carefully buried and provided with everything she would need in her afterlife including the seeds found in a little pouch tied around her neck. Her chosen burial site overlooked the Northumberand Strait and faces the rising sun for most of the year. *(16)*

The initial remains and artifacts were gathered up at the site by tourists over a least a six day period before they turned over what they found to the Amherst RCMP detachment who then contacted the Nova Scotia Museum. What became of the remains of the young Mi'kmaq women is unknown to this study at this time. *(16)*

Traditional Mi'kmaq Territory

Traditional Mi'kmaq territory is called *Mi'kma'ki* and covered an area that extended from the St. John River east to include Cape Breton Island, southern Newfoundland and from the Gaspe' Peninsula, south to the south shore of Nova Scotia.

Mainland peninsular Nova Scotia is named *Kmitkinag* by Mi'kmaq and Cape Breton Island is named *Unimaki*. *Mi'kma'ki* is further divided into seven political districts: *(17)*



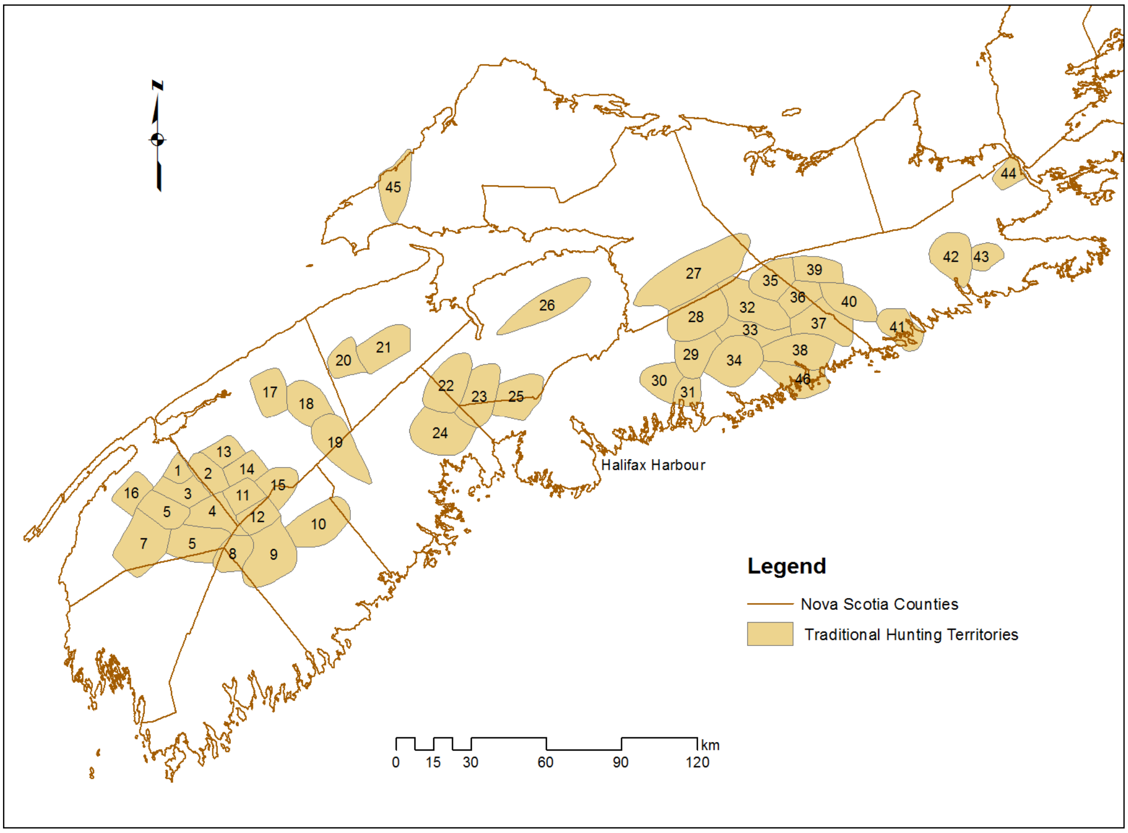
Mi'kma'ki Political Districts Circa 1600 (17)(18)(19)(20)

District (Various Spellings)	**Geographic Territory**
Unimaki (17) (Unama'kik) (18)(19)(20)	Cape Breton Island Southern Newfoundland
Esgigeoag (17) (Eskikewa'kik) (18) (Eski'kewag) (19)	Canso-Sheet Harbour
Sipeknekatik (17) (Sipekne'katik) (18) (Sikepne'katik) (19)	Sheet Harbour-LaHave including Minas Basin and Cobequid Bay
Kespukwitk (17)(18)(19)	Southern Nova Scotia, LaHave-Middleton
Pittukewwaq (17) (Epexiwitk) (18) (Epekwitk) (19)	Prince Edward Island
aqq Epekwtk (17) (Aqq Piktuk) (18) (Piktuk) (19)	Shediac to Canso Strait
Kespekewaq (17) (Kespek) (18) (Kespe'kewag) (19)	Chaleur Bay to Gaspe Peninsula
Sikniktewaq(17) (Siknikt) (18) (Sikniktewag) (19)	Chaleur Bay to Shediac

Three of these political districts are close proximity to each other and converge to share a portion of the Bay of Fundy and Minas Basin. *Pittukewwaq agg Epekwtk* (P.E.I and Northumberland Strait from Shediac to Canso Strait) territory is only the distance of the width of the Chignecto Isthmus to access the Bay of Fundy. *(17)* Other sources indicate different interpretation of the bounds of Pittukewwaq agg Epekwtk as being separate districts with Pittukewwaq being only PEI and agg Epekwtk being an area between approximately Merigomish Harbour and Canso Strait. *(18)(19)* The same sources interpret Esgigeoag district as extending from Canso through to St. Margarets Bay and Sipeknekatik as extending northwest through to the Northumberland Strait as shown on above Map. *(18)(19)* With these different interpretations, the Study Area is either within the *Sipekne'katik* or *Pittukewwaq agg Epekwtk* Political District.

Mi'kmaq had an intimate knowledge of the ecology of their territory and fit their lives to seasonal cycles of the vegetation and animals and fish. Due to climate conditions, agriculture for food was a risk for Mi'kmaq. *(21)* Highly mobile Bands consisting of several related families would assemble at favorite camp sites. In the fall and winter the camps would disperse into small groups of 10-15 people for winter hunting. *(21)*

It was the duty and responsibility of the chief of each political district to assign the hunting territories to families and any changes were made in the presence of the Council of Elders which met in the spring and fall of every year. *(22)* Hunting districts of approximately 200-300 square miles were assigned to families. *(21)*



Mainland Nova Scotia Traditional Hunting Territories (23)

The districts were usually surrounded lakes and rivers and were passed on to sons unless there were no sons where the district was then assigned to another family. *(23)* The Mi'kmaq respected the boundaries of the assigned territories and only took from the land what they needed for the family to survive thereby preserving game and fish for the family's future survival. *(22)*

The hunting territories of the mainland Nova Scotia were numerous compact interior territories that encompassed the watersheds of interior lakes and rivers as Mi'kmaq did most their game hunting during colder months of the year when they moved inland from the summer coastal camps. *(23)(22)* Cape Breton Island Mi'kmaq hunting territories are larger and more regional encompassing shorelines and interior river systems indicating a more sparse population. *(23)*

The Project Site does not appear to be within any last known traditional hunting territories. The nearest last known traditional hunting territory is area 45 of the source's map reference *(23)* The territorial reference numbers pertain to the source's original reference system and it is unknown if territorial numbers were assigned by Chiefs.

Map Reference	Name of Family	Geographic Territory
45	John Williams	Shulie Lake and river (Cumberland county)

Mainland Nova Scotia Traditional Hunting Territories Recorded Circa 1919 (23)

The warmer months were times of abundance with surrounding areas of coastal camps providing fish, shellfish, fowl and eggs. Offerings were made to spirits but the Mi'kmaq rarely stockpiled enough food for the entire winter. They brought with them from the coast smoked and sun-dried seafood, dried and powdered hard boiled eggs. Berries were boiled and formed into cakes were sun-dried. Grease and oils from boiled marrow and fat were stored and transported in animal bladders. Root vegetables such as *segubun* (wild potato) which was similar to today's sweet potatoes and wild nuts were also part of the winter food supply. *(22)*

Month	Seasonal Locations	Seasonal Groupings	Food Resource
Jan.	Sea Coast	Bands	Smelt, Tomcod, Seals & Walrus Beaver, Moose, Bear, Caribou
Feb. (Period of Winter Famine Begins)	Inland	Bands & Family Units	Smelt, Tomcod (ending) Seals & Walrus, Beaver, Moose, Bear, Caribou

Mar. (Period of Winter Famine)	Inland	Bands & Family Units	Smelt, Seals & Walrus (ending) Scallops, Crab, Urchins, Winter Flounder, Beaver, Moose, Bear, Caribou
April (Period of Winter Famine ends)	Sea Coast	Villages	Smelt, Winter Flounder, Scallops, Crab, Urchins, Sturgeon, Brook Trout, Alewife, Herring, Spring Bird Migrations, Beaver, Moose, Bear, Caribou
May	Sea Coast	Villages	Smelt, Scallops, Crab, Urchins, Sturgeon, Salmon, Brook Trout Alewife, Codfish, Capelin, Shad, Mackerel, Skates, Herring, Spring Bird Migrations, Beaver, Moose, Bear, Caribou
Jun.	Sea Coast	Villages	Scallops, Crab, Urchins, Sturgeon, Salmon, Brook Trout Alewife, Codfish, Capelin, Shad, Mackerel, Skates Lobsters, Spring Bird Migrations, Beaver, Moose, Bear, Caribou
Jul.	Sea Coast	Villages	Scallops, Crab, Urchins, Codfish, Capelin, Shad, Mackerel, Skates Lobsters, Spring Bird Migrations, Beaver, Moose, Bear, Caribou, Strawberries, Raspberries
Aug.	Sea Coast	Villages	Scallops, Crab, Urchins, Codfish, Skates Lobsters, Beaver, Moose, Bear, Caribou, Strawberries, Raspberries, Blueberries, Ground Nuts
Sept.	Sea Coast	Villages	Scallops, Crab, Urchins, Codfish, Skates, Salmon, Herring, Eels, Fall Bird Migrations, Beaver, Moose, Bear, Raspberries, Blueberries, Ground Nuts, Cranberries
Oct.	Small Rivers	Villages	Scallops, Crab, Urchins, Smelt Codfish, Skates, Salmon, Herring, Eels, Brook Trout, Fall Bird Migrations, Beaver, Moose, Bear, Blueberries, Ground Nuts, Cranberries
Nov.	Inland	Bands	Smelt, Tomcod, Turtles, Seals, Beaver, Moose, Bear, Ground Nuts, Cranberries
Dec.	Rivers	Bands	Smelt, Tomcod, Turtles, Seals, Beaver, Moose, Bear, Ground Nuts,

Mi'kmaq Annual Subsistence (24)

Local History

Much of the source history of the Mi'kmaq in the Chignecto area after contact with Europeans revolves around the former Acadian Settlement at Beaubassin and the English and French hostilities over control of the Chignecto Isthmus.

Settlement of the Chignecto Isthmus began in the mid 1660's and after the Treaty of Breda returned Acadia to France. Some prominent Acadians while under British rule enjoyed some autonomy as the British had a disinterest in the Acadians at Port Royal. Anticipating an influx of French Officials into Port Royal these Prominent Acadians wished to maintain their independence and decided to begin again far away from the anticipated French Officials. The location they chose was the middle ridge of five ridges that rose out of the tidal marshes and where the Missaquash and La Planche rivers meet the Cumberland Basin and called it Beaubassin. *(25)*

Mi'kmaq had an encampment on a slightly elevated ground on the Tantramar Marsh between the Aulac and Tantramar rivers that the Acadians called *ile de Indiens*. The raised ground is barely noticeable on the landscape today but was featured prominently in early maps of the area. Indian Island is known today as Coles Island and is the location of the existing CBC Radio towers. *(25)*

Battle for Chignecto

Rival claims to Nova Scotia by Britain and France continued for over 100 years where France had the advantage of establishing settlements in the territory the French referred to as l'Acadie. In 1710, a small British force captured the main Acadian settlement of Port Royal and renamed the area Annapolis Royal. Three years later the negotiated terms of the Treaty of Utrecht would cede control of Acadia and the Acadian settlers to Britain. *(26)*

The boundaries of Acadia along the Chignecto Isthmus between mainland Nova Scotia and New Brunswick of today were in dispute with France claiming control of the isthmus, New Brunswick and a portion of Maine. The French and Abenaki allies had turned back incursions by New Englanders into the claimed territory in Maine in 1720. Thirteen years later in 1736, the Governor of Nova Scotia demanded the Acadian population of Beaubassin submit to British Authority but did not have the resources to force the demand. *(26)*

At this time there was no desire to renew conflict by pressing the demand for Acadians to submit as the British Homeland was committed to peace. However, renewed tensions and conflict in Europe spilled over into the new world resulting in the capture of Louisbourg in 1745. The French were unable to recapture Louisbourg but a small raiding force of Canadian Militiamen and Chignecto Mi'kmaq were able to harass the British capital at Annapolis Royal. With Acadians refusing to submit to British authority and warring Chignecto Mi'kmaq, there was concern by the British that the Chignecto area was too unstable. *(26)*

The French had moved 600 French soldiers to the Chignecto area in 1749-50 to protect Quebec's access to the Bay of Fundy through the Chignecto Isthmus. The British were determined to remove the French from the Chignecto area but a failed first attempt was aborted to the presence of Mi'kmaq warriors and lack of British resources at hand. The French watched helplessly as the second attempt saw British forces systematically unload troops and supplies from vessel after vessel on the Missaguash River. The British built a small fort on the same ridge as the ruins of the former Acadian Village of Beaubassin and was named Fort Lawrence. The French were busy building fortifications on an opposing ridge 2.8km to the northwest of Fort Lawrence that was named Fort Beausejour. The two forts were separated by the Missaguash River which was the perceived division between British and French territories. *(26)*

It was during the British failed first attempt to land on the eastern bank of the Missaguash River the Mi'kmaq took a historic action against the Acadian village of Beaubassin on the British side of the Missaguash River. *(27)* The Mi’kmaq did not recognize British authority and were not part of the terms of the Treaty of Utrecht. Based on French recognition of the Mi’kmaq right to self-government, the French military had friendly relations with the Mi’kmaq. *(26)*

The source gives a vivid picture of the British vessel(s) stranded in the mud at low tide and within visual range of Beaubassin. The British could only watch as the Acadians were evacuated and the Mi’kmaq burned every building within the Acadian village, 121 in total including the church. *(27)*

The sources provide a number of interpretations of the strategy behind the burning of Beaubassin such as the French and their allies were following a scorched earth strategy and left nothing for the British. Another possible strategy was to force the Acadians of Beaubassin to cross to the French side of the Missaguash River and to resettle as committed refugees. The displaced Acadians would also bolster the labour required to build fortifications. What the sources do agree on is that the burning of Beaubassin was done on the orders of Father Abbe’ Jean-Louis LeLoutre. *(26)(27)*

Father Abbe’ LeLoutre provided spiritual services to the Mi’kmaq between 1738 and 1749 at the French Mission Sainte Anne located deep within Mi’kmaq territory on the west bank of Shubenacadie River. The influential Priest also incited the Mi’kmaq to fight the British and used the mission as a staging area for Mi’kmaq attacks on Halifax. *(28)* A letter written by LeLoutre in July, 1749 stated that “we cannot do better than to incite the Indians to continue warring on the English”. Not completely without a purpose of their own, the Mi’kmaq attacks that followed were a message to Cornwallis that they had the rights to their own territory as well as to hunt and fish freely within. *(29)*

In 1749, LeLoutre moved the Mission to the Isthmus of Chignecto where he and French soldiers, officers and displaced Acadian settlers established a new settlement. His announcement divided the Shubenacadie Mi’kmaq as some wanted to be close to their religious services and some did not want to abandon their traditional territory. Jean

Baptist Cope chose to stay at Shubenacadie and became the prominent elder and leader. *(30)* Cope would break the treaty he signed with Cornwallis and launch a long campaign of skirmish attacks on English settlements and troops. His actions may have been in retaliation for the killing of Mi'kmaq women and children in a skirmish between British sailors and Mi'kmaq on the Atlantic Coast. *(30)*

The Mi'kmaq returned to Chebucto to begin a series of attacks on the settlement lasting 10 years. In response to the attacks, Cornwallis extended the 1744 Massachusetts Scalp Bounty to include all Mi'kmaq. *(31)*Similar continuous attacks on the British network of new Block Houses throughout the province confined the English to garrison towns and unable explore or clear land for settlements and cultivation. *(32)*

The Mi'kmaq were occupied in helping to build French fortifications at Beausejour and other locations in the Spring of 1754. The French had 3 Mi'kmaq tribes assisting them in their fortifications and committed to side with the French against the British. *(32)*

The French commander LaCorne had hoped to recruit displaced Acadians to work on Fort Beausejour fortifications but the influential Abbe' LeLoutre had a large scale aboiteau project that drew most Acadian labour away from the fortifications. There was a 5 year stalemate on the Chignecto Isthmus between the French and British while the negotiations continued in Europe. However, the opposing forces in such close proximity developed trading relations with each other and particularly between the British and Acadians. *(26)*

While the Chignectou Acadians tried to remain neutral between the two military powers, the colonists in New England pressed for military action to remove the French. Eventually, it was pressure from the New Englanders that broke the stalemate in Chignecto when 2000 militiamen from New England joined 500 British regulars at Fort Lawrence in June of 1755. At this time the French fort under the command of the Marquis Louis Du Pont de Vergor, had 160 regular troops along with some reluctant Acadians. *(26)(27)*

The source explains the military situation in Chignecto as unique where opposing forces fortifications are within sight of each other. The French watched the British train and parade in full view while the British watched the progression of the French fortifications. The British had 5 years to study the French position and recognized a weakness in the downslope location of the French fort at the southwest end of the ridge. Higher ground existed on the ridge northeast of the fort that was being occupied by an Acadian settlement. *(27)*

Approximate view of Fort Beausejour from Fort Lawrence. The French fort is on the left of the ridge in the image and the British mortar trench lines are on the high ground to the right of Fort Beausejour.

View of Fort Lawrence from Fort Beausejour. The British Fort is located in a present-day farmers field adjacent and right of the Nova Scotia Welcome Centre in the image.

The Mi’kmaq warriors were deployed in patrols to do what they did best which was guerrilla warfare. In the spring of 1755, a patrol of Mi’kmaq and Acadians ambushed British soldiers gathering firewood, killing 5 soldiers. Another British soldier was killed soon after and a New Englander was taken prisoner. *(47)*

On June 04, 1755, the British Troops marched along the eastern face of the ridge behind Fort Lawrence and hidden from view of the French. The British marched northeast at the base of the ridge for about 6 km before crossing the ridge and heading across the lowland for another 5 km toward an existing bridge across the Missaguash River at Point au Buot. *(27)*

The source describes how the next 12 days of the siege did not go well for the French with meager troops, missed opportunities, fleeing Acadians and no hope for reinforcements. The bridge at Point au Bout was an obvious strategic position the French lightly defended and only partially destroyed the bridge. After a light arms skirmish with mostly Acadians and Natives the British took the crossing and repaired the bridge to continue across the Missaguash River. The source describes the collection of Mi’kmaq and Abenaki at the fort as Natives. The British then fortified the bridge position against possible French reinforcements that never arrived. Continuing southwest, the British established another bridge across the Missaguash River at the base of their camp at present-day Mount Whatley. *(27)*

Out of the base camp at Mount Whatley, the British started to advance to the high ground spotted from Fort Lawrence. Not yet within mortar range, the British had to dig zig-zag trenches towards Fort Beausejour with only light resistance from the French. Inside the fort the moral was very low and Abbe’ LaLoutre had lost his commanding influence over the Acadians. When the mortar shells began to landing inside the fort walls, all was lost and Vergor surrendered the fort. *(27)*The British renamed the captured fort, Fort Cumberland. The following day the commander of the small French fort, Fort Gaspereau, located near Port Elgin on the shores of Baie Verte, surrendered the fort to the British. *(25)* This was the first British victory in a campaign to win the battle for North America.

The French were losing the Battle for North America and their Mi'kmaq allies had to think of their future in a British Nova Scotia. Jean Baptist Cope was killed in the spring of 1758 at Point Pleasant Park during a meeting of Mi'kmaq Leaders trying to come to a consensus among themselves on negotiating a peace with the English. An argument and skirmish broke out among the group leaving 17 Mi'kmaq dead. *(33)* Jean Baptist Cope was buried at the same location thought to be Father Abbe Thury's burial site at Point Pleasant Park. *(34)*

News of the fall of Quebec on September 18, 1759 reached the town of Halifax. After 10 years of inciting the Mi'kmaq to hostilities against the English in the province, the French Priest LeLoutre was disowned by the Quebec Bishop and later captured by the English aboard a ship leaving for France. *(32)* Father Maillard, who had spent 25 years with the Mi'kmaq, convinced the Chiefs to go to Halifax and bury the hatchet with the English which finally allowed the English to leave their fortified towns and explore the rest of the province and bring more settlers into the province. There was still some residual apprehension on the English side as to if the Mi'kmaq would hold the peace. *(32)*

Although the Mi'kmaq were beginning to suffer as early as 1758 from years of warfare and diseases, the English remained fearful of the Mi'kmaq, particularly with growing tensions in the New England Colonies. Both the English and the Mi'kmaq were eager to negotiate a peace treaty and the Mi'kmaq were still able to negotiate from a position of strength. The treaties of 1760 did not resolve territorial limits but assured Mi'kmaq access to the natural resources the land had always provided them. *(30)* However, the land provided less over time as they were displaced from traditional territories and the amount of game available declined. *(30)*

The 1760 series of treaty signings with various chiefs of the Mi'kmaq was for the purpose of negotiating peace and trade. The English built Truck Houses at each of the existing forts for the exclusive trade with the Mi'kmaq. *(32)*

Post British-Mi’kmaq Hostilities

The late1700’s was a critical time in Mi’kmaq history when the Mi’kmaq population was decimated by disease and Mi’kmaq way of life was disappearing. It was at this time that England encouraged settlement on Acadian lands that had been abandoned after the Acadian Deportation in 1755. The New England Planters arrived between 1760 and 1766 and began to occupy former Acadian farms. *(35)* Mi’kmaq and Acadian place names were replaced with English names. *(35)*

A second wave of approximately 1000 English settlers known as the Yorkshire Migration arrived in Nova Scotia between 1771 and 1776. The Yorkshire Emigrants were recruited from northern England to occupy Acadian farms and increase British presence among the planters and republican sentiments. The Yorkshire Emigrants landed at Fort Cumberland in 1772. *(36)*

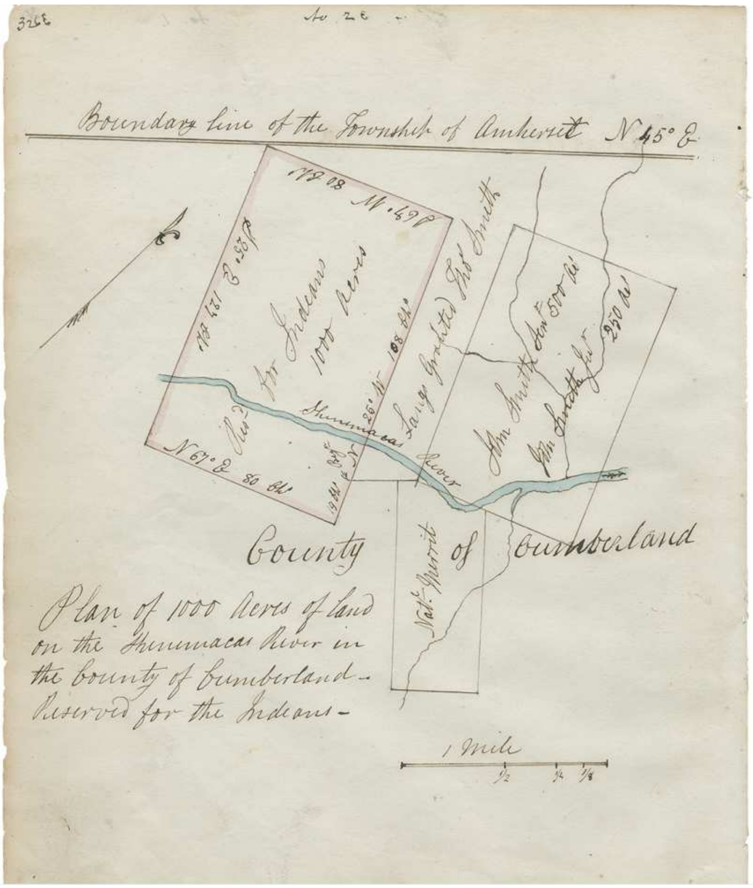
American Revolution was fought and won by the Americans and Loyalists (citizens loyal to England) and British soldiers and officers were looking for land and British protection. These Loyalists arrived in large numbers between 1783 and 1784 and founded numerous new Cumberland settlements. *(37)*

The land grants to the Loyalist and the Scottish-Irish emigrants that followed was wide spread throughout Nova Scotia and most all remaining lands in Nova Scotia were granted to Emigrants. *(38)*

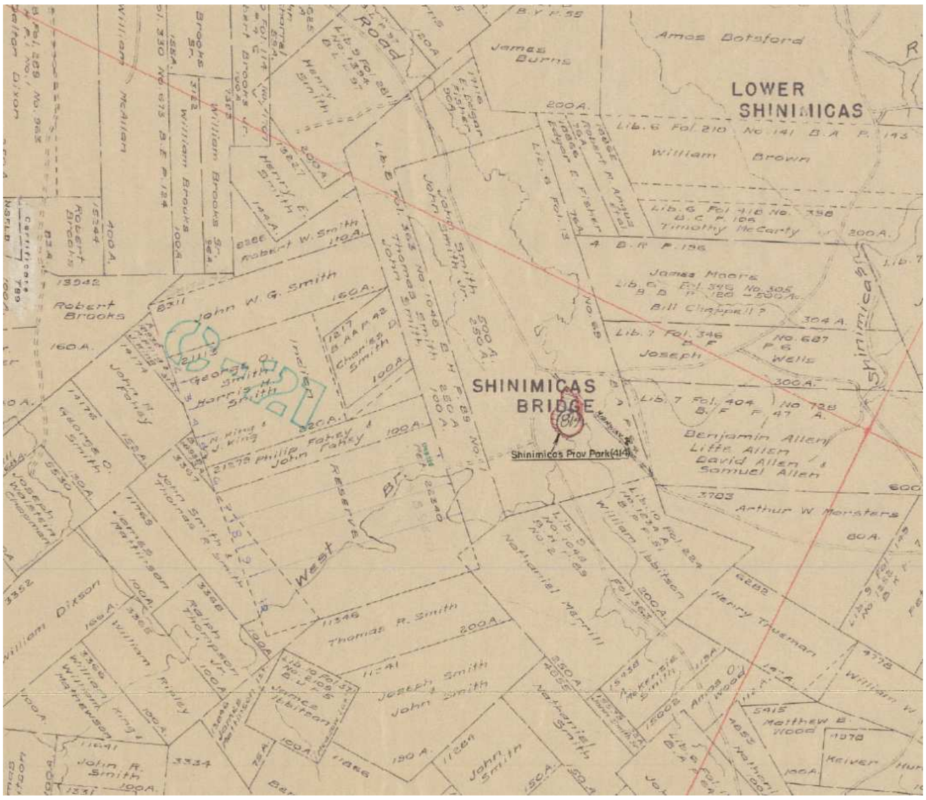
The Mi’kmaq traditional territories were granted away to these successive waves of emigrants. During these times of emigrant settlers Mi’kmaq were not granted title to land but rather were granted “Licenses of occupation during pleasure”. The land was owned by the Crown and reserved for particular Mi’kmaq Bands. The first of these licenses in Nova Scotia was granted in the 1780’s and locations were typically coastal and ravine sites long frequented by Mi’kmaq. In 1820 the reserve system was started and each county was instructed to set aside lands near sites frequented by Mi’kmaq. A number of reserves of approximately 1000 acres each was planned for each county of Nova Scotia totaling 22,050 acres for exclusive use by the Mi'kmaq. This produced little action and it was the Mi'kmaq themselves that pushed for reserve lands. However, what the Mi'kmaq received was not always of their choosing and if their reserve was good land, it was subject to encroachment by settlers. *(39)*

Cumberland County had surveyed and set aside 500 acres on the western shore of Pugwash Harbour. However, these lands were subject to title dispute due to a questionable transaction concerning two Loyalist brothers buying the 500 acres from 3 Mi'kmaq which had no authority to sell the land. After prospering for a while, the title dispute continued to plague the brothers until their eventual financial ruin. The title dispute was put to rest when the crown auctioned off the Pugwash Indian Lands. *(43)* The Mi'kmaq eventually had 1000 Acres surveyed at Shinimicas which is approximately 20 km west of Pugwash and 23 km east of Amherst. The parcel straddled the West Branch of the Shinimicas River and the plan lists the parcel as *reserved for Indians 1000 acres* and is shown adjacent the boundary for the Township of Amherst. East of the 1000 acre parcel are adjacent parcels of J. Smith and to the southeast is the parcel of N. Merrit. *(44)*

However, Crown Land Grant maps show the same 1000 acre parcel with 580 acres subdivided into 4 parcels distributed among four title holders with the last name of Smith and two other of the last name Fahey. The remaining acreage of the former 1000 acre Reserve parcel is still listed as reserve but is also subdivided with no title owners listed. The circumstances as to how this Reserve Parcel became subdivided are unknown to this study at this time. *(45)*



Indian Lands 1842 (44)



Land Grant Map 68 (45)

Current Mi’kmaq communities and lands along the Northumberland Shore area include Fishers Grant IR24, Fishers Grant IR24G and Boat Harbour West IR37 near Pictou Harbour. Other Mi’kmaq lands are Merigomish Harbour IR31located on the coast midway between the New Glasgow and Antigonish areas and another parcel is Franklin Manor IR22 located 35 km south of Amherst near the ancient trail between Amherst and Parrsboro.

Inland, the Crown Land Maps shows approximately 1000 acre Reserve near and west of the Herbert River, northwest of Halfway River (Newville Lake). *(38)* A.F. Church’s 1873 Map indicates an “Indian Grant” in the same approximate location as the Reserve shown on the Crown Land Map. However, Church’s map also shows an “Indian Village” on the western shore of Halfway River Lake (Newville Lake).The name scribed within the Indian village on the map is that of P. Toney. *(40)* The “Indian Village” location today is approximately the same location as Newville Lake Park. The “Indian Grant” on Church’s map is today Franklin Manor I.R. No. 22 located approximately 5km northwest of the former Halfway River Lake Indian Camp.

It is possible that the above “Indian Village” is the subject of a Specific Claim by Paq’tnkek First Nation regarding unlawful granting of 250 acres without surrender in 1827. The status on that claim is “Concluded”. *(41)* The Crown Land Index Sheet 50, shows a date icon of 1827 at the site on the western shore of Newville lake. *(42)*

There was a period beginning in the early 1800’s when Mi’kmaq were encouraged to remain in a single location. Attempts were made to introduce Mi’kmaq to farming and centralizing Mik’maq on large reserves such as Indian Brook I. R. 14 located at Shubenacadie, East Hants Co. *(39)* However, Franklin Manor I. R. 22 maintains a Mi’kmaq presence in this portion of Cumberland County.

A review of the Aboriginal Affairs and Northern Development Canada, Status Report on Specific Claims does not show any specific claims that would directly impact the Project Site. *(41)*

Place Names

Some surviving Mi’kmaq place names within the surrounding area are *(46)*:

Location	**Mi’kmaq**	**English Translation**
Chignecto	*Sigunikt* *Siganectoe*	*“a foot of cloth”* *(Pron. from 1601 English records)*
Amherst	*Memaloos Kudaagun* *Nemcheboogwek*	*“going up rising ground”*
Fort Lawrence	*Kwesowmalegek*	*“hardwood point”*
Joggins	*Chegoggin* *Joggins*	*“great fish wier”* *“a fish weir place”*
Maccan	*Maagan or Maakan*	*“fishing Place”*
Minudie	*Menoodek* *Munoodek*	*“small bag”* *“sack or bag”*

Tidnish	*Mtagunechk*	*"paddle"*
Nappan	*Menabank* *Nepan*	*"washed away"* *"a good place for poles"*

Summary

The geology of the Study Area and surrounding region does not provide source material for early peoples to make stone tools and weapons.

There is a wide distribution of pre-contact and post-contact archaeological sites in this portion of Cumberland County but no such sites are known to be within the Study.

Acadians began to settle the area and reclaim the tidal marshes in the 1660's and they named the high ground on the marsh *ile de Indiens* where the Mi'kmaq had an encampment. The encampment location is the present site of the CBC Radio towers.

Father Abbe' LeLoutre had a strong influence over the Acadians, Mi'kmaq and the French commanders during his stay in Acadia at the Mission in Shubenacadie and later at Chignecto. He incited the Mi'kmaq against the British at Halifax and later recruited the Mi'kmaq and displaced Acadians for his land reclamation and fortification projects. He is also responsible for the burning of Beaubassin.

The British defeat of the French at Chignecto and the surrender of the forts in the area marked the first British victory in a campaign to remove the French from North America.

After the treaties of the 1760's, the Mi'kmaq had to adapt to a *Mi'kma'ki* under British rule.

There were some stumbling starts to setting aside the required 1000 acres for the Mi'kmaq within the area of Cumberland County of today. Land set aside for the Mi'kmaq in Pugwash was lost due to a questionable transaction and later lands at

Shimmicas Bridge were lost due to subdivision of the parcel and granting to settlers. Franklin Manor I. R. 22 is the only reserve in Cumberland County and is not currently occupied.

A review of the Aboriginal Affairs and Northern Development Canada, Status Report on Specific Claims does not show any specific claims that would directly impact the Project Site.

4.4 Mi’kmaq Traditional Use Findings

The traditional use data gathered for this MEKS was drawn from one primary source: the Mi’kmaq individuals who reside in the surrounding Mi’kmaq communities and those who are familiar with or undertake these types of activities. This data was acquired through interviews with informants that allowed the study team to identify the various traditional use activities, resources and areas that are currently or have been used by the Mi’kmaq, and any information that was gathered in previous MEKS in the area. Interviewees were asked to identify areas within the Study Area and Project Site where they knew of traditional use that had taken place, or currently in use. These interviews took place in September, 2014.

To easily identify the traditional use data findings of this study, the analysis has been categorized into two (2) geographic areas. The first is the Project Site area – an area located approximately 3 km east of Amherst, Nova Scotia.

The second is the Study Area which includes areas that fall within a 5 km radius of the Project Site.

Based on the data that was gathered by the study team, it appears there are some Mi’kmaq traditional use activities that have occurred, or are occurring, within the Study Area.

Project Site

The Project Site, as well as locations in the *immediate* vicinity (<50 meters) of the Project Site, will be considered when analyzing traditional use activities.

Fishing

There were no fishing areas identified within the Project Site by informants.

Hunting

There were no hunting areas identified within the Project Site by informants.

Gathering

The northwest area of the Project Site was identified as an area to gather apples, blueberries, cow lilies, flag root, ground juniper, and princess pine, with one area recorded for each species.

Study Area

As mentioned previously, the MEKS data is also drawn from the Study Area which encompasses areas within a five (5) kilometer radius from the Project Site boundaries. The purpose of this portion of the study is to portray other land use activities that may have been missed in the Project Site data analysis.

Fishing

From the data gathered, the study found that trout (including lake, brook, and sea trout) and bass (including stripped and small mouth) were the species reportedly caught in the highest frequency in the Study Area.

Fifteen (15) trout fishing areas (including 5 lake trout, 1 brook trout, and 1 sea trout) were reported by informants in the areas of:

- North of Amherst in the LaPlanche River through to Little Round Lake
- Lakes and streams north of Warren
- Waters from Blair Lake to Brookdale

Bass was identified by informants in eight (8) areas (including 4 small mouth, and 2 stripped). These areas were found to be located:

- LaPlance River
- Lakes and rivers north of East Amherst and Tyndal Road including Howards Lake, Grass Lake, Black Pond, and Little Round Lake
- Lakes and streams north of Warren
- Waters surrounding Blair Lake

Other species reportedly fished in the Study Area were salmon (4 areas), clams (4 areas), perch (3 areas), eel (1 area), and smelt (1 area).

When broken into timeline categories, Recent Past activities were reported in approximately forty three percent (43%) of the data gathered. Current use was reflected in thirty percent (30%) of the data, and Historic Past use areas occupied twenty seven (27) percent of the information. Much of the information gathered found itself placed in multiple timeline categories, if not all three, suggesting a continuous use of the area spanning 25+ years.

All fishing areas were identified as fishing areas for harvesting purposes.

Hunting

Deer and rabbit were found to the most hunted species within the Study Area.

Four (4) deer hunting areas were found to be located:

- Near East Amherst
- Areas near Brookdale past Warren around Beaver Brook

Four (4) rabbit hunting areas were identified in:

- Near East Amherst
- Areas near Brookdale past Warren around Beaver Brook

Other species reportedly hunted in the Study Area are partridge (3 areas), pheasant (3 areas), beaver (2 areas), fox (1 area), muskrat (1 area) and raccoon (1 area).

In terms of timelines of when the hunting took place, areas were labeled historic use areas in sixty three percent (63%) of the data gathered and Recent use was reflected in thirty percent six (36%) of the areas. Hunting seems to be, according to the data, an activity that is occurring in this area less often.

Gathering

Blueberries and apples were reported as the most gathered plants in the Study Area.

Five (5) blueberry gathering areas were found in:

- Areas in and surrounding Amherst
- East Amherst
- Near Tyndal Road
- Around Hanstings

Apples were found in four (4) areas such as:

- East Amherst
- Near Tyndal Road
- Around Hastings

Other species reportedly gathered were cranberries (2 areas), ash trees (1 area), cow lily (1 area), crabapple (1 area), “firewood” (1 area), flag root (1 area), ground juniper (1 area), mushrooms (1 area), and princess pine (1 area).

4.5 Mi’kmaq Significant Species Process

In order to identify possible project activities which may be of significance to the Mi’kmaq with regards to traditional use of the Study Area, the project team undertakes a number of steps in order to properly consider the MEK data. This involves three main components: Type of Use, Availability, and Importance.

Type of Use

The first component of analysis is the “Type of Use” of the resource which involves the categorization of the resource. All resources are placed into various general categories regarding the Type of Use**.** The category headings are Medicinal/Ceremonial, Food/Sustenance, and Tool/Art. These general headings are used so as to ensure further confidentiality with respect to the resources and the area where they are harvested. As well, the total number of instances where a resource harvest has been documented by the study is quantified here as well.

Availability

After the data is considered by the Type of Use, it is considered in accordance with its availability: this involves considering whether the resource is abundant in the Study Area or whether it is rare or scarce. Based on the information that is provided to the team from the ecological knowledge holders and/or written literature sources, the availability of the resource is then measured in regards to other water or land areas that are outside of the Study Area. This measuring is primarily done in the context of the areas adjacent to the Study Area, and if required, other areas throughout the province. By proceeding in this manner, the study can provide an opinion on whether that resource may be **Rare, Scarce** or **Abundant**.

The data is classified in accordance with following:

Rare – only known to be found in a minimum of areas, may also be on the species at risk or endangered plants list;
Common – known to be available in a number of areas; and
Abundant – easily found throughout the Study Area or in other areas in the vicinity.
This allows the study team to identify the potential impact of a resource being destroyed, by the proposed project activities, will affect the traditional use activity being undertaken.

Importance

The final factor the MEKS team considers when attempting to identify the significance of a resource to Mi'kmaq use is whether the resource is of major importance to Mi'kmaq traditional use activities. This can be a somewhat subjective process, as any traditional resource use will be of importance to the individual who is acquiring it, regardless of whether its use is for food or art, and regardless if the resource is scarce or abundant. However, to further identify the importance, the MEKS team also considers the frequency of its use by the Mi'kmaq; whether the resource is commonly used by more than one individual, the perceived importance to the Mi'kmaq in the area, and finally the actual use itself. These factors support the broad analysis of many issues in formulating an opinion on significance and supports identifying whether the loss of a resource will be a significant issue to future Mi'kmaq traditional use, if it is impacted by the project activities.

4.6 Mi'kmaq Significance Species Findings

This MEKS identified resource and land/water use areas within the Project Site and Study Area that continue to be utilized by the Mi'kmaq people, to varying degrees.

Type of Use

The study identified the following:

TYPE OF USE	NUMBER OF AREAS	NUMBER OF SPECIES
Food/Sustenance	70	28
Medicinal/Ceremonial	21	10
Tools/Art	2	2

Availability

During the information gathering for the Study Area, informants had mentioned the fishing for salmon. The Atlantic Salmon is considered an endangered species in Canada. (48)

No other rare or endangered species were identified by informants.

Importance

While stated above, it is worth noting again that assigning an importance designation for any activity done by Mi'kmaq can be a subjective process, and that all activities are considered ways of preserving the Mi'kmaq way of life, in some shape or form.

As noted previously, Atlantic Salmon is considered an endangered species in Canada and the Mi’kmaq still rely on this species for sustenance and cultural ceremonies and disturbances to their habitats could have an impact on Mi’kmaq use.

Trout and bass fishing is noted to be an activity occurring in high frequency in the area, particularly in the lakes, rivers, and brooks north of East Amherst and Tyndal Road.

5.0 CONCLUSIONS AND RECOMMENDATIONS

This Mi’kmaq Ecological Knowledge Study has gathered, documented and analyzed the traditional use activities that have been occurring in the Project Site and Study Area by undertaking interviews with individuals who practice traditional use, or know of traditional use activities within these areas and reside in the nearby Mi’kmaq communities.

The information gathered was then considered in regards to species, location, use, availability and frequency of use to further understand the traditional use relationship that the Mi’kmaq maintain within the Project Site and Study Area.

Project Site

Based on the data documented and analyzed, it was concluded that the Mi’kmaq have undertaken some traditional use activities. Gathering activities had taken place in the northern portion of the Project Site. Plants gathered were apples, blueberries, cow lilies, flag root, ground juniper, and princess pine

Study Area

Based on the data documentation and analysis, it was concluded that the Mi’kmaq have historically undertaken traditional use activities in the Study Area, and that this practice continues to occur today. These activities primarily involve harvesting of fish, but also include harvesting of animal, plant, and tree species; all of which occurs in varying locations throughout the Study Area and at varying times of the year.

Trout and bass were found to be the most fished species in the Study Area. Deer and rabbit were found to be hunted in the Study Area. The harvesting of blueberries and apples were the most reported gathering activity found in the information recorded.

RECOMMENDATION # 1

> ***The Amherst Community Wind Farm MEKS has identified a small amount of Mi'kmaq Traditional Use Activities occurring in the Project Site, as well as additional activities within the Study Area that have occurred in the past, as well as the present. Based on the information gathered and presented in this report, there is some potential this project could affect some Mi'kmaq traditional use, specifically trout and bass fishing, deer and rabbit hunting, and some blueberry and apple gathering identified in the Study Area. Although the possible effects from the project could be minimal, it is recommended that the proponent communicate with the Assembly of Nova Scotia Mi'kmaq Chiefs to discuss future steps, if required, with regards to Mi'kmaq use in the area.***

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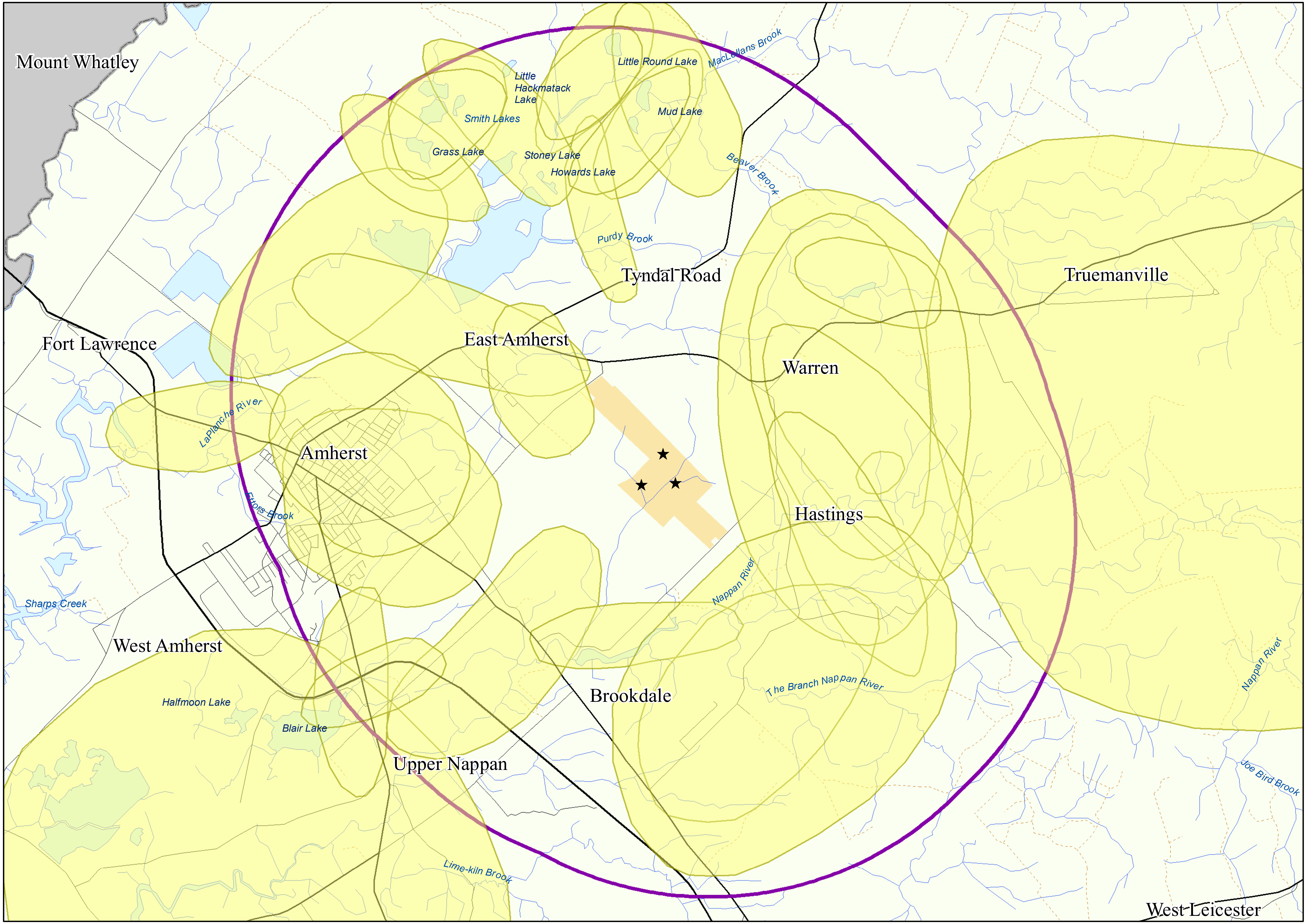
APPENDICES

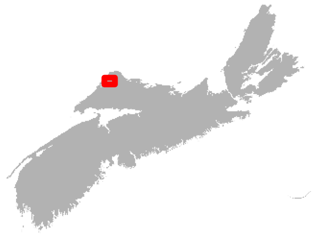
Map A

Mi’kmaq Traditional and Current Use Areas



Amherst Community Wind Farm MEKS

Mi'kmaq Traditional and Current Use Areas



Legend

★	Proposed Turbine Locations
🟨	Traditional Use Areas
🟧	Project Site
▭	Study Area
═	County Border
—	Highway
—	Trunk Road
—	Collector Road
—	Local Road
- -	Loose Surface/Cart Track
—	Rivers

Disclaimer

This map is a graphical representation of Mi'kmaq ecological knowledge gathered throughout the study, and should not be used for navigation purposes. Features presented may not accurately representaactual topographical or proposed features.

The Mi'kmaq ecological knowledge data presented is a sampling of knowledge held by those interviewed and should not be interpreted as an absolute measure of Mi'kmaq ecological knowledge and land use.

Datum: UTM NAD83
Zone 20
Scale: 1:50,000

Version: 1
5 Nov 2014

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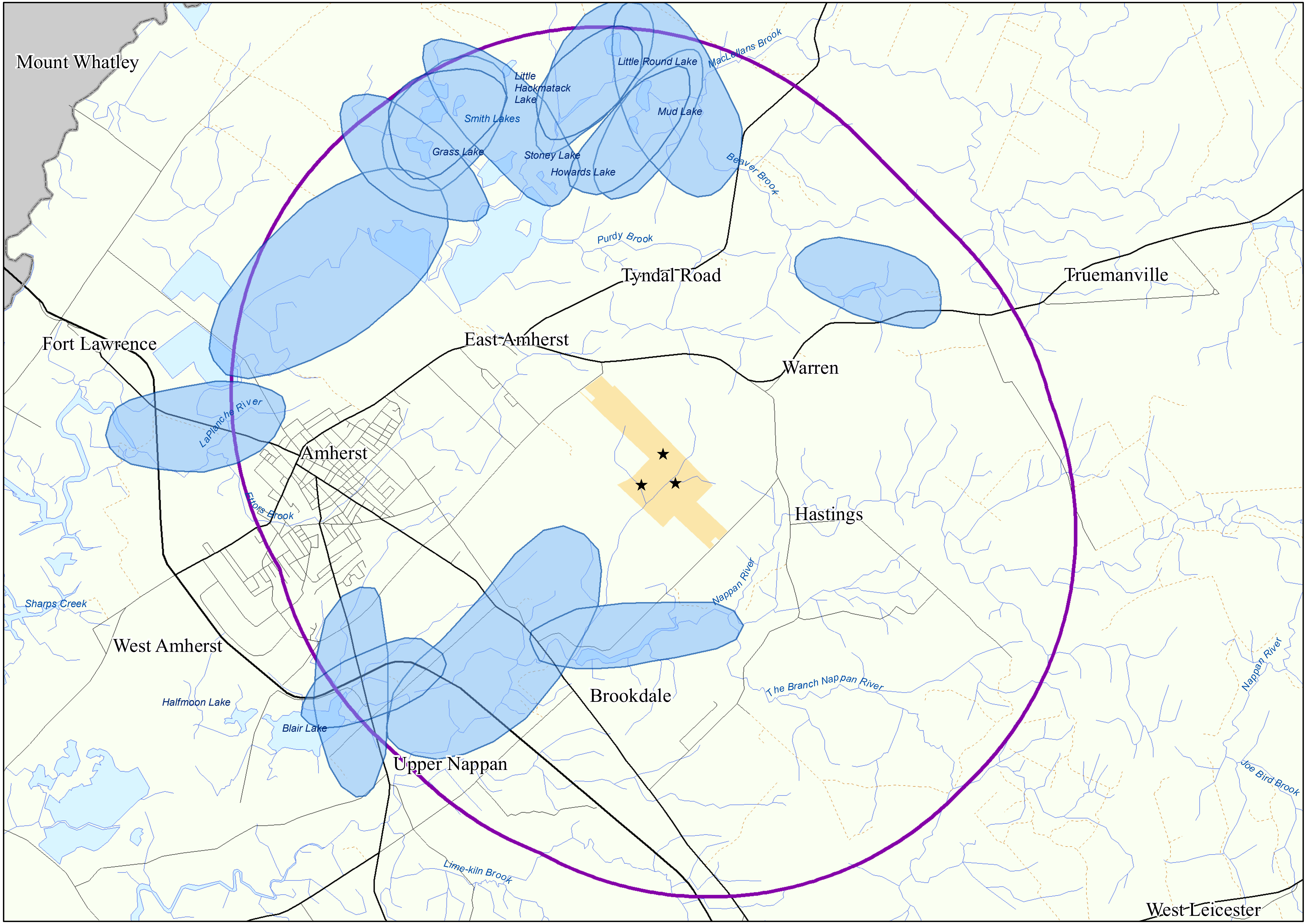
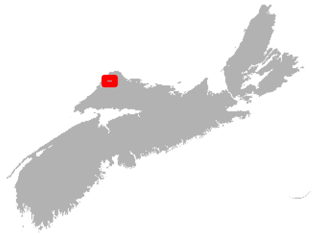
Map B
Mi’kmaq Traditional and Current Fishing Areas



Amherst Community Wind Farm MEKS

Mi'kmaq Traditional and Current Fishing Areas



Legend

★ Proposed Turbine Locations
▨ Fishing Areas
▨ Project Site
☐ Study Area
County Border
Highway
Trunk Road
Collector Road
Local Road
Loose Surface/Cart Track
Rivers

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Datum: UTM NAD83
Zone 20
Scale: 1:50,000

Version: 1
5 Nov 2014

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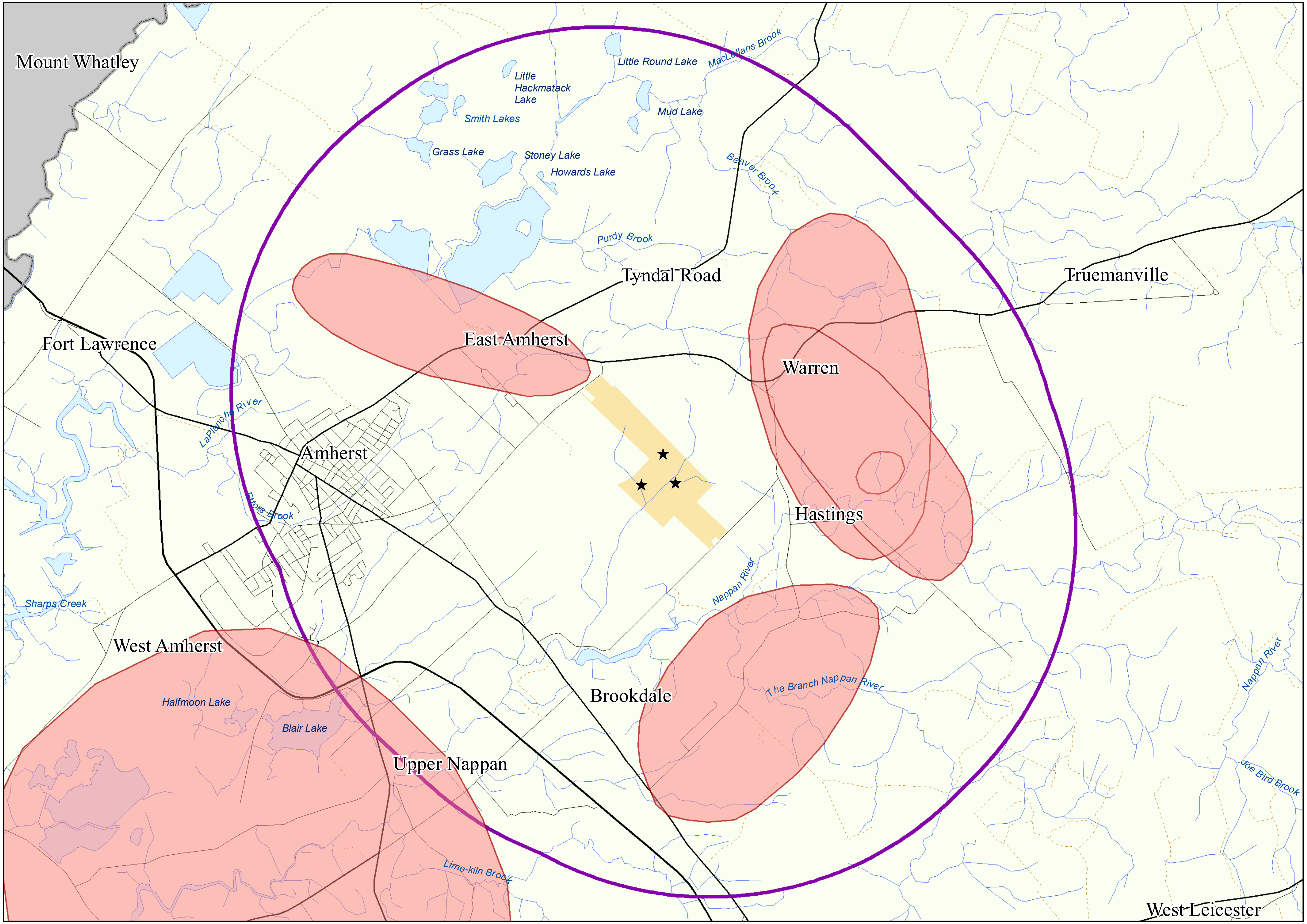
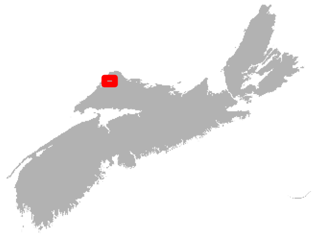
Map C
Mi’kmaq Traditional and Current Hunting Areas



Amherst Community Wind Farm MEKS

Mi'kmaq Traditional and Current Hunting Areas



Legend

★ Proposed Turbine Locations
🟥 Hunting Areas
🟨 Project Site
▭ Study Area
County Border
Highway
Trunk Road
Collector Road
Local Road
Loose Surface/Cart Track
Rivers

Disclaimer

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Datum: UTM NAD83
Zone 20
Scale: 1:50,000

Version: 1
5 Nov 2014

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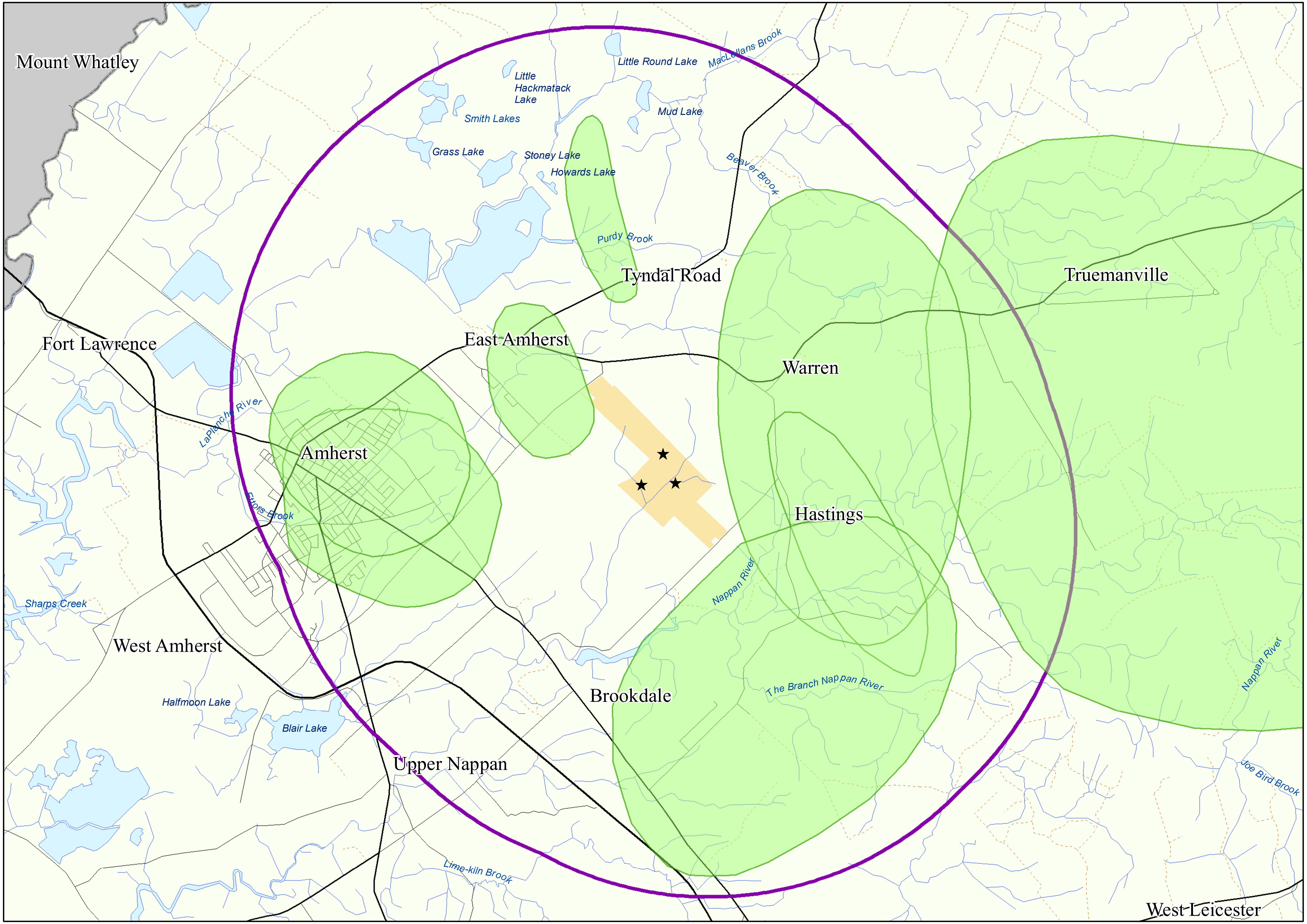
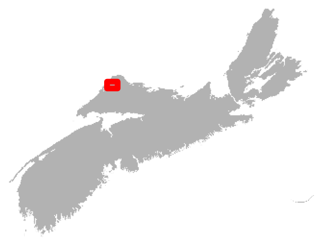
Map D

Mi’kmaq Traditional and Current Gathering Areas



Amherst Community Wind Farm MEKS

Mi'kmaq Traditional and Current Gathering Areas



Legend

- ★ Proposed Turbine Locations
- 🟩 Gathering Areas
- 🟧 Project Site
- ▢ Study Area
- County Border
- Highway
- Trunk Road
- Collector Road
- Local Road
- Loose Surface/Cart Track
- Rivers

Disclaimer

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Datum: UTM NAD83
Zone 20
Scale: 1:50,000

Version: 1
5 Nov 2014

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Appendix F:

Wetland Delineation Survey

Project: Amherst Community Wind Farm

Wetland delineation for proposed 3 turbine wind farm

Prepared by: Natural Forces Construction Inc.

1205 – 1801 Hollis Street,
Halifax, NS B3J 3N4
Date: August 21, 2014

I. Introduction

Natural Forces Construction Inc. completed a desktop study and field survey focusing on the proposed access road and wind turbine locations at the proposed Amherst Community Wind Farm. The objective of this study was to determine the presence of wetland habitat and watercourses in order to appropriately micro-site the WTGs.

II. Site Detail

The proposed Amherst Community Wind Farm (ACWF) will consist of three, 2 MW WTGs located between Pumping Station Road and John Black Road approximately 5.5 kilometers from the town of Amherst. The project area consists of three privately owned land parcels that are vacant and the two northern most parcels have been used for forestry in the last decade.

Figure 1 presents a general characterization of the lands at the proposed ACWF. The areas in dark green (identified as #1) are forested areas, mixed matured forest and some areas that are regenerating forest showing evidence of clear cutting within the past 10 years. The grey areas (identified as #2) are areas that have been clear cut recently, within the past two years. These areas are highly disturbed and have very little, if any herb and shrub vegetation remaining. The light green area (identified as #3) are farming fields used for harvesting hay.

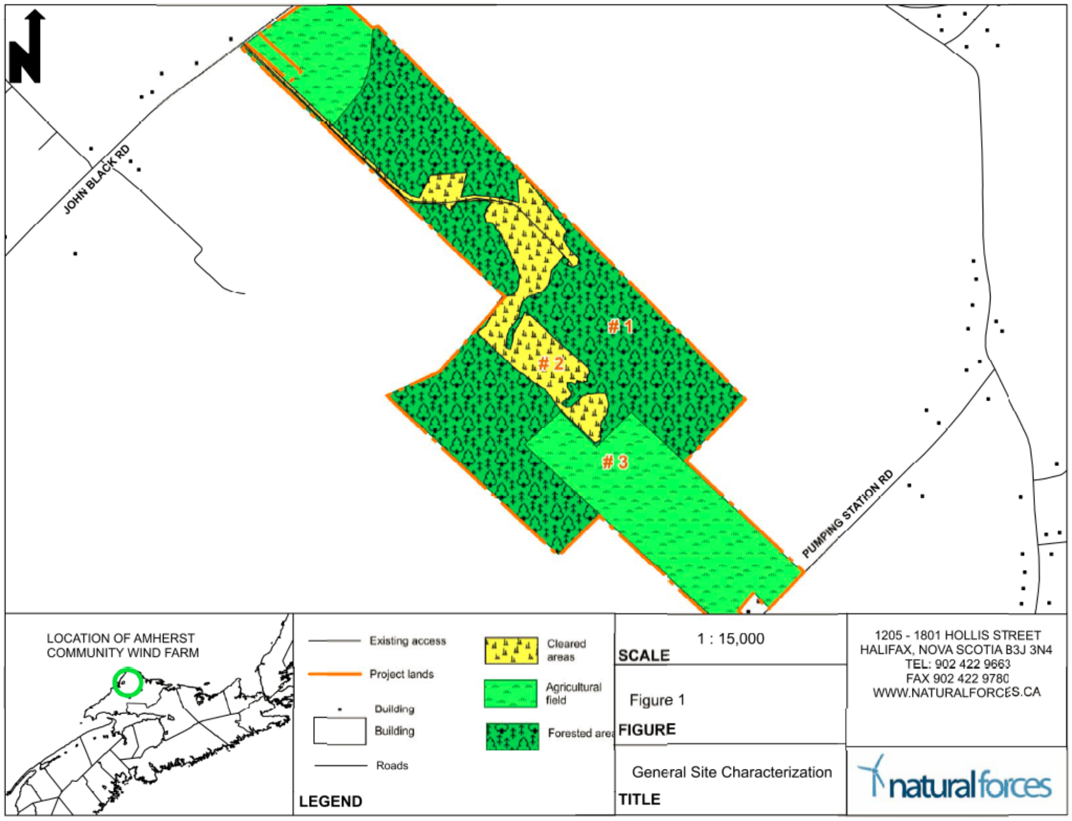


Figure 1: Site coverage characterization

III. Methodology

The wetland delineation was initiated by conducting a desktop search and review of available data to identify areas of high wetland potential. This information was then used with potential project site designs to create an assessment area followed by a field survey to identify wetland and watercourse boundaries.

Desktop Review

A desktop review of the general project area was conducted to identify location and extent of potential wetlands. Information was reviewed from the following sources:

- Nova Scotia Wet Areas Mapping database (WAM);
- Aerial imagery;
- Nova Scotia Significant Species and Habitats database; and
- Topographical maps.

This information was used to identify areas with a high potential for wetland habitat. All high potential areas were incorporated into developing a field survey strategy. Project constrains identified during previous development activities were also considered in developing a field survey strategy to

Field Survey

The field survey was completed in August 2014 and focused on assessing land associated with the proposed turbine locations and access road. Through Natural Forces' previous experience with the provincial environmental assessment process and in consultation with Nova Scotia Environment and Department of Natural Resources it is understood that WTGs must be setback 30 meters + blade length from wetlands and watercourses. The field assessment has been conducted with this setback requirement in mind; as it applies to this project, turbines must be setback 76 m from wetlands and watercourses (46 m rotor radius + 30 m).

The wetland assessment followed the methodology outlined in the US Corps of Engineers Wetland Delineation Manual (1987). The following three criteria were used to determine wetland habitat:

1. Presence of hydrophytic vegetation;
2. Presence of hyrologic conditions; and
3. Presence of hydric soils.

Wetland boundaries were defined by walking strategic transects based on the proposed WTG locations. Frequent soil pits were dug to assess the presence of hydric soils and the presence/absence of hydrology indicators. Vegetation surveys were also conducted to confirm the presence of hydrophytic vegetation for indentified wetlands.

Watercourses within the assessment area were also recorded; general notes were taken regarding the watercourses such as direction of flow, depth and connectivity with identified wetlands.

Coordinates of wetlands extents and watercourses were captured by using a GPS approximately every 3 - 5 meters. The assessment area can be found in Appendix A – Figure 2.

IV. Results

Results of the field wetland delineation identified three main types of wetlands present at the Project site; clear cut wetland, mature treed wetland and regenerating treed wetland, which were primarily treed swamps. The majority of the project site is very recent clear cut of regenerating forests that have been clear cut within the last 10 years. Relatively little of the project area consists of mature forests; one wetland northwest of proposed turbine 3 is a mature treed swamp.

Wetland habitat is interspersed throughout the project site and shows a general connectivity that flows from northeast to south west. Wetlands are drained via small brooks that connect in the southwestern corner of the assessment area.

Existing Access Road

The existing access road area contains several small treed swamps with poorly drained soils that were bound by the extents of the roadbed. Wetlands to the north of the access road appear to connect to a larger wetland matrix flowing north. Tree species along the access road is dominated by *Acer rubrum* (Red Maple), *Betula alleghaniensis* (Yellow Birch), and (speckled alder). Shrub and herb species consisted of *Osmunda cinnamomeum* (cinnamon fern), *Ilex verticillata (*Canada holly), grasses and sedges. Wetlands along the existing access road can be found in Appendix A – Figure 3.

Clear Cut Area

A wetland within a clear cut area has been identified during field delineation that is shown in Photo 1 and is shown in Appendix A - Figure 4 between watercourse 2 & 3. The wetland has been impacted during previous forestry activities with very little vegetation remaining. A watercourse along the northern portion of the assessment area has been identified, which drains to the wetland that has been clear cut. Much of the water in this wetland mosaic has been influenced by skidders during forestry activities that took place approximately 1-3 years ago. Soils in the area are poorly drained and there are patches of grasses and sedges in small areas that are starting to regenerate.

Photo 1: Clear cut wetland area found over most of the project site.

Mature Forest Wetland

The most mature forested area within the project site is a treed swamp that was found in the western portion of the assessment area. This wetland is shown in Appendix A - Figure 4 and is bound by watercourses 1 & 2, which the wetland uses as drainage, flowing south. Soils in this wetland are imperfectly to poorly drained and the area generally slopes to the south west draining into the two watercourses. The mature treed swamp is dominated by *Acer rubrum*, *Acer saccharum* (sugar maple) and *Picea mariana (*black spruce). The shrub and herb layer is dominated by *Ilex verticillata, Osmunda cinnamomeum*, *Ariala nudicaulis* (Wild sasaparilia) *and Maianthemum Canadensis* (Canada Mayflower).

Regenerating Forest Wetland

Much of the project site (surrounding turbine 1 & 2) has been clear cut within the past few years and is in a regenerative state. The forested swamps are found in the southern and eastern portion of the assessment area and drain into watercourse 3 flowing southwest and connecting with watercourses 1 & 2. Tree species in dominated by *Acer Rub rubrum, Betula alleghaniensis* and *Abies balsamea* (Balsam fir). Shrub and herb layers were dominated by *Osmunda cinnamomeum*, *Ariala nudicaulis*, *Alnus incana* and *Kalmia angustifolia* (Sheep laurel). Regenerating forested wetlands can be found in Appendix A – Figure 4.

V. Conclusion and Recommendations

A wetland delineation was completed within the defined assessment area at the proposed Amherst Community Wind Farm in August 2014. The purpose of the wetland delineation was to identify wetlands and watercourses to aid in the development and site design of the proposed wind farm. Further, the wetland assessment will help natural forces site turbines the recommended 30 m plus blade length from all wetlands and watercourses as recommended by Nova Scotia Department of Natural Resources.

Multiple areas of treed swamps were identified in both matured forests and regenerating forests that had been clear cut within the past 10 years. A recent clear cut starting near the end of the existing access road and continuing to the middle of the assessment area shows signs of heavy disturbance through forestry activities.

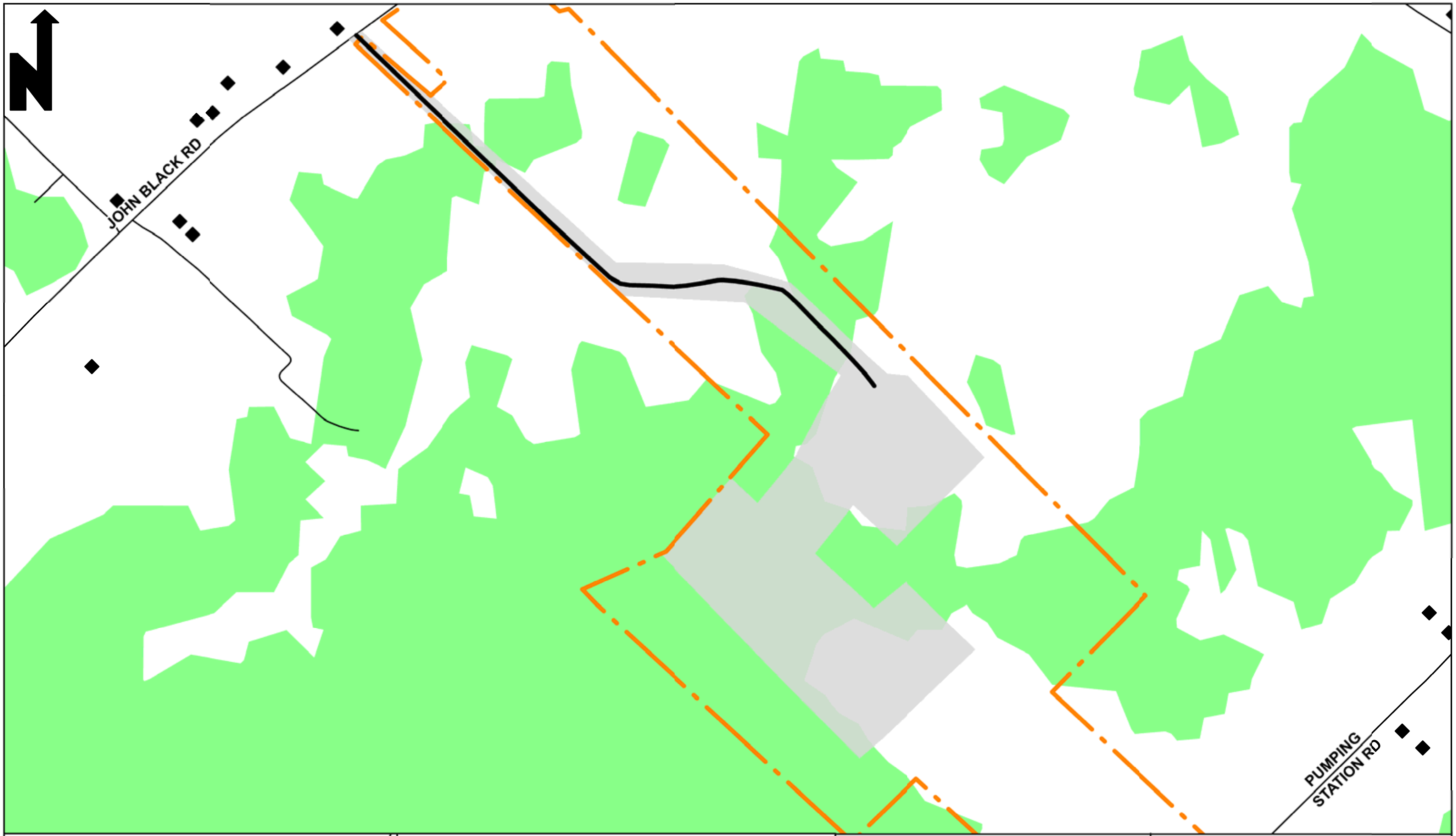
Should an access road is proposed through the clear cut area and it is anticipated that wetland alteration permit will be required to do so. As a result, a qualified third party consultant should be engaged to complete a functional assessment of the area and will apply for the wetland alteration permit.

VI. Closure

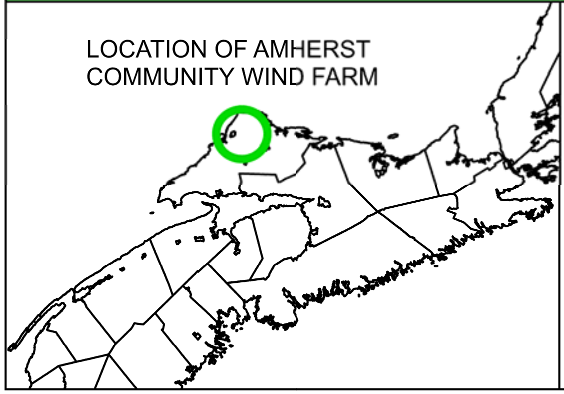
This report has been prepared for the Amherst Community Wind Farm as proposed by Mi'kmaq Wind4All Communities L.P. Any other person or entity may not rely on this report without the express written consent of Natural Forces Construction Inc.

APPENDIX A

Maps



LOCATION OF AMHERST
COMMUNITY WIND FARM



LEGEND

- ▬ Existing Access
- ▨ Assessment Area
- ▬ Project Lands
- ▪ Building
- 🟩 Vegetation
- — Road

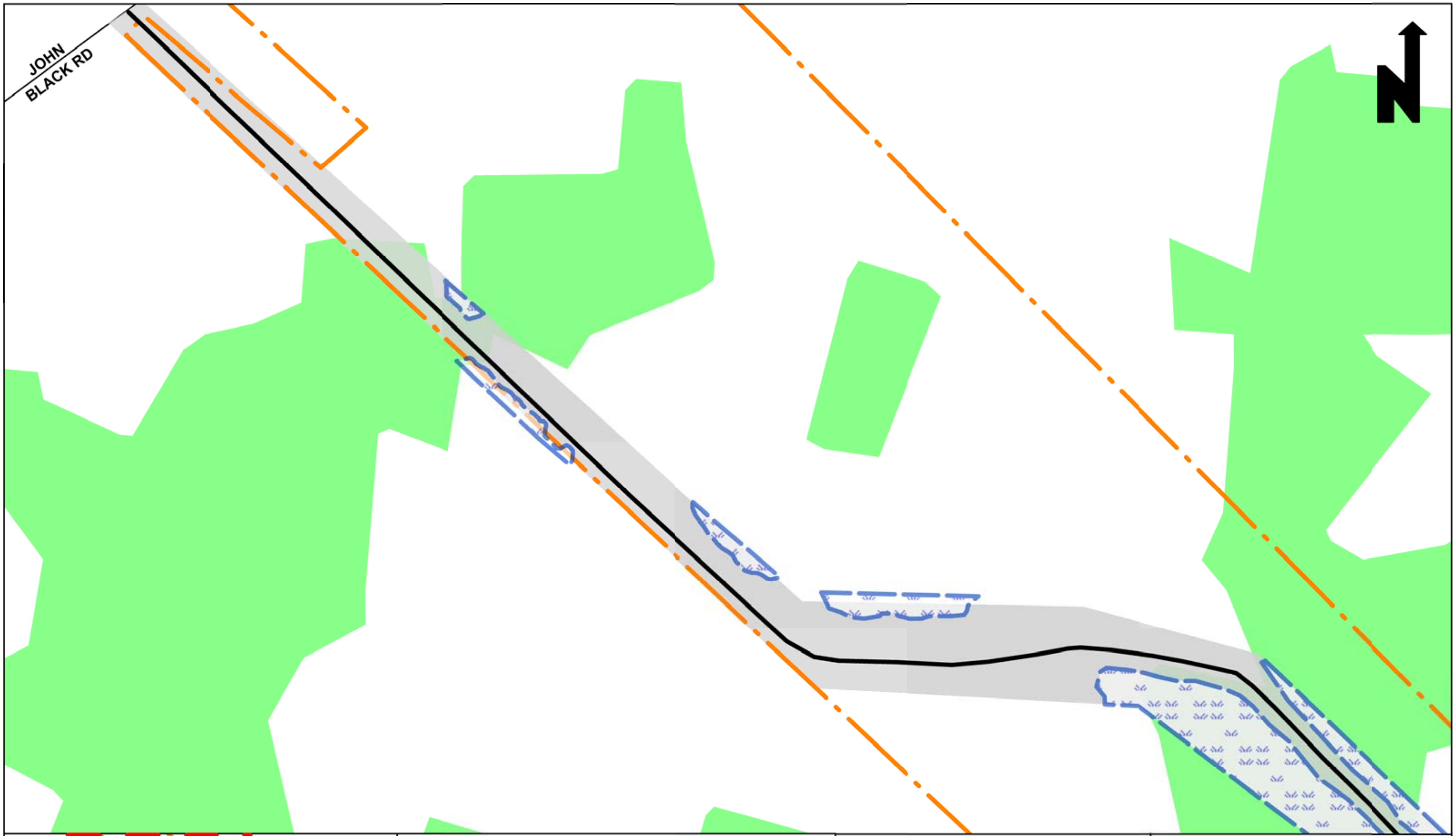
SCALE 1 : 13,000

FIGURE Figure 2

TITLE Assessment Area

1205 - 1801 HOLLIS STREET
HALIFAX, NOVA SCOTIA B3J 3N4
TEL: 902 422 9663
FAX 902 422 9780
WWW.NATURALFORCES.CA

natural forces



LEGEND

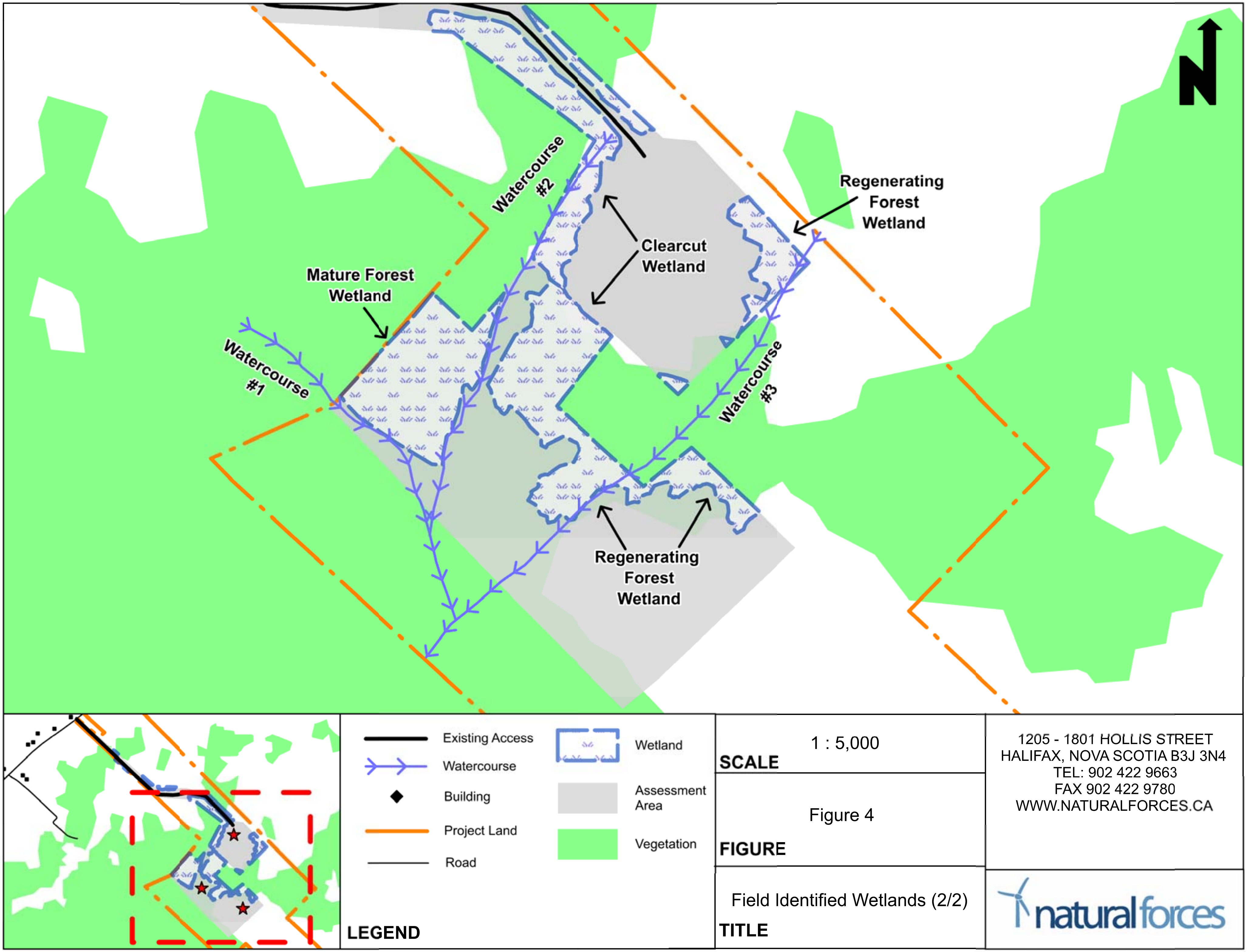
- Existing Access
- Watercourse
- ◆ Building
- Project Land
- Road
- Wetland
- Assessment Area
- 🟩 Vegetation

SCALE 1 : 5,000

FIGURE Figure 3

TITLE Field Identified Wetlands (1/2)

1205 - 1801 HOLLIS STREET
HALIFAX, NOVA SCOTIA B3J 3N4
TEL: 902 422 9663
FAX 902 422 9780
WWW.NATURALFORCES.CA



SCALE
1 : 5,000

FIGURE
Figure 4

TITLE
Field Identified Wetlands (2/2)

1205 - 1801 HOLLIS STREET
HALIFAX, NOVA SCOTIA B3J 3N4
TEL: 902 422 9663
FAX 902 422 9780
WWW.NATURALFORCES.CA

natural forces

Appendix G:

Vascular Plants and Plant Communities Survey

Vascular plants and plant communities of the Amherst Community Wind Farm site, Cumberland County, Nova Scotia, with notes on birds

Mixed forest at proposed site of Turbine 3, Amherst Community Wind Farm.

September 30, 2014

Sean Blaney and David Mazerolle, Atlantic Canada Conservation Data Centre

for Natural Forces Technologies Inc.

Methods

AC CDC botanists Sean Blaney and David Mazerolle conducted a total of 12.5 hours of fieldwork on foot at the Amherst Community Wind Farm project site in Cumberland County, Nova Scotia on June 9, 2014 (Sean Blaney), and July 2 (David Mazerolle), walking a total of 17.6 km. GPS tracks of site coverage are mapped in Figure 1.

We documented full lists of vascular plant species observed with locations documented for the first observation of each species. Sean Blaney also documented bird species. For provincially rare species (those ranked S3S4 or lower by AC CDC, or Sensitive, May Be At Risk or At Risk by the province; see Appendix 1), we recorded location by GPS and noted abundance, extent of occurrence and habitat. Breeding evidence for birds was recorded using the categories of the Maritimes Breeding Bird Atlas. In addition, Sean Blaney documented plant communities present within the turbine construction footprints, by photograph and by recording dominant species in the canopy, sapling, low shrub/tree seedling and herbaceous strata.

Results and Discussion

I. Vascular Plant Species

We recorded 263 vascular plant taxa (211 native, 52 exotic; Table 1), two of which are of some conservation significance. Site-specific details are given in Table 2, and locations are mapped in Figure 2.

Halberd-Leaved Tearthumb (*Polygonum arifolium*, S2 – Sensitive; Figure 3) is a species of wet deciduous forest and thickets, known from 17 locations in Nova Scotia between Yarmouth and Cumberland Counties, but with the greatest concentration of records being from Cumberland County. There is also an unconfirmed, but likely correct report from Malagawatch, Cape Breton Island. The speciesa is also rare in Prince Edward Island (S2 - Sensitive) and New Brunswick (S3 – Secure).

Wiegand's Sedge (*Carex wiegandii*) is an uncommon sedge of wet, generally acidic swamps and bog margins. It is quite similar to some more common sedges (especially *Carex atlantica* ssp. *atlantica* and *Carex echinata*), and as a result was poorly documented in the province until the past 10 years, when it has been found to be fairly common in peatland margins of the Cape Breton Highlands plateau, and scattered uncommonly on mainland Nova Scotia. It is also uncommon in New Brunswick (S3 – Secure) and rare in Prince Edward Island (S1 – May Be At Risk).

Further visits to the site would yield additional species to those recorded. However, our native species total is fairly large for the size and habitat diversity of the site, indicating relatively complete coverage, and based on the nature and condition of the plant communities present, it is unlikely that many additional provincially rare plant species would be found in the project footprint.

II. Breeding Birds

Sean Blaney recorded 34 species of breeding birds (Table 3) through incidental observations during plant fieldwork on June 9. The mid-day to late afternoon fieldwork meant that bird activity was reduced relative to its maximum around daybreak and thus only a small proportion of the species actually breeding on the site were documented.

Five bird species of conservation significance were noted, with three having legal protection under the Nova Scotia Species at Risk Act: Common Nighthawk (S3B – At Risk; NS Threatened), Olive-sided Flycatcher (S3B – At Risk; NS Threatened), Eastern Wood-Pewee (S3S4B – Sensitive; NS Vulnerable). Other provincially rare species were Yellow-bellied Flycatcher (S3B – Sensitive) and Golden-crowned Kinglet (S4 – Sensitive). Details of these records are given in Table 2, and locations are mapped in Figure 2. All these species are still fairly common to common in Nova Scotia but are of concern because of major population declines.

We also documented an active Osprey nest on the existing powerline at 45.832861, -64.140289.

III. Plant Communities

Notes on plant communities at the proposed turbine construction sites are given in Table 3 and photographs of the proposed turbine sites are given in Figures 4 to 6. None of the plant communities documented within the turbine or road construction footprints are considered provincially rare (AC CDC data, S. Blaney, pers. obs.). Relatively little of the proposed project footprint falls within forest older than 40 years, as a large proportion of the footprint area is either very recent clearcut (within the last one to three years), or is regenerating forest under 20 years old. Part of the footprint of the proposed site of Turbine 3 is within swampy intermediate to mature mixed forest dominated by Red Maple and Red Spruce. The turbine 3 site is on the edge of the most significant remaining forest on property, wich extends north and west from the stream just north of the cultivated cropland at the site’s south end. The forest along the main stream is especially mature and on somewhat richer soil than the remainder of the site, supporting Sugar Maple (*Acer saccharum*), Eastern Hemlock (*Tsuga canadensis*) and Ostrich Fern (*Matteuccia struthiopteris*), among other species not found elsewhere on the project area. The gently sloping ground to the north of the stream has extensive groundwater seepage, and the path walked by Sean Blaney in this area was entirely swamp forest wetland for about 400 m, again with slightly richer soil than is present over most of the project area.

Additional plant community notes compiled by David Mazerolle, focusing especially on where he entered and left wetlands, are given in Table 5, with noted locations mapped in Figure 7.

Table 1. Vascular plants recorded in the Amherst Community Wind Farm project site, with Nova Scotia S-ranks and General Status (GS) ranks (defined in Appendix 1). Taxonomy follows Kartesz (1999) – *Synthesis of the North American Flora*, CD-ROM. Site status ranks are: x = observed, no status assigned; R = rare; U = uncommon; L = locally common (large population, localized to one or a few areas); F = fairly common; C = common.

Species / Family	Common Name	Site Status	S-rank	GS Rank	ID Comment
Lycopodiaceae	**Clubmosses**				
Huperzia lucidula	Shining Firmoss	x	S5	Secure	
Lycopodiella inundata	Northern Bog Clubmoss	R	S5	Secure	
Lycopodium annotinum	Stiff Clubmoss	R	S5	Secure	
Lycopodium clavatum	Running Clubmoss	U	S5	Secure	ID refers to the sp. in the broad sense (L. lagopus not excluded)
Lycopodium dendroideum	Round-branched Tree-clubmoss	C	S5	Secure	
Lycopodium obscurum	Flat-branched Tree-clubmoss	R	S4S5	Secure	
Equisetaceae	**Horsetails**				
Equisetum arvense	Field Horsetail	C	S5	Secure	
Equisetum fluviatile	Water Horsetail	R	S5	Secure	
Equisetum sylvaticum	Woodland Horsetail	F	S5	Secure	
Osmundaceae	**Flowering Ferns**				
Osmunda cinnamomea	Cinnamon Fern	C	S5	Secure	
Osmunda claytoniana	Interrupted Fern	C	S5	Secure	
Dennstaedtiaceae	**Hay-Scented Ferns**				
Dennstaedtia punctilobula	Eastern Hay-Scented Fern	L	S5	Secure	
Pteridium aquilinum var. latiusculum	Bracken Fern	L	S5	Secure	
Thelypteridaceae	**Marsh Ferns**				
Phegopteris connectilis	Northern Beech Fern	R-U	S5	Secure	
Thelypteris noveboracensis	New York Fern	F	S5	Secure	
Dryopteridaceae	**Wood Ferns**				
Athyrium filix-femina ssp. angustum	Common Lady Fern	U	S5	Secure	
Dryopteris campyloptera	Mountain Wood Fern	R	S5	Secure	
Dryopteris carthusiana	Spinulose Wood Fern	x	S5	Secure	
Dryopteris cristata	Crested Wood Fern	L	S5	Secure	
Dryopteris intermedia	Evergreen Wood Fern	C	S5	Secure	
Gymnocarpium dryopteris	Common Oak Fern	R	S5	Secure	
Matteuccia struthiopteris	Ostrich Fern	x	S5	Secure	
Onoclea sensibilis	Sensitive Fern	C	S5	Secure	
Polystichum acrostichoides	Christmas Fern	x	S5	Secure	
Pinaceae	**Pines**				
Abies balsamea	Balsam Fir	C	S5	Secure	
Larix laricina	Tamarack	L	S5	Secure	
Picea glauca	White Spruce	C	S5	Secure	
Picea mariana	Black Spruce	C	S5	Secure	
Picea rubens	Red Spruce	C	S5	Secure	

Species / Family	Common Name	Site Status	S-rank	GS Rank	ID Comment
Pinus strobus	Eastern White Pine	U	S5	Secure	
Tsuga canadensis	Eastern Hemlock	R	S4S5	Secure	
Ranunculaceae	**Buttercups**				
Coptis trifolia	Goldthread	F	S5	Secure	
Ranunculus acris	Common Buttercup	U	SNA	Exotic	
Ranunculus repens	Creeping Buttercup	L	SNA	Exotic	
Thalictrum pubescens	Tall Meadow-Rue	U	S5	Secure	
Betulaceae	**Birches**				
Alnus incana ssp. rugosa	Speckled Alder	C	S5	Secure	
Alnus viridis ssp. crispa	Green Alder	F	S5	Secure	
Betula alleghaniensis	Yellow Birch	U-F	S5	Secure	
Betula papyrifera var. cordifolia	Heart-leaved Birch	x	S5	Secure	
Betula papyrifera var. papyrifera	Heart-leaved Birch	C	S5	Secure	
Betula populifolia	Gray Birch	C	S5	Secure	
Corylus cornuta	Beaked Hazel	F	S5	Secure	
Caryophyllaceae	**Pinks**				
Cerastium fontanum ssp. vulgare	Common Chickweed	U	SNA	Exotic	
Moehringia lateriflora	Blunt-leaved Sandwort	R	S5	Secure	
Spergula arvensis	Common Corn Spurrey	R	SNA	Exotic	
Spergularia rubra	Ruby Sandspurrey	R	SNA	Exotic	
Stellaria graminea	Little Starwort	C	SNA	Exotic	
Polygonaceae	**Smartweeds**				
Polygonum arifolium	Halberd-leaved Tearthumb	R	S2	Sensitive	
Polygonum hydropiper	Marshpepper Smartweed	U	SNA	Exotic	young; ID to sp. probable, not confirmed
Polygonum sagittatum	Arrow-leaved Smartweed	C	S5	Secure	
Rumex acetosella	Sheep Sorrel	L	SNA	Exotic	
Rumex crispus	Curled Dock	R	SNA	Exotic	
Clusiaceae	**St. John's-worts**				
Hypericum canadense	Canada St John's-wort	U	S5	Secure	
Hypericum mutilum	Dwarf St John's-wort	x	S4S5	Secure	ID refers to the sp. in the broad sense (*H. boreale* not excluded)
Hypericum perforatum	Common St. John's-wort	C	SNA	Exotic	
Triadenum fraseri	Fraser's Marsh St John's-wort	F	S5	Secure	
Droseraceae	**Sundews**				
Drosera rotundifolia	Round-leaved Sundew	R	S5	Secure	
Violaceae	**Violets**				
Viola cucullata	Marsh Blue Violet	R-U	S5	Secure	
Viola macloskeyi ssp. pallens	Small White Violet	F	S5	Secure	
Viola sororia	Woolly Blue Violet	F	S5	Secure	
Cucurbitaceae	**Cucumbers**				
Echinocystis lobata	Wild Cucumber	R	SNA	Exotic	
Salicaceae	**Willows**				
Populus tremuloides	Trembling Aspen	L	S5	Secure	

Species / Family	Common Name	Site Status	S-rank	GS Rank	ID Comment
Salix bebbiana	Bebb's Willow	F	S5	Secure	
Salix discolor	Pussy Willow	x	S5	Secure	
Salix humilis	Upland Willow	U	S5	Secure	
Salix pyrifolia	Balsam Willow	x	S5	Secure	
Brassicaceae	**Mustards**				
Brassica sp.	mustard species	R	[SNA]	[Exotic]	
Cardamine pensylvanica	Pennsylvania Bittercress	x	S5	Secure	
Raphanus raphanistrum	Wild Radish	R	SNA	Exotic	
Ericaceae	**Heaths**				
Gaultheria hispidula	Creeping Snowberry	C	S5	Secure	
Gaultheria procumbens	Eastern Teaberry	F	S5	Secure	
Gaylussacia baccata	Black Huckleberry	U	S5	Secure	
Kalmia angustifolia	Sheep Laurel	C	S5	Secure	
Kalmia polifolia	Pale Bog Laurel	x	S5	Secure	
Ledum groenlandicum	Common Labrador Tea	C	S5	Secure	
Rhododendron canadense	Rhodora	L	S5	Secure	
Vaccinium angustifolium	Late Lowbush Blueberry	C	S5	Secure	
Vaccinium myrtilloides	Velvet-leaved Blueberry	C	S5	Secure	
Monotropaceae	**Indian Pipes**				
Monotropa uniflora	Indian Pipe	x	S5	Secure	
Primulaceae	**Primroses**				
Lysimachia terrestris	Swamp Yellow Loosestrife	U	S5	Secure	
Trientalis borealis	Northern Starflower	C	S5	Secure	
Grossulariaceae	**Gooseberries**				
Ribes glandulosum	Skunk Currant	F	S5	Secure	
Ribes lacustre	Bristly Black Currant	x	S5	Secure	
Saxifragaceae	**Saxifrages**				
Chrysosplenium americanum	American Golden Saxifrage	x	S5	Secure	
Rosaceae	**Roses**				
Amelanchier bartramiana	Bartram's Serviceberry	U	S5	Secure	
Amelanchier sp.	serviceberry species	C		[native]	*A. laevis / interior / intermedia* (coppery leaves at anthesis)
Fragaria virginiana	Wild Strawberry	C	S5	Secure	
Geum rivale	Water Avens	R	S5	Secure	
Malus pumila	Common Apple	R	SNA	Exotic	
Photinia melanocarpa	Black Chokeberry	x	S5	Secure	
Potentilla norvegica ssp. monspeliensis	Rough Cinquefoil	x	S5	Secure	
Potentilla recta	Sulphur Cinquefoil	U	SNA	Exotic	
Potentilla simplex	Old Field Cinquefoil	F	S5	Secure	
Prunus pensylvanica	Pin Cherry	C	S5	Secure	
Prunus virginiana	Chokecherry	F	S5	Secure	
Rosa nitida	Shining Rose	R	S4	Secure	
Rubus allegheniensis	Alleghaney Blackberry	x	S5	Secure	
Rubus canadensis	Smooth Blackberry	C	S5	Secure	
Rubus hispidus	Bristly Dewberry	C	S5	Secure	

Species / Family	**Common Name**	**Site Status**	**S-rank**	**GS Rank**	**ID Comment**
Rubus idaeus ssp. strigosus	Red Raspberry	C	S5	Secure	
Rubus pubescens	Dwarf Red Raspberry	C	S5	Secure	
Sorbus americana	American Mountain Ash	C	S5	Secure	
Spiraea alba var. latifolia	White Meadowsweet	C	S5	Secure	
Spiraea tomentosa	Steeplebush	F	S5	Secure	
Fabaceae	**Beans**				
Medicago sativa	Alfalfa	R	SNA	Exotic	
Trifolium pratense	Red Clover	U	SNA	Exotic	
Trifolium repens	White Clover	L	SNA	Exotic	
Vicia cracca	Tufted Vetch	L	SNA	Exotic	
Onagraceae	**Evening-Primroses**				
Chamerion angustifolium	Fireweed	F	S5	Secure	
Circaea alpina	Small Enchanter's Nightshade	x	S5	Secure	
Epilobium ciliatum	Northern Willowherb	U	S5	Secure	
Epilobium leptophyllum	Bog Willowherb	F	S5	Secure	
Epilobium palustre	Marsh Willowherb	x	S5	Secure	young; essentially hairless leaves; ID to sp. probable vs. *E. leptophyllum*
Oenothera biennis	Common Evening Primrose	U	S5	Secure	young; ID to sp. probable, not confirmed
Cornaceae	**Dogwoods**				
Cornus canadensis	Bunchberry	C	S5	Secure	
Cornus sericea	Red Osier Dogwood	C	S5	Secure	
Aquifoliaceae	**Hollies**				
Ilex verticillata	Common Winterberry	L	S5	Secure	
Nemopanthus mucronatus	Mountain Holly	C	S5	Secure	
Rhamnaceae	**Buckthorns**				
Frangula alnus	Glossy Buckthorn	C	SNA	Exotic	
Aceraceae	**Maples**				
Acer pensylvanicum	Striped Maple	R	S5	Secure	
Acer rubrum	Red Maple	C	S5	Secure	
Acer saccharum	Sugar Maple	R	S5	Secure	
Acer spicatum	Mountain Maple	R	S5	Secure	
Oxalidaceae	**Wood Sorrels**				
Oxalis montana	Common Wood Sorrel	C	S5	Secure	
Oxalis stricta	European Wood Sorrel	L	S5	Secure	
Balsaminaceae	**Touch-Me-Nots**				
Impatiens capensis	Spotted Jewelweed	C	S5	Secure	
Araliaceae	**Sarsaparillas**				
Aralia hispida	Bristly Sarsaparilla	R	S5	Secure	
Aralia nudicaulis	Wild Sarsaparilla	C	S5	Secure	
Apiaceae	**Parsleys**				
Hydrocotyle americana	American Marsh Pennywort	x	S5	Secure	
Lamiaceae	**Mints**				
Galeopsis tetrahit	Common Hemp-nettle	C	SNA	Exotic	

Species / Family	Common Name	Site Status	S-rank	GS Rank	ID Comment
Lycopus uniflorus	Northern Water Horehound	U	S5	Secure	
Mentha sp.	mint species	R	[SNA]	[Exotic]	
Scutellaria galericulata	Marsh Skullcap	U-F	S5	Secure	
Scutellaria lateriflora	Mad-dog Skullcap	F	S5	Secure	
Callitrichaceae	**Water-Starworts**				
Callitriche sp.	water-starwort species	R		[Secure]	
Plantaginaceae	**Plantains**				
Plantago major	Common Plantain	L	SNA	Exotic	
Oleaceae	**Olives**				
Fraxinus americana	White Ash	x	S5	Secure	
Scrophulariaceae	**Figworts**				
Chelone glabra	White Turtlehead	R	S5	Secure	
Rhinanthus minor	Little Yellow Rattle	R	S5	Secure	
Veronica officinalis	Common Speedwell	L	S5	Exotic	
Veronica scutellata	Marsh Speedwell	x	S5	Secure	
Veronica serpyllifolia ssp. serpyllifolia	Thyme-Leaved Speedwell	R	SNA	Exotic	
Rubiaceae	**Bedstraws**				
Galium asprellum	Rough Bedstraw	x	S5	Secure	
Galium mollugo	Smooth Bedstraw	C	SNA	Exotic	
Galium palustre	Common Marsh Bedstraw	F	S5	Secure	
Galium trifidum ssp. trifidum	Three-petaled Bedstraw	C	S5	Secure	
Mitchella repens	Partridgeberry	R	S5	Secure	
Caprifoliaceae	**Honeysuckles**				
Diervilla lonicera	Northern Bush Honeysuckle	R	S5	Secure	
Linnaea borealis ssp. americana	Twinflower	x	S5	Secure	
Lonicera canadensis	Canada Fly Honeysuckle	R-U	S5	Secure	
Sambucus nigra ssp. canadensis	Black Elderberry	x	S5	Secure	
Sambucus racemosa	Red Elderberry	C	S5	Secure	
Viburnum nudum var. cassinoides	Northern Wild Raisin	C	S5	Secure	
Valerianaceae	**Valerians**				
Valeriana officinalis	Common Valerian	L	SNA	Exotic	
Asteraceae	**Asters**				
Achillea millefolium	Common Yarrow	C	S5	Secure	
Anaphalis margaritacea	Pearly Everlasting	C	S5	Secure	
Bidens frondosa	Devil's Beggarticks	x	S5	Secure	
Cirsium arvense	Canada Thistle	R	SNA	Exotic	
Doellingeria umbellata	Hairy Flat-top White Aster	C	S5	Secure	
Erechtites hieraciifolia	Eastern Burnweed	R	S5	Secure	
Erigeron annuus	Annual Fleabane	R	S4S5	Secure	
Erigeron strigosus	Rough Fleabane	R	S5	Secure	
Eupatorium maculatum	Spotted Joe-pye-weed	R	S5	Secure	
Eupatorium perfoliatum	Common Boneset	x	S5	Secure	
Eurybia macrophylla	Large-leaved Aster	x	S5	Secure	
Euthamia graminifolia	Grass-leaved Goldenrod	C	S5	Secure	

Species / Family	Common Name	Site Status	S-rank	GS Rank	ID Comment
Gnaphalium uliginosum	Marsh Cudweed	R	SNA	Exotic	
Hieracium caespitosum	Field Hawkweed	C	SNA	Exotic	
Hieracium lachenalii	Common Hawkweed	R	SNA	Exotic	
Hieracium pilosella	Mouse-ear Hawkweed	L	SNA	Exotic	
Hieracium scabrum	Rough Hawkweed	x	S5	Secure	
Hieracium umbellatum/tridentatum	hawkweed species	x	[SNA]	[Exotic]	
Hieracium x floribundum	Smoothish Hawkweed	U	SNA	Exotic	
Lactuca biennis	Tall Blue Lettuce	x	S5	Secure	
Leontodon autumnalis	Fall Dandelion	U	SNA	Exotic	
Leucanthemum vulgare	Oxeye Daisy	R	SNA	Exotic	
Matricaria discoidea	Pineapple Weed	R	SNA	Exotic	
Oclemena acuminata	Whorled Wood Aster	C	S5	Secure	
Prenanthes altissima	Tall Rattlesnakeroot	x	S5	Secure	
Prenanthes trifoliolata	Three-leaved Rattlesnakeroot	C	S5	Secure	
Solidago bicolor	White Goldenrod	C	S5	Secure	
Solidago canadensis	Canada Goldenrod	C	S5	Secure	
Solidago puberula	Downy Goldenrod	C	S5	Secure	
Solidago rugosa	Rough-stemmed Goldenrod	C	S5	Secure	
Solidago uliginosa	Northern Bog Goldenrod	R	S5	Secure	
Symphyotrichum cordifolium	Heart-leaved Aster	F	S4S5	Secure	
Symphyotrichum lateriflorum	Calico Aster	F	S5	Secure	
Symphyotrichum novi-belgii	New York Aster	x	S5	Secure	
Symphyotrichum puniceum	Purple-stemmed Aster	C	S5	Secure	
Taraxacum officinale	Common Dandelion	L	SNA	Exotic	
Tragopogon pratensis	Meadow Goatsbeard	R	SNA	Exotic	
Tripleurospermum maritima	Seashore Chamomile	R	SNA	Exotic	
Tussilago farfara	Coltsfoot	R	SNA	Exotic	
Araceae	**Arums**				
Arisaema triphyllum	Jack-in-the-pulpit	L	S4S5	Secure	
Juncaceae	**Rushs**				
Juncus brevicaudatus	Narrow-Panicled Rush	F	S5	Secure	
Juncus effusus	Soft Rush	L	S5	Secure	
Juncus filiformis	Thread Rush	C	S5	Secure	
Juncus tenuis	Slender Rush	C	S5	Secure	
Luzula multiflora	Common Woodrush	F	S5	Secure	
Cyperaceae	**Sedges**				
Carex arctata	Black Sedge	R	S5	Secure	
Carex brunnescens ssp. sphaerostachya	Brownish Sedge	C	S5	Secure	
Carex canescens	Silvery Sedge	L	S5	Secure	
Carex communis	Fibrous-Root Sedge	x	S5	Secure	
Carex debilis var. rudgei	White-edged Sedge	C	S5	Secure	
Carex disperma	Two-seeded Sedge	x	S5	Secure	
Carex echinata	Star Sedge	U	S5	Secure	

Species / Family	Common Name	Site Status	S-rank	GS Rank	ID Comment
Carex flava	Yellow Sedge	R	S5	Secure	
Carex gynandra	Nodding Sedge	C	S5	Secure	
Carex intumescens	Bladder Sedge	F	S5	Secure	
Carex leptalea	Bristly-stalked Sedge	C	S5	Secure	
Carex leptonervia	Finely-Nerved Sedge	F	S5	Secure	
Carex nigra	Smooth Black Sedge	U	S5	Secure	
Carex novae-angliae	New England Sedge	U	S5	Secure	
Carex projecta	Necklace Sedge	U	S5	Secure	
Carex scoparia	Broom Sedge	F	S5	Secure	
Carex stipata	Awl-fruited Sedge	F	S5	Secure	
Carex trisperma var. trisperma	Three-seeded Sedge	C	S5	Secure	
Carex wiegandii	Wiegand's Sedge	R	S3	Sensitive	
Eleocharis palustris	Common Spikerush	x	S5	Secure	
Eleocharis tenuis	Slender Spikerush	R	S5	Secure	
Eriophorum vaginatum	Tussock Cottongrass	R	S5	Secure	
Eriophorum vaginatum var. spissum	Tussock Cottongrass	x	S5	Secure	
Scirpus atrocinctus	Black-girdled Bulrush	F	S5	Secure	
Scirpus cyperinus	Common Woolly Bulrush	F	S5	Secure	
Scirpus microcarpus	Small-fruited Bulrush	F	S5	Secure	
Poaceae	**Grasses**				
Agrostis capillaris	Colonial Bent Grass	C	SNA	Exotic	
Agrostis scabra	Rough Bent Grass	x	S5	Secure	
Alopecurus geniculatus	Water Foxtail	R	SNA	Exotic	
Alopecurus pratensis	Meadow Foxtail	R	SNA	Exotic	
Anthoxanthum odoratum	Large Sweet Vernal Grass	C	SNA	Exotic	
Brachyelytrum septentrionale	Northern Shorthusk	F	S5	Secure	
Calamagrostis canadensis	Bluejoint Reed Grass	C	S5	Secure	
Danthonia spicata	Poverty Oat Grass	C	S5	Secure	
Dichanthelium acuminatum	Woolly Panic Grass	R	S5	Secure	
Elymus repens	Quack Grass	R	SNA	Exotic	
Festuca filiformis	Hair Fescue	F	SNA	Exotic	
Festuca heteromalla	Spreading Fescue	R	SNA	Exotic	
Glyceria canadensis	Canada Manna Grass	x	S5	Secure	
Glyceria melicaria	Slender Manna Grass	C	S4	Secure	
Glyceria striata	Fowl Manna Grass	C	S5	Secure	
Hordeum vulgare	Common Barley	R	SNA	Exotic	
Lolium arundinaceum	Tall Fescue	R	SNA	Exotic	
Muhlenbergia uniflora	Bog Muhly	x	S5	Secure	
Phalaris arundinacea	Reed Canary Grass	U	S5	Secure	
Phleum pratense	Common Timothy	L	SNA	Exotic	
Poa compressa	Canada Blue Grass	x	SNA	Exotic	
Poa palustris	Fowl Blue Grass	F	S5	Secure	
Poa pratensis	Kentucky Blue Grass	L	S5	Secure	
Sparganiaceae	**Bur-Reeds**				
Sparganium sp.	bur-reed species	x	[S5]	[Secure]	

Species / Family	Common Name	Site Status	S-rank	GS Rank	ID Comment
Typhaceae	**Cattails**				
Typha latifolia	Broad-leaved Cattail	L	S5	Secure	
Liliaceae	**Lilies**				
Clintonia borealis	Yellow Bluebead Lily	x	S5	Secure	
Maianthemum canadense	Wild Lily-of-The-Valley	C	S5	Secure	
Maianthemum trifolium	Three-leaved False Soloman's Seal	L	S5	Secure	
Medeola virginiana	Indian Cucumber Root	U	S5	Secure	
Streptopus amplexifolius	Clasping-leaved Twisted-stalk	x	S4S5	Secure	
Streptopus lanceolatus	Rose Twisted-stalk	R	S5	Secure	
Trillium cernuum	Nodding Trillium	x	S4	Secure	
Trillium undulatum	Painted Trillium	F	S5	Secure	
Iridaceae	**Irises**				
Iris versicolor	Harlequin Blue Flag	F	S5	Secure	
Sisyrinchium montanum	Mountain Blue-eyed-grass	R	S5	Secure	
Orchidaceae	**Orchids**				
Cypripedium acaule	Pink Lady's-Slipper	F	S5	Secure	
Platanthera psycodes	Small Purple Fringed Orchid	R	S4	Secure	young; ID to sp. probable, not confirmed
Platanthera sp.	orchid species			[native]	

Table 2. Provincially rare and/or legally protected species observed during fieldwork at Amherst Community Wind Farm site, with details and locations. Note that locations of birds are approximate and that relevant occupied habitat extends beyond the given points.

Species	**Common Name**	**S-rank**	**GS Rank**	**Description**	**Latitude (start)**	**Longitude (start)**	**Latitude (end)**	**Longitude (end)**
Chordeiles minor	Common Nighthawk	S3B	At Risk	two adults in breeding or territorial display/interaction; pair displaying widely over clearcuts in general vicinity of Turbine 3	45.830147	-64.148986		
Contopus cooperi	Olive-sided Flycatcher	S3B	At Risk	singing male in suitable breeding habitat; location uncertainty = 50m	45.834840	-64.145570		
Contopus virens	Eastern Wood-Pewee	S3S4B	Sensitive	singing male in suitable breeding habitat; location uncertainty = 75m	45.831060	-64.138400		
Empidonax flaviventris	Yellow-bellied Flycatcher	S3S4B	Sensitive	singing male in suitable breeding habitat	45.835240	-64.146290		
Regulus satrapa	Golden-crowned Kinglet	S4	Sensitive	singing male in suitable breeding habitat	45.837544	-64.146417		
Polygonum arifolium	Halberd-leaved Tearthumb	S2	Sensitive	uncommon in seepy semi-open red maple swamp remnant island in recent clearcut	45.837544	-64.146417	45.837390	-64.146320
Polygonum arifolium	Halberd-leaved Tearthumb	S2	Sensitive	~40 plants in above habitat	45.834870	-64.146894		
Carex wiegandii	Wiegand's Sedge	S3	Sensitive	~35 stems in wet mossy ditch along logging road, at margin of small acidic wetland; site seems to have been altered somewhat by impoundment effect from road	45.840433	-64.151862		

Table 3. List of birds recorded incidentally by Sean Blaney on June 9, 2014 at the Amherst Community Wind Farm site, with breeding evidence recorded following the methods of the Maritimes Breeding Bird Atlas.

Species	**Common Name**	**S-rank**	**GS Rank**	**obACTIV**
Chordeiles minor	Common Nighthawk	S3B	At Risk	two adults in breeding or territorial display/interaction
Contopus cooperi	Olive-sided Flycatcher	S3B	At Risk	singing male in suitable breeding habitat
Contopus virens	Eastern Wood-Pewee	S3S4B	Sensitive	singing male in suitable breeding habitat
Empidonax flaviventris	Yellow-bellied Flycatcher	S3S4B	Sensitive	singing male in suitable breeding habitat
Regulus satrapa	Golden-crowned Kinglet	S4	Sensitive	singing male in suitable breeding habitat
Turdus migratorius	American Robin	S5B	Secure	agitated behaviour
Dendroica magnolia	Magnolia Warbler	S5B	Secure	two adults in breeding or territorial display/interaction
Junco hyemalis	Dark-eyed Junco	S4S5	Secure	flightless or dependent young; very early, well-fledged young
Picoides villosus	Hairy Woodpecker	S5	Secure	adult in suitable breeding habitat
Corvus brachyrhynchos	American Crow	S5	Secure	adult in suitable breeding habitat
Corvus corax	Common Raven	S5	Secure	adult in suitable breeding habitat
Carduelis tristis	American Goldfinch	S5	Secure	adult in suitable breeding habitat
Pandion haliaetus	Osprey	S5B	Secure	adults entering active nest
Cyanocitta cristata	Blue Jay	S5	Secure	pair in suitable breeding habitat
Bombycilla cedrorum	Cedar Waxwing	S5B	Secure	pair in suitable breeding habitat
Zonotrichia albicollis	White-throated Sparrow	S5B	Secure	pair in suitable breeding habitat
Melospiza melodia	Song Sparrow	S5B	Secure	singing male in suitable breeding habitat
Seiurus aurocapilla	Ovenbird	S5B	Secure	singing male in suitable breeding habitat
Empidonax alnorum	Alder Flycatcher	S5B	Secure	singing male in suitable breeding habitat
Sitta canadensis	Red-breasted Nuthatch	S4S5	Secure	singing male in suitable breeding habitat
Catharus ustulatus	Swainson's Thrush	S4S5B	Secure	singing male in suitable breeding habitat
Catharus guttatus	Hermit Thrush	S5B	Secure	singing male in suitable breeding habitat
Vireo solitarius	Blue-headed Vireo	S5B	Secure	singing male in suitable breeding habitat
Vireo olivaceus	Red-eyed Vireo	S5B	Secure	singing male in suitable breeding habitat
Vermivora ruficapilla	Nashville Warbler	S5B	Secure	singing male in suitable breeding habitat
Parula americana	Northern Parula	S5B	Secure	singing male in suitable breeding habitat
Dendroica coronata	Yellow-rumped Warbler	S5B	Secure	singing male in suitable breeding habitat
Dendroica virens	Black-throated Green Warbler	S4S5B	Secure	singing male in suitable breeding habitat
Dendroica fusca	Blackburnian Warbler	S4B	Secure	singing male in suitable breeding habitat
Dendroica palmarum	Palm Warbler	S5B	Secure	singing male in suitable breeding habitat
Mniotilta varia	Black-and-White Warbler	S4S5B	Secure	singing male in suitable breeding habitat
Geothlypis trichas	Common Yellowthroat	S5B	Secure	singing male in suitable breeding habitat
Junco hyemalis	Dark-eyed Junco	S4S5	Secure	singing male in suitable breeding habitat
Carpodacus purpureus	Purple Finch	S4S5	Secure	singing male in suitable breeding habitat

Table 4. Locations, site community descriptions and dominant understory flora of proposed turbine locations at the Amherst Community Wind Farm site. For Turbine 2, location a) is originally proposed site (flooded by beavers); location b) is nearest adjacent upland site.

Turbine #	Latitude	Longitude	Site Description	Dominant Understory Species
01	45.8351674	-64.1447673	Approximately 15 year old black spruce and/or red spruce plantation on clearcut site. Acidic heathy site with slight peat accumumulation in some wetter areas but predominantly upland. Natural regeneration dominated by gray and white Birch.	*Shrub cover 85% (Kalmia angustifolia, Vaccinium angustifolium, Vaccinium myrtilloides, Nemopanthus mucronatus, Viburnum nudum var. cassinoides, Betula populifolia (saplings), Betula papyrifera (saplings). Herb cover – Cornus canadensis, Gaultheria hispidula*
02	a) 45.83135 b)45.830769	a) -64.14336 b) -64.14332	Recent clearcut heavily covered by remaining branches and having very little live plant matter visible	Very little visible during survey.
03	45.49554	-63.11373	Turbine footprint crosses boundary of two community types: To north - Intermediate to mature (50 to 70 years old) seepy red maple and red spruce-dominated mixed forest swamp, with a small stream flowing through. To south – intermediate-aged (about 40-50 years old) red spruce-dominanted upland forest.	To north – diverse understory, dominated by *Osmunda claytoniana, Dryopteris campyloptera, Dryopteris intermedia, Aralia nudicaulis, Maianthemum canadense, Trientalis borealis.* To south – limited shrub & herbaceous understory due to dense spruce canopy. Patchy dominance of *Pleurozium schreberi.*

Table 5. Plant community notes from areas outside of proposed turbine footprints, mostly compiled by David Mazerolle. Locations are mapped in Figure 7.

#	Habitat / Plant Community notes	Latitude (start)	Longitude (start)	Latitude (end)	Longitude (end)
1	Old field	45.841045	-64.157174		
2	Immature mixed woods, *Acer rubrum/Abies balsamea/Picea glauca/Betula papyrifera*, avg dbh ~10cm	45.842591	-64.155323		
3	Forested wetland; Wet coniferous woods with seepage and shallow peat accumulation; *Picea mariana* common; understory dominated by Ericaceous shrubs; some selective cutting and pre-commercial thinning	45.842406	-64.154895	45.842350	-64.154680
4	Out of young shrubby woods and into immature mixed woods; selective cutting	45.841741	-64.153427		
5	Recent clear cutting along rd	45.840367	-64.152219		
6	Open wetland corridor adjacent and parallel to rd	45.840930	-64.150224		
7	Exiting acidic ericaceous shrub-dominated wet/dry mosaic	45.839720	-64.149340		
8	Young regenerating *Picea mariana/Abies balsamea* with dense ericaceous shrub layer	45.839361	-64.148971		
9	Very recent cutting	45.839100	-64.149020		
10	Entering wetland/upland mosaic; *Sphagnum* patches covering only ~25 percent	45.837720	-64.147990		
11	Clear-cut Acer rubrum forested wetland	45.837720	-64.147990		
12	Out of clear cut/ into wet immature mixed *Acer rubrum*-dominated woods	45.836227	-64.147469		
13	Reaching wetland edge but heading back in	45.835210	-64.147970		
14	Back into clear cut	45.835101	-64.147168		
15	Out of very recent clear cut	45.835176	-64.145628		
16	young regenerating *Picea mariana/Acer rubrum/Betula papyrifera* with dense ericaceous shrub layer	45.834970	-64.145200		

#	**Habitat / Plant Community notes**	**Latitude (start)**	**Longitude (start)**	**Latitude (end)**	**Longitude (end)**
17	Heathy wet/dry mosaic	45.834520	-64.144550	45.833720	-64.143070
18	Into wetland	45.833720	-64.143070		
19	Pocket of mature *Acer rubrum/Betula alleghaniensis/Abies balsamea* swamp	45.833362	-64.141503		
20	Picea mariana swamp	45.833222	-64.140778		
21	Out of wetland and into fairly dry clear cut	45.831886	-64.139699		
22	Back into wetland	45.831206	-64.138189		
23	Out of wetland	45.829966	-64.138567		
24	Mature *Picea mariana/Acer rubrum/Abies balsamea*; mainly gentle slope swamp with some areas more likely small shallow basin swamps; >60% Sphagnum cover; avg dbh 20-30 cm	45.827560	-64.144100		
25	Transition to upland	45.827900	-64.147590		
26	Nice mature *Acer saccharum/Acer rubrum/Betula alleghaniensis/Picea* sp. on stream valley slopes; some trees with dbh to 40cm	45.828491	-64.148442		
27	Intermediate to mature *Picea mariana/Acer rubrum/Picea glauca*	45.830381	-64.145905		
28	Forested wetland; Picea *mariana/Acer rubrum* swamp; wet/dry mosaic	45.830381	-64.145905		
29	Small unmarked brook and fairly wide seepage corridor	45.832279	-64.147819		
30	Clear-cut *Acer rubrum/Picea mariana* swamp	45.832730	-64.147830	45.833431	-64.147586
31	Wetland	45.832730	-64.147830	45.835579	-64.148043
32	Transition to upland	45.835579	-64.148043		
33	Into heathy regenerating wet/dry mosaic	45.837440	-64.150640		
34	Out of wetland	45.837800	-64.150760		
35	Wet clear-cut swamp	45.838555	-64.153333		
36	Into heathy wet/dry mosaic	45.839240	-64.152980		

#	Habitat / Plant Community notes	Latitude (start)	Longitude (start)	Latitude (end)	Longitude (end)
37	Transition to upland	45.840234	-64.153833		
38	Very seepy, shallowly sloped mixed forest swamp; mostly followed small, unmarked stream in this zone; upland beyond the end	45.828830	-64.148320	45.832140	-64.150660

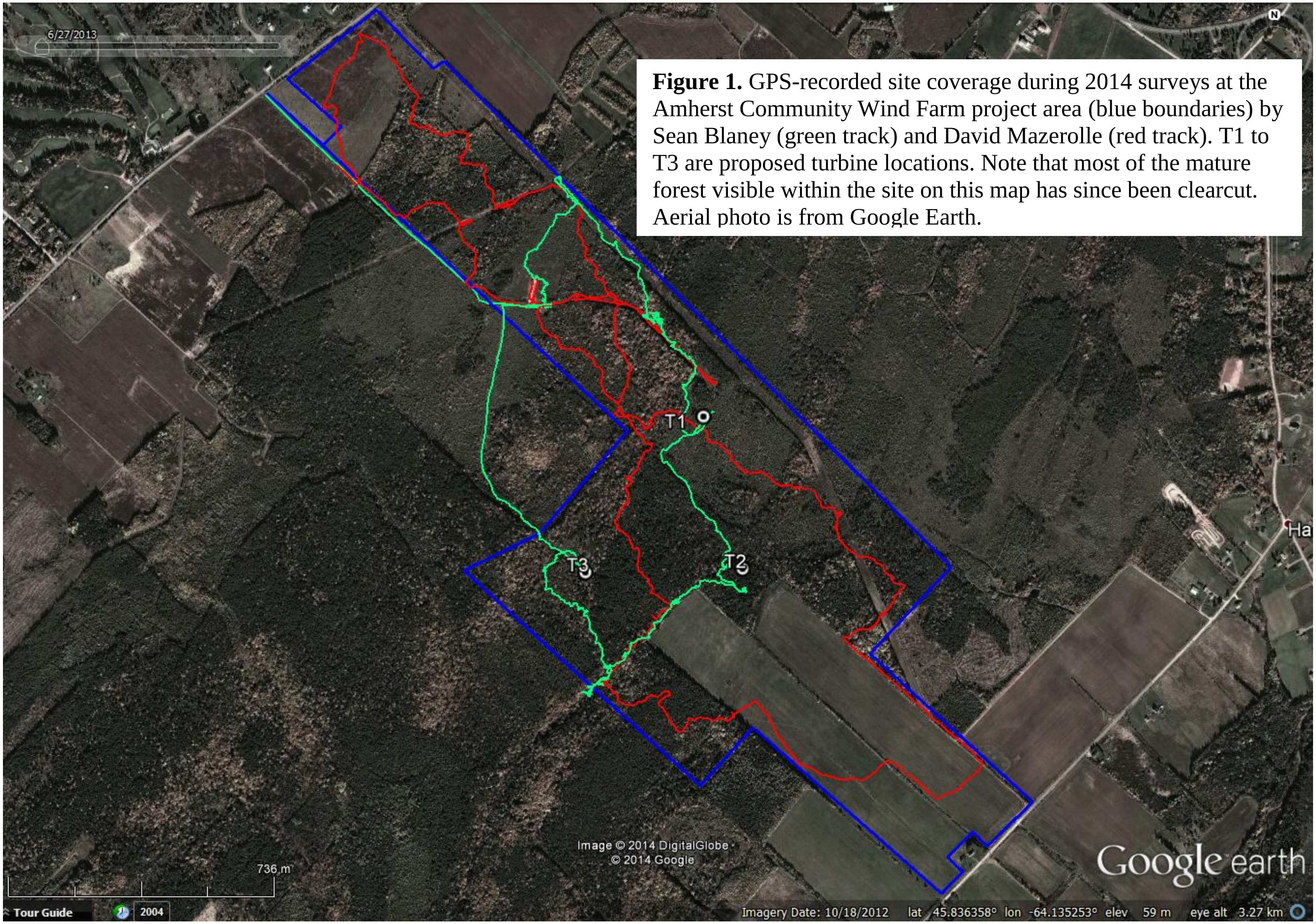


Figure 1. GPS-recorded site coverage during 2014 surveys at the Amherst Community Wind Farm project area (blue boundaries) by Sean Blaney (green track) and David Mazerolle (red track). T1 to T3 are proposed turbine locations. Note that most of the mature forest visible within the site on this map has since been clearcut. Aerial photo is from Google Earth.

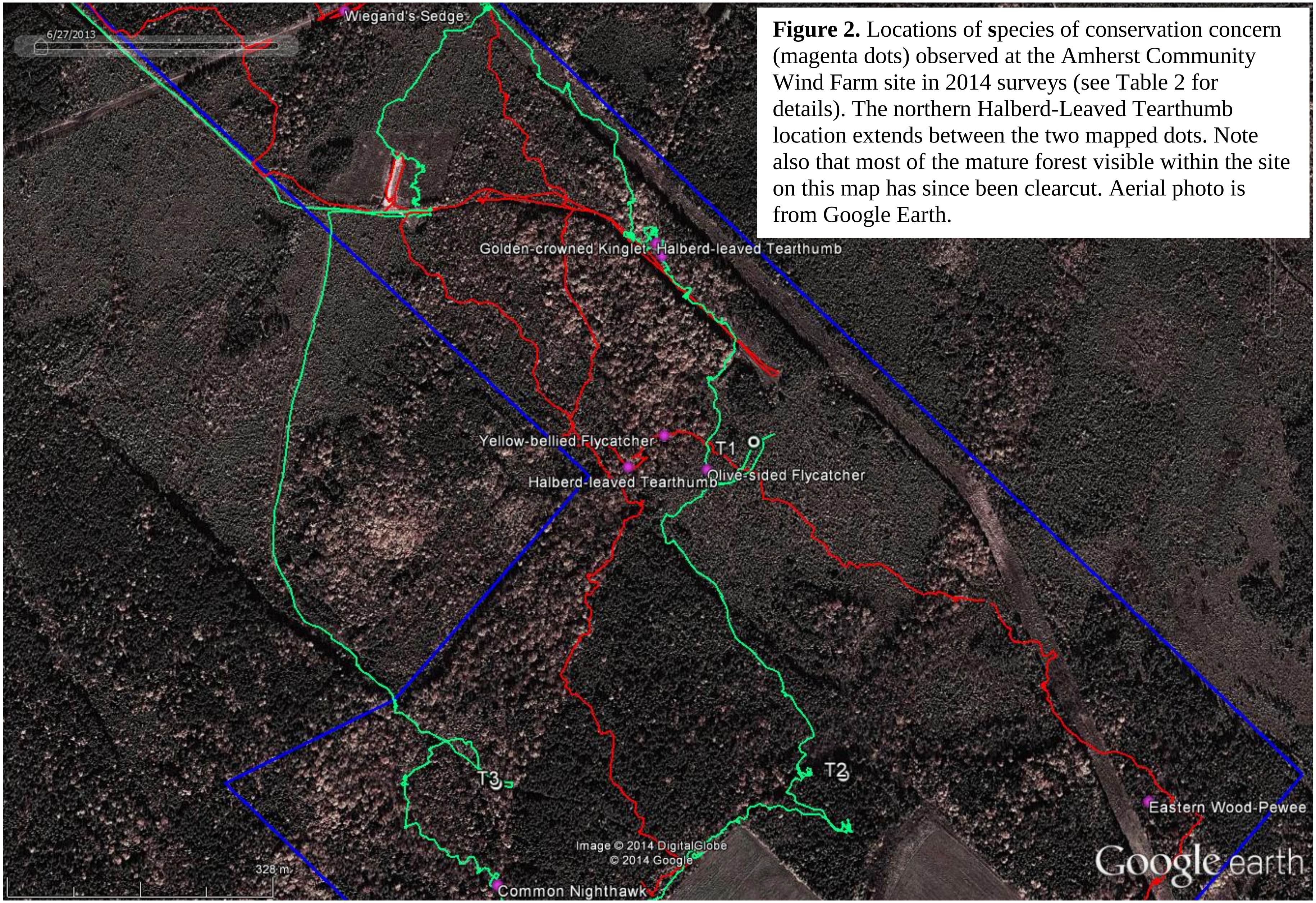


Figure 2. Locations of species of conservation concern (magenta dots) observed at the Amherst Community Wind Farm site in 2014 surveys (see Table 2 for details). The northern Halberd-Leaved Tearthumb location extends between the two mapped dots. Note also that most of the mature forest visible within the site on this map has since been clearcut. Aerial photo is from Google Earth.

Figure 3. Halberd-Leaved Tearthumb (*Polygonum arifolium*, S2 – Sensitive) seedlings at the Amherst Community Wind Farm site. We found two locations in remnant patches of seepy red maple-dominated swamp forest within a large, recent clearcut to the north of the proposed site of Turbine 1.

Figure 4. Proposed turbine site T1, a fairly open, approximately 15 year old Black and/or Red Spruce plantation in a clearcut with some natural regeneration.

Figure 5. Location near proposed turbine site T2, which beavers had flooded. The site photographed above, in a recent clearcut heavily covered by remaining branches and having very little live plant matter visible, was in an adjacent area to the initially proposed turbine site T2.

Figure 6. Proposed turbine site T3, showing intermediate-mature, seepy mixed forest in foreground and younger red spruce – balsam fir upland forest in background. The small stream is flowing across the centre portion of the photograph.

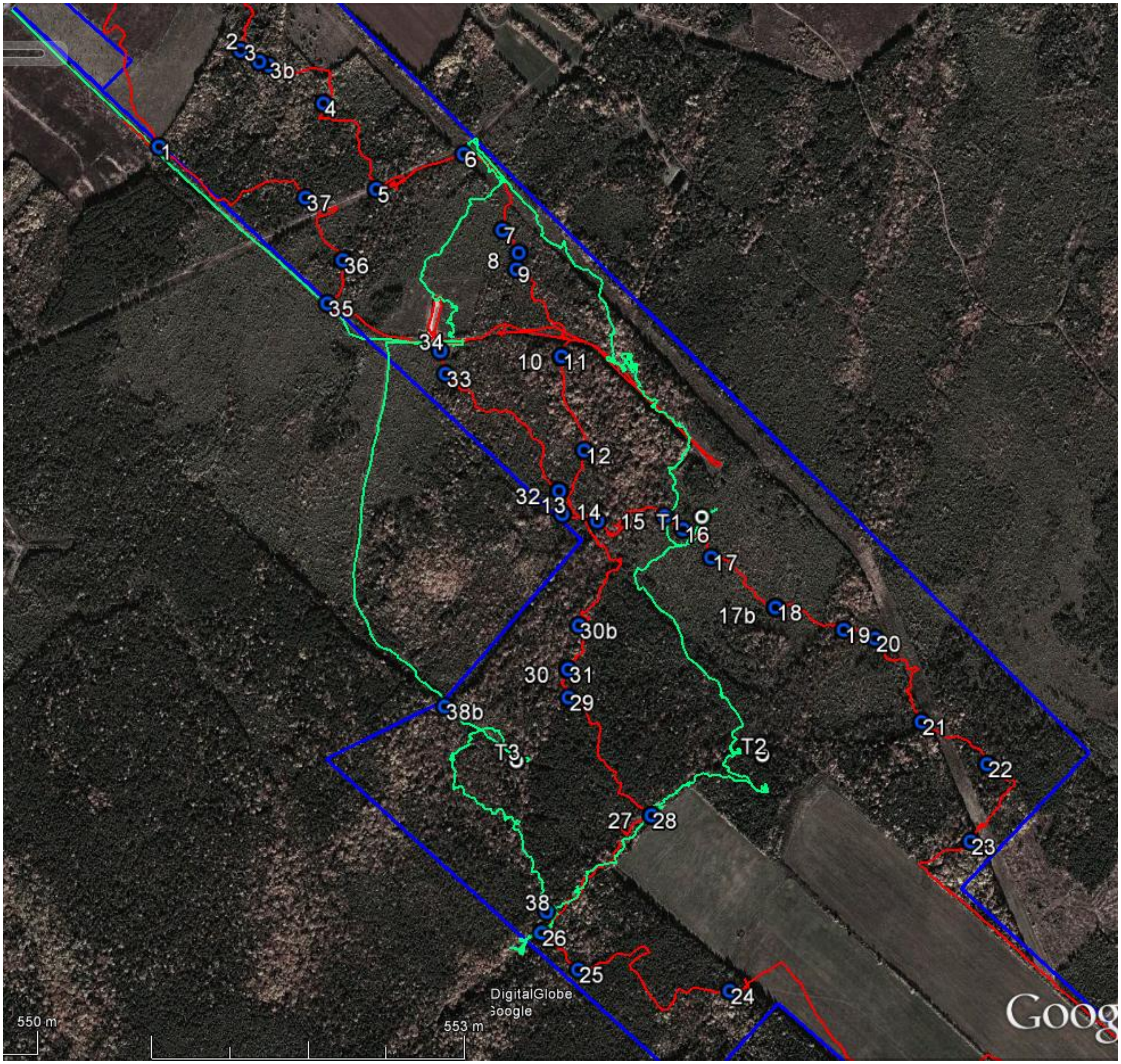


Figure 7. Locations documented in plant community notes for the Amherst Community Wind Farm site, compiled primarily by David Mazerolle and listed in Table 5.

Appendix 1. Definitions of Atlantic Canada Conservation Data Centre (AC CDC) provincial ranks (S-ranks) and Nova Scotia Department of Natural Resources General Status Ranks. Both sets of ranks were developed through the consensus of the Nova Scotia Flora Ranking Committee, cooperatively led by Nova Scotia Department of Natural Resources and AC CDC. The ranks reflect the best understanding of plant status at the time of ranking, but are subject to revision as new information becomes available.

Definitions of provincial (subnational) ranks (S-ranks):

S1	Extremely rare throughout its range in the province (typically 5 or fewer occurrences or very few remaining individuals). May be especially vulnerable to extirpation.
S	Rare throughout its range in the province (usually 6 to 20 occurrences or few remaining individuals). May be vulnerable to extirpation due to rarity or other factors.
S3	Uncommon throughout its range in the province (usually 21 to 100 occurrences), or found only in a restricted range, even if abundant in at some locations.
S	Usually widespread, fairly common throughout its range in the province (usually 100+ occurrences), and apparently secure, but the element is of long-term concern.
S5	Demonstrably widespread, abundant, and secure throughout its range in the province, and essentially ineradicable under present conditions (100+ occurrences).
S#S#	Numeric range rank: A range between two consecutive numeric ranks. Denotes range of uncertainty about the exact rarity of the Element (e.g., S1S2).
SNA	Conservation status not applicable: The taxon is exotic, its occurrence in the jurisdiction is not confirmed, or it is a hybrid without conservation value.
?	Is used as a qualifier indicating uncertainty: for numeric ranks, denotes inexactness, e.g., SE? denotes uncertainty of exotic status. (The ? qualifies the character immediately preceding it in the SRANK).

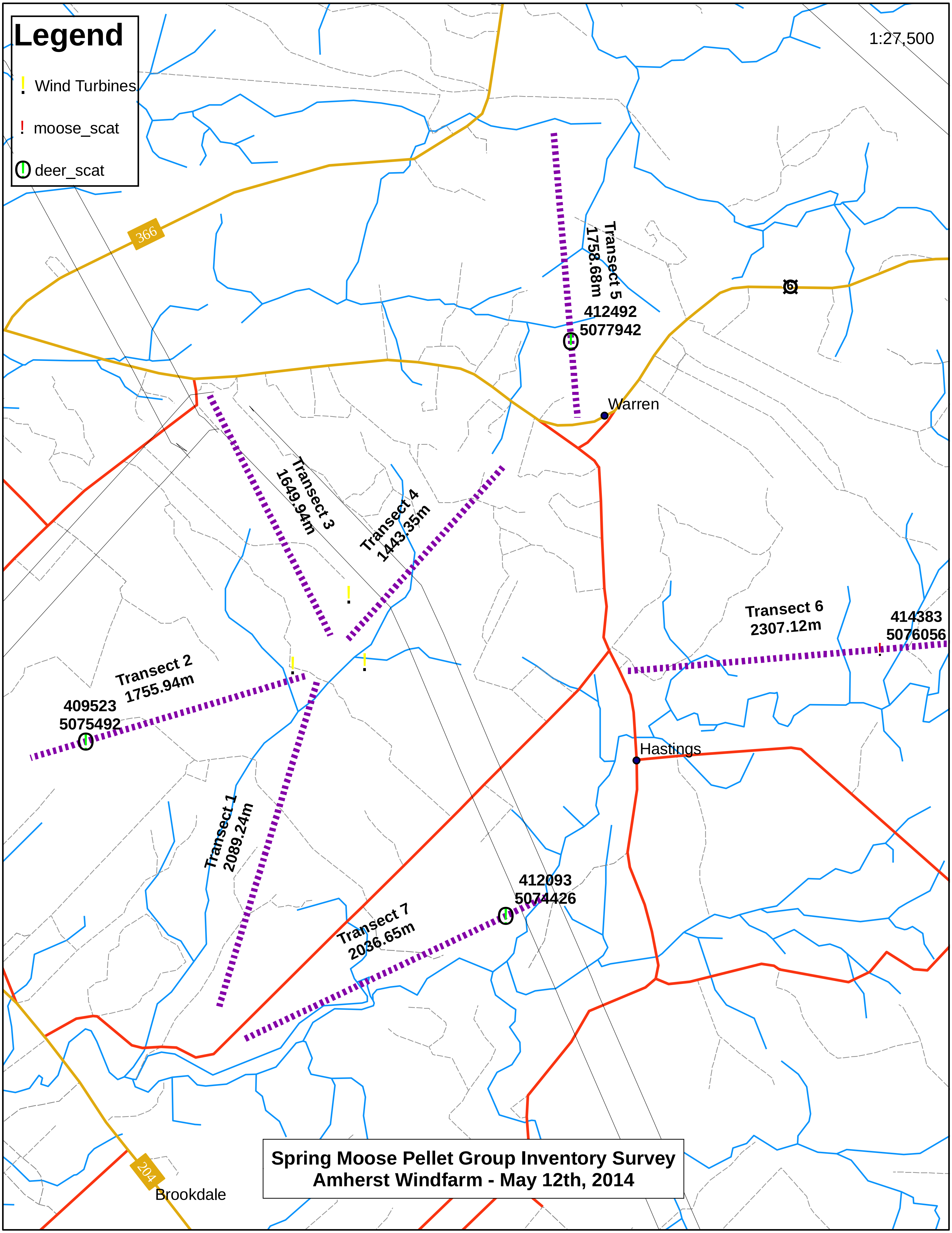
Definitions of National General Status Ranks (from *Wild Species: the General Status Program in Canada, Lisa Twolan and Simon Nadeau, 2004, Canadian Wildlife Service, Ottawa)*

- *Extirpated*: species that have disappeared from (or are no longer present in) a given geographic area but which occur in other areas
- *Extinct:* species that are extirpated worldwide (i.e., they no longer exist anywhere)
- *At Risk*: species for which a formal detailed risk assessment (COSEWIC assessment or provincial or territorial equivalent) has been completed, and which have been determined to be at risk of extirpation or extinction (i.e., Endangered) or are likely to become at risk of extirpation or extinction if limiting factors are not reversed (i.e., Threatened)
- *May Be At Risk*: species that may be at risk of extirpation or extinction and are, therefore, candidates for a detailed risk assessment by COSEWIC or the provincial or territorial equivalent
- *Sensitive*: species that are believed to not be at risk of extirpation or extinction but which may require special attention or protection to prevent them from becoming at risk
- *Secure*: species that are believed to not belong in the categories At Risk, May Be At Risk, Extirpated, Extinct, Accidental, or Exotic. This category includes some species that show a declining trend in numbers in Canada but which remain relatively widespread or abundant.
- *Undetermined*: species for which insufficient data, information, or knowledge is available with which to reliably evaluate their general status
- *Not Assessed*: species that are known or believed to be present in the geographic area in Canada to which the general status rank applies but which have not yet been assessed

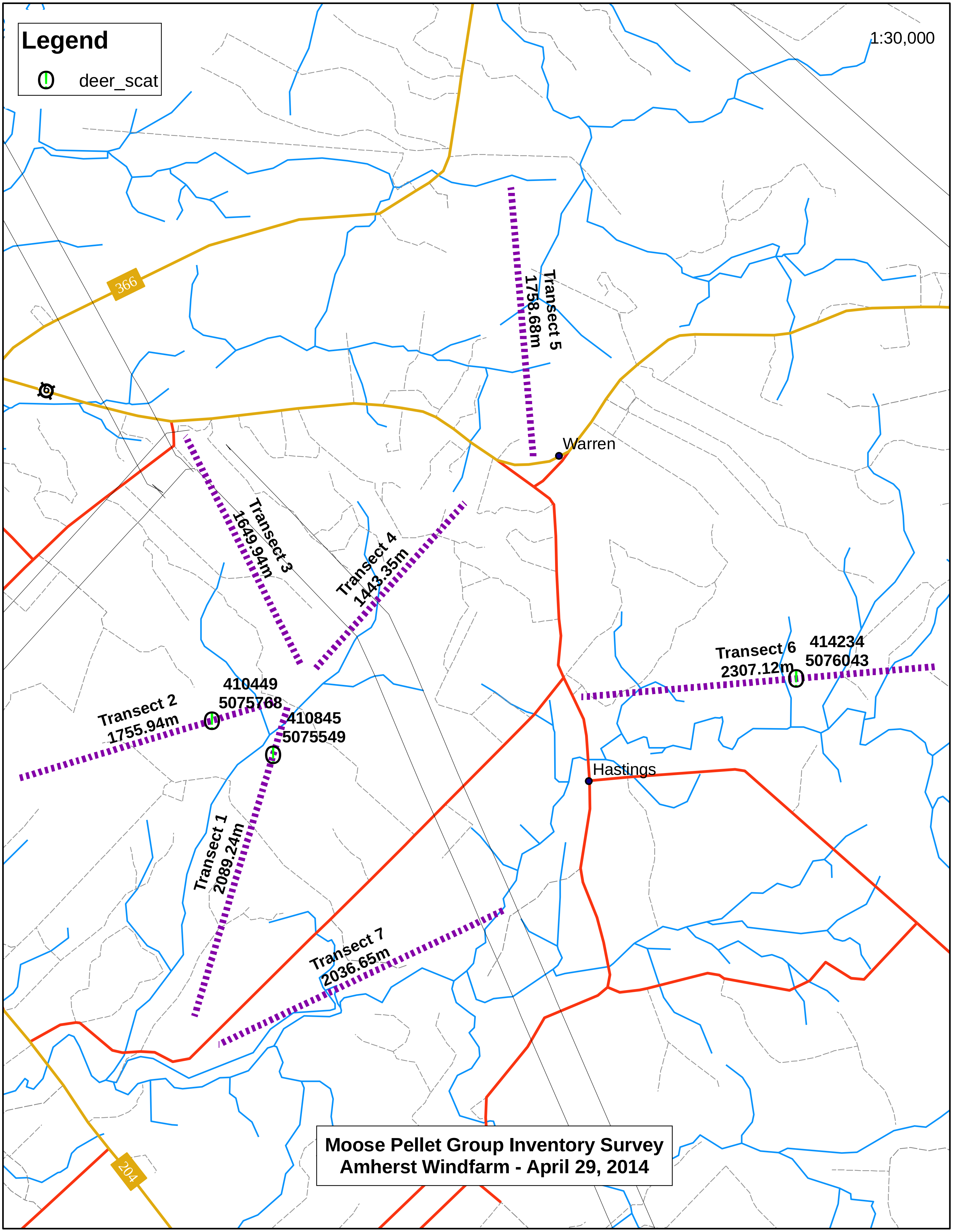
- *Exotic*: species that have been moved beyond their natural range as a result of human activity. In the *Wild Species 2005* report, exotic species have been purposefully excluded from all other categories.
- *Accidental*: species occurring infrequently and unpredictably outside their usual range

Appendix H:

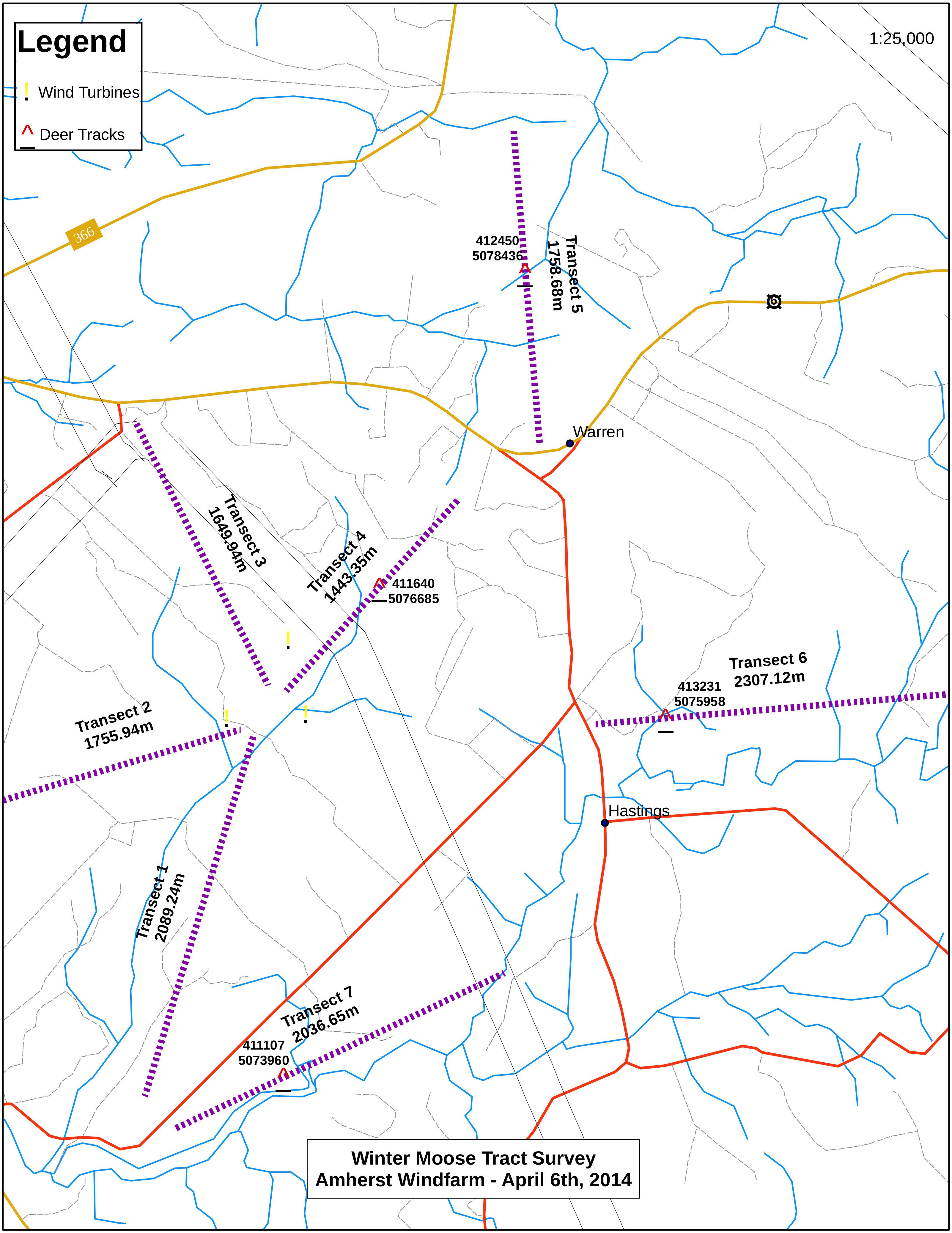
Moose Track and Pellet Group Inventory Surveys



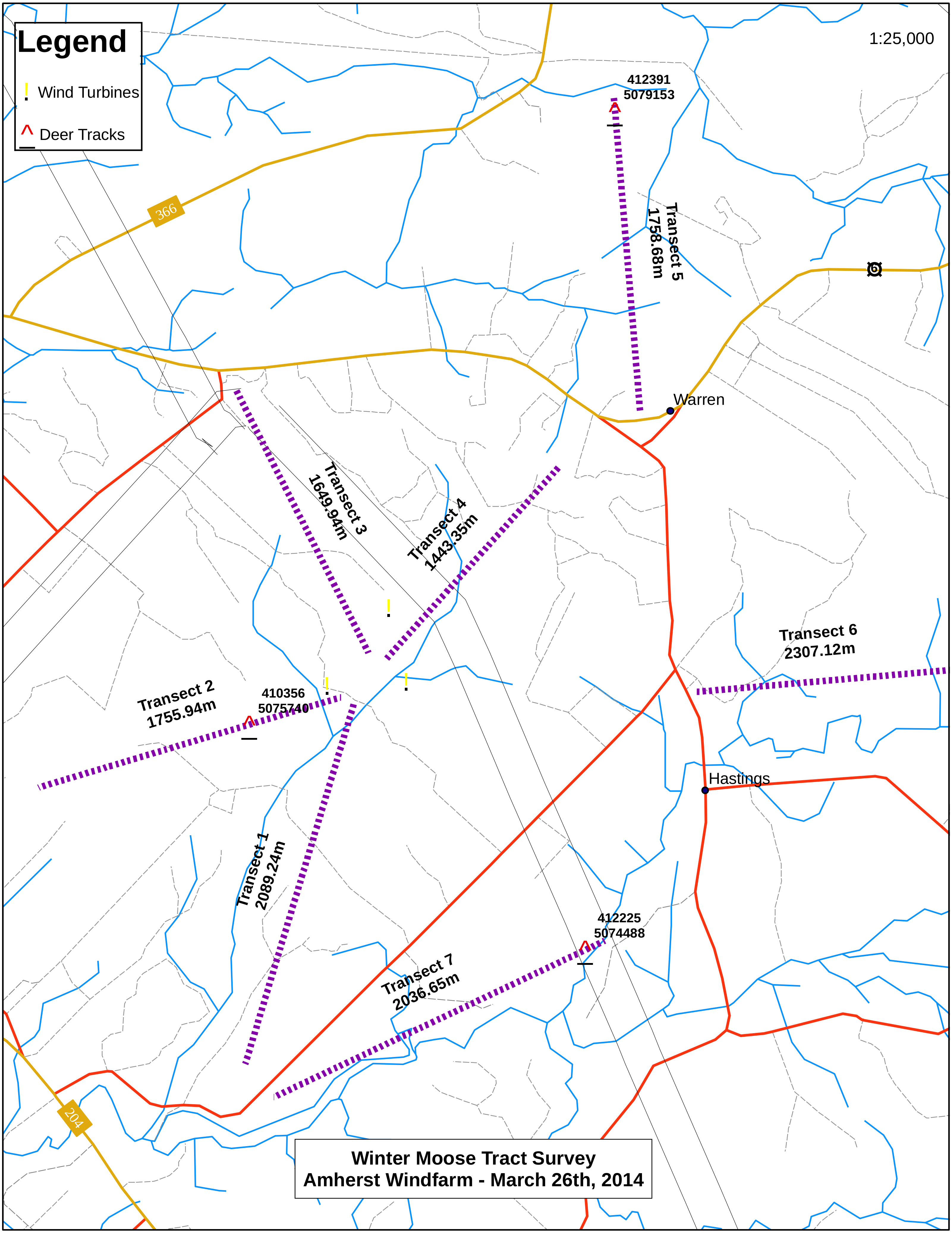
Spring Moose Pellet Group Inventory Survey
Amherst Windfarm - May 12th, 2014



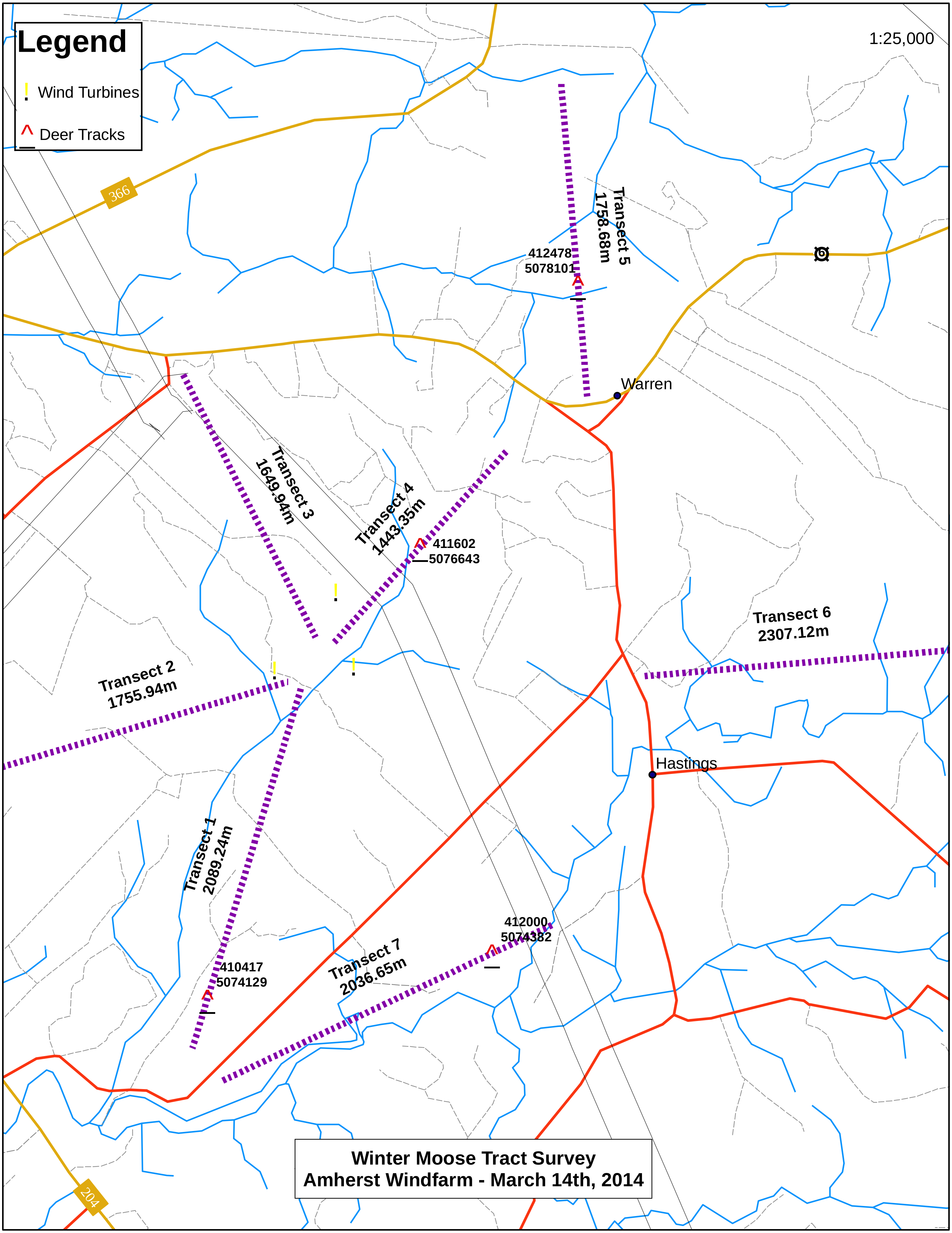
Moose Pellet Group Inventory Survey
Amherst Windfarm - April 29, 2014



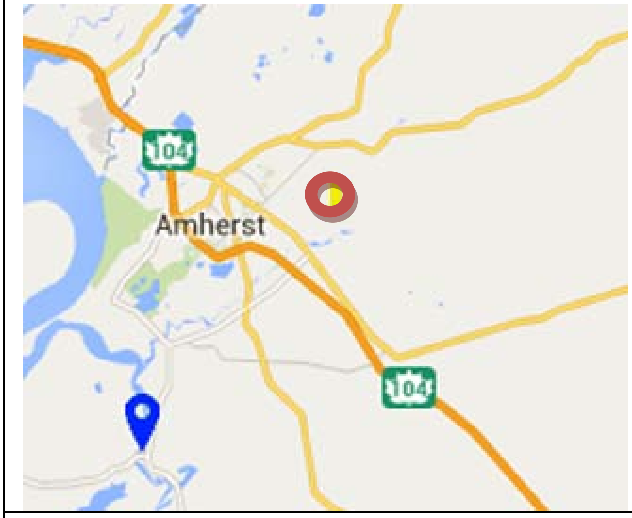
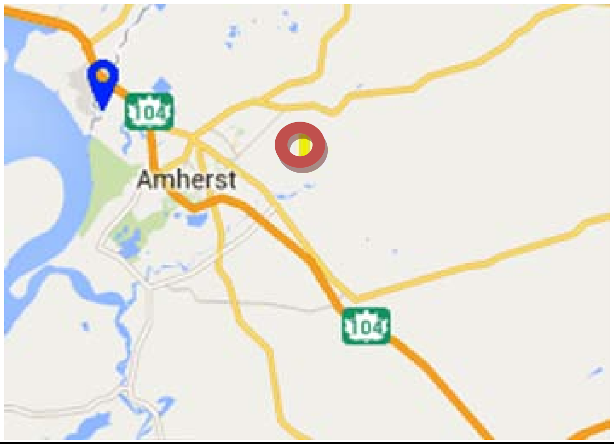
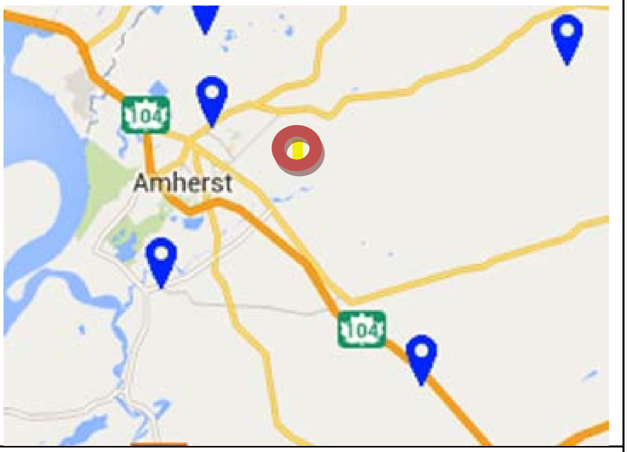
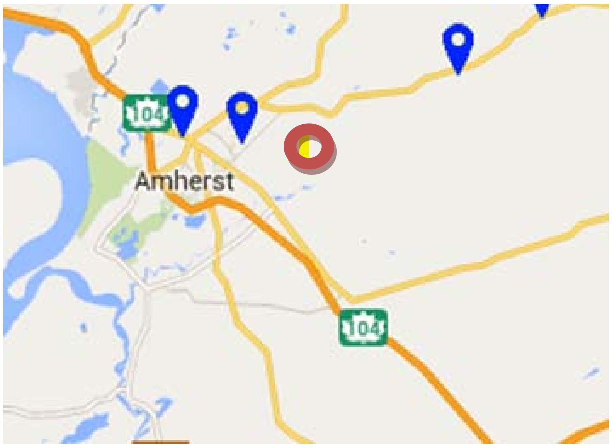
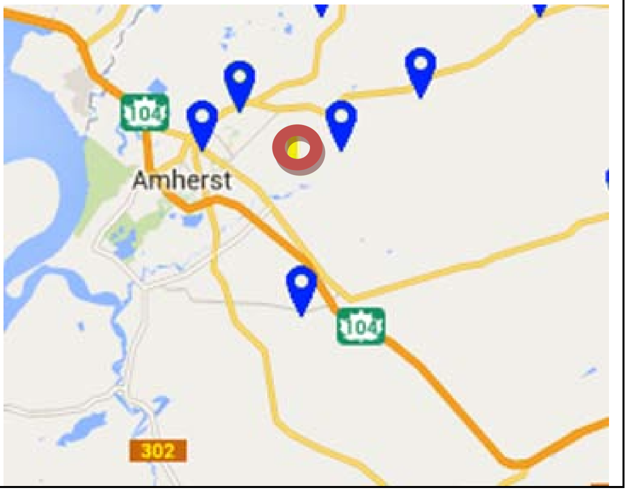
Winter Moose Tract Survey
Amherst Windfarm - April 6th, 2014



Winter Moose Tract Survey
Amherst Windfarm - March 26th, 2014



Winter Moose Tract Survey
Amherst Windfarm - March 14th, 2014

Reported moose sightings to DNR by year.	
2009 	**2010** 
2011 	**2012** 
2013 	**2014** 

Appendix I:

Noise Impact Assessment

Amherst Community Wind Farm
Noise Impact Assessment Report
December 2014

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Report Information

Client	Natural Forces Wind Inc.
Client Contact	Chris Veinot
Report Name	Amherst Community Wind Farm Noise Impact Assessment
Created By	Chris Veinot
Signature	

** The WindPRO v2.9, Decibel Module Calculation Results for Enercon E-92 2.3 MW @ 98m Hub Height. To review General Specification for the Enercon E-92 2.3 MW please contact:

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1. Introduction

Natural Forces Wind Inc. has undertaken a noise impact assessment for the proposed Amherst Community Wind Farm site to assess the impact of the wind farm's sound emissions on the surrounding points of immission. Details outlining the project, noise receptors, prediction methodology and assumptions made for the assessment are included in this report and the WindPRO results for the turbine supplied in located in the annexes. The Land Use By-law for Municipality of Cumberland County does not state any restrictions pertaining to sound pressure levels relating to wind turbines activities. Therefore, the Ontario *Noise Guidelines for Wind Farms* will be used during this assessment as a guideline regarding acceptable noise emission from the proposed Amherst Wind Farm.

The noise analysis was conducted using the ISO 9613-2: Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation model within the Decibel module of the software package, WindPRO version 2.9.

2. General Description of Project Site and Surrounds

The proposed Amherst Community Wind Farm consists of a maximum of 3 wind turbine generators (WTG) located in the Municipality of Cumberland County, Nova Scotia. Currently, Enercon E-92 2.0 MW wind turbines are being considered for the project and therefore were used to calculate predicted sound pressure levels, however if the turbine type was to change, a new noise assessment would be conducted. The project site is situated approximately 5 kilometers east of Amherst between Pumping Station Road and John Black Road. A map of the site is included in Annex A.

The predominant noise sources in the area are from road traffic along Pumping Station Road and John Black Road. Farming activities during the summer months may also contribute to local noise.

3. Noise Guidelines for Wind Farm

3.1. Provincial and Municipal Noise Guidelines

As previously mentioned, the Municipality of Cumberland County does not include any restrictions concerning acceptable sound pressure levels being emitted from wind turbines.

The province of Nova Scotia does not have any guidelines or written restrictions for acceptable sound pressure levels, but adheres to the guidelines outlined in Ontario's *Noise Guidelines for Wind Farms*.

3.2. Ontario Provincial Noise Guidelines

For the proposed Amherst Community Wind Farm, the Ontario *Noise Guidelines for Wind Farms* was used as a general guideline. The guidelines describe receptors in rural environments as Class 3. The sound level limits established for this class of receptors is demonstrated in Table 1 for wind turbines at different wind speeds.

Table 1 - Summary of sound level limits for wind turbines (Ministry of the Environment, 2008).

Wind Speed (m/s) at 10 m height	4	5	6	7	8	9	10
Wind Turbine Sound Level Limits Class 3 Area, dB(A)	40.0	40.0	40.0	43.0	45.0	49.0	51.0

To ensure a conservative assessment of the sound level limits emitted by the proposed Amherst Community Wind Farm, a general limit of 40 dB(A) was used for wind speeds ranging between and including 4 and 12 m/s.

The noise assessment used the height above grade at the centre of the receptors of 4.5 m as proposed by the guideline for single and two story dwellings.

4. Description of Receptors

The Ontario guidelines requires the noise assessment to consider all receptors within a 2,000 meter radius of the WTGs, for the purpose of this report a conservative radius of 2,500 meters has been used. The 314 points of reception taken into consideration for this noise impact assessment are residential buildings and/or seasonal camps located within 2,500 metres (m) of the nearest proposed WTG. The receptors are located at dwellings along Pumping Station Road, John Black Road, D'Orsay Road, Fox Ranch Road, Hastings Road and other areas within 2,500 meters from the WTGs.

Details of receptor locations and distances to nearest WTG are detailed in Table 2. The receptor IDs included in Table 2 corresponds with the WindPRO generated map included in Annex B.

Table 2 - Description of receptors.

Point of Reception ID	Location (UTM Zone 20, NAD 83)		Distance from receptor to: (meters)		
	Easting	Northing	Wind Turbine 1	Wind Turbine 2	Wind Turbine 3
A	410687	5077694	1472	1924	1636
B	412917	5075407	2000	1816	2259
C	412770	5077450	2016	2293	2449
D	411637	5077534	1348	1775	1719
E	412772	5077381	1979	2246	2412
F	412548	5077384	1799	2093	2230
G	411522	5074857	1486	1039	1426
H	410752	5077687	1447	1902	1628
I	410886	5077728	1459	1919	1674
J	409985	5078587	2565	2996	2642
K	411218	5077847	1562	2021	1847
L	412545	5077331	1764	2051	2197
M	412672	5076299	1550	1593	1933
N	411712	5077716	1545	1971	1914
O	408873	5077294	2464	2709	2250
P	408859	5074597	2825	2600	2393
Q	412869	5077709	2252	2549	2682
R	412802	5075612	1811	1666	2096
S	412515	5077219	1675	1950	2109
T	410620	5077696	1495	1943	1642
U	412931	5075350	2038	1844	2290
V	409450	5077924	2339	2700	2276
W	411964	5077748	1685	2086	2078
X	411426	5077867	1608	2059	1929
Y	410833	5077687	1429	1887	1630
Z	411651	5077709	1516	1948	1878

Point of Reception ID	Location (UTM Zone 20, NAD 83)		Distance from receptor to: (meters)		
	Easting	Northing	Wind Turbine 1	Wind Turbine 2	Wind Turbine 3
AA	412356	5075531	1448	1242	1687
AB	410362	5077647	1557	1983	1636
AC	413531	5075487	2539	2405	2835
AD	409342	5076720	1832	2017	1559
AE	412583	5075822	1534	1433	1844
AF	411398	5077908	1643	2096	1958
AG	412629	5077251	1788	2053	2222
AH	408937	5076375	2187	2280	1844
AI	411274	5077854	1573	2031	1869
AJ	408809	5077359	2549	2798	2339
AK	411218	5077771	1486	1945	1774
AL	409789	5073827	2799	2419	2432
AM	411056	5077731	1445	1906	1699
AN	409952	5077647	1793	2179	1779
AO	411435	5077793	1537	1987	1863
AP	412657	5076391	1538	1609	1932
AQ	411822	5074852	1598	1184	1612
AR	411931	5077767	1686	2091	2074
AS	412980	5077625	2289	2566	2722
AT	412722	5076231	1601	1623	1975
AU	411337	5077903	1629	2084	1934
AV	409973	5077612	1753	2138	1738
AW	412848	5075349	1965	1764	2211
AX	410575	5077689	1504	1949	1640
AY	412716	5075955	1628	1571	1965
AZ	410809	5077676	1423	1880	1618
BA	409819	5077307	1654	1991	1559
BB	412854	5075234	2028	1804	2256
BC	410573	5078822	2593	3050	2769
BD	411281	5077776	1496	1953	1796
BE	411755	5074975	1458	1045	1475
BF	409573	5077673	2078	2428	2000
BG	412840	5075082	2099	1847	2303
BH	411385	5077782	1517	1969	1835
BI	412181	5075412	1374	1111	1567
BJ	409564	5077151	1781	2066	1615
BK	409521	5077076	1784	2053	1598
BL	411829	5075161	1330	951	1401

Point of Reception ID	Location (UTM Zone 20, NAD 83)		Distance from receptor to: (meters)		
	Easting	Northing	Wind Turbine 1	Wind Turbine 2	Wind Turbine 3
BM	409821	5077822	2011	2397	1995
BN	412926	5075138	2139	1905	2359
BO	411328	5077855	1581	2036	1886
BP	412716	5077559	2039	2335	2470
BQ	409280	5073978	2954	2630	2550
BR	412052	5077442	1482	1850	1897
BS	411061	5077829	1542	2004	1796
BT	412655	5076219	1535	1555	1908
BU	409819	5073832	2780	2398	2415
BV	413605	5075505	2604	2476	2904
BW	412682	5077344	1884	2156	2317
BX	410520	5078801	2584	3040	2752
BY	410203	5073611	2830	2410	2509
BZ	409689	5077214	1706	2015	1571
CA	412647	5076460	1535	1625	1935
CB	410561	5077786	1600	2046	1738
CC	410282	5077768	1702	2126	1773
CD	410532	5077683	1515	1956	1639
CE	412639	5077501	1942	2240	2373
CF	408957	5076550	2181	2309	1863
CG	410871	5077619	1354	1814	1564
CH	409864	5077809	1974	2363	1963
CI	410056	5078619	2563	2999	2653
CJ	411620	5074792	1577	1137	1535
CK	410139	5073616	2847	2431	2519
CL	413559	5075468	2571	2436	2867
CM	412846	5075215	2031	1803	2256
CN	409496	5077941	2319	2684	2264
CO	413083	5075431	2140	1973	2412
CP	412040	5077678	1666	2054	2068
CQ	410988	5077728	1446	1908	1685
CR	409723	5077872	2113	2494	2086
CS	410429	5077688	1562	1996	1661
CT	410008	5077764	1849	2249	1861
CU	410131	5078630	2543	2983	2645
CV	411555	5077917	1686	2129	2023
CW	409514	5077056	1782	2046	1591
CX	412671	5076075	1564	1541	1917

Point of Reception ID	Location (UTM Zone 20, NAD 83)		Distance from receptor to: (meters)		
	Easting	Northing	Wind Turbine 1	Wind Turbine 2	Wind Turbine 3
CY	411191	5077777	1491	1950	1773
CZ	413150	5077878	2577	2865	3008
DA	411129	5077856	1568	2029	1836
DB	409209	5076469	1922	2044	1598
DC	412591	5077280	1773	2046	2206
DD	412888	5077758	2298	2598	2728
DE	410214	5077780	1747	2166	1804
DF	410075	5073646	2842	2432	2507
DG	409777	5077617	1891	2256	1839
DH	412653	5076088	1544	1525	1899
DI	411499	5077845	1602	2048	1935
DJ	412983	5078023	2544	2861	2971
DK	409292	5076881	1924	2136	1677
DL	410501	5077760	1598	2039	1720
DM	409648	5073801	2891	2522	2514
DN	412013	5077394	1420	1789	1835
DO	412938	5075690	1912	1793	2215
DP	412810	5077685	2191	2492	2621
DQ	410251	5077632	1602	2017	1652
DR	410048	5077769	1829	2233	1850
DS	412838	5075164	2051	1814	2268
DT	412752	5075742	1719	1604	2023
DU	412809	5075941	1722	1663	2058
DV	412727	5075907	1650	1579	1979
DW	412556	5075942	1475	1411	1806
DX	412602	5075989	1510	1461	1849
DY	412665	5076029	1565	1528	1911
DZ	411436	5074795	1526	1071	1436
EA	411323	5074711	1590	1129	1463
EB	411343	5074557	1745	1285	1613
EC	411223	5074585	1706	1244	1547
ED	411200	5074416	1874	1412	1702
EE	411046	5074410	1880	1421	1675
EF	410991	5074359	1933	1477	1716
EG	410962	5074302	1992	1537	1769
EH	410847	5074207	2099	1648	1854
EI	410735	5074078	2244	1798	1981
EJ	410669	5074028	2305	1862	2033

Point of Reception ID	Location (UTM Zone 20, NAD 83)		Distance from receptor to: (meters)		
	Easting	Northing	Wind Turbine 1	Wind Turbine 2	Wind Turbine 3
EK	410614	5073961	2382	1941	2103
EL	410502	5073855	2511	2076	2218
EM	410440	5073776	2603	2170	2304
EN	410381	5073715	2678	2248	2374
EO	410338	5073669	2734	2306	2426
EP	410299	5073643	2770	2344	2458
EQ	410268	5073611	2810	2385	2496
ER	410183	5073596	2851	2432	2528
ES	410112	5073628	2845	2432	2514
ET	409024	5074298	2892	2619	2469
EU	408806	5076791	2370	2535	2081
EV	408762	5076595	2380	2508	2063
EW	408811	5076539	2325	2445	2001
EX	408876	5076594	2267	2400	1953
EY	408902	5076567	2237	2367	1920
EZ	408851	5076499	2281	2395	1953
FA	408876	5076468	2253	2363	1922
FB	408823	5076389	2301	2394	1959
FC	409006	5076580	2136	2272	1824
FD	409036	5076615	2111	2256	1806
FE	408848	5077333	2503	2751	2293
FF	408816	5077274	2508	2746	2287
FG	408790	5077254	2524	2758	2299
FH	408765	5077234	2540	2769	2310
FI	408854	5077222	2453	2687	2228
FJ	408834	5077189	2459	2687	2228
FK	408784	5077149	2491	2710	2251
FL	408889	5077170	2401	2630	2171
FM	408899	5077029	2343	2552	2093
FN	408906	5077257	2419	2661	2202
FO	408933	5077225	2381	2621	2162
FP	408968	5077195	2337	2575	2117
FQ	408987	5077171	2310	2546	2088
FR	408982	5077077	2281	2503	2044
FS	408965	5077052	2288	2505	2046
FT	409085	5077090	2189	2421	1962
FU	409119	5077060	2147	2376	1917
FV	409165	5076994	2080	2303	1844

Point of Reception ID	Location (UTM Zone 20, NAD 83)		Distance from receptor to: (meters)		
	Easting	Northing	Wind Turbine 1	Wind Turbine 2	Wind Turbine 3
FW	409080	5076943	2144	2352	1893
FX	409096	5076843	2101	2292	1834
FY	409023	5076890	2184	2378	1920
FZ	409149	5076893	2064	2267	1809
GA	409213	5076950	2021	2239	1780
GB	409262	5076909	1961	2176	1717
GC	409201	5076822	1994	2188	1730
GD	409617	5077923	2222	2597	2183
GE	409763	5077549	1854	2211	1789
GF	409784	5077492	1800	2154	1730
GG	409801	5077452	1761	2112	1688
GH	409838	5077414	1708	2059	1636
GI	409894	5077483	1713	2078	1664
GJ	409861	5077504	1752	2115	1699
GK	409887	5077667	1851	2232	1827
GL	409938	5077562	1739	2116	1710
GM	410012	5077627	1739	2130	1735
GN	409988	5077526	1679	2058	1655
GO	410074	5077535	1629	2019	1625
GP	409927	5077710	1857	2245	1847
GQ	410091	5077651	1709	2109	1725
GR	410175	5077737	1731	2144	1775
GS	410244	5077747	1703	2123	1763
GT	410304	5077752	1677	2103	1752
GU	410219	5077668	1649	2063	1696
GV	410242	5077624	1600	2013	1647
GW	411329	5077781	1507	1962	1815
GX	411616	5077845	1634	2071	1983
GY	411648	5077836	1635	2070	1989
GZ	412916	5077837	2370	2676	2799
HA	412949	5077888	2429	2736	2857
HB	412979	5077927	2477	2785	2905
HC	412665	5077213	1799	2053	2232
HD	412710	5077128	1796	2031	2229
HE	412732	5077070	1790	2012	2221
HF	412619	5076996	1656	1877	2087
HG	412763	5076976	1779	1980	2208
HH	412634	5076917	1638	1841	2067

Point of Reception ID	Location (UTM Zone 20, NAD 83)		Distance from receptor to: (meters)		
	Easting	Northing	Wind Turbine 1	Wind Turbine 2	Wind Turbine 3
HI	412751	5076885	1735	1919	2161
HJ	412621	5076849	1601	1791	2027
HK	412751	5076815	1712	1881	2135
HL	412612	5076785	1571	1748	1995
HM	412607	5076709	1543	1703	1964
HN	412606	5076659	1530	1677	1947
HO	412613	5076560	1516	1636	1925
HP	412961	5074234	2757	2412	2864
HQ	412627	5076481	1517	1615	1920
HR	412861	5073989	2883	2511	2954
HS	413071	5074350	2749	2423	2879
HT	412749	5076324	1627	1674	2013
HU	413229	5075453	2266	2112	2548
HV	409888	5077361	1635	1986	1564
HW	413009	5074477	2615	2297	2755
HX	410404	5077677	1564	1995	1655
HY	410466	5077689	1547	1984	1655
HZ	408680	5076222	2443	2501	2080
IA	408648	5076184	2476	2527	2110
IB	408619	5076158	2506	2553	2137
IC	408593	5076117	2535	2573	2162
ID	408550	5076083	2580	2613	2204
IE	408425	5075931	2721	2727	2333
IF	408403	5075924	2743	2749	2355
IG	408566	5075990	2573	2589	2189
IH	408572	5075967	2570	2582	2184
II	408553	5075947	2592	2600	2204
IJ	408424	5075815	2739	2726	2343
IK	408401	5075793	2766	2749	2368
IL	408389	5075769	2782	2762	2383
IM	408453	5075840	2706	2697	2311
IN	408437	5075832	2723	2713	2328
IO	408864	5076443	2263	2368	1929
IP	408708	5076635	2439	2572	2126
IQ	408926	5076353	2197	2285	1851
IR	408670	5076609	2473	2600	2155
IS	408683	5076628	2463	2594	2148
IT	408617	5076701	2539	2680	2231

Point of Reception ID	Location (UTM Zone 20, NAD 83)		Distance from receptor to: (meters)		
	Easting	Northing	Wind Turbine 1	Wind Turbine 2	Wind Turbine 3
IU	408572	5076771	2595	2745	2295
IV	408540	5076735	2620	2763	2315
IW	408677	5076803	2499	2659	2206
IX	408645	5076834	2536	2700	2247
IY	408583	5076908	2614	2785	2331
IZ	408971	5076639	2179	2325	1875
JA	409016	5076651	2137	2288	1836
JB	408928	5076992	2304	2509	2051
JC	410435	5078635	2445	2898	2596
JD	411332	5078365	2088	2545	2377
JE	411342	5078397	2120	2577	2411
JF	413544	5075493	2549	2417	2847
JG	413205	5075446	2247	2090	2527
JH	410460	5073823	2552	2119	2255
JI	410234	5073606	2825	2403	2508
JJ	410171	5073620	2832	2414	2508
JK	410079	5073674	2814	2405	2479
JL	409784	5073681	2930	2544	2568
JM	409799	5073696	2910	2523	2549
JN	409810	5073852	2767	2387	2400
JO	409707	5073761	2896	2520	2525
JP	409624	5073854	2858	2494	2478
JQ	409638	5073866	2840	2476	2461
JR	409477	5073946	2862	2517	2469
JS	409397	5073956	2901	2564	2503
JT	409033	5074316	2873	2601	2449
JU	409241	5076446	1888	2007	1562
JV	410583	5077810	1615	2062	1759
JW	410806	5077700	1447	1904	1642
JX	410799	5077727	1475	1932	1669
JY	410836	5077708	1448	1907	1651
JZ	411084	5077830	1542	2004	1801
KA	411343	5077856	1584	2038	1891
KB	411351	5077763	1493	1946	1806
KC	411559	5077890	1661	2103	2000
KD	411573	5077865	1640	2081	1983
KE	411583	5077836	1615	2055	1961
KF	411645	5077877	1673	2109	2025

Point of Reception ID	Location (UTM Zone 20, NAD 83)		Distance from receptor to: (meters)		
	Easting	Northing	Wind Turbine 1	Wind Turbine 2	Wind Turbine 3
KG	411628	5077731	1529	1963	1887
KH	411682	5077731	1548	1977	1912
KI	412061	5077716	1709	2097	2110
KJ	412836	5077338	2010	2264	2444
KK	412749	5076218	1628	1646	2001
KL	412462	5075862	1406	1312	1719
KM	412490	5075869	1431	1341	1746
KN	412775	5075725	1746	1628	2048
KO	412808	5075957	1718	1663	2057
KP	412854	5075174	2059	1825	2279
KQ	412847	5075131	2077	1834	2290
KR	412833	5075144	2058	1816	2271
KS	411782	5074810	1619	1197	1618
KT	412319	5075502	1432	1213	1661
KU	411597	5074808	1554	1113	1509
KV	411500	5074910	1429	982	1370
KW	411473	5074877	1454	1003	1383
KX	411438	5074808	1513	1059	1426
KY	411474	5074807	1522	1070	1444
KZ	410737	5074093	2229	1783	1966
LA	412703	5075931	1621	1556	1953
LB	411232	5074559	1733	1271	1574

5. Description of Sources

5.1. Turbine Locations

A map of the project area with the proposed WTG layout is illustrated in Annex A. The existing Amherst Wind Farm, located on the Tantramar Marsh is approximately 7.5 kilometers North West of the proposed Amherst Community Windy Farm. There are no existing or proposed wind farms within 5 kilometers of the project; therefore it is unlikely any cumulative noise effects will occur. At the request of Nova Scotia Environment, Natural Forces may undertake post construction noise monitoring if deemed necessary. UTM coordinates of the WTGs are given below in Table 3. WTG ID numbers included in Table 3 correspond with the labels to the WindPRO generated map included Annex B.

Table 3 - Coordinates of proposed turbine locations.

WTG ID Number	Proposed WTG Location (UTM Zone 20, NAD 83)	
	Easting	Northing
1	411,122 m E	5,076,288 m N
2	411,150 m E	5,075,827 m N
3	410,754 m E	5,076,059 m N

5.2. Turbine Types

The model of WTGs being considered for the proposed wind farm is the Enercon E-92 2.0 MW. Because the WTGs will be de-rated Enercon E-92 turbines from their maximum capacity of 2.3 MW to 2.0 MW, this assessment uses E-92 2.3 MW turbines to model the noise impact on nearby receptors. This will produce conservative results as the noise values produced by the 2.3 MW WTG will be slightly louder than the 2.0 MW WTG.

This model utilizes horizontal axis, upwind, 3-bladed, and a microprocessor pitch control system.
Table 4 - Enercon E-92 2.3 MW turbine characteristics below outlines their main characteristics.

Table 4 - Enercon E-92 2.3 MW turbine characteristics. (Enercon, 2012)

WTG Type	Rotor Diameter (m)	Hub Height (m)	Rated Output (MW)
E-92 2.3	92.0	98	2.3

5.3. Power Curve Data

The power curve for the E-92 2.3 MW WTGs at Noise Mode 0 and with an air density of 1.225 kg/m³ is shown below in Figure 1.

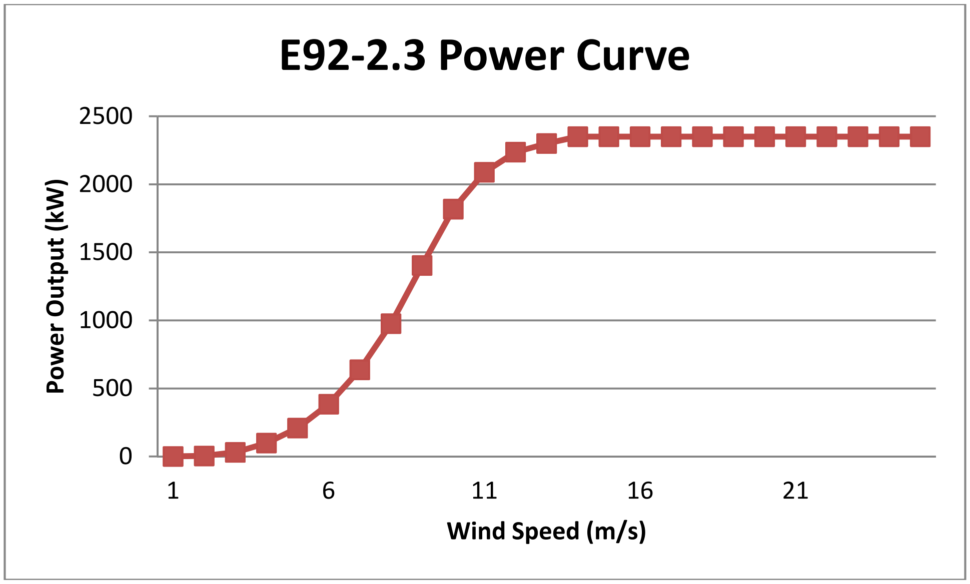

Figure 1 – Power curve for the Enercon E-92 2.3.

6. Wind Turbine Noise Emission Rating

The noise emission data for the Enercon E-92 2.3 WTG, shown in Table 5 below, was provided by Enercon Canada (2012). The Sound Pressure Levels (SPL) were measured to IEC 61400-11 standards, which stipulate measurements at a height of 10m above ground level (a.g.l.) with an air density of 1.225 kg/m^3 that is taken to be representative of the project area. Where data is shown as 'N/A', WindPRO has extrapolated octave band data to generate appropriate Sound Pressure Level values in order to complete the calculation. These source noise levels are incorporated in the prediction calculations referenced in Section 7.

Table 5 - Enercon E-92 2.3 MW noise emission data for 98m hub height.

Wind speed at 10m a.g.l. (m/s)	SPL (LWA) (dB(A) re 10^{-12} Watts)	Octave Band Centre Frequency (Hz)							
		63	125	250	500	1000	2000	4000	8000
4	97.6	79.2	86.2	89.6	92.2	92.2	89.1	84.3	74.8
5	99.9	81.5	88.5	91.9	94.5	94.3	91.4	86.6	77.1
6	102.2	83.8	90.8	84.2	96.8	96.6	93.7	88.9	79.4
7	103.4	85.0	92.0	95.4	98.0	97.8	94.9	90.1	80.6
8	104.4	86.0	93.0	96.4	99.0	98.8	95.9	91.1	81.6
9	105.0	86.6	93.6	97.0	99.6	99.4	96.5	91.7	82.2
10	105.0	86.6	93.6	97.0	99.6	99.4	96.5	91.7	82.2
11	105.0	86.6	93.6	97.0	99.6	99.4	96.5	91.7	82.2
12	105.0	86.6	93.6	97.0	99.6	99.4	96.5	91.7	82.2

7. Impact Assessment

7.1. Prediction Methodology

The SPL was calculated at each point of reception (listed in Table 2) using the Decibel module of WindPRO v.2.9 which uses the ISO 9613-2 model "Attenuation of sound during propagation outdoors, Part 2: A general method of calculation". The calculations were performed using the Enercon E-92 2.3 MW wind turbine generators with a hub height of 98 m. A global ground attenuation of 0.0 was used to represent a 'worst case scenario' that produces results that are unaffected by sound absorption from topographical characteristics such as trees, grass, etc.

As another conservative measure, downwind propagation has been assumed to occur simultaneously in all directions and from all wind turbines. Furthermore, no attenuation from topographical shielding (other buildings, barns, trees etc.) has been considered between the turbines and receptors. Noise propagation in an upwind direction will result in a significant reduction of noise levels at any receptor located upwind.

No correction for special audible characteristics such as clearly audible tones, impulses or modulation of sound levels has been made. These are not common characteristics of modern wind turbine generators (WTG) in a well designed wind farm. It is habitual that WTG manufacturers guarantee the absence of tonal noise produced by the WTG. Furthermore, impulses and modulation of sound levels from the wind farm under normal conditions would not be of a level to necessitate the application of any penalty.

A full list of parameters assumed for the predictions is provided in Annex B.

7.2. Results of Noise Predictions

The results of the noise prediction model at each point of reception, as summarized in Table 6, prove compliance with the Ontario *Noise Guidelines for Wind Farms* and the 40 dB(A) conservative SPL emission limit. The table demonstrates the loudest noise levels for any wind speed modelled between and including 4 to 12 m/s. As the guideline requirements have been exceeded, it was deemed unnecessary to conduct noise monitoring to establish background noise levels.

The receptor with the highest perceived noise level was receptor BL, which received a worst case scenario emission of 37.3 dB(A) from the Enercon E-92 2.3 MW machine, at a 98 m hub heights.

The modelled noise results at a wind speed of 9 m/s, approximately the 'noisiest' operational speed of an Enercon E92 2.3 MW wind turbine is mapped in Annexe B. The receptor ID labels on the contour plot correspond with the WindPRO ID listed in Table 2.

The WindPRO software generated a noise contour map for the Enercon E-92 2.3 with a 98 m hub height, and can be found in Annex B.

Table 6 - Wind turbine noise impact assessment summary.

Point of Reception ID	Max Sound Level from WTG [dB(A)]	Compliance with Ontario Guidelines	Compliance with 40 dB(A) noise level (Yes/No)
A	33.4	Yes	Yes
B	31.1	Yes	Yes
C	29.8	Yes	Yes
D	33.9	Yes	Yes
E	30.1	Yes	Yes
F	31.1	Yes	Yes
G	36.4	Yes	Yes
H	33.5	Yes	Yes
I	33.4	Yes	Yes
J	27.4	Yes	Yes
K	32.5	Yes	Yes
L	31.3	Yes	Yes
M	33.3	Yes	Yes
N	32.5	Yes	Yes
O	28.7	Yes	Yes
P	28	Yes	Yes
Q	28.6	Yes	Yes
R	32.2	Yes	Yes
S	31.8	Yes	Yes
T	33.3	Yes	Yes
U	30.9	Yes	Yes
V	28.8	Yes	Yes
W	31.6	Yes	Yes
X	32.2	Yes	Yes
Y	33.6	Yes	Yes
Z	32.7	Yes	Yes
AA	35.1	Yes	Yes
AB	33.1	Yes	Yes
AC	28.1	Yes	Yes
AD	32.6	Yes	Yes
AE	33.9	Yes	Yes
AF	31.9	Yes	Yes
AG	31.2	Yes	Yes
AH	30.7	Yes	Yes
AI	32.4	Yes	Yes
AJ	28.2	Yes	Yes
AK	33	Yes	Yes

Point of Reception ID	Max Sound Level from WTG [dB(A)]	Compliance with Ontario Guidelines	Compliance with 40 dB(A) noise level (Yes/No)
AL	28.3	Yes	Yes
AM	33.4	Yes	Yes
AN	31.8	Yes	Yes
AO	32.6	Yes	Yes
AP	33.3	Yes	Yes
AQ	35.1	Yes	Yes
AR	31.6	Yes	Yes
AS	28.4	Yes	Yes
AT	33	Yes	Yes
AU	32	Yes	Yes
AV	32	Yes	Yes
AW	31.4	Yes	Yes
AX	33.3	Yes	Yes
AY	33.1	Yes	Yes
AZ	33.7	Yes	Yes
BA	33	Yes	Yes
BB	31.1	Yes	Yes
BC	27.1	Yes	Yes
BD	32.9	Yes	Yes
BE	36.3	Yes	Yes
BF	30.3	Yes	Yes
BG	30.8	Yes	Yes
BH	32.8	Yes	Yes
BI	36	Yes	Yes
BJ	32.4	Yes	Yes
BK	32.5	Yes	Yes
BL	37.3	Yes	Yes
BM	30.5	Yes	Yes
BN	30.5	Yes	Yes
BO	32.4	Yes	Yes
BP	29.7	Yes	Yes
BQ	27.5	Yes	Yes
BR	33	Yes	Yes
BS	32.7	Yes	Yes
BT	33.4	Yes	Yes
BU	28.4	Yes	Yes
BV	27.7	Yes	Yes
BW	30.6	Yes	Yes

Point of Reception ID	Max Sound Level from WTG [dB(A)]	Compliance with Ontario Guidelines	Compliance with 40 dB(A) noise level (Yes/No)
BX	27.1	Yes	Yes
BY	28.1	Yes	Yes
BZ	32.8	Yes	Yes
CA	33.2	Yes	Yes
CB	32.6	Yes	Yes
CC	32.1	Yes	Yes
CD	33.2	Yes	Yes
CE	30.2	Yes	Yes
CF	30.6	Yes	Yes
CG	34.2	Yes	Yes
CH	30.7	Yes	Yes
CI	27.4	Yes	Yes
CJ	35.5	Yes	Yes
CK	28	Yes	Yes
CL	27.9	Yes	Yes
CM	31.1	Yes	Yes
CN	28.9	Yes	Yes
CO	30.2	Yes	Yes
CP	31.8	Yes	Yes
CQ	33.4	Yes	Yes
CR	29.9	Yes	Yes
CS	33	Yes	Yes
CT	31.4	Yes	Yes
CU	27.4	Yes	Yes
CV	31.6	Yes	Yes
CW	32.5	Yes	Yes
CX	33.4	Yes	Yes
CY	33	Yes	Yes
CZ	27	Yes	Yes
DA	32.5	Yes	Yes
DB	32.2	Yes	Yes
DC	31.2	Yes	Yes
DD	28.3	Yes	Yes
DE	31.9	Yes	Yes
DF	28.1	Yes	Yes
DG	31.3	Yes	Yes
DH	33.5	Yes	Yes
DI	32.2	Yes	Yes

Point of Reception ID	Max Sound Level from WTG [dB(A)]	Compliance with Ontario Guidelines	Compliance with 40 dB(A) noise level (Yes/No)
DJ	27.1	Yes	Yes
DK	31.8	Yes	Yes
DL	32.6	Yes	Yes
DM	27.8	Yes	Yes
DN	33.4	Yes	Yes
DO	31.4	Yes	Yes
DP	28.9	Yes	Yes
DQ	32.8	Yes	Yes
DR	31.4	Yes	Yes
DS	31	Yes	Yes
DT	32.6	Yes	Yes
DU	32.4	Yes	Yes
DV	33	Yes	Yes
DW	34.2	Yes	Yes
DX	33.9	Yes	Yes
DY	33.4	Yes	Yes
DZ	36.1	Yes	Yes
EA	35.7	Yes	Yes
EB	34.4	Yes	Yes
EC	34.8	Yes	Yes
ED	33.5	Yes	Yes
EE	33.6	Yes	Yes
EF	33.2	Yes	Yes
EG	32.8	Yes	Yes
EH	32.1	Yes	Yes
EI	31.2	Yes	Yes
EJ	30.9	Yes	Yes
EK	30.4	Yes	Yes
EL	29.7	Yes	Yes
EM	29.2	Yes	Yes
EN	28.9	Yes	Yes
EO	28.6	Yes	Yes
EP	28.4	Yes	Yes
EQ	28.2	Yes	Yes
ER	28	Yes	Yes
ES	28	Yes	Yes
ET	27.7	Yes	Yes
EU	29.4	Yes	Yes

Point of Reception ID	Max Sound Level from WTG [dB(A)]	Compliance with Ontario Guidelines	Compliance with 40 dB(A) noise level (Yes/No)
EV	29.5	Yes	Yes
EW	29.8	Yes	Yes
EX	30.1	Yes	Yes
EY	30.3	Yes	Yes
EZ	30.1	Yes	Yes
FA	30.3	Yes	Yes
FB	30	Yes	Yes
FC	30.8	Yes	Yes
FD	31	Yes	Yes
FE	28.5	Yes	Yes
FF	28.5	Yes	Yes
FG	28.4	Yes	Yes
FH	28.3	Yes	Yes
FI	28.8	Yes	Yes
FJ	28.7	Yes	Yes
FK	28.6	Yes	Yes
FL	29	Yes	Yes
FM	29.4	Yes	Yes
FN	28.9	Yes	Yes
FO	29.1	Yes	Yes
FP	29.3	Yes	Yes
FQ	29.5	Yes	Yes
FR	29.7	Yes	Yes
FS	29.7	Yes	Yes
FT	30.2	Yes	Yes
FU	30.4	Yes	Yes
FV	30.8	Yes	Yes
FW	30.5	Yes	Yes
FX	30.8	Yes	Yes
FY	30.4	Yes	Yes
FZ	31	Yes	Yes
GA	31.2	Yes	Yes
GB	31.6	Yes	Yes
GC	31.5	Yes	Yes
GD	29.4	Yes	Yes
GE	31.6	Yes	Yes
GF	31.9	Yes	Yes
GG	32.2	Yes	Yes

Point of Reception ID	Max Sound Level from WTG [dB(A)]	Compliance with Ontario Guidelines	Compliance with 40 dB(A) noise level (Yes/No)
GH	32.5	Yes	Yes
GI	32.4	Yes	Yes
GJ	32.2	Yes	Yes
GK	31.5	Yes	Yes
GL	32.2	Yes	Yes
GM	32.1	Yes	Yes
GN	32.6	Yes	Yes
GO	32.8	Yes	Yes
GP	31.4	Yes	Yes
GQ	32.2	Yes	Yes
GR	32	Yes	Yes
GS	32.1	Yes	Yes
GT	32.3	Yes	Yes
GU	32.5	Yes	Yes
GV	32.9	Yes	Yes
GW	32.9	Yes	Yes
GX	32	Yes	Yes
GY	32	Yes	Yes
GZ	28	Yes	Yes
HA	27.7	Yes	Yes
HB	27.5	Yes	Yes
HC	31.1	Yes	Yes
HD	31.2	Yes	Yes
HE	31.2	Yes	Yes
HF	32.1	Yes	Yes
HG	31.3	Yes	Yes
HH	32.2	Yes	Yes
HI	31.6	Yes	Yes
HJ	32.5	Yes	Yes
HK	31.8	Yes	Yes
HL	32.7	Yes	Yes
HM	33	Yes	Yes
HN	33.1	Yes	Yes
HO	33.3	Yes	Yes
HP	27.7	Yes	Yes
HQ	33.3	Yes	Yes
HR	27.2	Yes	Yes
HS	27.7	Yes	Yes

Point of Reception ID	Max Sound Level from WTG [dB(A)]	Compliance with Ontario Guidelines	Compliance with 40 dB(A) noise level (Yes/No)
HT	32.7	Yes	Yes
HU	29.5	Yes	Yes
HV	33	Yes	Yes
HW	28.3	Yes	Yes
HX	33	Yes	Yes
HY	33	Yes	Yes
HZ	29.4	Yes	Yes
IA	29.2	Yes	Yes
IB	29.1	Yes	Yes
IC	28.9	Yes	Yes
ID	28.7	Yes	Yes
IE	28.1	Yes	Yes
IF	28	Yes	Yes
IG	28.8	Yes	Yes
IH	28.8	Yes	Yes
II	28.7	Yes	Yes
IJ	28	Yes	Yes
IK	27.9	Yes	Yes
IL	27.8	Yes	Yes
IM	28.2	Yes	Yes
IN	28.1	Yes	Yes
IO	30.2	Yes	Yes
IP	29.2	Yes	Yes
IQ	30.6	Yes	Yes
IR	29	Yes	Yes
IS	29	Yes	Yes
IT	28.6	Yes	Yes
IU	28.3	Yes	Yes
IV	28.2	Yes	Yes
IW	28.8	Yes	Yes
IX	28.6	Yes	Yes
IY	28.2	Yes	Yes
IZ	30.6	Yes	Yes
JA	30.8	Yes	Yes
JB	29.6	Yes	Yes
JC	27.8	Yes	Yes
JD	29.4	Yes	Yes
JE	29.2	Yes	Yes

Point of Reception ID	Max Sound Level from WTG [dB(A)]	Compliance with Ontario Guidelines	Compliance with 40 dB(A) noise level (Yes/No)
JF	28	Yes	Yes
JG	29.6	Yes	Yes
JH	29.5	Yes	Yes
JI	28.1	Yes	Yes
JJ	28.1	Yes	Yes
JK	28.2	Yes	Yes
JL	27.6	Yes	Yes
JM	27.7	Yes	Yes
JN	28.4	Yes	Yes
JO	27.8	Yes	Yes
JP	28	Yes	Yes
JQ	28.1	Yes	Yes
JR	27.9	Yes	Yes
JS	27.8	Yes	Yes
JT	27.8	Yes	Yes
JU	32.5	Yes	Yes
JV	32.5	Yes	Yes
JW	33.5	Yes	Yes
JX	33.3	Yes	Yes
JY	33.5	Yes	Yes
JZ	32.7	Yes	Yes
KA	32.3	Yes	Yes
KB	32.9	Yes	Yes
KC	31.8	Yes	Yes
KD	31.9	Yes	Yes
KE	32.1	Yes	Yes
KF	31.7	Yes	Yes
KG	32.6	Yes	Yes
KH	32.5	Yes	Yes
KI	31.5	Yes	Yes
KJ	29.9	Yes	Yes
KK	32.8	Yes	Yes
KL	34.8	Yes	Yes
KM	34.6	Yes	Yes
KN	32.5	Yes	Yes
KO	32.4	Yes	Yes
KP	31	Yes	Yes
KQ	30.9	Yes	Yes

Point of Reception ID	Max Sound Level from WTG [dB(A)]	Compliance with Ontario Guidelines	Compliance with 40 dB(A) noise level (Yes/No)
KR	31	Yes	Yes
KS	35	Yes	Yes
KT	35.3	Yes	Yes
KU	35.7	Yes	Yes
KV	36.9	Yes	Yes
KW	36.7	Yes	Yes
KX	36.2	Yes	Yes
KY	36.1	Yes	Yes
KZ	31.3	Yes	Yes
LA	33.1	Yes	Yes
LB	34.6	Yes	Yes

8. Conclusions and Recommendations

Natural Forces Wind Inc. has completed a thorough assessment to evaluate the noise impact of the proposed Amherst Community Wind Farm on the identified noise receptors located within 2,500 meters of a proposed WTG. Based on the parameters used to run the WindPRO noise prediction model, it has been shown that the predicted Sound Pressure Levels emitted by all three of the proposed WTGs using conservative assumptions are less than 40 dB(A), thus demonstrating compliance with the Ontario *Noise Guidelines for Wind Farms*. As a result of this study, no noise mitigation strategies have been deemed necessary.

9. References

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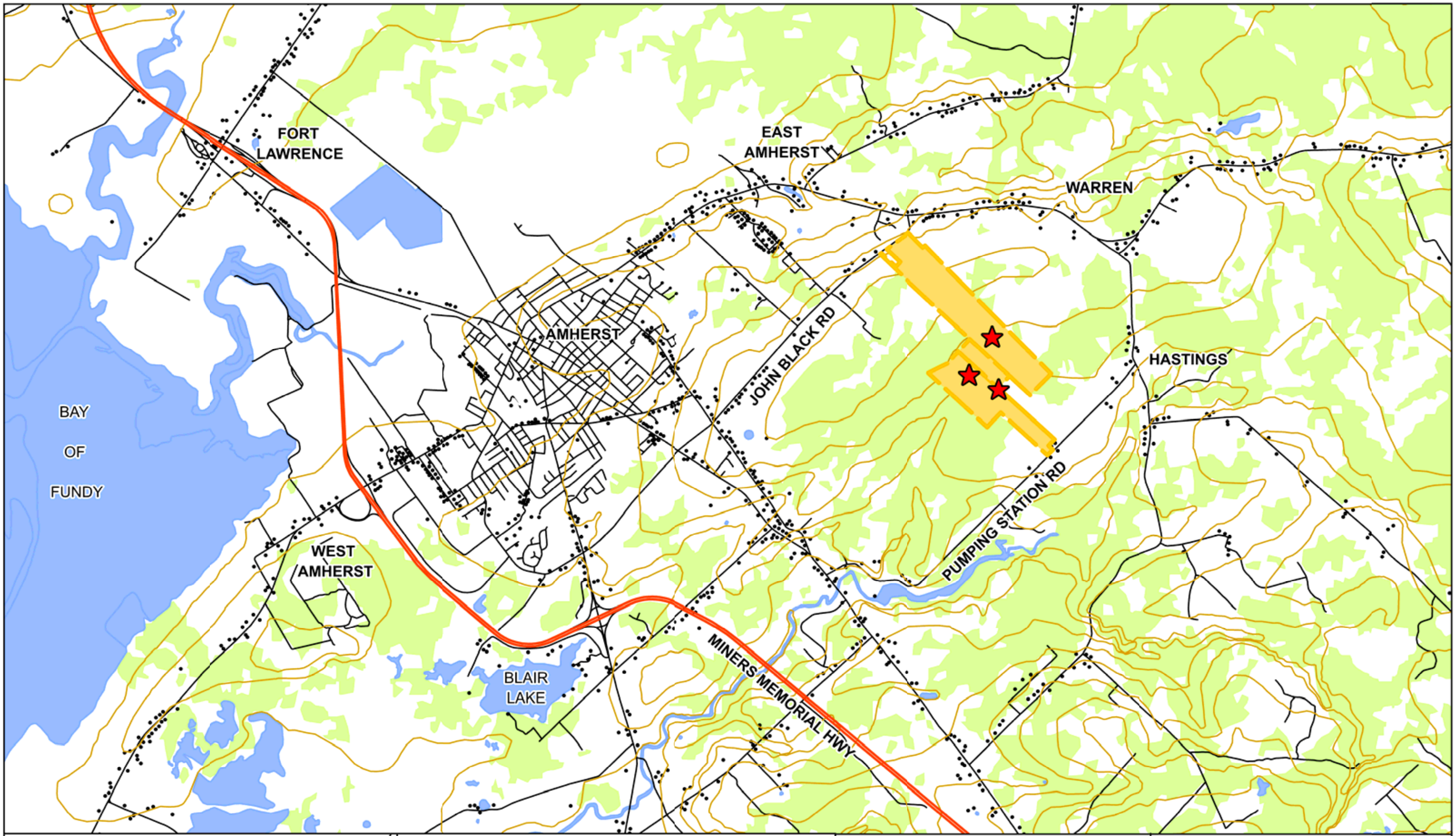
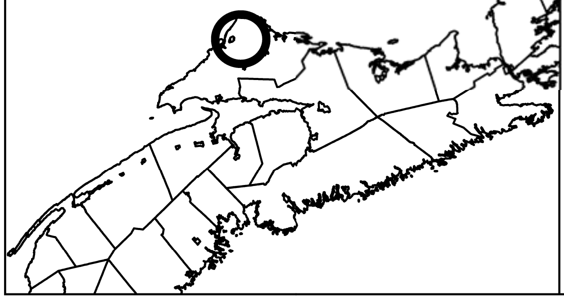
ANNEX A

Site Layout Map



LOCATION OF AMHERST
COMMUNITY WIND FARM



LEGEND

★	Proposed Turbines	—	Road
—	Highway	🟦	Water
—	Project Area	🟩	Forest
—	Elevation Contour		
•	Building		

SCALE

1 : 60,000

ANNEX

Annex A

TITLE

Site Layout Map

1205 - 1801 HOLLIS STREET
HALIFAX, NOVA SCOTIA B3J 3N4
TEL: 902 422 9663
FAX 902 422 9780
WWW.NATURALFORCES.CA

November 19, 2014

natural forces

ANNEX B

WindPRO v2.8, Decibel Module Calculation Results

Enercon E-92 2.3 MW @ 98m Hub Height

Project:
AMR_WindPro final location 141204

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04/12/2014 3:18 PM / 1

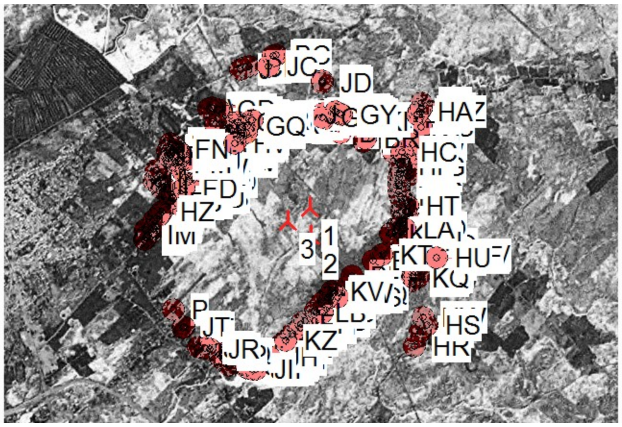
Licensed user:
Natural Forces Wind Inc
1791 Barrington Street Suite 1030
CA-HALIFAX, Nova Scotia B3J 3L1
902 422 9663
Amy / apellerin@naturalforces.ca

Calculated:
04/12/2014 3:18 PM/2.9.269

DECIBEL - Main Result

Calculation: Amherst Noise Assessment

Noise calculation model:
ISO 9613-2 General
Wind speed:
4.0 m/s - 12.0 m/s, step 1.0 m/s
Ground attenuation:
None
Meteorological coefficient, C0:
0.0 dB
Type of demand in calculation:
1: WTG noise is compared to demand (DK, DE, SE, NL etc.)
Noise values in calculation:
All noise values are mean values (Lwa) (Normal)
Pure tones:
Pure and Impulse tone penalty are added to WTG source noise
Height above ground level, when no value in NSA object:
4.5 m Don't allow override of model height with height from NSA object
Deviation from "official" noise demands. Negative is more restrictive, positive is less restrictive.:
0.0 dB(A)



Scale 1:125,000
⅄ New WTG ⬟ Noise sensitive area

WTGs

	UTM (north)-NAD83 (US+CA) Zone: 20				WTG type						Noise data							
	East	North	Z	Row data/Description	Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Creator	Name	First wind speed	LwaRef	Last wind speed	LwaRef	Pure tones	
			[m]					[kW]	[m]	[m]			[m/s]	[dB(A)]	[m/s]	[dB(A)]		
1	411,122	5,076,288	60.4	ENERCON E-92 2,3 MW 2300 ...	Yes	ENERCON	E-92 2,3 MW-2,300	2,300	92.0	98.0	EMD	Level 0 - calculated - Op.Mode I - 03/2012	4.0	97.6	12.0	105.0	0 dB	g
2	411,150	5,075,827	56.1	ENERCON E-92 2,3 MW 2300 ...	Yes	ENERCON	E-92 2,3 MW-2,300	2,300	92.0	98.0	EMD	Level 0 - calculated - Op.Mode I - 03/2012	4.0	97.6	12.0	105.0	0 dB	g
3	410,754	5,076,059	65.1	ENERCON E-92 2,3 MW 2300 ...	Yes	ENERCON	E-92 2,3 MW-2,300	2,300	92.0	98.0	EMD	Level 0 - calculated - Op.Mode I - 03/2012	4.0	97.6	12.0	105.0	0 dB	g

h) Generic octave distribution used
g) Data calculated from data for other wind speed (uncertain)

Calculation Results

Sound Level

Noise sensitive area		UTM (north)-NAD83 (US+CA) Zone: 20			Demands			Sound Level		Demands fulfilled ?		
No.	Name	East	North	Z	Imission height	Max Noise	Distance	Max From WTGs	Distance to noise demand	Noise	Distance	All
				[m]	[m]	[dB(A)]	[m]	[dB(A)]	[m]			
A	Noise sensitive point: User defined (1)	410,687	5,077,694	58.4	4.5	40.0	600	33.4	728	Yes	Yes	Yes
B	Noise sensitive point: User defined (2)	412,917	5,075,407	34.6	4.5	40.0	600	31.1	1,079	Yes	Yes	Yes
C	Noise sensitive point: User defined (3)	412,770	5,077,450	74.5	4.5	40.0	600	29.8	1,299	Yes	Yes	Yes
D	Noise sensitive point: User defined (4)	411,637	5,077,534	68.5	4.5	40.0	600	33.9	643	Yes	Yes	Yes
E	Noise sensitive point: User defined (5)	412,772	5,077,381	73.6	4.5	40.0	600	30.1	1,260	Yes	Yes	Yes
F	Noise sensitive point: User defined (6)	412,548	5,077,384	70.0	4.5	40.0	600	31.1	1,084	Yes	Yes	Yes
G	Noise sensitive point: User defined (7)	411,522	5,074,857	50.8	4.5	40.0	600	36.4	338	Yes	Yes	Yes
H	Noise sensitive point: User defined (8)	410,752	5,077,687	60.1	4.5	40.0	600	33.5	708	Yes	Yes	Yes
I	Noise sensitive point: User defined (9)	410,886	5,077,728	60.8	4.5	40.0	600	33.4	729	Yes	Yes	Yes
J	Noise sensitive point: User defined (10)	409,985	5,078,587	37.8	4.5	40.0	600	27.4	1,797	Yes	Yes	Yes
K	Noise sensitive point: User defined (11)	411,218	5,077,847	54.8	4.5	40.0	600	32.5	846	Yes	Yes	Yes
L	Noise sensitive point: User defined (12)	412,545	5,077,331	70.0	4.5	40.0	600	31.3	1,048	Yes	Yes	Yes
M	Noise sensitive point: User defined (13)	412,672	5,076,299	60.0	4.5	40.0	600	33.3	760	Yes	Yes	Yes
N	Noise sensitive point: User defined (14)	411,712	5,077,716	58.4	4.5	40.0	600	32.5	839	Yes	Yes	Yes
O	Noise sensitive point: User defined (15)	408,873	5,077,294	35.0	4.5	40.0	600	28.7	1,522	Yes	Yes	Yes
P	Noise sensitive point: User defined (16)	408,859	5,074,597	46.1	4.5	40.0	600	28.0	1,663	Yes	Yes	Yes
Q	Noise sensitive point: User defined (17)	412,869	5,077,709	75.0	4.5	40.0	600	28.6	1,538	Yes	Yes	Yes
R	Noise sensitive point: User defined (18)	412,802	5,075,612	34.8	4.5	40.0	600	32.2	917	Yes	Yes	Yes
S	Noise sensitive point: User defined (19)	412,515	5,077,219	70.0	4.5	40.0	600	31.8	957	Yes	Yes	Yes
T	Noise sensitive point: User defined (20)	410,620	5,077,696	56.3	4.5	40.0	600	33.3	746	Yes	Yes	Yes
U	Noise sensitive point: User defined (21)	412,931	5,075,350	35.0	4.5	40.0	600	30.9	1,110	Yes	Yes	Yes

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DECIBEL - Main Result

Calculation: Amherst Noise Assessment

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Noise sensitive area		**UTM (north)-NAD83 (US+CA) Zone: 20**			**Demands**			**Sound Level**		**Demands fulfilled ?**		
No.	Name	East	North	Z [m]	Imission height [m]	Max Noise [dB(A)]	Distance [m]	Max From WTGs [dB(A)]	Distance to noise demand [m]	Noise	Distance	All
V	Noise sensitive point: User defined (22)	409,450	5,077,924	30.4	4.5	40.0	600	28.8	1,501	Yes	Yes	Yes
W	Noise sensitive point: User defined (23)	411,964	5,077,748	58.3	4.5	40.0	600	31.6	980	Yes	Yes	Yes
X	Noise sensitive point: User defined (24)	411,426	5,077,867	51.3	4.5	40.0	600	32.2	898	Yes	Yes	Yes
Y	Noise sensitive point: User defined (25)	410,833	5,077,687	62.7	4.5	40.0	600	33.6	694	Yes	Yes	Yes
Z	Noise sensitive point: User defined (26)	411,651	5,077,709	57.7	4.5	40.0	600	32.7	811	Yes	Yes	Yes
AA	Noise sensitive point: User defined (27)	412,356	5,075,531	51.1	4.5	40.0	600	35.1	507	Yes	Yes	Yes
AB	Noise sensitive point: User defined (28)	410,362	5,077,647	53.7	4.5	40.0	600	33.1	784	Yes	Yes	Yes
AC	Noise sensitive point: User defined (29)	413,531	5,075,487	40.0	4.5	40.0	600	28.1	1,656	Yes	Yes	Yes
AD	Noise sensitive point: User defined (30)	409,342	5,076,720	70.0	4.5	40.0	600	32.6	841	Yes	Yes	Yes
AE	Noise sensitive point: User defined (31)	412,583	5,075,822	48.5	4.5	40.0	600	33.9	666	Yes	Yes	Yes
AF	Noise sensitive point: User defined (32)	411,398	5,077,908	47.0	4.5	40.0	600	31.9	933	Yes	Yes	Yes
AG	Noise sensitive point: User defined (33)	412,629	5,077,251	70.0	4.5	40.0	600	31.2	1,068	Yes	Yes	Yes
AH	Noise sensitive point: User defined (34)	408,937	5,076,375	64.2	4.5	40.0	600	30.7	1,136	Yes	Yes	Yes
AI	Noise sensitive point: User defined (35)	411,274	5,077,854	54.3	4.5	40.0	600	32.4	860	Yes	Yes	Yes
AJ	Noise sensitive point: User defined (36)	408,809	5,077,359	33.8	4.5	40.0	600	28.2	1,610	Yes	Yes	Yes
AK	Noise sensitive point: User defined (37)	411,218	5,077,771	60.2	4.5	40.0	600	33.0	771	Yes	Yes	Yes
AL	Noise sensitive point: User defined (38)	409,789	5,073,827	32.0	4.5	40.0	600	28.3	1,622	Yes	Yes	Yes
AM	Noise sensitive point: User defined (39)	411,056	5,077,731	61.9	4.5	40.0	600	33.4	723	Yes	Yes	Yes
AN	Noise sensitive point: User defined (40)	409,952	5,077,647	42.9	4.5	40.0	600	31.8	979	Yes	Yes	Yes
AO	Noise sensitive point: User defined (41)	411,435	5,077,793	56.2	4.5	40.0	600	32.6	828	Yes	Yes	Yes
AP	Noise sensitive point: User defined (42)	412,657	5,076,391	63.1	4.5	40.0	600	33.3	760	Yes	Yes	Yes
AQ	Noise sensitive point: User defined (43)	411,822	5,074,852	50.7	4.5	40.0	600	35.1	485	Yes	Yes	Yes
AR	Noise sensitive point: User defined (44)	411,931	5,077,767	57.6	4.5	40.0	600	31.6	981	Yes	Yes	Yes
AS	Noise sensitive point: User defined (45)	412,980	5,077,625	75.0	4.5	40.0	600	28.4	1,572	Yes	Yes	Yes
AT	Noise sensitive point: User defined (46)	412,722	5,076,231	54.1	4.5	40.0	600	33.0	802	Yes	Yes	Yes
AU	Noise sensitive point: User defined (47)	411,337	5,077,903	49.2	4.5	40.0	600	32.0	917	Yes	Yes	Yes
AV	Noise sensitive point: User defined (48)	409,973	5,077,612	45.0	4.5	40.0	600	32.0	938	Yes	Yes	Yes
AW	Noise sensitive point: User defined (49)	412,848	5,075,349	32.9	4.5	40.0	600	31.4	1,031	Yes	Yes	Yes
AX	Noise sensitive point: User defined (50)	410,575	5,077,689	57.8	4.5	40.0	600	33.3	751	Yes	Yes	Yes
AY	Noise sensitive point: User defined (51)	412,716	5,075,955	44.8	4.5	40.0	600	33.1	788	Yes	Yes	Yes
AZ	Noise sensitive point: User defined (52)	410,809	5,077,676	62.5	4.5	40.0	600	33.7	687	Yes	Yes	Yes
BA	Noise sensitive point: User defined (53)	409,819	5,077,307	57.3	4.5	40.0	600	33.0	793	Yes	Yes	Yes
BB	Noise sensitive point: User defined (54)	412,854	5,075,234	35.0	4.5	40.0	600	31.1	1,078	Yes	Yes	Yes
BC	Noise sensitive point: User defined (55)	410,573	5,078,822	37.4	4.5	40.0	600	27.1	1,857	Yes	Yes	Yes
BD	Noise sensitive point: User defined (56)	411,281	5,077,776	60.2	4.5	40.0	600	32.9	783	Yes	Yes	Yes
BE	Noise sensitive point: User defined (57)	411,755	5,074,975	57.8	4.5	40.0	600	36.3	346	Yes	Yes	Yes
BF	Noise sensitive point: User defined (58)	409,573	5,077,673	33.5	4.5	40.0	600	30.3	1,229	Yes	Yes	Yes
BG	Noise sensitive point: User defined (59)	412,840	5,075,082	35.0	4.5	40.0	600	30.8	1,127	Yes	Yes	Yes
BH	Noise sensitive point: User defined (60)	411,385	5,077,782	59.2	4.5	40.0	600	32.8	806	Yes	Yes	Yes
BI	Noise sensitive point: User defined (61)	412,181	5,075,412	56.8	4.5	40.0	600	36.0	390	Yes	Yes	Yes
BJ	Noise sensitive point: User defined (62)	409,564	5,077,151	59.6	4.5	40.0	600	32.4	873	Yes	Yes	Yes
BK	Noise sensitive point: User defined (63)	409,521	5,077,076	62.4	4.5	40.0	600	32.5	861	Yes	Yes	Yes
BL	Noise sensitive point: User defined (64)	411,829	5,075,161	66.3	4.5	40.0	600	37.3	249	Yes	Yes	Yes
BM	Noise sensitive point: User defined (65)	409,821	5,077,822	32.6	4.5	40.0	600	30.5	1,197	Yes	Yes	Yes
BN	Noise sensitive point: User defined (66)	412,926	5,075,138	35.0	4.5	40.0	600	30.5	1,181	Yes	Yes	Yes
BO	Noise sensitive point: User defined (67)	411,328	5,077,855	55.0	4.5	40.0	600	32.4	868	Yes	Yes	Yes
BP	Noise sensitive point: User defined (68)	412,716	5,077,559	75.0	4.5	40.0	600	29.7	1,325	Yes	Yes	Yes
BQ	Noise sensitive point: User defined (69)	409,280	5,073,978	27.3	4.5	40.0	600	27.5	1,783	Yes	Yes	Yes
BR	Noise sensitive point: User defined (70)	412,052	5,077,442	69.3	4.5	40.0	600	33.0	775	Yes	Yes	Yes
BS	Noise sensitive point: User defined (71)	411,061	5,077,829	58.5	4.5	40.0	600	32.7	821	Yes	Yes	Yes
BT	Noise sensitive point: User defined (72)	412,655	5,076,219	58.7	4.5	40.0	600	33.4	734	Yes	Yes	Yes
BU	Noise sensitive point: User defined (73)	409,819	5,073,832	32.6	4.5	40.0	600	28.4	1,604	Yes	Yes	Yes
BV	Noise sensitive point: User defined (74)	413,605	5,075,505	39.8	4.5	40.0	600	27.7	1,725	Yes	Yes	Yes
BW	Noise sensitive point: User defined (75)	412,682	5,077,344	71.6	4.5	40.0	600	30.6	1,165	Yes	Yes	Yes

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Project:
AMR_WindPro final location 141204

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04/12/2014 3:18 PM / 3

Licensed user:
Natural Forces Wind Inc
1791 Barrington Street Suite 1030
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902 422 9663
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Calculated:
04/12/2014 3:18 PM/2.9.269

DECIBEL - Main Result

Calculation: Amherst Noise Assessment

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Noise sensitive area		**UTM (north)-NAD83 (US+CA) Zone: 20**			**Demands**			**Sound Level**		**Demands fulfilled ?**		
No.	Name	East	North	Z	Imission height	Max Noise	Distance	Max From WTGs	Distance to noise demand	Noise	Distance	All
				[m]	[m]	[dB(A)]	[m]	[dB(A)]	[m]			
BX	Noise sensitive point: User defined (76)	410,520	5,078,801	38.8	4.5	40.0	600	27.1	1,845	Yes	Yes	Yes
BY	Noise sensitive point: User defined (77)	410,203	5,073,611	28.7	4.5	40.0	600	28.1	1,650	Yes	Yes	Yes
BZ	Noise sensitive point: User defined (78)	409,689	5,077,214	57.6	4.5	40.0	600	32.8	819	Yes	Yes	Yes
CA	Noise sensitive point: User defined (79)	412,647	5,076,460	64.4	4.5	40.0	600	33.2	764	Yes	Yes	Yes
CB	Noise sensitive point: User defined (80)	410,561	5,077,786	55.0	4.5	40.0	600	32.6	848	Yes	Yes	Yes
CC	Noise sensitive point: User defined (81)	410,282	5,077,768	45.8	4.5	40.0	600	32.1	927	Yes	Yes	Yes
CD	Noise sensitive point: User defined (82)	410,532	5,077,683	58.0	4.5	40.0	600	33.2	758	Yes	Yes	Yes
CE	Noise sensitive point: User defined (83)	412,639	5,077,501	72.6	4.5	40.0	600	30.2	1,229	Yes	Yes	Yes
CF	Noise sensitive point: User defined (84)	408,957	5,076,550	60.7	4.5	40.0	600	30.6	1,152	Yes	Yes	Yes
CG	Noise sensitive point: User defined (85)	410,871	5,077,619	65.1	4.5	40.0	600	34.2	622	Yes	Yes	Yes
CH	Noise sensitive point: User defined (86)	409,864	5,077,809	33.7	4.5	40.0	600	30.7	1,163	Yes	Yes	Yes
CI	Noise sensitive point: User defined (87)	410,056	5,078,619	38.9	4.5	40.0	600	27.4	1,800	Yes	Yes	Yes
CJ	Noise sensitive point: User defined (88)	411,620	5,074,792	47.0	4.5	40.0	600	35.5	436	Yes	Yes	Yes
CK	Noise sensitive point: User defined (89)	410,139	5,073,616	26.1	4.5	40.0	600	28.0	1,667	Yes	Yes	Yes
CL	Noise sensitive point: User defined (90)	413,559	5,075,468	40.0	4.5	40.0	600	27.9	1,687	Yes	Yes	Yes
CM	Noise sensitive point: User defined (91)	412,846	5,075,215	35.0	4.5	40.0	600	31.1	1,077	Yes	Yes	Yes
CN	Noise sensitive point: User defined (92)	409,496	5,077,941	30.7	4.5	40.0	600	28.9	1,485	Yes	Yes	Yes
CO	Noise sensitive point: User defined (93)	413,083	5,075,431	34.1	4.5	40.0	600	30.2	1,233	Yes	Yes	Yes
CP	Noise sensitive point: User defined (94)	412,040	5,077,678	60.0	4.5	40.0	600	31.8	961	Yes	Yes	Yes
CQ	Noise sensitive point: User defined (95)	410,988	5,077,728	62.2	4.5	40.0	600	33.4	721	Yes	Yes	Yes
CR	Noise sensitive point: User defined (96)	409,723	5,077,872	30.9	4.5	40.0	600	29.9	1,294	Yes	Yes	Yes
CS	Noise sensitive point: User defined (97)	410,429	5,077,688	55.7	4.5	40.0	600	33.0	797	Yes	Yes	Yes
CT	Noise sensitive point: User defined (98)	410,008	5,077,764	38.4	4.5	40.0	600	31.4	1,049	Yes	Yes	Yes
CU	Noise sensitive point: User defined (99)	410,131	5,078,630	40.0	4.5	40.0	600	27.4	1,784	Yes	Yes	Yes
CV	Noise sensitive point: User defined (100)	411,555	5,077,917	50.0	4.5	40.0	600	31.6	978	Yes	Yes	Yes
CW	Noise sensitive point: User defined (101)	409,514	5,077,056	63.3	4.5	40.0	600	32.5	855	Yes	Yes	Yes
CX	Noise sensitive point: User defined (102)	412,671	5,076,075	51.9	4.5	40.0	600	33.4	742	Yes	Yes	Yes
CY	Noise sensitive point: User defined (103)	411,191	5,077,777	60.0	4.5	40.0	600	33.0	774	Yes	Yes	Yes
CZ	Noise sensitive point: User defined (104)	413,150	5,077,878	74.7	4.5	40.0	600	27.0	1,863	Yes	Yes	Yes
DA	Noise sensitive point: User defined (105)	411,129	5,077,856	56.1	4.5	40.0	600	32.5	849	Yes	Yes	Yes
DB	Noise sensitive point: User defined (106)	409,209	5,076,469	68.8	4.5	40.0	600	32.2	888	Yes	Yes	Yes
DC	Noise sensitive point: User defined (107)	412,591	5,077,280	70.0	4.5	40.0	600	31.2	1,054	Yes	Yes	Yes
DD	Noise sensitive point: User defined (108)	412,888	5,077,758	75.0	4.5	40.0	600	28.3	1,584	Yes	Yes	Yes
DE	Noise sensitive point: User defined (109)	410,214	5,077,780	45.3	4.5	40.0	600	31.9	966	Yes	Yes	Yes
DF	Noise sensitive point: User defined (110)	410,075	5,073,646	25.1	4.5	40.0	600	28.1	1,663	Yes	Yes	Yes
DG	Noise sensitive point: User defined (111)	409,777	5,077,617	37.7	4.5	40.0	600	31.3	1,057	Yes	Yes	Yes
DH	Noise sensitive point: User defined (112)	412,653	5,076,088	53.6	4.5	40.0	600	33.5	724	Yes	Yes	Yes
DI	Noise sensitive point: User defined (113)	411,499	5,077,845	55.0	4.5	40.0	600	32.2	893	Yes	Yes	Yes
DJ	Noise sensitive point: User defined (114)	412,983	5,078,023	69.5	4.5	40.0	600	27.1	1,834	Yes	Yes	Yes
DK	Noise sensitive point: User defined (115)	409,292	5,076,881	62.9	4.5	40.0	600	31.8	954	Yes	Yes	Yes
DL	Noise sensitive point: User defined (116)	410,501	5,077,760	55.3	4.5	40.0	600	32.6	841	Yes	Yes	Yes
DM	Noise sensitive point: User defined (117)	409,648	5,073,801	27.1	4.5	40.0	600	27.8	1,716	Yes	Yes	Yes
DN	Noise sensitive point: User defined (118)	412,013	5,077,394	70.1	4.5	40.0	600	33.4	714	Yes	Yes	Yes
DO	Noise sensitive point: User defined (119)	412,938	5,075,690	32.5	4.5	40.0	600	31.4	1,036	Yes	Yes	Yes
DP	Noise sensitive point: User defined (120)	412,810	5,077,685	75.0	4.5	40.0	600	28.9	1,478	Yes	Yes	Yes
DQ	Noise sensitive point: User defined (121)	410,251	5,077,632	49.9	4.5	40.0	600	32.8	817	Yes	Yes	Yes
DR	Noise sensitive point: User defined (122)	410,048	5,077,769	40.0	4.5	40.0	600	31.4	1,033	Yes	Yes	Yes
DS	Noise sensitive point: User defined (123)	412,838	5,075,164	35.0	4.5	40.0	600	31.0	1,090	Yes	Yes	Yes
DT	Noise sensitive point: User defined (124)	412,752	5,075,742	38.4	4.5	40.0	600	32.6	844	Yes	Yes	Yes
DU	Noise sensitive point: User defined (125)	412,809	5,075,941	42.0	4.5	40.0	600	32.4	882	Yes	Yes	Yes
DV	Noise sensitive point: User defined (126)	412,727	5,075,907	43.4	4.5	40.0	600	33.0	802	Yes	Yes	Yes
DW	Noise sensitive point: User defined (127)	412,556	5,075,942	51.7	4.5	40.0	600	34.2	629	Yes	Yes	Yes
DX	Noise sensitive point: User defined (128)	412,602	5,075,989	50.5	4.5	40.0	600	33.9	673	Yes	Yes	Yes
DY	Noise sensitive point: User defined (129)	412,665	5,076,029	50.1	4.5	40.0	600	33.4	736	Yes	Yes	Yes

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DECIBEL - Main Result

Calculation: Amherst Noise Assessment

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Noise sensitive area		**UTM (north)-NAD83 (US+CA) Zone: 2**			**Demands**			**Sound Level**		**Demands fulfilled ?**		
No.	Name	East	North	Z	Imission height	Max Noise	Distance	Max From WTGs	Distance to noise demand	Noise	Distance	All
				[m]	[m]	[dB(A)]	[m]	[dB(A)]	[m]			
DZ	Noise sensitive point: User defined (130)	411,436	5,074,795	49.0	4.5	40.0	600	36.1	367	Yes	Yes	Yes
EA	Noise sensitive point: User defined (131)	411,323	5,074,711	40.9	4.5	40.0	600	35.7	422	Yes	Yes	Yes
EB	Noise sensitive point: User defined (132)	411,343	5,074,557	35.0	4.5	40.0	600	34.4	577	Yes	Yes	Yes
EC	Noise sensitive point: User defined (133)	411,223	5,074,585	33.6	4.5	40.0	600	34.8	532	Yes	Yes	Yes
ED	Noise sensitive point: User defined (134)	411,200	5,074,416	25.2	4.5	40.0	600	33.5	698	Yes	Yes	Yes
EE	Noise sensitive point: User defined (135)	411,046	5,074,410	30.0	4.5	40.0	600	33.6	700	Yes	Yes	Yes
EF	Noise sensitive point: User defined (136)	410,991	5,074,359	32.5	4.5	40.0	600	33.2	753	Yes	Yes	Yes
EG	Noise sensitive point: User defined (137)	410,962	5,074,302	33.6	4.5	40.0	600	32.8	811	Yes	Yes	Yes
EH	Noise sensitive point: User defined (138)	410,847	5,074,207	34.1	4.5	40.0	600	32.1	917	Yes	Yes	Yes
EI	Noise sensitive point: User defined (139)	410,735	5,074,078	30.2	4.5	40.0	600	31.2	1,061	Yes	Yes	Yes
EJ	Noise sensitive point: User defined (140)	410,669	5,074,028	30.7	4.5	40.0	600	30.9	1,123	Yes	Yes	Yes
EK	Noise sensitive point: User defined (141)	410,614	5,073,961	33.0	4.5	40.0	600	30.4	1,199	Yes	Yes	Yes
EL	Noise sensitive point: User defined (142)	410,502	5,073,855	35.0	4.5	40.0	600	29.7	1,329	Yes	Yes	Yes
EM	Noise sensitive point: User defined (143)	410,440	5,073,776	35.0	4.5	40.0	600	29.2	1,421	Yes	Yes	Yes
EN	Noise sensitive point: User defined (144)	410,381	5,073,715	35.0	4.5	40.0	600	28.9	1,496	Yes	Yes	Yes
EO	Noise sensitive point: User defined (145)	410,338	5,073,669	35.0	4.5	40.0	600	28.6	1,553	Yes	Yes	Yes
EP	Noise sensitive point: User defined (146)	410,299	5,073,643	33.7	4.5	40.0	600	28.4	1,589	Yes	Yes	Yes
EQ	Noise sensitive point: User defined (147)	410,268	5,073,611	31.2	4.5	40.0	600	28.2	1,629	Yes	Yes	Yes
ER	Noise sensitive point: User defined (148)	410,183	5,073,596	27.2	4.5	40.0	600	28.0	1,671	Yes	Yes	Yes
ES	Noise sensitive point: User defined (149)	410,112	5,073,628	25.3	4.5	40.0	600	28.0	1,666	Yes	Yes	Yes
ET	Noise sensitive point: User defined (150)	409,024	5,074,298	44.8	4.5	40.0	600	27.7	1,724	Yes	Yes	Yes
EU	Noise sensitive point: User defined (151)	408,806	5,076,791	55.0	4.5	40.0	600	29.4	1,366	Yes	Yes	Yes
EV	Noise sensitive point: User defined (152)	408,762	5,076,595	55.0	4.5	40.0	600	29.5	1,352	Yes	Yes	Yes
EW	Noise sensitive point: User defined (153)	408,811	5,076,539	58.9	4.5	40.0	600	29.8	1,291	Yes	Yes	Yes
EX	Noise sensitive point: User defined (154)	408,876	5,076,594	57.0	4.5	40.0	600	30.1	1,241	Yes	Yes	Yes
EY	Noise sensitive point: User defined (155)	408,902	5,076,567	58.7	4.5	40.0	600	30.3	1,209	Yes	Yes	Yes
EZ	Noise sensitive point: User defined (156)	408,851	5,076,499	60.0	4.5	40.0	600	30.1	1,243	Yes	Yes	Yes
FA	Noise sensitive point: User defined (157)	408,876	5,076,468	60.8	4.5	40.0	600	30.3	1,212	Yes	Yes	Yes
FB	Noise sensitive point: User defined (158)	408,823	5,076,389	61.2	4.5	40.0	600	30.0	1,251	Yes	Yes	Yes
FC	Noise sensitive point: User defined (159)	409,006	5,076,580	64.8	4.5	40.0	600	30.8	1,112	Yes	Yes	Yes
FD	Noise sensitive point: User defined (160)	409,036	5,076,615	65.0	4.5	40.0	600	31.0	1,093	Yes	Yes	Yes
FE	Noise sensitive point: User defined (161)	408,848	5,077,333	33.9	4.5	40.0	600	28.5	1,564	Yes	Yes	Yes
FF	Noise sensitive point: User defined (162)	408,816	5,077,274	36.4	4.5	40.0	600	28.5	1,561	Yes	Yes	Yes
FG	Noise sensitive point: User defined (163)	408,790	5,077,254	37.7	4.5	40.0	600	28.4	1,573	Yes	Yes	Yes
FH	Noise sensitive point: User defined (164)	408,765	5,077,234	39.1	4.5	40.0	600	28.3	1,585	Yes	Yes	Yes
FI	Noise sensitive point: User defined (165)	408,854	5,077,222	40.0	4.5	40.0	600	28.8	1,502	Yes	Yes	Yes
FJ	Noise sensitive point: User defined (166)	408,834	5,077,189	41.6	4.5	40.0	600	28.7	1,503	Yes	Yes	Yes
FK	Noise sensitive point: User defined (167)	408,784	5,077,149	43.5	4.5	40.0	600	28.6	1,529	Yes	Yes	Yes
FL	Noise sensitive point: User defined (168)	408,889	5,077,170	43.1	4.5	40.0	600	29.0	1,446	Yes	Yes	Yes
FM	Noise sensitive point: User defined (169)	408,899	5,077,029	53.4	4.5	40.0	600	29.4	1,372	Yes	Yes	Yes
FN	Noise sensitive point: User defined (170)	408,906	5,077,257	37.7	4.5	40.0	600	28.9	1,475	Yes	Yes	Yes
FO	Noise sensitive point: User defined (171)	408,933	5,077,225	40.9	4.5	40.0	600	29.1	1,435	Yes	Yes	Yes
FP	Noise sensitive point: User defined (172)	408,968	5,077,195	43.5	4.5	40.0	600	29.3	1,390	Yes	Yes	Yes
FQ	Noise sensitive point: User defined (173)	408,987	5,077,171	45.5	4.5	40.0	600	29.5	1,361	Yes	Yes	Yes
FR	Noise sensitive point: User defined (174)	408,982	5,077,077	51.8	4.5	40.0	600	29.7	1,320	Yes	Yes	Yes
FS	Noise sensitive point: User defined (175)	408,965	5,077,052	52.6	4.5	40.0	600	29.7	1,323	Yes	Yes	Yes
FT	Noise sensitive point: User defined (176)	409,085	5,077,090	54.2	4.5	40.0	600	30.2	1,236	Yes	Yes	Yes
FU	Noise sensitive point: User defined (177)	409,119	5,077,060	55.5	4.5	40.0	600	30.4	1,191	Yes	Yes	Yes
FV	Noise sensitive point: User defined (178)	409,165	5,076,994	57.6	4.5	40.0	600	30.8	1,119	Yes	Yes	Yes
FW	Noise sensitive point: User defined (179)	409,080	5,076,943	58.3	4.5	40.0	600	30.5	1,171	Yes	Yes	Yes
FX	Noise sensitive point: User defined (180)	409,096	5,076,843	62.8	4.5	40.0	600	30.8	1,115	Yes	Yes	Yes
FY	Noise sensitive point: User defined (181)	409,023	5,076,890	60.0	4.5	40.0	600	30.4	1,201	Yes	Yes	Yes
FZ	Noise sensitive point: User defined (182)	409,149	5,076,893	60.0	4.5	40.0	600	31.0	1,088	Yes	Yes	Yes
GA	Noise sensitive point: User defined (183)	409,213	5,076,950	59.2	4.5	40.0	600	31.2	1,056	Yes	Yes	Yes

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DECIBEL - Main Result

Calculation: Amherst Noise Assessment

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Noise sensitive area		**UTM (north)-NAD83 (US+CA) Zone: 2**			**Demands**			**Sound Level**		**Demands fulfilled ?**		
No.	Name	East	North	Z	Imission height	Max Noise	Distance	Max From WTGs	Distance to noise demand	Noise	Distance	All
				[m]	[m]	[dB(A)]	[m]	[dB(A)]	[m]			
GB	Noise sensitive point: User defined (184)	409,262	5,076,909	61.4	4.5	40.0	600	31.6	994	Yes	Yes	Yes
GC	Noise sensitive point: User defined (185)	409,201	5,076,822	65.5	4.5	40.0	600	31.5	1,011	Yes	Yes	Yes
GD	Noise sensitive point: User defined (186)	409,617	5,077,923	30.0	4.5	40.0	600	29.4	1,398	Yes	Yes	Yes
GE	Noise sensitive point: User defined (187)	409,763	5,077,549	42.1	4.5	40.0	600	31.6	1,013	Yes	Yes	Yes
GF	Noise sensitive point: User defined (188)	409,784	5,077,492	45.9	4.5	40.0	600	31.9	955	Yes	Yes	Yes
GG	Noise sensitive point: User defined (189)	409,801	5,077,452	48.4	4.5	40.0	600	32.2	914	Yes	Yes	Yes
GH	Noise sensitive point: User defined (190)	409,838	5,077,414	50.9	4.5	40.0	600	32.5	861	Yes	Yes	Yes
GI	Noise sensitive point: User defined (191)	409,894	5,077,483	48.8	4.5	40.0	600	32.4	879	Yes	Yes	Yes
GJ	Noise sensitive point: User defined (192)	409,861	5,077,504	46.9	4.5	40.0	600	32.2	916	Yes	Yes	Yes
GK	Noise sensitive point: User defined (193)	409,887	5,077,667	39.9	4.5	40.0	600	31.5	1,032	Yes	Yes	Yes
GL	Noise sensitive point: User defined (194)	409,938	5,077,562	46.1	4.5	40.0	600	32.2	917	Yes	Yes	Yes
GM	Noise sensitive point: User defined (195)	410,012	5,077,627	44.7	4.5	40.0	600	32.1	930	Yes	Yes	Yes
GN	Noise sensitive point: User defined (196)	409,988	5,077,526	48.0	4.5	40.0	600	32.6	859	Yes	Yes	Yes
GO	Noise sensitive point: User defined (197)	410,074	5,077,535	47.8	4.5	40.0	600	32.8	819	Yes	Yes	Yes
GP	Noise sensitive point: User defined (198)	409,927	5,077,710	39.8	4.5	40.0	600	31.4	1,046	Yes	Yes	Yes
GQ	Noise sensitive point: User defined (199)	410,091	5,077,651	45.0	4.5	40.0	600	32.2	910	Yes	Yes	Yes
GR	Noise sensitive point: User defined (200)	410,175	5,077,737	45.5	4.5	40.0	600	32.0	945	Yes	Yes	Yes
GS	Noise sensitive point: User defined (201)	410,244	5,077,747	46.5	4.5	40.0	600	32.1	923	Yes	Yes	Yes
GT	Noise sensitive point: User defined (202)	410,304	5,077,752	46.4	4.5	40.0	600	32.3	903	Yes	Yes	Yes
GU	Noise sensitive point: User defined (203)	410,219	5,077,668	48.2	4.5	40.0	600	32.5	863	Yes	Yes	Yes
GV	Noise sensitive point: User defined (204)	410,242	5,077,624	49.8	4.5	40.0	600	32.9	814	Yes	Yes	Yes
GW	Noise sensitive point: User defined (205)	411,329	5,077,781	60.0	4.5	40.0	600	32.9	796	Yes	Yes	Yes
GX	Noise sensitive point: User defined (206)	411,616	5,077,845	54.2	4.5	40.0	600	32.0	927	Yes	Yes	Yes
GY	Noise sensitive point: User defined (207)	411,648	5,077,836	54.3	4.5	40.0	600	32.0	928	Yes	Yes	Yes
GZ	Noise sensitive point: User defined (208)	412,916	5,077,837	73.4	4.5	40.0	600	28.0	1,658	Yes	Yes	Yes
HA	Noise sensitive point: User defined (209)	412,949	5,077,888	71.4	4.5	40.0	600	27.7	1,716	Yes	Yes	Yes
HB	Noise sensitive point: User defined (210)	412,979	5,077,927	70.0	4.5	40.0	600	27.5	1,765	Yes	Yes	Yes
HC	Noise sensitive point: User defined (211)	412,665	5,077,213	70.0	4.5	40.0	600	31.1	1,077	Yes	Yes	Yes
HD	Noise sensitive point: User defined (212)	412,710	5,077,128	68.9	4.5	40.0	600	31.2	1,070	Yes	Yes	Yes
HE	Noise sensitive point: User defined (213)	412,732	5,077,070	67.1	4.5	40.0	600	31.2	1,061	Yes	Yes	Yes
HF	Noise sensitive point: User defined (214)	412,619	5,076,996	68.4	4.5	40.0	600	32.1	927	Yes	Yes	Yes
HG	Noise sensitive point: User defined (215)	412,763	5,076,976	65.0	4.5	40.0	600	31.3	1,045	Yes	Yes	Yes
HH	Noise sensitive point: User defined (216)	412,634	5,076,917	67.1	4.5	40.0	600	32.2	903	Yes	Yes	Yes
HI	Noise sensitive point: User defined (217)	412,751	5,076,885	64.9	4.5	40.0	600	31.6	996	Yes	Yes	Yes
HJ	Noise sensitive point: User defined (218)	412,621	5,076,849	66.6	4.5	40.0	600	32.5	863	Yes	Yes	Yes
HK	Noise sensitive point: User defined (219)	412,751	5,076,815	64.3	4.5	40.0	600	31.8	969	Yes	Yes	Yes
HL	Noise sensitive point: User defined (220)	412,612	5,076,785	66.8	4.5	40.0	600	32.7	829	Yes	Yes	Yes
HM	Noise sensitive point: User defined (221)	412,607	5,076,709	66.0	4.5	40.0	600	33.0	796	Yes	Yes	Yes
HN	Noise sensitive point: User defined (222)	412,606	5,076,659	65.3	4.5	40.0	600	33.1	779	Yes	Yes	Yes
HO	Noise sensitive point: User defined (223)	412,613	5,076,560	65.0	4.5	40.0	600	33.3	756	Yes	Yes	Yes
HP	Noise sensitive point: User defined (224)	412,961	5,074,234	29.8	4.5	40.0	600	27.7	1,708	Yes	Yes	Yes
HQ	Noise sensitive point: User defined (225)	412,627	5,076,481	65.0	4.5	40.0	600	33.3	750	Yes	Yes	Yes
HR	Noise sensitive point: User defined (226)	412,861	5,073,989	32.4	4.5	40.0	600	27.2	1,810	Yes	Yes	Yes
HS	Noise sensitive point: User defined (227)	413,071	5,074,350	35.0	4.5	40.0	600	27.7	1,716	Yes	Yes	Yes
HT	Noise sensitive point: User defined (228)	412,749	5,076,324	54.1	4.5	40.0	600	32.7	840	Yes	Yes	Yes
HU	Noise sensitive point: User defined (229)	413,229	5,075,453	35.0	4.5	40.0	600	29.5	1,369	Yes	Yes	Yes
HV	Noise sensitive point: User defined (230)	409,888	5,077,361	55.8	4.5	40.0	600	33.0	788	Yes	Yes	Yes
HW	Noise sensitive point: User defined (231)	413,009	5,074,477	35.0	4.5	40.0	600	28.3	1,590	Yes	Yes	Yes
HX	Noise sensitive point: User defined (232)	410,404	5,077,677	55.0	4.5	40.0	600	33.0	796	Yes	Yes	Yes
HY	Noise sensitive point: User defined (233)	410,466	5,077,689	57.6	4.5	40.0	600	33.0	785	Yes	Yes	Yes
HZ	Noise sensitive point: User defined (234)	408,680	5,076,222	61.5	4.5	40.0	600	29.4	1,373	Yes	Yes	Yes
IA	Noise sensitive point: User defined (235)	408,648	5,076,184	62.5	4.5	40.0	600	29.2	1,403	Yes	Yes	Yes
IB	Noise sensitive point: User defined (236)	408,619	5,076,158	62.3	4.5	40.0	600	29.1	1,431	Yes	Yes	Yes
IC	Noise sensitive point: User defined (237)	408,593	5,076,117	62.4	4.5	40.0	600	28.9	1,455	Yes	Yes	Yes

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Project:

AMR_WindPro final location 141204

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Licensed user:

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DECIBEL - Main Result

Calculation: Amherst Noise Assessment

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Noise sensitive area		UTM (north)-NAD83 (US+CA) Zone: 20			Demands			Sound Level		Demands fulfilled ?		
No.	Name	East	North	Z [m]	Imission height [m]	Max Noise [dB(A)]	Distance [m]	Max From WTGs [dB(A)]	Distance to noise demand [m]	Noise	Distance	All
ID	Noise sensitive point: User defined (238)	408,550	5,076,083	61.5	4.5	40.0	600	28.7	1,498	Yes	Yes	Yes
IE	Noise sensitive point: User defined (239)	408,425	5,075,931	59.0	4.5	40.0	600	28.1	1,626	Yes	Yes	Yes
IF	Noise sensitive point: User defined (240)	408,403	5,075,924	58.3	4.5	40.0	600	28.0	1,648	Yes	Yes	Yes
IG	Noise sensitive point: User defined (241)	408,566	5,075,990	64.4	4.5	40.0	600	28.8	1,483	Yes	Yes	Yes
IH	Noise sensitive point: User defined (242)	408,572	5,075,967	65.0	4.5	40.0	600	28.8	1,477	Yes	Yes	Yes
II	Noise sensitive point: User defined (243)	408,553	5,075,947	65.0	4.5	40.0	600	28.7	1,497	Yes	Yes	Yes
IJ	Noise sensitive point: User defined (244)	408,424	5,075,815	63.5	4.5	40.0	600	28.0	1,636	Yes	Yes	Yes
IK	Noise sensitive point: User defined (245)	408,401	5,075,793	63.1	4.5	40.0	600	27.9	1,661	Yes	Yes	Yes
IL	Noise sensitive point: User defined (246)	408,389	5,075,769	62.4	4.5	40.0	600	27.8	1,676	Yes	Yes	Yes
IM	Noise sensitive point: User defined (247)	408,453	5,075,840	64.7	4.5	40.0	600	28.2	1,605	Yes	Yes	Yes
IN	Noise sensitive point: User defined (248)	408,437	5,075,832	63.8	4.5	40.0	600	28.1	1,622	Yes	Yes	Yes
IO	Noise sensitive point: User defined (249)	408,864	5,076,443	61.2	4.5	40.0	600	30.2	1,219	Yes	Yes	Yes
IP	Noise sensitive point: User defined (250)	408,708	5,076,635	55.0	4.5	40.0	600	29.2	1,414	Yes	Yes	Yes
IQ	Noise sensitive point: User defined (251)	408,926	5,076,353	64.5	4.5	40.0	600	30.6	1,143	Yes	Yes	Yes
IR	Noise sensitive point: User defined (252)	408,670	5,076,609	56.7	4.5	40.0	600	29.0	1,445	Yes	Yes	Yes
IS	Noise sensitive point: User defined (253)	408,683	5,076,628	55.8	4.5	40.0	600	29.0	1,437	Yes	Yes	Yes
IT	Noise sensitive point: User defined (254)	408,617	5,076,701	55.4	4.5	40.0	600	28.6	1,519	Yes	Yes	Yes
IU	Noise sensitive point: User defined (255)	408,572	5,076,771	50.6	4.5	40.0	600	28.3	1,583	Yes	Yes	Yes
IV	Noise sensitive point: User defined (256)	408,540	5,076,735	52.1	4.5	40.0	600	28.2	1,603	Yes	Yes	Yes
IW	Noise sensitive point: User defined (257)	408,677	5,076,803	51.7	4.5	40.0	600	28.8	1,492	Yes	Yes	Yes
IX	Noise sensitive point: User defined (258)	408,645	5,076,834	49.1	4.5	40.0	600	28.6	1,532	Yes	Yes	Yes
IY	Noise sensitive point: User defined (259)	408,583	5,076,908	45.0	4.5	40.0	600	28.2	1,616	Yes	Yes	Yes
IZ	Noise sensitive point: User defined (260)	408,971	5,076,639	60.5	4.5	40.0	600	30.6	1,162	Yes	Yes	Yes
JA	Noise sensitive point: User defined (261)	409,016	5,076,651	63.4	4.5	40.0	600	30.8	1,123	Yes	Yes	Yes
JB	Noise sensitive point: User defined (262)	408,928	5,076,992	56.4	4.5	40.0	600	29.6	1,330	Yes	Yes	Yes
JC	Noise sensitive point: User defined (263)	410,435	5,078,635	40.0	4.5	40.0	600	27.8	1,702	Yes	Yes	Yes
JD	Noise sensitive point: User defined (264)	411,332	5,078,365	33.8	4.5	40.0	600	29.4	1,374	Yes	Yes	Yes
JE	Noise sensitive point: User defined (265)	411,342	5,078,397	34.7	4.5	40.0	600	29.2	1,407	Yes	Yes	Yes
JF	Noise sensitive point: User defined (266)	413,544	5,075,493	40.0	4.5	40.0	600	28.0	1,667	Yes	Yes	Yes
JG	Noise sensitive point: User defined (267)	413,205	5,075,446	35.0	4.5	40.0	600	29.6	1,347	Yes	Yes	Yes
JH	Noise sensitive point: User defined (268)	410,460	5,073,823	35.0	4.5	40.0	600	29.5	1,371	Yes	Yes	Yes
JI	Noise sensitive point: User defined (269)	410,234	5,073,606	30.0	4.5	40.0	600	28.1	1,645	Yes	Yes	Yes
JJ	Noise sensitive point: User defined (270)	410,171	5,073,620	27.3	4.5	40.0	600	28.1	1,652	Yes	Yes	Yes
JK	Noise sensitive point: User defined (271)	410,079	5,073,674	27.3	4.5	40.0	600	28.2	1,635	Yes	Yes	Yes
JL	Noise sensitive point: User defined (272)	409,784	5,073,681	22.8	4.5	40.0	600	27.6	1,754	Yes	Yes	Yes
JM	Noise sensitive point: User defined (273)	409,799	5,073,696	24.7	4.5	40.0	600	27.7	1,733	Yes	Yes	Yes
JN	Noise sensitive point: User defined (274)	409,810	5,073,852	35.0	4.5	40.0	600	28.4	1,590	Yes	Yes	Yes
JO	Noise sensitive point: User defined (275)	409,707	5,073,761	25.3	4.5	40.0	600	27.8	1,720	Yes	Yes	Yes
JP	Noise sensitive point: User defined (276)	409,624	5,073,854	28.9	4.5	40.0	600	28.0	1,684	Yes	Yes	Yes
JQ	Noise sensitive point: User defined (277)	409,638	5,073,866	30.3	4.5	40.0	600	28.1	1,666	Yes	Yes	Yes
JR	Noise sensitive point: User defined (278)	409,477	5,073,946	32.6	4.5	40.0	600	27.9	1,689	Yes	Yes	Yes
JS	Noise sensitive point: User defined (279)	409,397	5,073,956	31.5	4.5	40.0	600	27.8	1,728	Yes	Yes	Yes
JT	Noise sensitive point: User defined (280)	409,033	5,074,316	45.0	4.5	40.0	600	27.8	1,705	Yes	Yes	Yes
JU	Noise sensitive point: User defined (281)	409,241	5,076,446	70.0	4.5	40.0	600	32.5	852	Yes	Yes	Yes
JV	Noise sensitive point: User defined (282)	410,583	5,077,810	53.4	4.5	40.0	600	32.5	866	Yes	Yes	Yes
JW	Noise sensitive point: User defined (283)	410,806	5,077,700	60.8	4.5	40.0	600	33.5	711	Yes	Yes	Yes
JX	Noise sensitive point: User defined (284)	410,799	5,077,727	58.6	4.5	40.0	600	33.3	739	Yes	Yes	Yes
JY	Noise sensitive point: User defined (285)	410,836	5,077,708	61.3	4.5	40.0	600	33.5	715	Yes	Yes	Yes
JZ	Noise sensitive point: User defined (286)	411,084	5,077,830	58.6	4.5	40.0	600	32.7	822	Yes	Yes	Yes
KA	Noise sensitive point: User defined (287)	411,343	5,077,856	55.1	4.5	40.0	600	32.3	872	Yes	Yes	Yes
KB	Noise sensitive point: User defined (288)	411,351	5,077,763	60.0	4.5	40.0	600	32.9	782	Yes	Yes	Yes
KC	Noise sensitive point: User defined (289)	411,559	5,077,890	52.7	4.5	40.0	600	31.8	953	Yes	Yes	Yes
KD	Noise sensitive point: User defined (290)	411,573	5,077,865	54.4	4.5	40.0	600	31.9	933	Yes	Yes	Yes
KE	Noise sensitive point: User defined (291)	411,583	5,077,836	55.0	4.5	40.0	600	32.1	908	Yes	Yes	Yes

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DECIBEL - Main Result

Calculation: Amherst Noise Assessment

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Noise sensitive area		**UTM (north)-NAD83 (US+CA) Zone: 20**			**Demands**			**Sound Level**		**Demands fulfilled ?**		
No.	Name	East	North	Z	Imission height	Max Noise	Distance	Max From WTGs	Distance to noise demand	Noise	Distance	All
				[m]	[m]	[dB(A)]	[m]	[dB(A)]	[m]			
KF	Noise sensitive point: User defined (292)	411,645	5,077,877	50.0	4.5	40.0	600	31.7	966	Yes	Yes	Yes
KG	Noise sensitive point: User defined (293)	411,628	5,077,731	56.4	4.5	40.0	600	32.6	823	Yes	Yes	Yes
KH	Noise sensitive point: User defined (294)	411,682	5,077,731	57.4	4.5	40.0	600	32.5	842	Yes	Yes	Yes
KI	Noise sensitive point: User defined (295)	412,061	5,077,716	56.9	4.5	40.0	600	31.5	1,004	Yes	Yes	Yes
KJ	Noise sensitive point: User defined (296)	412,836	5,077,338	71.8	4.5	40.0	600	29.9	1,288	Yes	Yes	Yes
KK	Noise sensitive point: User defined (297)	412,749	5,076,218	50.7	4.5	40.0	600	32.8	828	Yes	Yes	Yes
KL	Noise sensitive point: User defined (298)	412,462	5,075,862	55.0	4.5	40.0	600	34.8	541	Yes	Yes	Yes
KM	Noise sensitive point: User defined (299)	412,490	5,075,869	55.0	4.5	40.0	600	34.6	569	Yes	Yes	Yes
KN	Noise sensitive point: User defined (300)	412,775	5,075,725	37.8	4.5	40.0	600	32.5	870	Yes	Yes	Yes
KO	Noise sensitive point: User defined (301)	412,808	5,075,957	42.5	4.5	40.0	600	32.4	880	Yes	Yes	Yes
KP	Noise sensitive point: User defined (302)	412,854	5,075,174	35.0	4.5	40.0	600	31.0	1,101	Yes	Yes	Yes
KQ	Noise sensitive point: User defined (303)	412,847	5,075,131	35.0	4.5	40.0	600	30.9	1,112	Yes	Yes	Yes
KR	Noise sensitive point: User defined (304)	412,833	5,075,144	35.0	4.5	40.0	600	31.0	1,094	Yes	Yes	Yes
KS	Noise sensitive point: User defined (305)	411,782	5,074,810	49.1	4.5	40.0	600	35.0	498	Yes	Yes	Yes
KT	Noise sensitive point: User defined (306)	412,319	5,075,502	51.5	4.5	40.0	600	35.3	482	Yes	Yes	Yes
KU	Noise sensitive point: User defined (307)	411,597	5,074,808	47.8	4.5	40.0	600	35.7	412	Yes	Yes	Yes
KV	Noise sensitive point: User defined (308)	411,500	5,074,910	54.5	4.5	40.0	600	36.9	281	Yes	Yes	Yes
KW	Noise sensitive point: User defined (309)	411,473	5,074,877	53.1	4.5	40.0	600	36.7	302	Yes	Yes	Yes
KX	Noise sensitive point: User defined (310)	411,438	5,074,808	49.9	4.5	40.0	600	36.2	355	Yes	Yes	Yes
KY	Noise sensitive point: User defined (311)	411,474	5,074,807	49.2	4.5	40.0	600	36.1	368	Yes	Yes	Yes
KZ	Noise sensitive point: User defined (312)	410,737	5,074,093	30.8	4.5	40.0	600	31.3	1,046	Yes	Yes	Yes
LA	Noise sensitive point: User defined (313)	412,703	5,075,931	44.5	4.5	40.0	600	33.1	776	Yes	Yes	Yes
LB	Noise sensitive point: User defined (314)	411,232	5,074,559	32.8	4.5	40.0	600	34.6	559	Yes	Yes	Yes

Distances (m)

	WTG		
NSA	1	2	3
A	1472	1924	1636
B	2000	1816	2259
C	2016	2293	2449
D	1348	1775	1719
E	1979	2246	2412
F	1799	2093	2230
G	1486	1039	1426
H	1447	1902	1628
I	1459	1919	1674
J	2565	2996	2642
K	1562	2021	1847
L	1764	2051	2197
M	1550	1593	1933
N	1545	1971	1914
O	2464	2709	2250
P	2825	2600	2393
Q	2252	2549	2682
R	1811	1666	2096
S	1675	1950	2109
T	1495	1943	1642
U	2038	1844	2290
V	2339	2700	2276
W	1685	2086	2078
X	1608	2059	1929
Y	1429	1887	1630
Z	1516	1948	1878

To be continued on next page...

DECIBEL - Main Result

Calculation: Amherst Noise Assessment

...continued from previous page

	WTG		
NSA	1	2	3
AA	1448	1242	1687
AB	1557	1983	1636
AC	2539	2405	2835
AD	1832	2017	1559
AE	1534	1433	1844
AF	1643	2096	1958
AG	1788	2053	2222
AH	2187	2280	1844
AI	1573	2031	1869
AJ	2549	2798	2339
AK	1486	1945	1774
AL	2799	2419	2432
AM	1445	1906	1699
AN	1793	2179	1779
AO	1537	1987	1863
AP	1538	1609	1932
AQ	1598	1184	1612
AR	1686	2091	2074
AS	2289	2566	2722
AT	1601	1623	1975
AU	1629	2084	1934
AV	1753	2138	1738
AW	1965	1764	2211
AX	1504	1949	1640
AY	1628	1571	1965
AZ	1423	1880	1618
BA	1654	1991	1559
BB	2028	1804	2256
BC	2593	3050	2769
BD	1496	1953	1796
BE	1458	1045	1475
BF	2078	2428	2000
BG	2099	1847	2303
BH	1517	1969	1835
BI	1374	1111	1567
BJ	1781	2066	1615
BK	1784	2053	1598
BL	1330	951	1401
BM	2011	2397	1995
BN	2139	1905	2359
BO	1581	2036	1886
BP	2039	2335	2470
BQ	2954	2630	2550
BR	1482	1850	1897
BS	1542	2004	1796
BT	1535	1555	1908
BU	2780	2398	2415
BV	2604	2476	2904
BW	1884	2156	2317
BX	2584	3040	2752
BY	2830	2410	2509
BZ	1706	2015	1571
CA	1535	1625	1935
CB	1600	2046	1738
CC	1702	2126	1773
CD	1515	1956	1639
CE	1942	2240	2373

To be continued on next page...

DECIBEL - Main Result

Calculation: Amherst Noise Assessment

...continued from previous page

	WTG		
NSA	1	2	3
CF	2181	2309	1863
CG	1354	1814	1564
CH	1974	2363	1963
CI	2563	2999	2653
CJ	1577	1137	1535
CK	2847	2431	2519
CL	2571	2436	2867
CM	2031	1803	2256
CN	2319	2684	2264
CO	2140	1973	2412
CP	1666	2054	2068
CQ	1446	1908	1685
CR	2113	2494	2086
CS	1562	1996	1661
CT	1849	2249	1861
CU	2543	2983	2645
CV	1686	2129	2023
CW	1782	2046	1591
CX	1564	1541	1917
CY	1491	1950	1773
CZ	2577	2865	3008
DA	1568	2029	1836
DB	1922	2044	1598
DC	1773	2046	2206
DD	2298	2598	2728
DE	1747	2166	1804
DF	2842	2432	2507
DG	1891	2256	1839
DH	1544	1525	1899
DI	1602	2048	1935
DJ	2544	2861	2971
DK	1924	2136	1677
DL	1598	2039	1720
DM	2891	2522	2514
DN	1420	1789	1835
DO	1912	1793	2215
DP	2191	2492	2621
DQ	1602	2017	1652
DR	1829	2233	1850
DS	2051	1814	2268
DT	1719	1604	2023
DU	1722	1663	2058
DV	1650	1579	1979
DW	1475	1411	1806
DX	1510	1461	1849
DY	1565	1528	1911
DZ	1526	1071	1436
EA	1590	1129	1463
EB	1745	1285	1613
EC	1706	1244	1547
ED	1874	1412	1702
EE	1880	1421	1675
EF	1933	1477	1716
EG	1992	1537	1769
EH	2099	1648	1854
EI	2244	1798	1981
EJ	2305	1862	2033

To be continued on next page...

DECIBEL - Main Result

Calculation: Amherst Noise Assessment

...continued from previous page

	WTG		
NSA	1	2	3
EK	2382	1941	2103
EL	2511	2076	2218
EM	2603	2170	2304
EN	2678	2248	2374
EO	2734	2306	2426
EP	2770	2344	2458
EQ	2810	2385	2496
ER	2851	2432	2528
ES	2845	2432	2514
ET	2892	2619	2469
EU	2370	2535	2081
EV	2380	2508	2063
EW	2325	2445	2001
EX	2267	2400	1953
EY	2237	2367	1920
EZ	2281	2395	1953
FA	2253	2363	1922
FB	2301	2394	1959
FC	2136	2272	1824
FD	2111	2256	1806
FE	2503	2751	2293
FF	2508	2746	2287
FG	2524	2758	2299
FH	2540	2769	2310
FI	2453	2687	2228
FJ	2459	2687	2228
FK	2491	2710	2251
FL	2401	2630	2171
FM	2343	2552	2093
FN	2419	2661	2202
FO	2381	2621	2162
FP	2337	2575	2117
FQ	2310	2546	2088
FR	2281	2503	2044
FS	2288	2505	2046
FT	2189	2421	1962
FU	2147	2376	1917
FV	2080	2303	1844
FW	2144	2352	1893
FX	2101	2292	1834
FY	2184	2378	1920
FZ	2064	2267	1809
GA	2021	2239	1780
GB	1961	2176	1717
GC	1994	2188	1730
GD	2222	2597	2183
GE	1854	2211	1789
GF	1800	2154	1730
GG	1761	2112	1688
GH	1708	2059	1636
GI	1713	2078	1664
GJ	1752	2115	1699
GK	1851	2232	1827
GL	1739	2116	1710
GM	1739	2130	1735
GN	1679	2058	1655
GO	1629	2019	1625

To be continued on next page...

DECIBEL - Main Result

Calculation: Amherst Noise Assessment

...continued from previous page

	WTG		
NSA	1	2	3
GP	1857	2245	1847
GQ	1709	2109	1725
GR	1731	2144	1775
GS	1703	2123	1763
GT	1677	2103	1752
GU	1649	2063	1696
GV	1600	2013	1647
GW	1507	1962	1815
GX	1634	2071	1983
GY	1635	2070	1989
GZ	2370	2676	2799
HA	2429	2736	2857
HB	2477	2785	2905
HC	1799	2053	2232
HD	1796	2031	2229
HE	1790	2012	2221
HF	1656	1877	2087
HG	1779	1980	2208
HH	1638	1841	2067
HI	1735	1919	2161
HJ	1601	1791	2027
HK	1712	1881	2135
HL	1571	1748	1995
HM	1543	1703	1964
HN	1530	1677	1947
HO	1516	1636	1925
HP	2757	2412	2864
HQ	1517	1615	1920
HR	2883	2511	2954
HS	2749	2423	2879
HT	1627	1674	2013
HU	2266	2112	2548
HV	1635	1986	1564
HW	2615	2297	2755
HX	1564	1995	1655
HY	1547	1984	1655
HZ	2443	2501	2080
IA	2476	2527	2110
IB	2506	2553	2137
IC	2535	2573	2162
ID	2580	2613	2204
IE	2721	2727	2333
IF	2743	2749	2355
IG	2573	2589	2189
IH	2570	2582	2184
II	2592	2600	2204
IJ	2739	2726	2343
IK	2766	2749	2368
IL	2782	2762	2383
IM	2706	2697	2311
IN	2723	2713	2328
IO	2263	2368	1929
IP	2439	2572	2126
IQ	2197	2285	1851
IR	2473	2600	2155
IS	2463	2594	2148
IT	2539	2680	2231

To be continued on next page...

DECIBEL - Main Result

Calculation: Amherst Noise Assessment

...continued from previous page

	WTG		
NSA	1	2	3
IU	2595	2745	2295
IV	2620	2763	2315
IW	2499	2659	2206
IX	2536	2700	2247
IY	2614	2785	2331
IZ	2179	2325	1875
JA	2137	2288	1836
JB	2304	2509	2051
JC	2445	2898	2596
JD	2088	2545	2377
JE	2120	2577	2411
JF	2549	2417	2847
JG	2247	2090	2527
JH	2552	2119	2255
JI	2825	2403	2508
JJ	2832	2414	2508
JK	2814	2405	2479
JL	2930	2544	2568
JM	2910	2523	2549
JN	2767	2387	2400
JO	2896	2520	2525
JP	2858	2494	2478
JQ	2840	2476	2461
JR	2862	2517	2469
JS	2901	2564	2503
JT	2873	2601	2449
JU	1888	2007	1562
JV	1615	2062	1759
JW	1447	1904	1642
JX	1475	1932	1669
JY	1448	1907	1651
JZ	1542	2004	1801
KA	1584	2038	1891
KB	1493	1946	1806
KC	1661	2103	2000
KD	1640	2081	1983
KE	1615	2055	1961
KF	1673	2109	2025
KG	1529	1963	1887
KH	1548	1977	1912
KI	1709	2097	2110
KJ	2010	2264	2444
KK	1628	1646	2001
KL	1406	1312	1719
KM	1431	1341	1746
KN	1746	1628	2048
KO	1718	1663	2057
KP	2059	1825	2279
KQ	2077	1834	2290
KR	2058	1816	2271
KS	1619	1197	1618
KT	1432	1213	1661
KU	1554	1113	1509
KV	1429	982	1370
KW	1454	1003	1383
KX	1513	1059	1426
KY	1522	1070	1444

To be continued on next page...

DECIBEL - Main Result

Calculation: Amherst Noise Assessment

...continued from previous page

	WTG		
NSA	1	2	3
KZ	2229	1783	1966
LA	1621	1556	1953
LB	1733	1271	1574

Project:
AMR_WindPro final location 141204

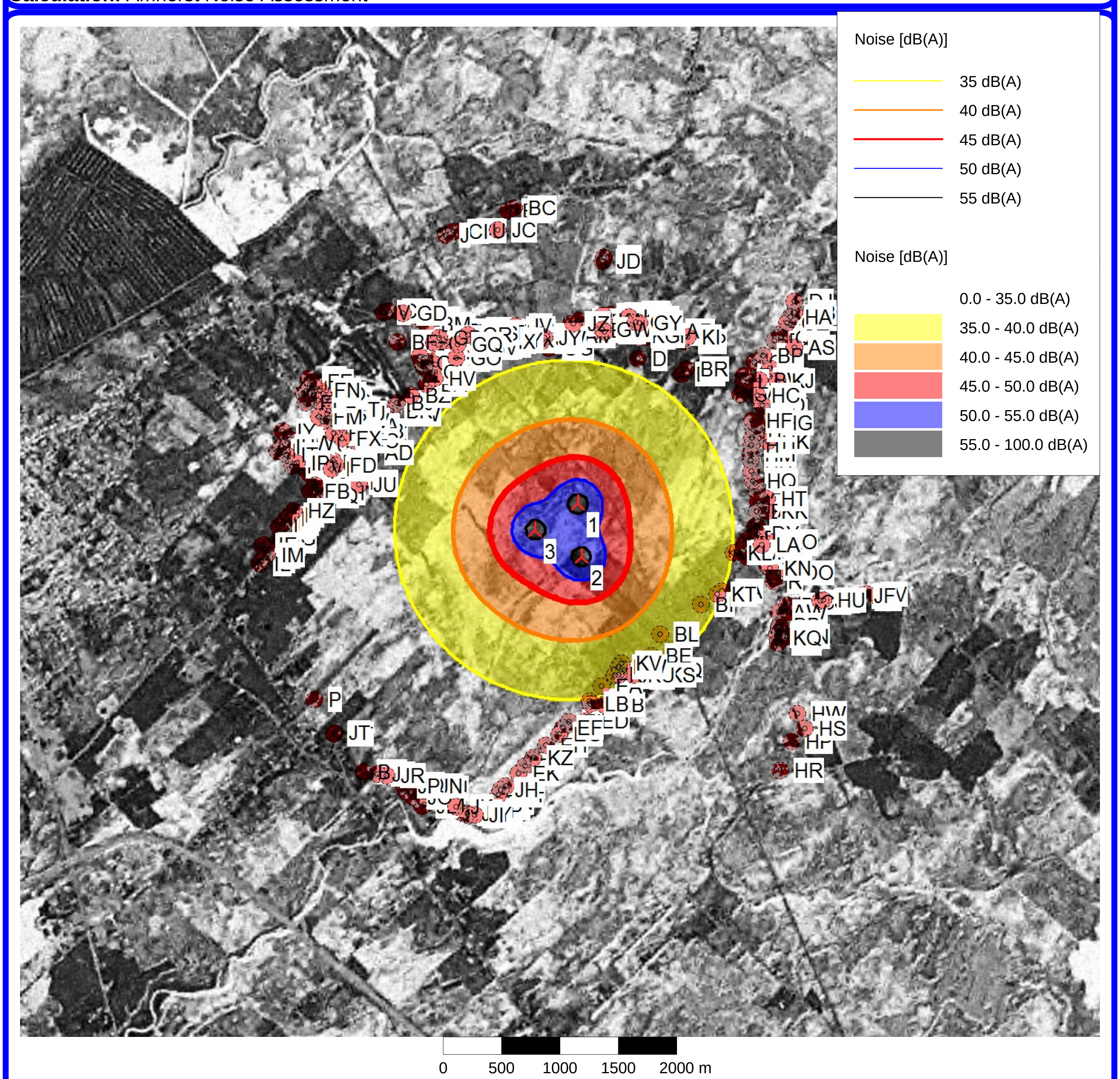
Printed/Page
05/12/2014 10:10 AM / 1

Licensed user:
Natural Forces Wind Inc
1791 Barrington Street Suite 1030
CA-HALIFAX, Nova Scotia B3J 3L1
902 422 9663
Amy / apellerin@naturalforces.ca

Calculated:
05/12/2014 9:57 AM/2.9.269

DECIBEL - Map 9.0 m/s

Calculation: Amherst Noise Assessment



Map: WindPRO map , Print scale 1:50,000, Map center UTM (north)-NAD83 (US+CA) Zone: 20 East: 410,952 North: 5,076,057

⅄ New WTG   ⬟ Noise sensitive area

Noise calculation model: ISO 9613-2 General. Wind speed: 9.0 m/s
Height above sea level from active line object

DECIBEL - Assumptions for noise calculation

Calculation: Amherst Noise Assessment

Noise calculation model:
ISO 9613-2 General
Wind speed:
4.0 m/s - 12.0 m/s, step 1.0 m/s
Ground attenuation:
None
Meteorological coefficient, C0:
0.0 dB
Type of demand in calculation:
1: WTG noise is compared to demand (DK, DE, SE, NL etc.)
Noise values in calculation:
All noise values are mean values (Lwa) (Normal)
Pure tones:
Pure and Impulse tone penalty are added to WTG source noise
Height above ground level, when no value in NSA object:
4.5 m Don't allow override of model height with height from NSA object
Deviation from "official" noise demands. Negative is more restrictive, positive is less restrictive.:
0.0 dB(A)
Octave data required
Air absorption

63 [db/km]	125 [db/km]	250 [db/km]	500 [db/km]	1,000 [db/km]	2,000 [db/km]	4,000 [db/km]	8,000 [db/km]
0.1	0.4	1.0	1.9	3.7	9.7	32.8	117.0

WTG: ENERCON E-92 2,3 MW 2300 92.0 !-!
Noise: Level 0 - calculated - Op.Mode I - 03/2012

Source	Source/Date	Creator	Edited
Manufacturer	16/03/2012	EMD	16/03/2012 5:58 PM

According to manufacturer specification document "SIAS-04-SPL-E-92 OM I 2 3 MW Est Rev1 1-en-eng.pdf" dated 03/2012

						Octave data							
Status	Hub height [m]	Wind speed [m/s]	LwA,ref [dB(A)]	Pure tones		63 [dB]	125 [dB]	250 [dB]	500 [dB]	1000 [dB]	2000 [dB]	4000 [dB]	8000 [dB]
ExtraPolated	98.0	4.0	97.6	No	Generic data	79.2	86.2	89.6	92.2	92.0	89.1	84.3	74.8
From Windcat	98.0	5.0	99.9	No	Generic data	81.5	88.5	91.9	94.5	94.3	91.4	86.6	77.1
From Windcat	98.0	6.0	102.2	No	Generic data	83.8	90.8	94.2	96.8	96.6	93.7	88.9	79.4
From Windcat	98.0	7.0	103.4	No	Generic data	85.0	92.0	95.4	98.0	97.8	94.9	90.1	80.6
From Windcat	98.0	8.0	104.4	No	Generic data	86.0	93.0	96.4	99.0	98.8	95.9	91.1	81.6
From Windcat	98.0	9.0	105.0	No	Generic data	86.6	93.6	97.0	99.6	99.4	96.5	91.7	82.2
From Windcat	98.0	10.0	105.0	No	Generic data	86.6	93.6	97.0	99.6	99.4	96.5	91.7	82.2
From Windcat	98.0	11.0	105.0	No	Generic data	86.6	93.6	97.0	99.6	99.4	96.5	91.7	82.2
From Windcat	98.0	12.0	105.0	No	Generic data	86.6	93.6	97.0	99.6	99.4	96.5	91.7	82.2

NSA: Noise sensitive point: User defined (1)-A
Predefined calculation standard:
Imission height(a.g.l.): Use standard value from calculation model

Noise demand: 40.0 dB(A)
Ambient noise: 0.0 dB(A)
Margin or Allowed additional exposure: 0.0 dB(A)
Sound level always accepted: 0.0 dB(A)
Distance demand: 600

NSA: Noise sensitive point: User defined (2)-B
Predefined calculation standard:
Imission height(a.g.l.): Use standard value from calculation model

Appendix J:

Shadow Flicker Assessment

Amherst Community Wind Farm
Shadow Flicker Assessment Report
November 2014

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Report Information

Client	Natural Forces Wind Inc.
Client Contact	Chris Veinot
Report Name	Amherst Community Wind Farm Shadow Flicker Assessment
Created By	Chris Veinot
Signature	

** The WindPRO v2.9, Decibel Module Calculation Results for Enercon E-92 2.3 MW @ 98m Hub Height. To review General Specification for the Enercon E-92 please contact:

Chris Veinot, Development Engineer
Natural Forces Wind Inc.
1801 Hollis Street Suite 1205
Halifax Nova Scotia B3J 3N4
Telephone: 902 422 9663 ext. 219
Fax: 902 422 9780
Contact email: cveinot@naturalforces.ca

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1. Introduction

Natural Forces Wind Inc. has undertaken a shadow flicker impact assessment for the proposed Amherst Community Wind Farm to assess the potential impact of shadow flicker on the surrounding shadow receptors. Details outlining the shadow receptors, prediction methodology and assumptions made for the assessment are included herein, with complete WindPRO results supplied in the annexes. This report also provides background information on shadow flicker.

As there are very few federal, provincial or municipal guidelines or policies for governing or quantifying what is an acceptable amount of shadow flicker at this time, the German standards, *Hinweise zur Ermittlung und Beurteilung der optischen Immissionen von Windenergianlagen*, have been adopted for this study. Often, careful site design in the first instance is recommended, followed by industry accepted mitigation strategies thereafter. This assessment will be used as supporting documentation to demonstrate compliance with these standards. The shadow flicker analysis was conducted using the Shadow module of the software package, WindPRO version 2.9.

2. Background

Flicker is caused by incident light rays on a moving object which then casts an intermittent shadow on a receptor. This intermittent shadow, perceived as a change in light intensity to an observer, as it pertains to wind turbine generators (WTG), is referred to as shadow flicker. Shadow flicker is caused by incident sun rays on the rotor blades as they turn.

For shadow flicker to occur, the following criteria must be met:

1. The sun must be shining and not obscured by any cloud cover.
2. The wind turbine must be between the sun and the shadow receptor.
3. The line of sight between the turbine and the shadow receptor must be clear. Light-impermeable obstacles, such as vegetation, buildings, awnings etc., will prevent shadow flicker from occurring at the receptor.
4. The shadow receptor has to be close enough to the turbine to be in the shadow.

3. Policy and Guidelines

As previously stated, there are no municipal, provincial or federal guidelines or policies for governing or quantifying what is an acceptable amount of shadow flicker. As a result, the German standards have been adopted for this study. The German shadow flicker guidelines provide a means of quantifying acceptable levels of shadow flicker exposure based on the astronomic worst case. Acceptable levels at shadow receptors are:

- no more than 30 hours per year of astronomical maximum shadow (worst case); and
- no more than 30 minutes on the worst day of astronomical maximum shadow (worst case).

The guidelines also stipulate two factors that limit the shadow flicker effect, due to optic conditions in the atmosphere:

1) the angle of the sun over the horizon, which must be at least 3 degrees; and
2) the blade of the WTG must cover at least 20 % of the sun.

Receptors not exposed to more than 30 minutes per day on the worst affected day or a total of 30 hours per year from all surrounding wind turbines are considered unlikely to require technical mitigation.

4. General Description of Project Site and Surrounds

The proposed Amherst Community Wind Farm consists of a maximum of 3 WTGs located in the Municipality of Cumberland County, Nova Scotia. Enercon E-92 wind turbines are being considered for the project and therefore are used in this assessment, however if the turbine type was to change, a new shadow flicker assessment would be conducted.

The project site is situated approximately 5.5 kilometers east of Amherst in between Pumping Station Road and John Black Road.

5. Description of Receptors

There are 314 points of reception taken into consideration for this shadow flicker assessment. The receptors are mostly residential buildings and/or seasonal camps located within 2,500 metres (m) of the nearest proposed WTG.

Details of receptor locations and distances to nearest WTG are detailed in Table 1. Receptor IDs included in Table 1 correspond with the WindPRO generated map included in Annex A.

Table 1: Description of receptors.

Point of Reception ID	Location (UTM Zone 20, NAD 83)		Distance from receptor to: (meters)		
	Easting	Northing	Wind Turbine 1	Wind Turbine 2	Wind Turbine 3
A	410687	5077694	1472	1924	1636
B	412917	5075407	2000	1816	2259
C	412770	5077450	2016	2293	2449
D	411637	5077534	1348	1775	1719
E	412772	5077381	1979	2246	2412
F	412548	5077384	1799	2093	2230
G	411522	5074857	1486	1039	1426
H	410752	5077687	1447	1902	1628
I	410886	5077728	1459	1919	1674
J	409985	5078587	2565	2996	2642
K	411218	5077847	1562	2021	1847
L	412545	5077331	1764	2051	2197
M	412672	5076299	1550	1593	1933
N	411712	5077716	1545	1971	1914
O	408873	5077294	2464	2709	2250
P	408859	5074597	2825	2600	2393
Q	412869	5077709	2252	2549	2682
R	412802	5075612	1811	1666	2096
S	412515	5077219	1675	1950	2109
T	410620	5077696	1495	1943	1642
U	412931	5075350	2038	1844	2290
V	409450	5077924	2339	2700	2276
W	411964	5077748	1685	2086	2078
X	411426	5077867	1608	2059	1929
Y	410833	5077687	1429	1887	1630
Z	411651	5077709	1516	1948	1878
AA	412356	5075531	1448	1242	1687
AB	410362	5077647	1557	1983	1636

Point of Reception ID	Location (UTM Zone 20, NAD 83)		Distance from receptor to: (meters)		
	Easting	Northing	Wind Turbine 1	Wind Turbine 2	Wind Turbine 3
AC	413531	5075487	2539	2405	2835
AD	409342	5076720	1832	2017	1559
AE	412583	5075822	1534	1433	1844
AF	411398	5077908	1643	2096	1958
AG	412629	5077251	1788	2053	2222
AH	408937	5076375	2187	2280	1844
AI	411274	5077854	1573	2031	1869
AJ	408809	5077359	2549	2798	2339
AK	411218	5077771	1486	1945	1774
AL	409789	5073827	2799	2419	2432
AM	411056	5077731	1445	1906	1699
AN	409952	5077647	1793	2179	1779
AO	411435	5077793	1537	1987	1863
AP	412657	5076391	1538	1609	1932
AQ	411822	5074852	1598	1184	1612
AR	411931	5077767	1686	2091	2074
AS	412980	5077625	2289	2566	2722
AT	412722	5076231	1601	1623	1975
AU	411337	5077903	1629	2084	1934
AV	409973	5077612	1753	2138	1738
AW	412848	5075349	1965	1764	2211
AX	410575	5077689	1504	1949	1640
AY	412716	5075955	1628	1571	1965
AZ	410809	5077676	1423	1880	1618
BA	409819	5077307	1654	1991	1559
BB	412854	5075234	2028	1804	2256
BC	410573	5078822	2593	3050	2769
BD	411281	5077776	1496	1953	1796
BE	411755	5074975	1458	1045	1475
BF	409573	5077673	2078	2428	2000
BG	412840	5075082	2099	1847	2303
BH	411385	5077782	1517	1969	1835
BI	412181	5075412	1374	1111	1567
BJ	409564	5077151	1781	2066	1615
BK	409521	5077076	1784	2053	1598
BL	411829	5075161	1330	951	1401
BM	409821	5077822	2011	2397	1995
BN	412926	5075138	2139	1905	2359

Point of Reception ID	Location (UTM Zone 20, NAD 83)		Distance from receptor to: (meters)		
	Easting	Northing	Wind Turbine 1	Wind Turbine 2	Wind Turbine 3
BO	411328	5077855	1581	2036	1886
BP	412716	5077559	2039	2335	2470
BQ	409280	5073978	2954	2630	2550
BR	412052	5077442	1482	1850	1897
BS	411061	5077829	1542	2004	1796
BT	412655	5076219	1535	1555	1908
BU	409819	5073832	2780	2398	2415
BV	413605	5075505	2604	2476	2904
BW	412682	5077344	1884	2156	2317
BX	410520	5078801	2584	3040	2752
BY	410203	5073611	2830	2410	2509
BZ	409689	5077214	1706	2015	1571
CA	412647	5076460	1535	1625	1935
CB	410561	5077786	1600	2046	1738
CC	410282	5077768	1702	2126	1773
CD	410532	5077683	1515	1956	1639
CE	412639	5077501	1942	2240	2373
CF	408957	5076550	2181	2309	1863
CG	410871	5077619	1354	1814	1564
CH	409864	5077809	1974	2363	1963
CI	410056	5078619	2563	2999	2653
CJ	411620	5074792	1577	1137	1535
CK	410139	5073616	2847	2431	2519
CL	413559	5075468	2571	2436	2867
CM	412846	5075215	2031	1803	2256
CN	409496	5077941	2319	2684	2264
CO	413083	5075431	2140	1973	2412
CP	412040	5077678	1666	2054	2068
CQ	410988	5077728	1446	1908	1685
CR	409723	5077872	2113	2494	2086
CS	410429	5077688	1562	1996	1661
CT	410008	5077764	1849	2249	1861
CU	410131	5078630	2543	2983	2645
CV	411555	5077917	1686	2129	2023
CW	409514	5077056	1782	2046	1591
CX	412671	5076075	1564	1541	1917
CY	411191	5077777	1491	1950	1773
CZ	413150	5077878	2577	2865	3008

Point of Reception ID	Location (UTM Zone 20, NAD 83)		Distance from receptor to: (meters)		
	Easting	Northing	Wind Turbine 1	Wind Turbine 2	Wind Turbine 3
DA	411129	5077856	1568	2029	1836
DB	409209	5076469	1922	2044	1598
DC	412591	5077280	1773	2046	2206
DD	412888	5077758	2298	2598	2728
DE	410214	5077780	1747	2166	1804
DF	410075	5073646	2842	2432	2507
DG	409777	5077617	1891	2256	1839
DH	412653	5076088	1544	1525	1899
DI	411499	5077845	1602	2048	1935
DJ	412983	5078023	2544	2861	2971
DK	409292	5076881	1924	2136	1677
DL	410501	5077760	1598	2039	1720
DM	409648	5073801	2891	2522	2514
DN	412013	5077394	1420	1789	1835
DO	412938	5075690	1912	1793	2215
DP	412810	5077685	2191	2492	2621
DQ	410251	5077632	1602	2017	1652
DR	410048	5077769	1829	2233	1850
DS	412838	5075164	2051	1814	2268
DT	412752	5075742	1719	1604	2023
DU	412809	5075941	1722	1663	2058
DV	412727	5075907	1650	1579	1979
DW	412556	5075942	1475	1411	1806
DX	412602	5075989	1510	1461	1849
DY	412665	5076029	1565	1528	1911
DZ	411436	5074795	1526	1071	1436
EA	411323	5074711	1590	1129	1463
EB	411343	5074557	1745	1285	1613
EC	411223	5074585	1706	1244	1547
ED	411200	5074416	1874	1412	1702
EE	411046	5074410	1880	1421	1675
EF	410991	5074359	1933	1477	1716
EG	410962	5074302	1992	1537	1769
EH	410847	5074207	2099	1648	1854
EI	410735	5074078	2244	1798	1981
EJ	410669	5074028	2305	1862	2033
EK	410614	5073961	2382	1941	2103
EL	410502	5073855	2511	2076	2218

Point of Reception ID	Location (UTM Zone 20, NAD 83)		Distance from receptor to: (meters)		
	Easting	Northing	Wind Turbine 1	Wind Turbine 2	Wind Turbine 3
EM	410440	5073776	2603	2170	2304
EN	410381	5073715	2678	2248	2374
EO	410338	5073669	2734	2306	2426
EP	410299	5073643	2770	2344	2458
EQ	410268	5073611	2810	2385	2496
ER	410183	5073596	2851	2432	2528
ES	410112	5073628	2845	2432	2514
ET	409024	5074298	2892	2619	2469
EU	408806	5076791	2370	2535	2081
EV	408762	5076595	2380	2508	2063
EW	408811	5076539	2325	2445	2001
EX	408876	5076594	2267	2400	1953
EY	408902	5076567	2237	2367	1920
EZ	408851	5076499	2281	2395	1953
FA	408876	5076468	2253	2363	1922
FB	408823	5076389	2301	2394	1959
FC	409006	5076580	2136	2272	1824
FD	409036	5076615	2111	2256	1806
FE	408848	5077333	2503	2751	2293
FF	408816	5077274	2508	2746	2287
FG	408790	5077254	2524	2758	2299
FH	408765	5077234	2540	2769	2310
FI	408854	5077222	2453	2687	2228
FJ	408834	5077189	2459	2687	2228
FK	408784	5077149	2491	2710	2251
FL	408889	5077170	2401	2630	2171
FM	408899	5077029	2343	2552	2093
FN	408906	5077257	2419	2661	2202
FO	408933	5077225	2381	2621	2162
FP	408968	5077195	2337	2575	2117
FQ	408987	5077171	2310	2546	2088
FR	408982	5077077	2281	2503	2044
FS	408965	5077052	2288	2505	2046
FT	409085	5077090	2189	2421	1962
FU	409119	5077060	2147	2376	1917
FV	409165	5076994	2080	2303	1844
FW	409080	5076943	2144	2352	1893
FX	409096	5076843	2101	2292	1834

Point of Reception ID	Location (UTM Zone 20, NAD 83)		Distance from receptor to: (meters)		
	Easting	Northing	Wind Turbine 1	Wind Turbine 2	Wind Turbine 3
FY	409023	5076890	2184	2378	1920
FZ	409149	5076893	2064	2267	1809
GA	409213	5076950	2021	2239	1780
GB	409262	5076909	1961	2176	1717
GC	409201	5076822	1994	2188	1730
GD	409617	5077923	2222	2597	2183
GE	409763	5077549	1854	2211	1789
GF	409784	5077492	1800	2154	1730
GG	409801	5077452	1761	2112	1688
GH	409838	5077414	1708	2059	1636
GI	409894	5077483	1713	2078	1664
GJ	409861	5077504	1752	2115	1699
GK	409887	5077667	1851	2232	1827
GL	409938	5077562	1739	2116	1710
GM	410012	5077627	1739	2130	1735
GN	409988	5077526	1679	2058	1655
GO	410074	5077535	1629	2019	1625
GP	409927	5077710	1857	2245	1847
GQ	410091	5077651	1709	2109	1725
GR	410175	5077737	1731	2144	1775
GS	410244	5077747	1703	2123	1763
GT	410304	5077752	1677	2103	1752
GU	410219	5077668	1649	2063	1696
GV	410242	5077624	1600	2013	1647
GW	411329	5077781	1507	1962	1815
GX	411616	5077845	1634	2071	1983
GY	411648	5077836	1635	2070	1989
GZ	412916	5077837	2370	2676	2799
HA	412949	5077888	2429	2736	2857
HB	412979	5077927	2477	2785	2905
HC	412665	5077213	1799	2053	2232
HD	412710	5077128	1796	2031	2229
HE	412732	5077070	1790	2012	2221
HF	412619	5076996	1656	1877	2087
HG	412763	5076976	1779	1980	2208
HH	412634	5076917	1638	1841	2067
HI	412751	5076885	1735	1919	2161
HJ	412621	5076849	1601	1791	2027

Point of Reception ID	Location (UTM Zone 20, NAD 83)		Distance from receptor to: (meters)		
	Easting	Northing	Wind Turbine 1	Wind Turbine 2	Wind Turbine 3
HK	412751	5076815	1712	1881	2135
HL	412612	5076785	1571	1748	1995
HM	412607	5076709	1543	1703	1964
HN	412606	5076659	1530	1677	1947
HO	412613	5076560	1516	1636	1925
HP	412961	5074234	2757	2412	2864
HQ	412627	5076481	1517	1615	1920
HR	412861	5073989	2883	2511	2954
HS	413071	5074350	2749	2423	2879
HT	412749	5076324	1627	1674	2013
HU	413229	5075453	2266	2112	2548
HV	409888	5077361	1635	1986	1564
HW	413009	5074477	2615	2297	2755
HX	410404	5077677	1564	1995	1655
HY	410466	5077689	1547	1984	1655
HZ	408680	5076222	2443	2501	2080
IA	408648	5076184	2476	2527	2110
IB	408619	5076158	2506	2553	2137
IC	408593	5076117	2535	2573	2162
ID	408550	5076083	2580	2613	2204
IE	408425	5075931	2721	2727	2333
IF	408403	5075924	2743	2749	2355
IG	408566	5075990	2573	2589	2189
IH	408572	5075967	2570	2582	2184
II	408553	5075947	2592	2600	2204
IJ	408424	5075815	2739	2726	2343
IK	408401	5075793	2766	2749	2368
IL	408389	5075769	2782	2762	2383
IM	408453	5075840	2706	2697	2311
IN	408437	5075832	2723	2713	2328
IO	408864	5076443	2263	2368	1929
IP	408708	5076635	2439	2572	2126
IQ	408926	5076353	2197	2285	1851
IR	408670	5076609	2473	2600	2155
IS	408683	5076628	2463	2594	2148
IT	408617	5076701	2539	2680	2231
IU	408572	5076771	2595	2745	2295
IV	408540	5076735	2620	2763	2315

Point of Reception ID	Location (UTM Zone 20, NAD 83)		Distance from receptor to: (meters)		
	Easting	Northing	Wind Turbine 1	Wind Turbine 2	Wind Turbine 3
IW	408677	5076803	2499	2659	2206
IX	408645	5076834	2536	2700	2247
IY	408583	5076908	2614	2785	2331
IZ	408971	5076639	2179	2325	1875
JA	409016	5076651	2137	2288	1836
JB	408928	5076992	2304	2509	2051
JC	410435	5078635	2445	2898	2596
JD	411332	5078365	2088	2545	2377
JE	411342	5078397	2120	2577	2411
JF	413544	5075493	2549	2417	2847
JG	413205	5075446	2247	2090	2527
JH	410460	5073823	2552	2119	2255
JI	410234	5073606	2825	2403	2508
JJ	410171	5073620	2832	2414	2508
JK	410079	5073674	2814	2405	2479
JL	409784	5073681	2930	2544	2568
JM	409799	5073696	2910	2523	2549
JN	409810	5073852	2767	2387	2400
JO	409707	5073761	2896	2520	2525
JP	409624	5073854	2858	2494	2478
JQ	409638	5073866	2840	2476	2461
JR	409477	5073946	2862	2517	2469
JS	409397	5073956	2901	2564	2503
JT	409033	5074316	2873	2601	2449
JU	409241	5076446	1888	2007	1562
JV	410583	5077810	1615	2062	1759
JW	410806	5077700	1447	1904	1642
JX	410799	5077727	1475	1932	1669
JY	410836	5077708	1448	1907	1651
JZ	411084	5077830	1542	2004	1801
KA	411343	5077856	1584	2038	1891
KB	411351	5077763	1493	1946	1806
KC	411559	5077890	1661	2103	2000
KD	411573	5077865	1640	2081	1983
KE	411583	5077836	1615	2055	1961
KF	411645	5077877	1673	2109	2025
KG	411628	5077731	1529	1963	1887
KH	411682	5077731	1548	1977	1912

Point of Reception ID	Location (UTM Zone 20, NAD 83)		Distance from receptor to: (meters)		
	Easting	Northing	Wind Turbine 1	Wind Turbine 2	Wind Turbine 3
KI	412061	5077716	1709	2097	2110
KJ	412836	5077338	2010	2264	2444
KK	412749	5076218	1628	1646	2001
KL	412462	5075862	1406	1312	1719
KM	412490	5075869	1431	1341	1746
KN	412775	5075725	1746	1628	2048
KO	412808	5075957	1718	1663	2057
KP	412854	5075174	2059	1825	2279
KQ	412847	5075131	2077	1834	2290
KR	412833	5075144	2058	1816	2271
KS	411782	5074810	1619	1197	1618
KT	412319	5075502	1432	1213	1661
KU	411597	5074808	1554	1113	1509
KV	411500	5074910	1429	982	1370
KW	411473	5074877	1454	1003	1383
KX	411438	5074808	1513	1059	1426
KY	411474	5074807	1522	1070	1444
KZ	410737	5074093	2229	1783	1966
LA	412703	5075931	1621	1556	1953
LB	411232	5074559	1733	1271	1574

6. Description of Sources

6.1. Turbine Locations

A map of the project area with the proposed WTG layout is illustrated in Annex A. The existing Amherst Wind Farm, owned by Capstone, located on the Tantramar Marsh is approximately 7.5 kilometers North West. There are no existing or proposed wind farms within 5 kilometers the project, thus it is unlikely any cumulative shadow flicker effects will occur. Coordinates of the wind turbines are given below in Table 2. Turbine ID numbers included in Table 2 with the WindPRO generated figures included Annex A.

Table 2: Coordinates of proposed turbine locations.

WTG ID Number	Proposed WTG Location (UTM Zone 20, NAD 83)	
	Easting	Northing
1	411,122 m E	5,076,288 m N
2	411,150 m E	5,075,827 m N
3	410,754 m E	5,076,059 m N

6.2. Turbine Types

The model of WTGs being considered for the proposed wind farm is the Enercon E-92 2.0 MW. The E-92 2.0 MW have the same hub height and blade length as the E-92 2.3 MW, however the turbine is derated to 2.0 MW.

This model utilizes horizontal axis, upwind, 3-bladed, and a microprocessor pitch control system. Table 3 below outlines their main characteristics.

Table 3: Enercon E-92 2.3 MW turbine characteristics. (Enercon, 2012)

Generator Type	Rotor Diameter (m)	Hub Height (m)	Swept area (m^2)	Rated Output (MW)
E-92 2.0	92	98	6648	2.0
E-92 2.3	92	98	6648	2.3

7. Impact Assessment

7.1. Prediction Methodology

The shadow flicker impact was calculated at each receptor using the Shadow module of the software package, WindPRO version 2.9. The model simulates the Earth's orbit and rotation, to provide the astronomical maximum shadow, also known as the astronomical worst-case scenario. The astronomical maximum shadow calculation assumes that for every day of the year:

1. The sky is cloudless between sunrise and sunset,
2. The turbines are always in operation, and
3. The wind direction changes throughout the day such that the rotor plane is perpendicular to the incident sun rays at all times.

The position of the sun relative to the wind turbine rotor plane and the resulting shadow is calculated in steps of one minute intervals throughout a complete year. If the rotor plane, assumed to be a solid disk equivalent in size to the swept area shown in Table 3 casts a shadow on a receptor window during one of these intervals, it is registered as one minute of potential shadow impact.

As previously noted, following the German guidelines, the impact of shadow flicker on surrounding receptors is limited by two factors; the first being that the angle of the sun over the horizon must be greater than 3 degrees, due to optic conditions in the atmosphere which cause the shadow to dissipate before it could potentially reach a receptor and the second is that the blade of the wind turbine must cover at least 20% of the incident solar rays in order to have a noticeable effect. Distances from WTGs to receptors are shown in Table 1.

Each receptor was treated as a 'greenhouse' with 3m high windows for 360° of the building. Furthermore, no topographical shielding (other buildings, barns, trees etc.) has been considered between the wind turbines and receptors. This is a worst-case assumption and results in a conservative prediction of the potential shadow flicker impacts.

7.2. Results of Shadow Flicker Predictions

The results of the shadow flicker prediction model at each receptor prove compliance with the German standards of no more than 30 hours per year of astronomical maximum shadow (worst case), and no more than 30 minutes on the worst day of astronomical maximum shadow (worst case). Table 4 shows the results of the receptors that are predicted to experience any shadow hours. The receptors not included in Table 4 are not predicted to encounter any shadow flicker impacts.

While all receptors are subject to less than 30hrs/year or 30mins/day, the highest worst case shadow flicker modelled was 12 hours 44 minutes per year and at a maximum of 26 minutes per day. Tabulated results for the Enercon E-92 2.3 MW can be found in Table 4, while modelled results representing shadow flicker hours per year and WindPRO generated shadow flicker calendars are mapped in Annex B.

Table 4: Predicted shadow flicker for E-92 2.3 MW @ 98 m hub height.

Receptor ID	Shadow hours per year (h/year)	Shadow days per year (days/year)	Max shadow hours per day (h/day)
BI	12:44	42	0:26
AA	11:13	64	0:18
KL	8:17	48	0:16
BK	8:16	48	0:14
CW	7:45	52	0:14
KM	7:44	44	0:16
HV	6:57	36	0:14
AE	6:55	41	0:15
DW	6:44	41	0:15
KT	6:34	40	0:19
DX	6:12	38	0:15
LA	5:26	36	0:14
AY	5:22	37	0:13
DY	5:21	36	0:14
CX	5:06	37	0:13
DH	5:06	35	0:14
BT	4:31	33	0:13
M	4:13	34	0:12
AT	4:12	32	0:13
HO	4:02	33	0:12
HQ	3:59	34	0:12
AP	3:58	33	0:12
CA	3:55	33	0:12
BJ	2:48	21	0:10
DT	2:40	18	0:13
KN	2:38	18	0:13
DV	2:35	18	0:13
AD	2:28	19	0:12
KK	2:13	16	0:12
HN	2:11	17	0:12
HT	2:08	16	0:12
HM	2:06	17	0:11
JU	2:05	16	0:12
DB	2:00	16	0:11

HL	2:00	16	0:11
HJ	1:52	17	0:10
HH	1:50	17	0:11

8. Conclusions and Recommendations

Natural Forces Wind Inc. has completed a thorough assessment to evaluate the astronomical worst case shadow flicker impact of the proposed Amherst Community Wind Farm at receptor locations within 2,500 m of a proposed wind turbine generator. Based on the parameters used to run the shadow flicker prediction model via WindPRO, it has been shown that the predicted duration of shadow flicker emitted by the wind turbine generators at all points of reception is less than the widely accepted German guidelines that were used in this assessment. As a result of this study, no mitigation strategies are recommended.

9. References

Enercon Canada (2012). *Enercon E-92 2.3 MW Wind Turbine Generator data sheet.*

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ANNEX A

Results Map

Project:
AMR_WindPro final location 141204

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04/12/2014 4:23 PM / 1

Licensed user:
Natural Forces Wind Inc
1791 Barrington Street Suite 1030
CA-HALIFAX, Nova Scotia B3J 3L1
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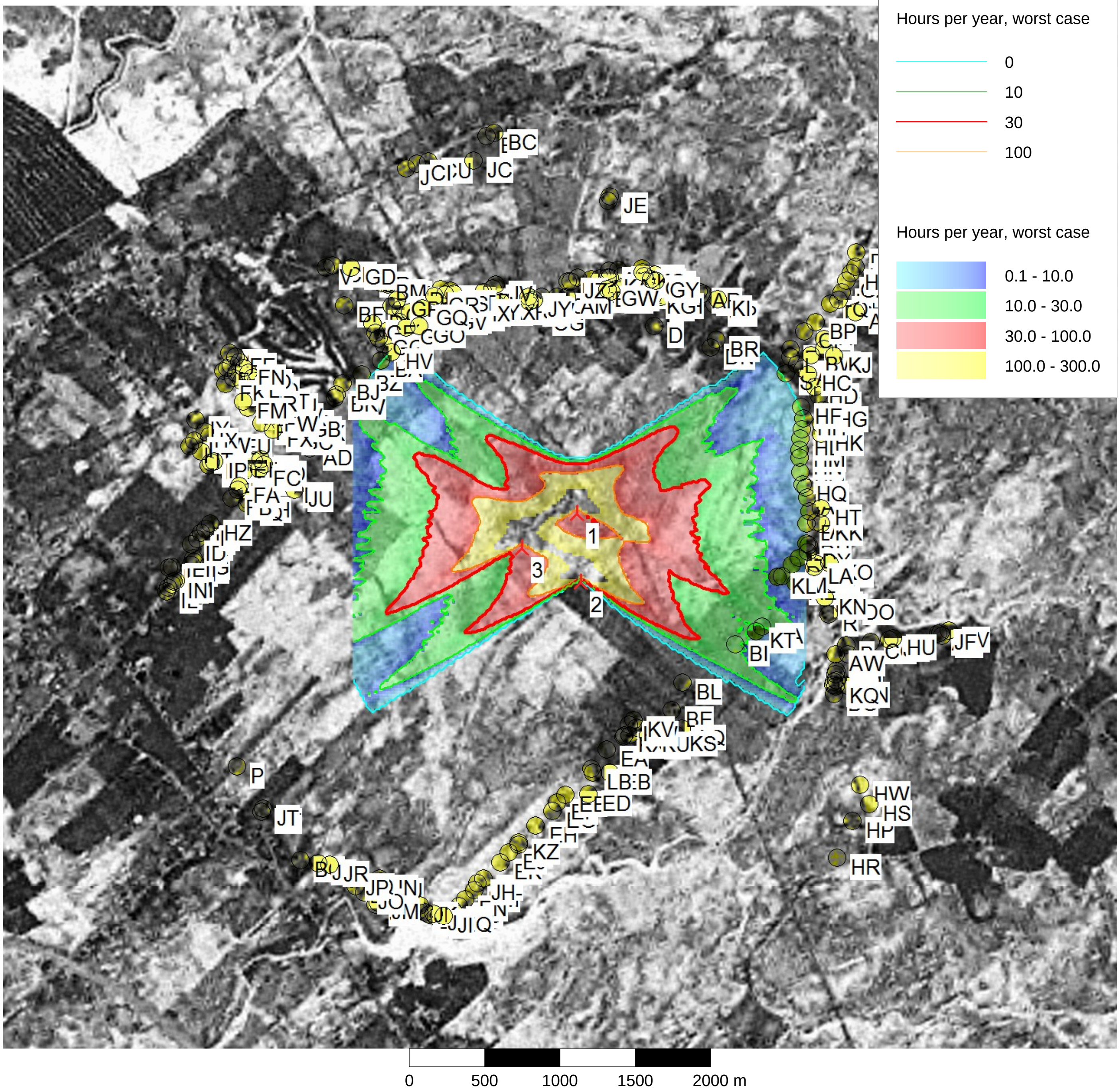
Calculated:
04/12/2014 4:19 PM/2.9.269

SHADOW - Map

Calculation: Amherst Community Shadow Flicker



Map: WindPRO map , Print scale 1:40,000, Map center UTM (north)-NAD83 (US+CA) Zone: 20 East: 410,997 North: 5,076,209

New WTG Shadow receptor

Flicker map level: Height Contours: CONTOURLINE_ONLINEDATA_3.wpo (1)

ANNEX B

WindPRO v2.9, Shadow Module Calculation Results

E92-2.3 MW @ 98m Hub Height

Project:

AMR_WindPro final location 141204

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Calculated:

05/12/2014 11:16 AM/2.9.269

SHADOW - Main Result

Calculation: Amherst Community Shadow Flicker

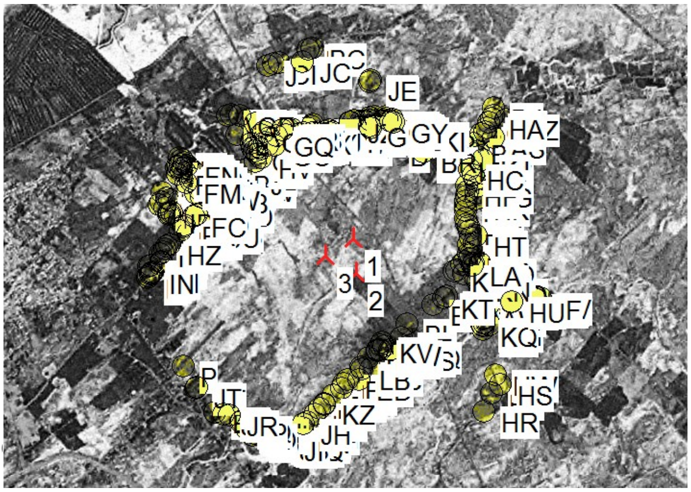
Assumptions for shadow calculations

Maximum distance for influence
Calculate only when more than 20 % of sun is covered by the blade
Please look in WTG table

Minimum sun height over horizon for influence	3 °
Day step for calculation	1 days
Time step for calculation	1 minutes

The calculated times are "worst case" given by the following assumptions:
- The sun is shining all the day, from sunrise to sunset
- The rotor plane is always perpendicular to the line from the WTG to the sun
- The WTG is always operating

A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values. A WTG will be visible if it is visible from any part of the receiver window. The ZVI calculation is based on the following assumptions:
Height contours used: Height Contours: CONTOURLINE_ONLINEDATA_3.wpo
Obstacles used in calculation
Eye height: 1.5 m
Grid resolution: 10.0 m



Scale 1:100,000

⅄ New WTG
Shadow receptor

WTGs

	UTM (north)-NAD83 (US+CA) Zone: 20				WTG type						Shadow data	
	East	North	Z [m]	Row data/Description	Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Calculation distance [m]	RPM [RPM]
1	411,122	5,076,288	60.4	ENERCON E-92 2,3 MW 2300 92.0 ...	Yes	ENERCON	E-92 2,3 MW-2,300	2,300	92.0	98.0	1,639	16.0
2	411,150	5,075,827	56.1	ENERCON E-92 2,3 MW 2300 92.0 ...	Yes	ENERCON	E-92 2,3 MW-2,300	2,300	92.0	98.0	1,639	16.0
3	410,754	5,076,059	65.1	ENERCON E-92 2,3 MW 2300 92.0 ...	Yes	ENERCON	E-92 2,3 MW-2,300	2,300	92.0	98.0	1,639	16.0

Shadow receptor-Input

	UTM (north)-NAD83 (US+CA) Zone: 20								
No.	East	North	Z [m]	Width [m]	Height [m]	Height a.g.l. [m]	Degrees from south cw [°]	Slope of window [°]	Direction mode
A	410,687	5,077,694	58.4	3.0	3.0	1.0	0.0	90.0	"Green house mode"
B	412,917	5,075,407	34.6	3.0	3.0	1.0	0.0	90.0	"Green house mode"
C	412,770	5,077,450	74.5	3.0	3.0	1.0	0.0	90.0	"Green house mode"
D	411,637	5,077,534	68.5	3.0	3.0	1.0	0.0	90.0	"Green house mode"
E	412,772	5,077,381	73.6	3.0	3.0	1.0	0.0	90.0	"Green house mode"
F	412,548	5,077,384	70.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
G	411,522	5,074,857	50.8	3.0	3.0	1.0	0.0	90.0	"Green house mode"
H	410,752	5,077,687	60.1	3.0	3.0	1.0	0.0	90.0	"Green house mode"
I	410,886	5,077,728	60.8	3.0	3.0	1.0	0.0	90.0	"Green house mode"
J	409,985	5,078,587	37.8	3.0	3.0	1.0	0.0	90.0	"Green house mode"
K	411,218	5,077,847	54.8	3.0	3.0	1.0	0.0	90.0	"Green house mode"
L	412,545	5,077,331	70.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
M	412,672	5,076,299	60.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
N	411,712	5,077,716	58.4	3.0	3.0	1.0	0.0	90.0	"Green house mode"
O	408,873	5,077,294	35.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
P	408,859	5,074,597	46.1	3.0	3.0	1.0	0.0	90.0	"Green house mode"
Q	412,869	5,077,709	75.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
R	412,802	5,075,612	34.8	3.0	3.0	1.0	0.0	90.0	"Green house mode"
S	412,515	5,077,219	70.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
T	410,620	5,077,696	56.3	3.0	3.0	1.0	0.0	90.0	"Green house mode"
U	412,931	5,075,350	35.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"

To be continued on next page...

Project:

AMR_WindPro final location 141204

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05/12/2014 11:19 AM / 2

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Calculated:

05/12/2014 11:16 AM/2.9.269

SHADOW - Main Result

Calculation: Amherst Community Shadow Flicker

...continued from previous page

	UTM (north)-NAD83 (US+CA) Zone: 20								
No.	East	North	Z [m]	Width [m]	Height [m]	Height a.g.l. [m]	Degrees from south cw [°]	Slope of window [°]	Direction mode
V	409,450	5,077,924	30.4	3.0	3.0	1.0	0.0	90.0	"Green house mode"
W	411,964	5,077,748	58.3	3.0	3.0	1.0	0.0	90.0	"Green house mode"
X	411,426	5,077,867	51.3	3.0	3.0	1.0	0.0	90.0	"Green house mode"
Y	410,833	5,077,687	62.7	3.0	3.0	1.0	0.0	90.0	"Green house mode"
Z	411,651	5,077,709	57.7	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AA	412,356	5,075,531	51.1	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AB	410,362	5,077,647	53.7	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AC	413,531	5,075,487	40.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AD	409,342	5,076,720	70.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AE	412,583	5,075,822	48.5	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AF	411,398	5,077,908	47.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AG	412,629	5,077,251	70.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AH	408,937	5,076,375	64.2	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AI	411,274	5,077,854	54.3	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AJ	408,809	5,077,359	33.8	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AK	411,218	5,077,771	60.2	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AL	409,789	5,073,827	32.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AM	411,056	5,077,731	61.9	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AN	409,952	5,077,647	42.9	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AO	411,435	5,077,793	56.2	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AP	412,657	5,076,391	63.1	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AQ	411,822	5,074,852	50.7	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AR	411,931	5,077,767	57.6	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AS	412,980	5,077,625	75.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AT	412,722	5,076,231	54.1	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AU	411,337	5,077,903	49.2	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AV	409,973	5,077,612	45.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AW	412,848	5,075,349	32.9	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AX	410,575	5,077,689	57.8	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AY	412,716	5,075,955	44.8	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AZ	410,809	5,077,676	62.5	3.0	3.0	1.0	0.0	90.0	"Green house mode"
BA	409,819	5,077,307	57.3	3.0	3.0	1.0	0.0	90.0	"Green house mode"
BB	412,854	5,075,234	35.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
BC	410,573	5,078,822	37.4	3.0	3.0	1.0	0.0	90.0	"Green house mode"
BD	411,281	5,077,776	60.2	3.0	3.0	1.0	0.0	90.0	"Green house mode"
BE	411,755	5,074,975	57.8	3.0	3.0	1.0	0.0	90.0	"Green house mode"
BF	409,573	5,077,673	33.5	3.0	3.0	1.0	0.0	90.0	"Green house mode"
BG	412,840	5,075,082	35.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
BH	411,385	5,077,782	59.2	3.0	3.0	1.0	0.0	90.0	"Green house mode"
BI	412,181	5,075,412	56.8	3.0	3.0	1.0	0.0	90.0	"Green house mode"
BJ	409,564	5,077,151	59.6	3.0	3.0	1.0	0.0	90.0	"Green house mode"
BK	409,521	5,077,076	62.4	3.0	3.0	1.0	0.0	90.0	"Green house mode"
BL	411,829	5,075,161	66.3	3.0	3.0	1.0	0.0	90.0	"Green house mode"
BM	409,821	5,077,822	32.6	3.0	3.0	1.0	0.0	90.0	"Green house mode"
BN	412,926	5,075,138	35.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
BO	411,328	5,077,855	55.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
BP	412,716	5,077,559	75.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
BQ	409,280	5,073,978	27.3	3.0	3.0	1.0	0.0	90.0	"Green house mode"
BR	412,052	5,077,442	69.3	3.0	3.0	1.0	0.0	90.0	"Green house mode"
BS	411,061	5,077,829	58.5	3.0	3.0	1.0	0.0	90.0	"Green house mode"
BT	412,655	5,076,219	58.7	3.0	3.0	1.0	0.0	90.0	"Green house mode"
BU	409,819	5,073,832	32.6	3.0	3.0	1.0	0.0	90.0	"Green house mode"
BV	413,605	5,075,505	39.8	3.0	3.0	1.0	0.0	90.0	"Green house mode"
BW	412,682	5,077,344	71.6	3.0	3.0	1.0	0.0	90.0	"Green house mode"
BX	410,520	5,078,801	38.8	3.0	3.0	1.0	0.0	90.0	"Green house mode"

To be continued on next page...

SHADOW - Main Result

Calculation: Amherst Community Shadow Flicker

...continued from previous page

No.	UTM (north)-NAD83 (US+CA) Zone: 20 East	North	Z [m]	Width [m]	Height [m]	Height a.g.l. [m]	Degrees from south cw [°]	Slope of window [°]	Direction mode
BY	410,203	5,073,611	28.7	3.0	3.0	1.0	0.0	90.0	"Green house mode"
BZ	409,689	5,077,214	57.6	3.0	3.0	1.0	0.0	90.0	"Green house mode"
CA	412,647	5,076,460	64.4	3.0	3.0	1.0	0.0	90.0	"Green house mode"
CB	410,561	5,077,786	55.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
CC	410,282	5,077,768	45.8	3.0	3.0	1.0	0.0	90.0	"Green house mode"
CD	410,532	5,077,683	58.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
CE	412,639	5,077,501	72.6	3.0	3.0	1.0	0.0	90.0	"Green house mode"
CF	408,957	5,076,550	60.7	3.0	3.0	1.0	0.0	90.0	"Green house mode"
CG	410,871	5,077,619	65.1	3.0	3.0	1.0	0.0	90.0	"Green house mode"
CH	409,864	5,077,809	33.7	3.0	3.0	1.0	0.0	90.0	"Green house mode"
CI	410,056	5,078,619	38.9	3.0	3.0	1.0	0.0	90.0	"Green house mode"
CJ	411,620	5,074,792	47.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
CK	410,139	5,073,616	26.1	3.0	3.0	1.0	0.0	90.0	"Green house mode"
CL	413,559	5,075,468	40.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
CM	412,846	5,075,215	35.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
CN	409,496	5,077,941	30.7	3.0	3.0	1.0	0.0	90.0	"Green house mode"
CO	413,083	5,075,431	34.1	3.0	3.0	1.0	0.0	90.0	"Green house mode"
CP	412,040	5,077,678	60.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
CQ	410,988	5,077,728	62.2	3.0	3.0	1.0	0.0	90.0	"Green house mode"
CR	409,723	5,077,872	30.9	3.0	3.0	1.0	0.0	90.0	"Green house mode"
CS	410,429	5,077,688	55.7	3.0	3.0	1.0	0.0	90.0	"Green house mode"
CT	410,008	5,077,764	38.4	3.0	3.0	1.0	0.0	90.0	"Green house mode"
CU	410,131	5,078,630	40.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
CV	411,555	5,077,917	50.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
CW	409,514	5,077,056	63.3	3.0	3.0	1.0	0.0	90.0	"Green house mode"
CX	412,671	5,076,075	51.9	3.0	3.0	1.0	0.0	90.0	"Green house mode"
CY	411,191	5,077,777	60.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
CZ	413,150	5,077,878	74.7	3.0	3.0	1.0	0.0	90.0	"Green house mode"
DA	411,129	5,077,856	56.1	3.0	3.0	1.0	0.0	90.0	"Green house mode"
DB	409,209	5,076,469	68.8	3.0	3.0	1.0	0.0	90.0	"Green house mode"
DC	412,591	5,077,280	70.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
DD	412,888	5,077,758	75.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
DE	410,214	5,077,780	45.3	3.0	3.0	1.0	0.0	90.0	"Green house mode"
DF	410,075	5,073,646	25.1	3.0	3.0	1.0	0.0	90.0	"Green house mode"
DG	409,777	5,077,617	37.7	3.0	3.0	1.0	0.0	90.0	"Green house mode"
DH	412,653	5,076,088	53.6	3.0	3.0	1.0	0.0	90.0	"Green house mode"
DI	411,499	5,077,845	55.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
DJ	412,983	5,078,023	69.5	3.0	3.0	1.0	0.0	90.0	"Green house mode"
DK	409,292	5,076,881	62.9	3.0	3.0	1.0	0.0	90.0	"Green house mode"
DL	410,501	5,077,760	55.3	3.0	3.0	1.0	0.0	90.0	"Green house mode"
DM	409,648	5,073,801	27.1	3.0	3.0	1.0	0.0	90.0	"Green house mode"
DN	412,013	5,077,394	70.1	3.0	3.0	1.0	0.0	90.0	"Green house mode"
DO	412,938	5,075,690	32.5	3.0	3.0	1.0	0.0	90.0	"Green house mode"
DP	412,810	5,077,685	75.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
DQ	410,251	5,077,632	49.9	3.0	3.0	1.0	0.0	90.0	"Green house mode"
DR	410,048	5,077,769	40.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
DS	412,838	5,075,164	35.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
DT	412,752	5,075,742	38.4	3.0	3.0	1.0	0.0	90.0	"Green house mode"
DU	412,809	5,075,941	42.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
DV	412,727	5,075,907	43.4	3.0	3.0	1.0	0.0	90.0	"Green house mode"
DW	412,556	5,075,942	51.7	3.0	3.0	1.0	0.0	90.0	"Green house mode"
DX	412,602	5,075,989	50.5	3.0	3.0	1.0	0.0	90.0	"Green house mode"
DY	412,665	5,076,029	50.1	3.0	3.0	1.0	0.0	90.0	"Green house mode"
DZ	411,436	5,074,795	49.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
EA	411,323	5,074,711	40.9	3.0	3.0	1.0	0.0	90.0	"Green house mode"

To be continued on next page...

SHADOW - Main Result

Calculation: Amherst Community Shadow Flicker

...continued from previous page

UTM (north)-NAD83 (US+CA) Zone: 20

No.	East	North	Z	Width	Height	Height a.g.l.	Degrees from south cw	Slope of window	Direction mode
			[m]	[m]	[m]	[m]	[°]	[°]	
EB	411,343	5,074,557	35.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
EC	411,223	5,074,585	33.6	3.0	3.0	1.0	0.0	90.0	"Green house mode"
ED	411,200	5,074,416	25.2	3.0	3.0	1.0	0.0	90.0	"Green house mode"
EE	411,046	5,074,410	30.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
EF	410,991	5,074,359	32.5	3.0	3.0	1.0	0.0	90.0	"Green house mode"
EG	410,962	5,074,302	33.6	3.0	3.0	1.0	0.0	90.0	"Green house mode"
EH	410,847	5,074,207	34.1	3.0	3.0	1.0	0.0	90.0	"Green house mode"
EI	410,735	5,074,078	30.2	3.0	3.0	1.0	0.0	90.0	"Green house mode"
EJ	410,669	5,074,028	30.7	3.0	3.0	1.0	0.0	90.0	"Green house mode"
EK	410,614	5,073,961	33.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
EL	410,502	5,073,855	35.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
EM	410,440	5,073,776	35.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
EN	410,381	5,073,715	35.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
EO	410,338	5,073,669	35.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
EP	410,299	5,073,643	33.7	3.0	3.0	1.0	0.0	90.0	"Green house mode"
EQ	410,268	5,073,611	31.2	3.0	3.0	1.0	0.0	90.0	"Green house mode"
ER	410,183	5,073,596	27.2	3.0	3.0	1.0	0.0	90.0	"Green house mode"
ES	410,112	5,073,628	25.3	3.0	3.0	1.0	0.0	90.0	"Green house mode"
ET	409,024	5,074,298	44.8	3.0	3.0	1.0	0.0	90.0	"Green house mode"
EU	408,806	5,076,791	55.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
EV	408,762	5,076,595	55.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
EW	408,811	5,076,539	58.9	3.0	3.0	1.0	0.0	90.0	"Green house mode"
EX	408,876	5,076,594	57.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
EY	408,902	5,076,567	58.7	3.0	3.0	1.0	0.0	90.0	"Green house mode"
EZ	408,851	5,076,499	60.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
FA	408,876	5,076,468	60.8	3.0	3.0	1.0	0.0	90.0	"Green house mode"
FB	408,823	5,076,389	61.2	3.0	3.0	1.0	0.0	90.0	"Green house mode"
FC	409,006	5,076,580	64.8	3.0	3.0	1.0	0.0	90.0	"Green house mode"
FD	409,036	5,076,615	65.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
FE	408,848	5,077,333	33.9	3.0	3.0	1.0	0.0	90.0	"Green house mode"
FF	408,816	5,077,274	36.4	3.0	3.0	1.0	0.0	90.0	"Green house mode"
FG	408,790	5,077,254	37.7	3.0	3.0	1.0	0.0	90.0	"Green house mode"
FH	408,765	5,077,234	39.1	3.0	3.0	1.0	0.0	90.0	"Green house mode"
FI	408,854	5,077,222	40.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
FJ	408,834	5,077,189	41.6	3.0	3.0	1.0	0.0	90.0	"Green house mode"
FK	408,784	5,077,149	43.5	3.0	3.0	1.0	0.0	90.0	"Green house mode"
FL	408,889	5,077,170	43.1	3.0	3.0	1.0	0.0	90.0	"Green house mode"
FM	408,899	5,077,029	53.4	3.0	3.0	1.0	0.0	90.0	"Green house mode"
FN	408,906	5,077,257	37.7	3.0	3.0	1.0	0.0	90.0	"Green house mode"
FO	408,933	5,077,225	40.9	3.0	3.0	1.0	0.0	90.0	"Green house mode"
FP	408,968	5,077,195	43.5	3.0	3.0	1.0	0.0	90.0	"Green house mode"
FQ	408,987	5,077,171	45.5	3.0	3.0	1.0	0.0	90.0	"Green house mode"
FR	408,982	5,077,077	51.8	3.0	3.0	1.0	0.0	90.0	"Green house mode"
FS	408,965	5,077,052	52.6	3.0	3.0	1.0	0.0	90.0	"Green house mode"
FT	409,085	5,077,090	54.2	3.0	3.0	1.0	0.0	90.0	"Green house mode"
FU	409,119	5,077,060	55.5	3.0	3.0	1.0	0.0	90.0	"Green house mode"
FV	409,165	5,076,994	57.6	3.0	3.0	1.0	0.0	90.0	"Green house mode"
FW	409,080	5,076,943	58.3	3.0	3.0	1.0	0.0	90.0	"Green house mode"
FX	409,096	5,076,843	62.8	3.0	3.0	1.0	0.0	90.0	"Green house mode"
FY	409,023	5,076,890	60.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
FZ	409,149	5,076,893	60.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
GA	409,213	5,076,950	59.2	3.0	3.0	1.0	0.0	90.0	"Green house mode"
GB	409,262	5,076,909	61.4	3.0	3.0	1.0	0.0	90.0	"Green house mode"
GC	409,201	5,076,822	65.5	3.0	3.0	1.0	0.0	90.0	"Green house mode"
GD	409,617	5,077,923	30.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"

To be continued on next page...

SHADOW - Main Result

Calculation: Amherst Community Shadow Flicker

...continued from previous page

UTM (north)-NAD83 (US+CA) Zone: 20

No.	East	North	Z [m]	Width [m]	Height [m]	Height a.g.l. [m]	Degrees from south cw [°]	Slope of window [°]	Direction mode
GE	409,763	5,077,549	42.1	3.0	3.0	1.0	0.0	90.0	"Green house mode"
GF	409,784	5,077,492	45.9	3.0	3.0	1.0	0.0	90.0	"Green house mode"
GG	409,801	5,077,452	48.4	3.0	3.0	1.0	0.0	90.0	"Green house mode"
GH	409,838	5,077,414	50.9	3.0	3.0	1.0	0.0	90.0	"Green house mode"
GI	409,894	5,077,483	48.8	3.0	3.0	1.0	0.0	90.0	"Green house mode"
GJ	409,861	5,077,504	46.9	3.0	3.0	1.0	0.0	90.0	"Green house mode"
GK	409,887	5,077,667	39.9	3.0	3.0	1.0	0.0	90.0	"Green house mode"
GL	409,938	5,077,562	46.1	3.0	3.0	1.0	0.0	90.0	"Green house mode"
GM	410,012	5,077,627	44.7	3.0	3.0	1.0	0.0	90.0	"Green house mode"
GN	409,988	5,077,526	48.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
GO	410,074	5,077,535	47.8	3.0	3.0	1.0	0.0	90.0	"Green house mode"
GP	409,927	5,077,710	39.8	3.0	3.0	1.0	0.0	90.0	"Green house mode"
GQ	410,091	5,077,651	45.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
GR	410,175	5,077,737	45.5	3.0	3.0	1.0	0.0	90.0	"Green house mode"
GS	410,244	5,077,747	46.5	3.0	3.0	1.0	0.0	90.0	"Green house mode"
GT	410,304	5,077,752	46.4	3.0	3.0	1.0	0.0	90.0	"Green house mode"
GU	410,219	5,077,668	48.2	3.0	3.0	1.0	0.0	90.0	"Green house mode"
GV	410,242	5,077,624	49.8	3.0	3.0	1.0	0.0	90.0	"Green house mode"
GW	411,329	5,077,781	60.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
GX	411,616	5,077,845	54.2	3.0	3.0	1.0	0.0	90.0	"Green house mode"
GY	411,648	5,077,836	54.3	3.0	3.0	1.0	0.0	90.0	"Green house mode"
GZ	412,916	5,077,837	73.4	3.0	3.0	1.0	0.0	90.0	"Green house mode"
HA	412,949	5,077,888	71.4	3.0	3.0	1.0	0.0	90.0	"Green house mode"
HB	412,979	5,077,927	70.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
HC	412,665	5,077,213	70.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
HD	412,710	5,077,128	68.9	3.0	3.0	1.0	0.0	90.0	"Green house mode"
HE	412,732	5,077,070	67.1	3.0	3.0	1.0	0.0	90.0	"Green house mode"
HF	412,619	5,076,996	68.4	3.0	3.0	1.0	0.0	90.0	"Green house mode"
HG	412,763	5,076,976	65.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
HH	412,634	5,076,917	67.1	3.0	3.0	1.0	0.0	90.0	"Green house mode"
HI	412,751	5,076,885	64.9	3.0	3.0	1.0	0.0	90.0	"Green house mode"
HJ	412,621	5,076,849	66.6	3.0	3.0	1.0	0.0	90.0	"Green house mode"
HK	412,751	5,076,815	64.3	3.0	3.0	1.0	0.0	90.0	"Green house mode"
HL	412,612	5,076,785	66.8	3.0	3.0	1.0	0.0	90.0	"Green house mode"
HM	412,607	5,076,709	66.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
HN	412,606	5,076,659	65.3	3.0	3.0	1.0	0.0	90.0	"Green house mode"
HO	412,613	5,076,560	65.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
HP	412,961	5,074,234	29.8	3.0	3.0	1.0	0.0	90.0	"Green house mode"
HQ	412,627	5,076,481	65.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
HR	412,861	5,073,989	32.4	3.0	3.0	1.0	0.0	90.0	"Green house mode"
HS	413,071	5,074,350	35.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
HT	412,749	5,076,324	54.1	3.0	3.0	1.0	0.0	90.0	"Green house mode"
HU	413,229	5,075,453	35.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
HV	409,888	5,077,361	55.8	3.0	3.0	1.0	0.0	90.0	"Green house mode"
HW	413,009	5,074,477	35.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
HX	410,404	5,077,677	55.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
HY	410,466	5,077,689	57.6	3.0	3.0	1.0	0.0	90.0	"Green house mode"
HZ	408,680	5,076,222	61.5	3.0	3.0	1.0	0.0	90.0	"Green house mode"
IA	408,648	5,076,184	62.5	3.0	3.0	1.0	0.0	90.0	"Green house mode"
IB	408,619	5,076,158	62.3	3.0	3.0	1.0	0.0	90.0	"Green house mode"
IC	408,593	5,076,117	62.4	3.0	3.0	1.0	0.0	90.0	"Green house mode"
ID	408,550	5,076,083	61.5	3.0	3.0	1.0	0.0	90.0	"Green house mode"
IE	408,425	5,075,931	59.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
IF	408,403	5,075,924	58.3	3.0	3.0	1.0	0.0	90.0	"Green house mode"
IG	408,566	5,075,990	64.4	3.0	3.0	1.0	0.0	90.0	"Green house mode"

To be continued on next page...

SHADOW - Main Result

Calculation: Amherst Community Shadow Flicker

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UTM (north)-NAD83 (US+CA) Zone: 20

No.	East	North	Z [m]	Width [m]	Height [m]	Height a.g.l. [m]	Degrees from south cw [°]	Slope of window [°]	Direction mode
IH	408,572	5,075,967	65.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
II	408,553	5,075,947	65.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
IJ	408,424	5,075,815	63.5	3.0	3.0	1.0	0.0	90.0	"Green house mode"
IK	408,401	5,075,793	63.1	3.0	3.0	1.0	0.0	90.0	"Green house mode"
IL	408,389	5,075,769	62.4	3.0	3.0	1.0	0.0	90.0	"Green house mode"
IM	408,453	5,075,840	64.7	3.0	3.0	1.0	0.0	90.0	"Green house mode"
IN	408,437	5,075,832	63.8	3.0	3.0	1.0	0.0	90.0	"Green house mode"
IO	408,864	5,076,443	61.2	3.0	3.0	1.0	0.0	90.0	"Green house mode"
IP	408,708	5,076,635	55.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
IQ	408,926	5,076,353	64.5	3.0	3.0	1.0	0.0	90.0	"Green house mode"
IR	408,670	5,076,609	56.7	3.0	3.0	1.0	0.0	90.0	"Green house mode"
IS	408,683	5,076,628	55.8	3.0	3.0	1.0	0.0	90.0	"Green house mode"
IT	408,617	5,076,701	55.4	3.0	3.0	1.0	0.0	90.0	"Green house mode"
IU	408,572	5,076,771	50.6	3.0	3.0	1.0	0.0	90.0	"Green house mode"
IV	408,540	5,076,735	52.1	3.0	3.0	1.0	0.0	90.0	"Green house mode"
IW	408,677	5,076,803	51.7	3.0	3.0	1.0	0.0	90.0	"Green house mode"
IX	408,645	5,076,834	49.1	3.0	3.0	1.0	0.0	90.0	"Green house mode"
IY	408,583	5,076,908	45.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
IZ	408,971	5,076,639	60.5	3.0	3.0	1.0	0.0	90.0	"Green house mode"
JA	409,016	5,076,651	63.4	3.0	3.0	1.0	0.0	90.0	"Green house mode"
JB	408,928	5,076,992	56.4	3.0	3.0	1.0	0.0	90.0	"Green house mode"
JC	410,435	5,078,635	40.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
JD	411,332	5,078,365	33.8	3.0	3.0	1.0	0.0	90.0	"Green house mode"
JE	411,342	5,078,397	34.7	3.0	3.0	1.0	0.0	90.0	"Green house mode"
JF	413,544	5,075,493	40.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
JG	413,205	5,075,446	35.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
JH	410,460	5,073,823	35.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
JI	410,234	5,073,606	30.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
JJ	410,171	5,073,620	27.3	3.0	3.0	1.0	0.0	90.0	"Green house mode"
JK	410,079	5,073,674	27.3	3.0	3.0	1.0	0.0	90.0	"Green house mode"
JL	409,784	5,073,681	22.8	3.0	3.0	1.0	0.0	90.0	"Green house mode"
JM	409,799	5,073,696	24.7	3.0	3.0	1.0	0.0	90.0	"Green house mode"
JN	409,810	5,073,852	35.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
JO	409,707	5,073,761	25.3	3.0	3.0	1.0	0.0	90.0	"Green house mode"
JP	409,624	5,073,854	28.9	3.0	3.0	1.0	0.0	90.0	"Green house mode"
JQ	409,638	5,073,866	30.3	3.0	3.0	1.0	0.0	90.0	"Green house mode"
JR	409,477	5,073,946	32.6	3.0	3.0	1.0	0.0	90.0	"Green house mode"
JS	409,397	5,073,956	31.5	3.0	3.0	1.0	0.0	90.0	"Green house mode"
JT	409,033	5,074,316	45.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
JU	409,241	5,076,446	70.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
JV	410,583	5,077,810	53.4	3.0	3.0	1.0	0.0	90.0	"Green house mode"
JW	410,806	5,077,700	60.8	3.0	3.0	1.0	0.0	90.0	"Green house mode"
JX	410,799	5,077,727	58.6	3.0	3.0	1.0	0.0	90.0	"Green house mode"
JY	410,836	5,077,708	61.3	3.0	3.0	1.0	0.0	90.0	"Green house mode"
JZ	411,084	5,077,830	58.6	3.0	3.0	1.0	0.0	90.0	"Green house mode"
KA	411,343	5,077,856	55.1	3.0	3.0	1.0	0.0	90.0	"Green house mode"
KB	411,351	5,077,763	60.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
KC	411,559	5,077,890	52.7	3.0	3.0	1.0	0.0	90.0	"Green house mode"
KD	411,573	5,077,865	54.4	3.0	3.0	1.0	0.0	90.0	"Green house mode"
KE	411,583	5,077,836	55.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
KF	411,645	5,077,877	50.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
KG	411,628	5,077,731	56.4	3.0	3.0	1.0	0.0	90.0	"Green house mode"
KH	411,682	5,077,731	57.4	3.0	3.0	1.0	0.0	90.0	"Green house mode"
KI	412,061	5,077,716	56.9	3.0	3.0	1.0	0.0	90.0	"Green house mode"
KJ	412,836	5,077,338	71.8	3.0	3.0	1.0	0.0	90.0	"Green house mode"

To be continued on next page...

SHADOW - Main Result

Calculation: Amherst Community Shadow Flicker

...continued from previous page

UTM (north)-NAD83 (US+CA) Zone: 20

No.	East	North	Z [m]	Width [m]	Height [m]	Height a.g.l. [m]	Degrees from south cw [°]	Slope of window [°]	Direction mode
KK	412,749	5,076,218	50.7	3.0	3.0	1.0	0.0	90.0	"Green house mode"
KL	412,462	5,075,862	55.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
KM	412,490	5,075,869	55.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
KN	412,775	5,075,725	37.8	3.0	3.0	1.0	0.0	90.0	"Green house mode"
KO	412,808	5,075,957	42.5	3.0	3.0	1.0	0.0	90.0	"Green house mode"
KP	412,854	5,075,174	35.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
KQ	412,847	5,075,131	35.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
KR	412,833	5,075,144	35.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
KS	411,782	5,074,810	49.1	3.0	3.0	1.0	0.0	90.0	"Green house mode"
KT	412,319	5,075,502	51.5	3.0	3.0	1.0	0.0	90.0	"Green house mode"
KU	411,597	5,074,808	47.8	3.0	3.0	1.0	0.0	90.0	"Green house mode"
KV	411,500	5,074,910	54.5	3.0	3.0	1.0	0.0	90.0	"Green house mode"
KW	411,473	5,074,877	53.1	3.0	3.0	1.0	0.0	90.0	"Green house mode"
KX	411,438	5,074,808	49.9	3.0	3.0	1.0	0.0	90.0	"Green house mode"
KY	411,474	5,074,807	49.2	3.0	3.0	1.0	0.0	90.0	"Green house mode"
KZ	410,737	5,074,093	30.8	3.0	3.0	1.0	0.0	90.0	"Green house mode"
LA	412,703	5,075,931	44.5	3.0	3.0	1.0	0.0	90.0	"Green house mode"
LB	411,232	5,074,559	32.8	3.0	3.0	1.0	0.0	90.0	"Green house mode"

Calculation Results

Shadow receptor

	Shadow, worst case		
No.	Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]
A	0:00	0	0:00
B	0:00	0	0:00
C	0:00	0	0:00
D	0:00	0	0:00
E	0:00	0	0:00
F	0:00	0	0:00
G	0:00	0	0:00
H	0:00	0	0:00
I	0:00	0	0:00
J	0:00	0	0:00
K	0:00	0	0:00
L	0:00	0	0:00
M	4:13	34	0:12
N	0:00	0	0:00
O	0:00	0	0:00
P	0:00	0	0:00
Q	0:00	0	0:00
R	0:00	0	0:00
S	0:00	0	0:00
T	0:00	0	0:00
U	0:00	0	0:00
V	0:00	0	0:00
W	0:00	0	0:00
X	0:00	0	0:00
Y	0:00	0	0:00
Z	0:00	0	0:00
AA	11:13	64	0:18
AB	0:00	0	0:00

To be continued on next page...

SHADOW - Main Result

Calculation: Amherst Community Shadow Flicker

...continued from previous page

	Shadow, worst case		
No.	Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]
AC	0:00	0	0:00
AD	2:28	19	0:12
AE	6:55	41	0:15
AF	0:00	0	0:00
AG	0:00	0	0:00
AH	0:00	0	0:00
AI	0:00	0	0:00
AJ	0:00	0	0:00
AK	0:00	0	0:00
AL	0:00	0	0:00
AM	0:00	0	0:00
AN	0:00	0	0:00
AO	0:00	0	0:00
AP	3:58	33	0:12
AQ	0:00	0	0:00
AR	0:00	0	0:00
AS	0:00	0	0:00
AT	4:12	32	0:13
AU	0:00	0	0:00
AV	0:00	0	0:00
AW	0:00	0	0:00
AX	0:00	0	0:00
AY	5:22	37	0:13
AZ	0:00	0	0:00
BA	0:00	0	0:00
BB	0:00	0	0:00
BC	0:00	0	0:00
BD	0:00	0	0:00
BE	0:00	0	0:00
BF	0:00	0	0:00
BG	0:00	0	0:00
BH	0:00	0	0:00
BI	12:44	42	0:26
BJ	2:48	21	0:10
BK	8:16	48	0:14
BL	0:00	0	0:00
BM	0:00	0	0:00
BN	0:00	0	0:00
BO	0:00	0	0:00
BP	0:00	0	0:00
BQ	0:00	0	0:00
BR	0:00	0	0:00
BS	0:00	0	0:00
BT	4:31	33	0:13
BU	0:00	0	0:00
BV	0:00	0	0:00
BW	0:00	0	0:00
BX	0:00	0	0:00
BY	0:00	0	0:00
BZ	0:00	0	0:00
CA	3:55	33	0:12
CB	0:00	0	0:00
CC	0:00	0	0:00
CD	0:00	0	0:00
CE	0:00	0	0:00

To be continued on next page...

SHADOW - Main Result

Calculation: Amherst Community Shadow Flicker

...continued from previous page

	Shadow, worst case		
No.	Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]
CF	0:00	0	0:00
CG	0:00	0	0:00
CH	0:00	0	0:00
CI	0:00	0	0:00
CJ	0:00	0	0:00
CK	0:00	0	0:00
CL	0:00	0	0:00
CM	0:00	0	0:00
CN	0:00	0	0:00
CO	0:00	0	0:00
CP	0:00	0	0:00
CQ	0:00	0	0:00
CR	0:00	0	0:00
CS	0:00	0	0:00
CT	0:00	0	0:00
CU	0:00	0	0:00
CV	0:00	0	0:00
CW	7:45	52	0:14
CX	5:06	37	0:13
CY	0:00	0	0:00
CZ	0:00	0	0:00
DA	0:00	0	0:00
DB	2:00	16	0:11
DC	0:00	0	0:00
DD	0:00	0	0:00
DE	0:00	0	0:00
DF	0:00	0	0:00
DG	0:00	0	0:00
DH	5:06	35	0:14
DI	0:00	0	0:00
DJ	0:00	0	0:00
DK	0:00	0	0:00
DL	0:00	0	0:00
DM	0:00	0	0:00
DN	0:00	0	0:00
DO	0:00	0	0:00
DP	0:00	0	0:00
DQ	0:00	0	0:00
DR	0:00	0	0:00
DS	0:00	0	0:00
DT	2:40	18	0:13
DU	0:00	0	0:00
DV	2:35	18	0:13
DW	6:44	41	0:15
DX	6:12	38	0:15
DY	5:21	36	0:14
DZ	0:00	0	0:00
EA	0:00	0	0:00
EB	0:00	0	0:00
EC	0:00	0	0:00
ED	0:00	0	0:00
EE	0:00	0	0:00
EF	0:00	0	0:00
EG	0:00	0	0:00
EH	0:00	0	0:00

To be continued on next page...

Project:
AMR_WindPro final location 141204

Licensed user:
Natural Forces Wind Inc
1791 Barrington Street Suite 1030
CA-HALIFAX, Nova Scotia B3J 3L1
902 422 9663
Amy / apellerin@naturalforces.ca

Calculated:
05/12/2014 11:16 AM/2.9.269

SHADOW - Main Result

Calculation: Amherst Community Shadow Flicker

...continued from previous page

	Shadow, worst case		
No.	Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]
EI	0:00	0	0:00
EJ	0:00	0	0:00
EK	0:00	0	0:00
EL	0:00	0	0:00
EM	0:00	0	0:00
EN	0:00	0	0:00
EO	0:00	0	0:00
EP	0:00	0	0:00
EQ	0:00	0	0:00
ER	0:00	0	0:00
ES	0:00	0	0:00
ET	0:00	0	0:00
EU	0:00	0	0:00
EV	0:00	0	0:00
EW	0:00	0	0:00
EX	0:00	0	0:00
EY	0:00	0	0:00
EZ	0:00	0	0:00
FA	0:00	0	0:00
FB	0:00	0	0:00
FC	0:00	0	0:00
FD	0:00	0	0:00
FE	0:00	0	0:00
FF	0:00	0	0:00
FG	0:00	0	0:00
FH	0:00	0	0:00
FI	0:00	0	0:00
FJ	0:00	0	0:00
FK	0:00	0	0:00
FL	0:00	0	0:00
FM	0:00	0	0:00
FN	0:00	0	0:00
FO	0:00	0	0:00
FP	0:00	0	0:00
FQ	0:00	0	0:00
FR	0:00	0	0:00
FS	0:00	0	0:00
FT	0:00	0	0:00
FU	0:00	0	0:00
FV	0:00	0	0:00
FW	0:00	0	0:00
FX	0:00	0	0:00
FY	0:00	0	0:00
FZ	0:00	0	0:00
GA	0:00	0	0:00
GB	0:00	0	0:00
GC	0:00	0	0:00
GD	0:00	0	0:00
GE	0:00	0	0:00
GF	0:00	0	0:00
GG	0:00	0	0:00
GH	0:00	0	0:00
GI	0:00	0	0:00
GJ	0:00	0	0:00
GK	0:00	0	0:00

To be continued on next page...

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Amy / apellerin@naturalforces.ca

Calculated:
05/12/2014 11:16 AM/2.9.269

SHADOW - Main Result

Calculation: Amherst Community Shadow Flicker

...continued from previous page

	Shadow, worst case		
No.	Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]
GL	0:00	0	0:00
GM	0:00	0	0:00
GN	0:00	0	0:00
GO	0:00	0	0:00
GP	0:00	0	0:00
GQ	0:00	0	0:00
GR	0:00	0	0:00
GS	0:00	0	0:00
GT	0:00	0	0:00
GU	0:00	0	0:00
GV	0:00	0	0:00
GW	0:00	0	0:00
GX	0:00	0	0:00
GY	0:00	0	0:00
GZ	0:00	0	0:00
HA	0:00	0	0:00
HB	0:00	0	0:00
HC	0:00	0	0:00
HD	0:00	0	0:00
HE	0:00	0	0:00
HF	0:00	0	0:00
HG	0:00	0	0:00
HH	1:50	17	0:11
HI	0:00	0	0:00
HJ	1:52	17	0:10
HK	0:00	0	0:00
HL	2:00	16	0:11
HM	2:06	17	0:11
HN	2:11	17	0:12
HO	4:02	33	0:12
HP	0:00	0	0:00
HQ	3:59	34	0:12
HR	0:00	0	0:00
HS	0:00	0	0:00
HT	2:08	16	0:12
HU	0:00	0	0:00
HV	6:57	36	0:14
HW	0:00	0	0:00
HX	0:00	0	0:00
HY	0:00	0	0:00
HZ	0:00	0	0:00
IA	0:00	0	0:00
IB	0:00	0	0:00
IC	0:00	0	0:00
ID	0:00	0	0:00
IE	0:00	0	0:00
IF	0:00	0	0:00
IG	0:00	0	0:00
IH	0:00	0	0:00
II	0:00	0	0:00
IJ	0:00	0	0:00
IK	0:00	0	0:00
IL	0:00	0	0:00
IM	0:00	0	0:00
IN	0:00	0	0:00

To be continued on next page...

Licensed user:
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1791 Barrington Street Suite 1030
CA-HALIFAX, Nova Scotia B3J 3L1
902 422 9663
Amy / apellerin@naturalforces.ca

Calculated:
05/12/2014 11:16 AM/2.9.269

SHADOW - Main Result

Calculation: Amherst Community Shadow Flicker

...continued from previous page

	Shadow, worst case		
No.	Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]
IO	0:00	0	0:00
IP	0:00	0	0:00
IQ	0:00	0	0:00
IR	0:00	0	0:00
IS	0:00	0	0:00
IT	0:00	0	0:00
IU	0:00	0	0:00
IV	0:00	0	0:00
IW	0:00	0	0:00
IX	0:00	0	0:00
IY	0:00	0	0:00
IZ	0:00	0	0:00
JA	0:00	0	0:00
JB	0:00	0	0:00
JC	0:00	0	0:00
JD	0:00	0	0:00
JE	0:00	0	0:00
JF	0:00	0	0:00
JG	0:00	0	0:00
JH	0:00	0	0:00
JI	0:00	0	0:00
JJ	0:00	0	0:00
JK	0:00	0	0:00
JL	0:00	0	0:00
JM	0:00	0	0:00
JN	0:00	0	0:00
JO	0:00	0	0:00
JP	0:00	0	0:00
JQ	0:00	0	0:00
JR	0:00	0	0:00
JS	0:00	0	0:00
JT	0:00	0	0:00
JU	2:05	16	0:12
JV	0:00	0	0:00
JW	0:00	0	0:00
JX	0:00	0	0:00
JY	0:00	0	0:00
JZ	0:00	0	0:00
KA	0:00	0	0:00
KB	0:00	0	0:00
KC	0:00	0	0:00
KD	0:00	0	0:00
KE	0:00	0	0:00
KF	0:00	0	0:00
KG	0:00	0	0:00
KH	0:00	0	0:00
KI	0:00	0	0:00
KJ	0:00	0	0:00
KK	2:13	16	0:12
KL	8:17	48	0:16
KM	7:44	44	0:16
KN	2:38	18	0:13
KO	0:00	0	0:00
KP	0:00	0	0:00
KQ	0:00	0	0:00

To be continued on next page...

SHADOW - Main Result

Calculation: Amherst Community Shadow Flicker

...continued from previous page

	Shadow, worst case		
No.	Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]
KR	0:00	0	0:00
KS	0:00	0	0:00
KT	6:34	40	0:19
KU	0:00	0	0:00
KV	0:00	0	0:00
KW	0:00	0	0:00
KX	0:00	0	0:00
KY	0:00	0	0:00
KZ	0:00	0	0:00
LA	5:26	36	0:14
LB	0:00	0	0:00

Total amount of flickering on the shadow receptors caused by each WTG

No.	Name	Worst case [h/year]	Expected [h/year]
1	ENERCON E-92 2,3 MW 2300 92.0 !-! hub: 98.0 m (TOT: 144.0 m) (1)	45:31	
2	ENERCON E-92 2,3 MW 2300 92.0 !-! hub: 98.0 m (TOT: 144.0 m) (2)	43:19	
3	ENERCON E-92 2,3 MW 2300 92.0 !-! hub: 98.0 m (TOT: 144.0 m) (3)	21:33	

Appendix K:

Microwave Radio Links Impact Assessment

Natural Forces

IMPACT ASSESSMENT OF PROPOSED WIND TURBINES IN AMHERST, NS ON PERFORMANCE OF EXISTING MICROWAVE RADIO LINKS

REVISION: B02
NOVEMBER 13TH, 2014

MACNEIL Telecom Inc.

TABLE OF CONTENTS

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LIST OF FIGURES

PURPOSE OF REPORT:

Natural Forces is proposing to construct 3 wind turbines in the Amherst, NS area. As part of the design phase of the project, MacNeil Telecom Inc. was contacted to examine the impact the proposed wind turbines may have on the performance of existing radio communication systems in the immediate area.

ANALYSIS METHODOLOGY:

1. Identify proposed location and size of wind turbines.
2. Obtain data for licensed radio systems within 35km of the wind farm from the radio spectrum licensing authority, Industry Canada (IC) – TAFL database.
3. Plot applicable radio links on a map to show their proximity wrt to the turbines.
4. Review the Industry Canada data records/map to produce a "short list" of radio systems that could potentially be impacted by the turbines.
5. Perform a site visit to verify the location of applicable radio towers and to verify the existence of the antennas identified on the "short list".
6. Tabulate a "verified inventory" of existing radio links that may be of concern and update maps with field verified data.
7. Calculate the recommended required clearance between the radio links of concern and the wind turbine: Fresnel zone and turbine radius.
8. Calculate the expected achievable clearance based on field verified radio site coordinates and specified turbine locations.
9. Assess the results and identify potential issues.
10. If required, recommend what steps can be taken to minimize the impact the turbines will have on existing radio links. The first approach will to work with Natural Forces to consider the possibility of relocating those wind turbines that infringe on existing radio links.

LIMITATIONS OF INDUSTRY CANADA DATA:

The data contained in the Industry Canada database, like any database is subject to certain limitations:

1. **Accuracy of Data**
   System parameters such as site locations (latitudes and longitudes), antenna heights and radio operating parameters are provided by the licensee (or their representative) and are sometimes prone to error. Other system parameters such as the operating frequencies assigned by Industry Canada are much less likely to suffer from serious errors. For the purpose of this report, the accuracy of physical parameters of the radio systems (i.e. site locations, elevations, antenna heights, etc.) are of highest importance, deeming it necessary to confirm the parameters by means of field survey.

2. **Extent of Data**
   The report considers only system data included in the Industry Canada database as of April 17th, 2014.

3. **Licensed Radio Systems**
   The Industry Canada database only includes radio systems that require a license from Industry Canada to operate. Non-licensed radio systems (e.g. certain spread-spectrum radios) are not captured in the database and therefore cannot be identified.

4. **Status of Systems**
   It is assumed that all systems identified on the Industry Canada database are still in service (provided the antennas associated with that system was found to still exist during the field survey).

LIMITATIONS OF ANALYSIS:

1. **Point-to-point Radio Links**
   The report considers point-to-point (PTP) radio links employing narrow beamwidth (e.g parabolic) antennas operating above 900MHz. It does not consider lower frequency systems (i.e. below 900MHz) employing wide beam antennas (e.g. omni-direction or yagi antennas) as such systems are not expected to be significantly impacted by the proposed structures. Typically, lower frequency systems operating in the VHF and UHF band for example are much less susceptible to diffraction loss resulting from obstructions beyond the immediate proximity of its antennas. The dimensions and shape of the proposed wind turbines (i.e. tower and blades) are considered relatively narrow wrt the wavelength of such lower frequency systems and would therefore only be of concern (to cause significant performance degradation) if positioned in very close proximity to the antenna itself. The performance of cellular type radio systems operating in the 1900/2100 MHz bands that use sectorial antennas and operate in the near vicinity of the wind turbines are also given consideration.

2. **Accuracy of Field Measurements**
   Location and ground elevations of towers were measured using Magellan Explorist 310 GPS receiver. The expected accuracy of this unit is in the neighborhood of +/- 5m horizontal.

3. **Accuracy of Customer Data**
   The accuracy of the location of the proposed wind turbines is unknown. Revised coordinates for the turbines was provided on early November 2014.

INPUTS:

The location of the proposed wind turbines have been identified as:

Turbine 1	45° 50' 6.37"N	64° 8' 38.67"W
Turbine 2	45° 49' 47.48"N	64° 8' 35.92"W
Turbine 3	45° 49' 52.93"N	64° 8' 51.14"W

Initial indications are the proposed turbines will have a blade length of 46m wrt to center of turbine.

FINDINGS:

Table A in Appendix A outlines the active licensed non-protected PTP radio links operating in the vicinity (within 20km) of the proposed wind turbines as of April 17th, 2014. This data was sourced from Industry Canada’s TAFL. This information is shown visually on a map in **Figure 1**. **Figure 2** shows a close up view of the area around the turbines and the links operating nearby.

Two existing licensed microwave radio links are of most concern and the focus of the study can be narrowed down to these two links. One radio link is owned by Rogers Communications and links their John Black Road site and their West Leicester site and operates in the 10.5GHz band. The second radio link is operated by Eastlink and links their Willow Street tower to their Truemanville tower. This link operates in the 18GHz band.

Consultation with the Province of Nova Scotia also determined that there are no protected public safety radio links on their nearby tower site in Salem that will be impacted by the proposed wind farm. Future radio links on the PNS Salem tower were also considered and are not expected to be impacted – Salem to Sugerloaf (PNS), Salem to Southampton (PNS), Salem to Mount Pleasant (NSP – 7GHz) and Salem to Church Street (NSP - 900MHz).

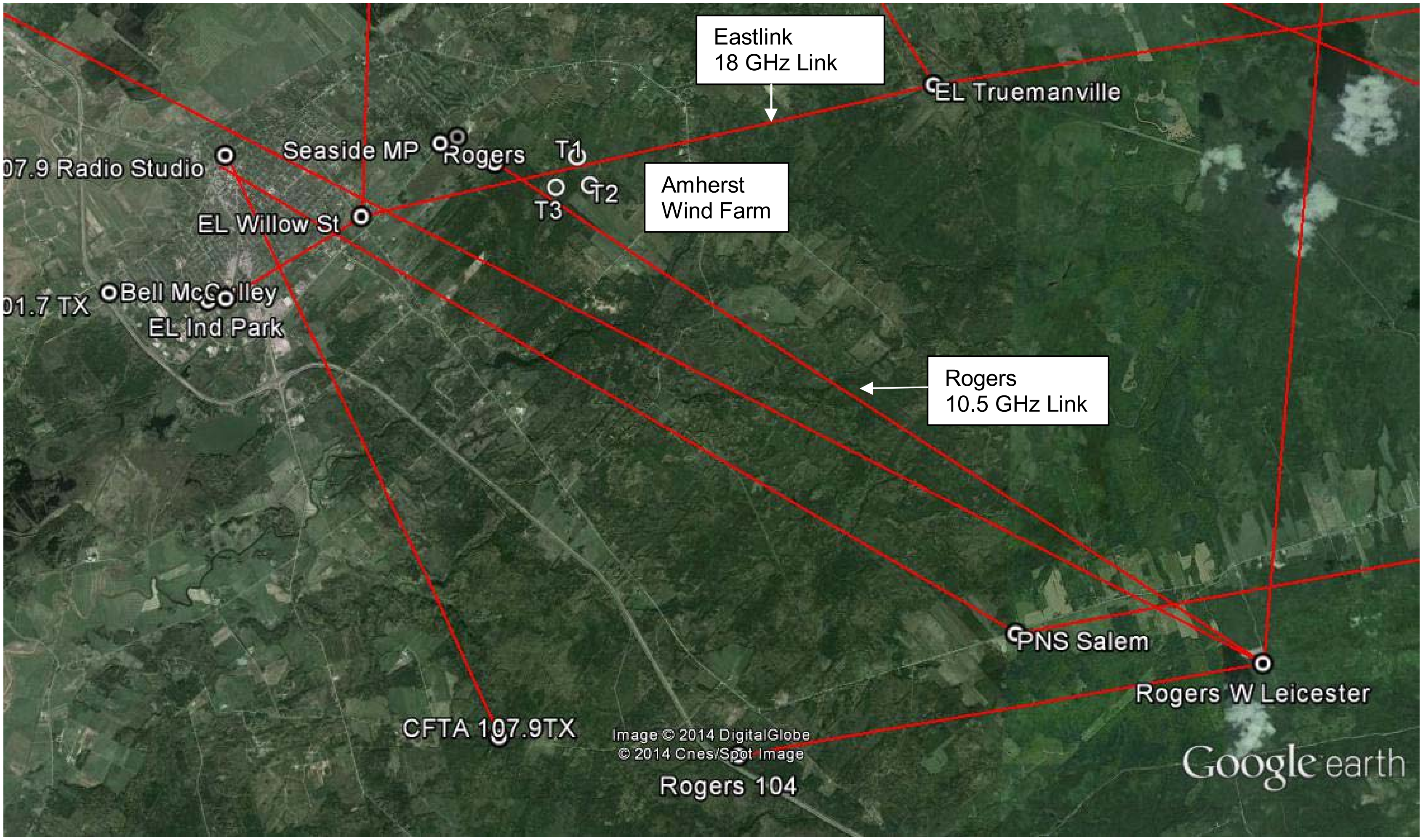

Figure 1 – Licensed PTP Radio Links wrt to \proposed Wind Farm (T1-3)

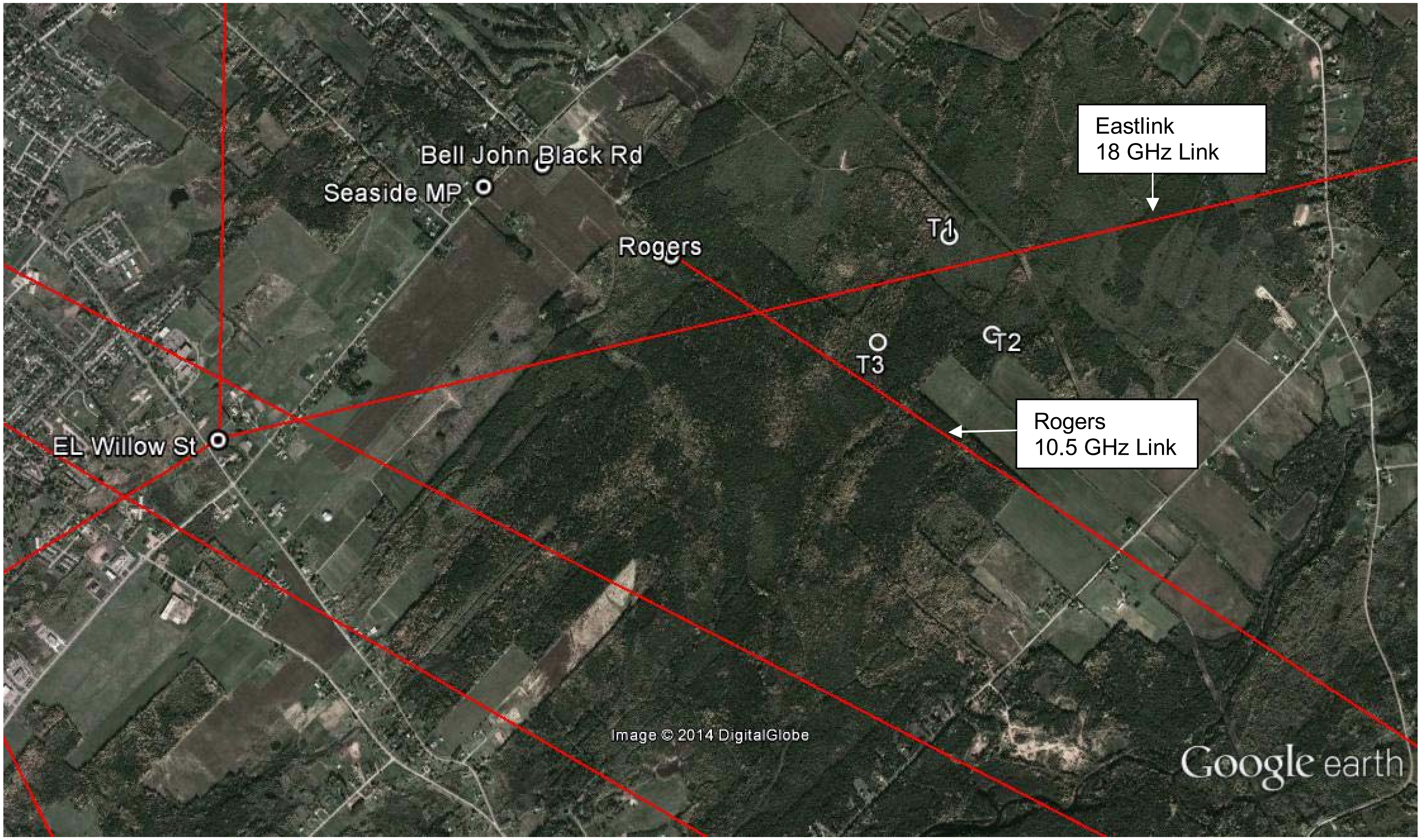

Figure 2 – Amherst Radio Links wrtWind Farm (T1-3) - Close Up

Figure 3 – Bell John Black Road Tower

Figure 4 – Eastlink Willow Street Tower

Figure 5 - Eastlink Truemanville Tower

Rogers John Black Rd Antenna To West Leicester

Figure 6- Rogers John Black Road

Figure 7 - Rogers West Leicester

Figure 8 - Province Nova Scotia - Salem Site

Figure 9 - Seaside John Black Road Tower

ANALYSIS:

The required clearance around a given radio link to avoid diffraction loss is inversely proportional to its frequency (i.e. the higher the frequency, the narrower the clearance area - aka the Fresnel zone).

The absolute minimum clearance required for a given radio link to avoid diffraction loss is 60% of the first fresnel zone (0.6 F1) at the obstruction. However to account for limitations of field measurements and inaccuracies of the actual positioning of turbines, we recommend a minimum clearance of 30m + F1.

Eastlink Willow Street => Truemanville

Eastlink's PTP link between Willow Street and Truemanville operates in the 18GHz band.

TABLE 1.1 – MEASURED RADIO SITE DATA

Site	Description	UTM Northing (m)	UTM Easting (m)	Site Elev. (m)
1	EL Willow Street	5075580	407944	66
2	EL Truemanville	5077404	416304	93

TABLE 1.2 – FRESNEL ZONE CALCULATION

Freq (GHz)	Wave Length	D (km) Link Length	d1 (km)	F1 (m)	F1 + 30m (m)	Rotor Radius (m)	Recommended Minimum Clearance (m)
18	2 cm	8.6	3.2	6.0	36	46m	82m

TABLE 1.3 – SPECIFIED TURBINE LOCATIONS AND CALCULATED OFFSET WRT LINK

Site	UTM Northing (m)	UTM Easting (m)	Calculated Offset (m)	Rec. Min Clearance (m)	Difference (m)	Status
T1	5076363	411149	82	82	+0m	OK
T2	5075779	411200	500	82	+418m	OK
T3	5075952	410874	260	82	+178m	OK

Rogers' John Black Rd => West Leicester

Rogers' PTP link between John Black Rd and West Leicester operates in the 10.5GHz band.

TABLE 2.1 – MEASURED RADIO SITE DATA

Site	Description	UTM Northing (m)	UTM Easting (m)	Site Elev. (m)
1	Rogers John Black Rd	5076332	409889	98
2	Rogers West Leicester	5068980	420734	161

TABLE 2.2 – FRESNEL ZONE CALCULATION

Freq (GHz)	Wave Length	D (km) Link Length	d1 (km)	F1 (m)	F1 + 30m (m)	Rotor Radius (m)	Recommended Minimum Clearance (m)
10.5	3 cm	13.1	1.2	5.5	36	46m	82m

TABLE 2.3 – SPECIFIED TURBINE LOCATIONS AND CALCULATED OFFSET WRT LINK

Site	UTM Northing (m)	UTM Easting (m)	Calculated Offset (m)	Rec. Min Clearance (m)	Difference (m)	Status
T1	5076363	411149	730	82	+648m	OK
T2	5075779	411200	280	82	+198m	OK
T3	5075952	410874	240	82	+158m	OK

Cellular Telephone Systems

It is noted that there are cellular type systems operating in the Amherst area, however these are 1 km (or more) away from the wind farm. Handheld units operating on higher frequency cellular systems (e.g. 1900HSPA and 2100-2600LTE) may potentially experience interference (i.e. noise/reduced data rates) in localized areas in the immediate vicinity of the wind farm and in areas east of the turbines (Bell and Rogers only, as Eastlink's Truemanville site provides coverage/protection in this area). The level of degradation and the number of subscribers potentially affected is difficult to predict, however given the remote location of the turbines (in relation to residents and highways), the wide beamwidth of the antennas employed, and the light population of the area in question (rural Amherst) the potential impact is expected to be minimal.

CONCLUSIONS/RECOMMENDATIONS:

Based on the results of our findings, the proposed wind turbines in Amherst are not expected to cause significant performance degradations on the identified existing radio systems in the area.

Point To Point Systems:
The proposed wind turbines are not expected to significantly impact the performance of licensed PTP radio systems operating in the area. It is noted that other non-licensed radios systems (not identified in the Industry Canada database) have not been identified or assessed unless mentioned in this report.

Fixed Mobile Radio Systems:
Lower frequency fixed systems (below 900MHz) utilizing non-directional antennas (i.e. omni-direction or sector type antennas) that operate close to the turbines are not expected to be negatively impacted with the possible exception being high EMI or local signal scatter that could negatively impacting mobile radio units operating very near the wind turbines.

HSPA/LTE Cellular Systems:
There are cellular type systems (800/1900/2100/2600 MHz bands) operating at Bell's John Black Road site, Rogers' John Black Road and Eastlink's Willow Street and Truemanville sites. The turbines are not expected to significantly impact the operation of these systems with the possible exception being reduced coverage/performance for subscribers operating in close proximity to the wind farm.

APPENDIX A – TAFL DATA (APRIL 17TH, 2014) – 20KM RADIUS AMHERST WIND FARM

Tx Frequency (MHz)	Rx Frequency (MHz)	Latitude (ddmmss)	Longitude (dddmmss)	Station Location	Tx Antenna Azimuth (deg)	Link Station Location	Azimuth (deg)	Distance (km)	Licensee Name
931.6125		454642	640241	WEST LEICESTER N.S.	0		127.93	9.64	Rogers Communications Inc. (Paging) Wilson Tam, Mgr. Radio Engineering
931.6875		454642	640241	WEST LEICESTER N.S.	0		127.93	9.64	Rogers Communications Inc. (Paging) Wilson Tam, Mgr. Radio Engineering
931.7375		454044	635857	CLAREMONT NS	0		143.74	21.05	Bell Mobility Inc Attn: Meyang Yunga: PEIN 6026826
931.7375		455017	641002	AMHERST, NS	0		290.57	2.02	Bell Mobility Inc Attn: Meyang Yunga: PEIN 6026826
931.7375		455430	642306	SACKVILLE, NB	35		294.53	20.6	Bell Mobility Inc Attn: Meyang Yunga: PEIN 6026826
931.9375		454642	640241	WEST LEICESTER N.S.	0		127.93	9.64	Rogers Communications Inc. (Paging) Wilson Tam, Mgr. Radio Engineering
942.2	933.2	454005	640221	SPRINGHILL, NS	45.9	MOUNT PLEASANT	156.12	19.89	NOVA SCOTIA POWER ATTN: CUSTOMER OPERATIONS - RAL
952.93125		454948	641220	AMHERST, NS -WATER METER READING	0		267.84	4.87	TOWN OF AMHERST WORKS
952.94375		455400	642157	SACKVILLE, NB-METER READING SYSTEM	0		293.83	18.87	TOWN OF SACKVILLE
958		455009	641240	AMHERST, NS - CFTA STUDIO	154	CUMBERLAND COUNTY	275.03	5.31	TANTRAMAR COUMMUNTIY RADIO SOCIETY ATT'N: RON BICKLE
1930	1850	454404	635322	A0345-1853, BLACK RIVER RD OXFORD	0		118.73	22.42	FIDO SOLUTIONS INC Ron Murphy, Dir. Radio Engineering
1930	1850	454530	640653	A0365-667, OLD HALIFAX ROAD SALEM	0		165.05	8.44	FIDO SOLUTIONS INC Ron Murphy, Dir. Radio Engineering
1930	1850	454611	640109	A0011-1149, MAPLE LANE WEST LEICES	120		125.66	11.8	FIDO SOLUTIONS INC Ron Murphy, Dir. Radio Engineering
1930	1850	455004	640936	A0194-200 ROBERT ANGUS DR AMHERST	0		283.04	1.37	FIDO SOLUTIONS INC Ron Murphy, Dir. Radio Engineering
1930	1850	455430	642308	A0374-39 HESLER DRIVE SACKVILLE	0		294.48	20.64	FIDO SOLUTIONS INC Ron Murphy, Dir. Radio Engineering
1957.5	1877.5	454859	641248	J0665-10 McCully	10		252.76	5.73	BELL MOBILITY INC. Attn: Meyang Yunga; PEIN 6026826
1957.5	1877.5	454859	641248	J0665-10 McCully	120		252.76	5.73	BELL MOBILITY INC. Attn: Meyang Yunga; PEIN 6026826
1957.5	1877.5	454859	641248	J0665-10 McCully	255		252.76	5.73	BELL MOBILITY INC. Attn: Meyang Yunga; PEIN 6026826
1957.5	1877.5	455017	641002	J0460-366 John Black Road	70		290.57	2.02	BELL MOBILITY INC. Attn: Meyang Yunga; PEIN 6026826
1957.5	1877.5	455017	641002	J0460-366 John Black Road	160		290.57	2.02	BELL MOBILITY INC. Attn: Meyang Yunga; PEIN 6026826
1957.5	1877.5	455017	641002	J0460-366 John Black Road	265		290.57	2.02	BELL MOBILITY INC. Attn: Meyang Yunga; PEIN 6026826
1958	1878	454859	641248	J0665-10 McCully Street	10		252.76	5.73	BELL MOBILITY INC. Attn: Meyang Yunga; PEIN 6026826
1958	1878	454859	641248	J0665-10 McCully Street	120		252.76	5.73	BELL MOBILITY INC. Attn: Meyang Yunga; PEIN 6026826
1958	1878	454859	641248	J0665-10 McCully Street	255		252.76	5.73	BELL MOBILITY INC. Attn: Meyang Yunga; PEIN 6026826

Tx Frequency (MHz)	Rx Frequency (MHz)	Latitude (ddmmss)	Longitude (dddmmss)	Station Location	Tx Antenna Azimuth (deg)	Link Station Location	Azimuth (deg)	Distance (km)	Licensee Name
1958	1878	455017	641002	J0460-366 John Black Road	70		290.57	2.02	BELL MOBILITY INC. Attn: Meyang Yunga; PEIN 6026826
1958	1878	455017	641002	J0460-366 John Black Road	160		290.57	2.02	BELL MOBILITY INC. Attn: Meyang Yunga; PEIN 6026826
1958	1878	455017	641002	J0460-366 John Black Road	265		290.57	2.02	BELL MOBILITY INC. Attn: Meyang Yunga; PEIN 6026826
1958	1878	455431	642308	J0387-39 Hesler Drive	60		294.56	20.65	BELL MOBILITY INC. Attn: Meyang Yunga; PEIN 6026826
1958	1878	455431	642308	J0387-39 Hesler Drive	160		294.56	20.65	BELL MOBILITY INC. Attn: Meyang Yunga; PEIN 6026826
1958	1878	455431	642308	J0387-39 Hesler Drive	320		294.56	20.65	BELL MOBILITY INC. Attn: Meyang Yunga; PEIN 6026826
1962.5	1882.5	454859	641248	J0665-10 McCully	10		252.76	5.73	BELL MOBILITY INC. Attn: Meyang Yunga; PEIN 6026826
1962.5	1882.5	454859	641248	J0665-10 McCully	120		252.76	5.73	BELL MOBILITY INC. Attn: Meyang Yunga; PEIN 6026826
1962.5	1882.5	454859	641248	J0665-10 McCully	255		252.76	5.73	BELL MOBILITY INC. Attn: Meyang Yunga; PEIN 6026826
1962.5	1882.5	455017	641002	J0460-366 John Black Road	70		290.57	2.02	BELL MOBILITY INC. Attn: Meyang Yunga; PEIN 6026826
1962.5	1882.5	455017	641002	J0460-366 John Black Road	160		290.57	2.02	BELL MOBILITY INC. Attn: Meyang Yunga; PEIN 6026826
1962.5	1882.5	455017	641002	J0460-366 John Black Road	265		290.57	2.02	BELL MOBILITY INC. Attn: Meyang Yunga; PEIN 6026826
1962.5	1882.5	455431	642308	J0387-39 Hesler Drive	60		294.56	20.65	BELL MOBILITY INC. Attn: Meyang Yunga; PEIN 6026826
1962.5	1882.5	455431	642308	J0387-39 Hesler Drive	160		294.56	20.65	BELL MOBILITY INC. Attn: Meyang Yunga; PEIN 6026826
1962.5	1882.5	455431	642308	J0387-39 Hesler Drive	320		294.56	20.65	BELL MOBILITY INC. Attn: Meyang Yunga; PEIN 6026826
1963	1883	454859	641248	J0665-10 McCully Street	10		252.76	5.73	BELL MOBILITY INC. Attn: Meyang Yunga; PEIN 6026826
1963	1883	454859	641248	J0665-10 McCully Street	120		252.76	5.73	BELL MOBILITY INC. Attn: Meyang Yunga; PEIN 6026826
1963	1883	454859	641248	J0665-10 McCully Street	255		252.76	5.73	BELL MOBILITY INC. Attn: Meyang Yunga; PEIN 6026826
1963	1883	455017	641002	J0460-366 John Black Road	70		290.57	2.02	BELL MOBILITY INC. Attn: Meyang Yunga; PEIN 6026826
1963	1883	455017	641002	J0460-366 John Black Road	160		290.57	2.02	BELL MOBILITY INC. Attn: Meyang Yunga; PEIN 6026826
1963	1883	455017	641002	J0460-366 John Black Road	265		290.57	2.02	BELL MOBILITY INC. Attn: Meyang Yunga; PEIN 6026826
1967.5	1887.5	454859	641248	J0665-10 McCully	10		252.76	5.73	Bell Mobility Inc. Attn: Meyang Yunga; PEIN 6026826
1967.5	1887.5	454859	641248	J0665-10 McCully	120		252.76	5.73	Bell Mobility Inc. Attn: Meyang Yunga; PEIN 6026826

Tx Frequency (MHz)	Rx Frequency (MHz)	Latitude (ddmmss)	Longitude (dddmmss)	Station Location	Tx Antenna Azimuth (deg)	Link Station Location	Azimuth (deg)	Distance (km)	Licensee Name
1967.5	1887.5	454859	641248	J0665-10 McCully	255		252.76	5.73	Bell Mobility Inc. Attn: Meyang Yunga; PEIN 6026826
1967.5	1887.5	455017	641002	J0460-366 John Black Road	70		290.57	2.02	Bell Mobility Inc. Attn: Meyang Yunga; PEIN 6026826
1967.5	1887.5	455017	641002	J0460-366 John Black Road	160		290.57	2.02	Bell Mobility Inc. Attn: Meyang Yunga; PEIN 6026826
1967.5	1887.5	455017	641002	J0460-366 John Black Road	265		290.57	2.02	Bell Mobility Inc. Attn: Meyang Yunga; PEIN 6026826
1970.4	1890.4	454530	640653	A0365-667, OLD HALIFAX ROAD SALEM	0		165.05	8.44	Rogers Communications Partnership Ron Murphy, Dir. Radio Engineering
1970.8	1890.8	455004	640936	A0194-200 ROBERT ANGUS DR AMHERST	0		283.04	1.37	Rogers Communications Partnership Ron Murphy, Dir. Radio Engineering
1971	1891	454404	635322	A0345-1853, BLACK RIVER RD OXFORD	0		118.73	22.42	Rogers Communications Partnership Ron Murphy, Dir. Radio Engineering
1971.8	1891.8	454611	640109	A0011-1149, MAPLE LANE WEST LEICES	120		125.66	11.8	Rogers Communications Partnership Ron Murphy, Dir. Radio Engineering
1973.4	1893.4	455430	642308	A0374-39 HESLER DRIVE SACKVILLE	0		294.48	20.64	Rogers Communications Partnership Ron Murphy, Dir. Radio Engineering
1983	1903	455431	642308	J0387-39 Hesler Drive	60		294.56	20.65	BELL MOBILITY INC. Attn: Meyang Yunga; PEIN 6026826
1983	1903	455431	642308	J0387-39 Hesler Drive	160		294.56	20.65	BELL MOBILITY INC. Attn: Meyang Yunga; PEIN 6026826
1983	1903	455431	642308	J0387-39 Hesler Drive	320		294.56	20.65	BELL MOBILITY INC. Attn: Meyang Yunga; PEIN 6026826
1987.5	1907.5	455431	642308	J0387-39 Hesler Drive	60		294.56	20.65	BELL MOBILITY INC. Attn: Meyang Yunga; PEIN 6026826
1987.5	1907.5	455431	642308	J0387-39 Hesler Drive	160		294.56	20.65	BELL MOBILITY INC. Attn: Meyang Yunga; PEIN 6026826
1987.5	1907.5	455431	642308	J0387-39 Hesler Drive	320		294.56	20.65	BELL MOBILITY INC. Attn: Meyang Yunga; PEIN 6026826
2115	1715	454859	641248	J0665-10 McCully Street	10		252.76	5.73	Bell Mobility Inc. Attn: Meyang Yunga; PEIN 6026826
2115	1715	454859	641248	J0665-10 McCully Street	120		252.76	5.73	Bell Mobility Inc. Attn: Meyang Yunga; PEIN 6026826
2115	1715	454859	641248	J0665-10 McCully Street	255		252.76	5.73	Bell Mobility Inc. Attn: Meyang Yunga; PEIN 6026826
2125	1725	454047	635827	NSD118 Clairmont Road, Springhill	90		142.19	21.37	Bragg Communications Inc. c/o Eastlink
2125	1725	454047	635827	NSD118 Clairmont Road, Springhill	90		142.19	21.37	Bragg Communications Inc. c/o Eastlink
2125	1725	454047	635827	NSD118 Clairmont Road, Springhill	210		142.19	21.37	Bragg Communications Inc. c/o Eastlink
2125	1725	454047	635827	NSD118 Clairmont Road, Springhill	210		142.19	21.37	Bragg Communications Inc. c/o Eastlink
2125	1725	454047	635827	NSD118 Clairmont Road, Springhill	320		142.19	21.37	Bragg Communications Inc. c/o Eastlink
2125	1725	454047	635827	NSD118 Clairmont Road, Springhill	320		142.19	21.37	Bragg Communications Inc. c/o Eastlink
2125	1725	454334	635349	NSD103 Black River Road, Oxford	30		121.53	22.39	Bragg Communications Inc. c/o Eastlink
2125	1725	454334	635349	NSD103 Black River Road, Oxford	30		121.53	22.39	Bragg Communications Inc. c/o Eastlink
2125	1725	454334	635349	NSD103 Black River Road, Oxford	130		121.53	22.39	Bragg Communications Inc. c/o Eastlink
2125	1725	454334	635349	NSD103 Black River Road, Oxford	130		121.53	22.39	Bragg Communications Inc. c/o Eastlink
2125	1725	454334	635349	NSD103 Black River Road, Oxford	240		121.53	22.39	Bragg Communications Inc. c/o Eastlink

Tx Frequency (MHz)	Rx Frequency (MHz)	Latitude (ddmmss)	Longitude (dddmmss)	Station Location	Tx Antenna Azimuth (deg)	Link Station Location	Azimuth (deg)	Distance (km)	Licensee Name
2125	1725	454334	635349	NSD103 Black River Road, Oxford	240		121.53	22.39	Bragg Communications Inc. c/o Eastlink
2125	1725	454530	640653	NSD104 HWY 104 Salem	50		165.05	8.44	Bragg Communications Inc. c/o Eastlink
2125	1725	454530	640653	NSD104 HWY 104 Salem	50		165.05	8.44	Bragg Communications Inc. c/o Eastlink
2125	1725	454530	640653	NSD104 HWY 104 Salem	130		165.05	8.44	Bragg Communications Inc. c/o Eastlink
2125	1725	454530	640653	NSD104 HWY 104 Salem	130		165.05	8.44	Bragg Communications Inc. c/o Eastlink
2125	1725	454530	640653	NSD104 HWY 104 Salem	290		165.05	8.44	Bragg Communications Inc. c/o Eastlink
2125	1725	454530	640653	NSD104 HWY 104 Salem	290		165.05	8.44	Bragg Communications Inc. c/o Eastlink
2125	1725	454939	641107	NSD105 Willow Street, Amherst	0		262.01	3.33	Bragg Communications Inc. c/o Eastlink
2125	1725	454939	641107	NSD105 Willow Street, Amherst	0		262.01	3.33	Bragg Communications Inc. c/o Eastlink
2125	1725	454939	641107	NSD105 Willow Street, Amherst	170		262.01	3.33	Bragg Communications Inc. c/o Eastlink
2125	1725	454939	641107	NSD105 Willow Street, Amherst	170		262.01	3.33	Bragg Communications Inc. c/o Eastlink
2125	1725	454939	641107	NSD105 Willow Street, Amherst	260		262.01	3.33	Bragg Communications Inc. c/o Eastlink
2125	1725	454939	641107	NSD105 Willow Street, Amherst	260		262.01	3.33	Bragg Communications Inc. c/o Eastlink
2125	1725	455042	640440	NSD111 Truemanville	55		73.57	5.25	Bragg Communications Inc. c/o Eastlink
2125	1725	455042	640440	NSD111 Truemanville	55		73.57	5.25	Bragg Communications Inc. c/o Eastlink
2125	1725	455042	640440	NSD111 Truemanville	180		73.57	5.25	Bragg Communications Inc. c/o Eastlink
2125	1725	455042	640440	NSD111 Truemanville	180		73.57	5.25	Bragg Communications Inc. c/o Eastlink
2125	1725	455042	640440	NSD111 Truemanville	280		73.57	5.25	Bragg Communications Inc. c/o Eastlink
2125	1725	455042	640440	NSD111 Truemanville	280		73.57	5.25	Bragg Communications Inc. c/o Eastlink
2125	1725	455218	641606	NBA010 Green Hill Road, Aulac	50		294.62	10.69	Bragg Communications Inc. c/o Eastlink
2125	1725	455218	641606	NBA010 Green Hill Road, Aulac	50		294.62	10.69	Bragg Communications Inc. c/o Eastlink
2125	1725	455218	641606	NBA010 Green Hill Road, Aulac	170		294.62	10.69	Bragg Communications Inc. c/o Eastlink
2125	1725	455218	641606	NBA010 Green Hill Road, Aulac	170		294.62	10.69	Bragg Communications Inc. c/o Eastlink
2125	1725	455218	641606	NBA010 Green Hill Road, Aulac	290		294.62	10.69	Bragg Communications Inc. c/o Eastlink
2125	1725	455218	641606	NBA010 Green Hill Road, Aulac	290		294.62	10.69	Bragg Communications Inc. c/o Eastlink
2125	1725	455430	642308	NBA009 93 King Street, Sackville	50		294.48	20.64	Bragg Communications Inc. c/o Eastlink
2125	1725	455430	642308	NBA009 93 King Street, Sackville	50		294.48	20.64	Bragg Communications Inc. c/o Eastlink
2125	1725	455430	642308	NBA009 93 King Street, Sackville	170		294.48	20.64	Bragg Communications Inc. c/o Eastlink
2125	1725	455430	642308	NBA009 93 King Street, Sackville	170		294.48	20.64	Bragg Communications Inc. c/o Eastlink
2125	1725	455430	642308	NBA009 93 King Street, Sackville	290		294.48	20.64	Bragg Communications Inc. c/o Eastlink
2125	1725	455430	642308	NBA009 93 King Street, Sackville	290		294.48	20.64	Bragg Communications Inc. c/o Eastlink
2125	1725	455755	641101	NBA021 Jolicure, NB	50		348.01	15.19	Bragg Communications Inc. c/o Eastlink
2125	1725	455755	641101	NBA021 Jolicure, NB	50		348.01	15.19	Bragg Communications Inc. c/o Eastlink
2125	1725	455755	641101	NBA021 Jolicure, NB	210		348.01	15.19	Bragg Communications Inc. c/o Eastlink
2125	1725	455755	641101	NBA021 Jolicure, NB	210		348.01	15.19	Bragg Communications Inc. c/o Eastlink
2125	1725	455755	641101	NBA021 Jolicure, NB	320		348.01	15.19	Bragg Communications Inc. c/o Eastlink
2125	1725	455755	641101	NBA021 Jolicure, NB	320		348.01	15.19	Bragg Communications Inc. c/o Eastlink
2132.5	1732.5	454047	635827	NSD118 Clairmont Road, Springhill	90		142.19	21.37	Bragg Communications Inc. c/o Eastlink
2132.5	1732.5	454047	635827	NSD118 Clairmont Road, Springhill	90		142.19	21.37	Bragg Communications Inc. c/o Eastlink
2132.5	1732.5	454047	635827	NSD118 Clairmont Road, Springhill	210		142.19	21.37	Bragg Communications Inc. c/o Eastlink
2132.5	1732.5	454047	635827	NSD118 Clairmont Road, Springhill	210		142.19	21.37	Bragg Communications Inc. c/o Eastlink
2132.5	1732.5	454047	635827	NSD118 Clairmont Road, Springhill	320		142.19	21.37	Bragg Communications Inc. c/o Eastlink
2132.5	1732.5	454047	635827	NSD118 Clairmont Road, Springhill	320		142.19	21.37	Bragg Communications Inc. c/o Eastlink
2132.5	1732.5	454334	635349	NSD103 Black River Road, Oxford	30		121.53	22.39	Bragg Communications Inc. c/o Eastlink
2132.5	1732.5	454334	635349	NSD103 Black River Road, Oxford	30		121.53	22.39	Bragg Communications Inc. c/o Eastlink
2132.5	1732.5	454334	635349	NSD103 Black River Road, Oxford	130		121.53	22.39	Bragg Communications Inc. c/o Eastlink
2132.5	1732.5	454334	635349	NSD103 Black River Road, Oxford	130		121.53	22.39	Bragg Communications Inc. c/o Eastlink

Tx Frequency (MHz)	Rx Frequency (MHz)	Latitude (ddmmss)	Longitude (dddmmss)	Station Location	Tx Antenna Azimuth (deg)	Link Station Location	Azimuth (deg)	Distance (km)	Licensee Name
2132.5	1732.5	454334	635349	NSD103 Black River Road, Oxford	240		121.53	22.39	Bragg Communications Inc. c/o Eastlink
2132.5	1732.5	454334	635349	NSD103 Black River Road, Oxford	240		121.53	22.39	Bragg Communications Inc. c/o Eastlink
2132.5	1732.5	454530	640653	NSD104 HWY 104 Salem	50		165.05	8.44	Bragg Communications Inc. c/o Eastlink
2132.5	1732.5	454530	640653	NSD104 HWY 104 Salem	50		165.05	8.44	Bragg Communications Inc. c/o Eastlink
2132.5	1732.5	454530	640653	NSD104 HWY 104 Salem	130		165.05	8.44	Bragg Communications Inc. c/o Eastlink
2132.5	1732.5	454530	640653	NSD104 HWY 104 Salem	130		165.05	8.44	Bragg Communications Inc. c/o Eastlink
2132.5	1732.5	454530	640653	NSD104 HWY 104 Salem	290		165.05	8.44	Bragg Communications Inc. c/o Eastlink
2132.5	1732.5	454530	640653	NSD104 HWY 104 Salem	290		165.05	8.44	Bragg Communications Inc. c/o Eastlink
2132.5	1732.5	454939	641107	NSD105 Willow Street, Amherst	0		262.01	3.33	Bragg Communications Inc. c/o Eastlink
2132.5	1732.5	454939	641107	NSD105 Willow Street, Amherst	0		262.01	3.33	Bragg Communications Inc. c/o Eastlink
2132.5	1732.5	454939	641107	NSD105 Willow Street, Amherst	170		262.01	3.33	Bragg Communications Inc. c/o Eastlink
2132.5	1732.5	454939	641107	NSD105 Willow Street, Amherst	170		262.01	3.33	Bragg Communications Inc. c/o Eastlink
2132.5	1732.5	454939	641107	NSD105 Willow Street, Amherst	260		262.01	3.33	Bragg Communications Inc. c/o Eastlink
2132.5	1732.5	454939	641107	NSD105 Willow Street, Amherst	260		262.01	3.33	Bragg Communications Inc. c/o Eastlink
2132.5	1732.5	455042	640440	NSD111 Truemanville	55		73.57	5.25	Bragg Communications Inc. c/o Eastlink
2132.5	1732.5	455042	640440	NSD111 Truemanville	55		73.57	5.25	Bragg Communications Inc. c/o Eastlink
2132.5	1732.5	455042	640440	NSD111 Truemanville	180		73.57	5.25	Bragg Communications Inc. c/o Eastlink
2132.5	1732.5	455042	640440	NSD111 Truemanville	180		73.57	5.25	Bragg Communications Inc. c/o Eastlink
2132.5	1732.5	455042	640440	NSD111 Truemanville	280		73.57	5.25	Bragg Communications Inc. c/o Eastlink
2132.5	1732.5	455042	640440	NSD111 Truemanville	280		73.57	5.25	Bragg Communications Inc. c/o Eastlink
2137.5	1737.5	455218	641606	NBA010 Green Hill Road, Aulac	50		294.62	10.69	Bragg Communications Inc. c/o Eastlink
2137.5	1737.5	455218	641606	NBA010 Green Hill Road, Aulac	50		294.62	10.69	Bragg Communications Inc. c/o Eastlink
2137.5	1737.5	455218	641606	NBA010 Green Hill Road, Aulac	170		294.62	10.69	Bragg Communications Inc. c/o Eastlink
2137.5	1737.5	455218	641606	NBA010 Green Hill Road, Aulac	170		294.62	10.69	Bragg Communications Inc. c/o Eastlink
2137.5	1737.5	455218	641606	NBA010 Green Hill Road, Aulac	290		294.62	10.69	Bragg Communications Inc. c/o Eastlink
2137.5	1737.5	455218	641606	NBA010 Green Hill Road, Aulac	290		294.62	10.69	Bragg Communications Inc. c/o Eastlink
2137.5	1737.5	455430	642308	NBA009 93 King Street, Sackville	50		294.48	20.64	Bragg Communications Inc. c/o Eastlink
2137.5	1737.5	455430	642308	NBA009 93 King Street, Sackville	50		294.48	20.64	Bragg Communications Inc. c/o Eastlink
2137.5	1737.5	455430	642308	NBA009 93 King Street, Sackville	170		294.48	20.64	Bragg Communications Inc. c/o Eastlink
2137.5	1737.5	455430	642308	NBA009 93 King Street, Sackville	170		294.48	20.64	Bragg Communications Inc. c/o Eastlink
2137.5	1737.5	455430	642308	NBA009 93 King Street, Sackville	290		294.48	20.64	Bragg Communications Inc. c/o Eastlink
2137.5	1737.5	455430	642308	NBA009 93 King Street, Sackville	290		294.48	20.64	Bragg Communications Inc. c/o Eastlink
2137.5	1737.5	455755	641101	NBA021 Jolicure, NB	50		348.01	15.19	Bragg Communications Inc. c/o Eastlink
2137.5	1737.5	455755	641101	NBA021 Jolicure, NB	50		348.01	15.19	Bragg Communications Inc. c/o Eastlink
2137.5	1737.5	455755	641101	NBA021 Jolicure, NB	210		348.01	15.19	Bragg Communications Inc. c/o Eastlink
2137.5	1737.5	455755	641101	NBA021 Jolicure, NB	210		348.01	15.19	Bragg Communications Inc. c/o Eastlink
2137.5	1737.5	455755	641101	NBA021 Jolicure, NB	320		348.01	15.19	Bragg Communications Inc. c/o Eastlink
2137.5	1737.5	455755	641101	NBA021 Jolicure, NB	320		348.01	15.19	Bragg Communications Inc. c/o Eastlink
2393	2293	454612	640101	WEST LEICESTER, NS	112.2	LOWER GREENVILLE	125.06	11.92	ROGERS COMMUNICATIONS PARTNERSHIP ATTN: M VUJOSEVIC, TRANSMISSION ENG
2411	2311	454612	640101	WEST LEICESTER, NS	297.4	FAIRFIELD	125.06	11.92	ROGERS COMMUNICATIONS PARTNERSHIP ATTN: M VUJOSEVIC, TRANSMISSION ENG
3555.5	3555.5	455739	641135	HALLS HILLS, NB (35 JOLICURE ROAD)	60		344.86	14.88	Xplornet Broadband Inc. VP, Engineering and Operations

Tx Frequency (MHz)	Rx Frequency (MHz)	Latitude (ddmmss)	Longitude (dddmmss)	Station Location	Tx Antenna Azimuth (deg)	Link Station Location	Azimuth (deg)	Distance (km)	Licensee Name
3555.5	3555.5	455739	641135	HALLS HILLS, NB (35 JOLICURE ROAD)	210		344.86	14.88	Xplornet Broadband Inc. VP, Engineering and Operations
3562.5	3562.5	455739	641135	HALLS HILLS, NB (35 JOLICURE ROAD)	150		344.86	14.88	Xplornet Broadband Inc. VP, Engineering and Operations
3569.5	3569.5	455739	641135	HALLS HILLS, NB (35 JOLICURE ROAD)	300		344.86	14.88	Xplornet Broadband Inc. VP, Engineering and Operations
5878.875	5912.375	454612	640101	WEST LEICESTER, NS	6.8	MELROSE	125.06	11.92	ROGERS COMMUNICATIONS PARTNERSHIP ATTN: M VUJOSEVIC, TRANSMISSION ENG
5912.375	5878.875	454404	635321	OXFORD, NS	143.9	WESTCHESTER, NS	118.71	22.44	ROGERS COMMUNICATIONS PARTNERSHIP ATTN: M VUJOSEVIC, TRANSMISSION ENG
10552.5	10617.5	455004	640937	AMHERST, NS	122.8	WEST LEICESTER, NS	282.84	1.39	ROGERS COMMUNICATIONS PARTNERSHIP ATTN: M VUJOSEVIC, TRANSMISSION ENG
10617.5	10552.5	454612	640101	WEST LEICESTER, NS	302.9	AMHERST, NS	125.06	11.92	ROGERS COMMUNICATIONS PARTNERSHIP ATTN: M VUJOSEVIC, TRANSMISSION ENG
10725	11215	454530	640653	AMHERST, NS (HWY 104)	157.4	SPRINGHILL, NS	165.05	8.44	ROGERS COMMUNICATIONS PARTNERSHIP ATTN: M VUJOSEVIC, TRANSMISSION ENG
14200	11904	455456	635854	AMHERST, NS - BEECHAM RD	249		53.15	15.58	RigNet (Ca), Inc. Attention: James Crenshaw
14471	12171	455657	640330	MLV 231 (***), NS	230.4		26.54	14.61	RIGNET (CA) INC. Attn: James Crenshaw
14630	15105	454530	640653	AMHERST, NS (HWY 104)	80.3	WEST LEICESTER	165.05	8.44	ROGERS COMMUNICATIONS PARTNERSHIP ATTN: M VUJOSEVIC, TRANSMISSION ENG
15105	14630	454612	640101	WEST LEICESTER, NS	260.3	AMHERST	125.06	11.92	ROGERS COMMUNICATIONS PARTNERSHIP ATTN: M VUJOSEVIC, TRANSMISSION ENG
15347.5	14872.5	455218	641605	AULAC NB	293.3	FAIRFIELD	294.67	10.67	ROGERS COMMUNICATIONS PARTNERSHIP ATTN: M VUJOSEVIC, TRANSMISSION ENG
17960	19520	454900	641237	AMHERST INDUSTRIAL PARK, NS	58.1	AMHERST, NS	252.34	5.49	Bragg Communications Inc. Attention: William Gooding
17960	19520	454047	635827	SALT SPRINGS, NS (EL-NSD118)	49.3	OXFORD	142.19	21.37	Bragg Communications Inc. Attention: William Gooding
17960	19520	455042	640440	TRUEMANVILLE, NS	81	WEST LINDEN, NS	73.57	5.25	Bragg Communications Inc. Attention: William Gooding
17960	19520	455042	640440	TRUEMANVILLE, NS	256.9	AMHERST, NS	73.57	5.25	Bragg Communications Inc. Attention: William Gooding
17960	19520	455754	641101	JOLICURE RIDGE, NB (EL-NBA021)	180.5	AMHERST	347.98	15.16	Bragg Communications Inc. Attention: William Gooding
19461.25	17901.25	455431	642306	SACKVILLE, NB (TOWN)	291.2	FAIRFIELD, NB	294.61	20.61	ROGERS COMMUNICATIONS PARTNERSHIP ATTN: M VUJOSEVIC, TRANSMISSION ENG

Tx Frequency (MHz)	Rx Frequency (MHz)	Latitude (ddmmss)	Longitude (dddmmss)	Station Location	Tx Antenna Azimuth (deg)	Link Station Location	Azimuth (deg)	Distance (km)	Licensee Name
19520	17960	454939	641107	AMHERST, NS	238.1	AMHERST IND PARK, NS	262.01	3.33	Bragg Communications Inc. Attention: William Gooding
19520	17960	454334	635349	OXFORD, NS (EL-NSD103)	229.3	SALT SPRINGS	121.53	22.39	Bragg Communications Inc. Attention: William Gooding
19520	17960	454939	641107	AMHERST, NS	0.5	JOLICURE RIDGE	262.01	3.33	Bragg Communications Inc. Attention: William Gooding
19520	17960	454939	641107	AMHERST, NS	76.8	TRUEMANVILLE, NS	262.01	3.33	Bragg Communications Inc. Attention: William Gooding
19600	18040	455739	641135	HALLS HILLS, NB (35 JOLICURE ROAD)	37.7	PORT ELGIN	344.86	14.88	Xplornet Broadband Inc. VP, Engineering and Operations
	958	454540	640933	CUMBERLAND COUNTY, NS - CFTA TXTR		AMHERST, NS	189.21	7.95	TANTRAMAR COUMMUNTIY RADIO SOCIETY ATT'N: RON BICKLE

Appendix L:

Complaint Resolution Plan

Formal complaints procedure for Mi'kmaq Wind4All Communities LP
Amherst Community Wind Farm

Mi'kmaq Wind4All Communities L.P. is committed to addressing any public concerns regarding the Amherst Community Wind Farm near Amherst, Nova Scotia. The intention is that this policy can inform the public on the ways that they can communicate their concerns to Mi'kmaq Wind4All., and how complaints will be addressed.

1.0 PURPOSE

The purpose of this policy is to ensure all public complaints are dealt with consistently and effectively. Mi'kmaq Wind4All Communities L.P. aims to:

- Manage complaints openly, promptly and properly;
- Try to resolve complaints as soon as possible; and
- Learn from complaints and improve our services.

2.0 SCOPE

This policy will address any complaint; written or spoken expression of dissatisfaction.

3.0 PROCEDURE

All complaints of the Amherst Community Wind Farm will be directed to the Community Liaison Officer, Amy Pellerin:

Amy Pellerin | Development Engineer
Natural Forces Wind Inc.
1801 Hollis Street | Suite 1205 | Halifax | NS | B3J 3N4
Tel: +1 902 422 9663 x 211
Fax: +1 902 425 7840
For more information please refer to Natural Forces Wind Inc. website
www.naturalforces.ca

Complainant will be notified upon receipt of the complaint. The Community Liaison Officer will investigate complaints within 20 days of receiving the complaint; upon which complainant will be notified of how the concern was or will be addressed.

3.1 Noise

Complaints dealing with noise will be assessed on whether noise monitoring is necessary.

If there are several complaints regarding noise from the Amherst Community Wind Farm, then a noise monitoring program may be implemented.

Ways on reducing noise will be discussed with the wind farm operators.

Complainant(s) will be informed of noise mitigation strategies and will be contacted within a year of implemented noise reduction strategies on the success of the noise reduction strategy. This will help address any noise issues that may arise from the Amherst Community Wind Farm.

3.2 Construction and Operation

Complaints regarding operation and construction activities will be discussed with workers or contractors involved.

Solutions to the complaints will be established with worker(s) and contractor(s). Complainant will be informed of how issue was addressed.

If complaints persist, then worker(s) and contractor(s) may be dismissed.

4.0 CLOSURE

If the complainant is not satisfied with the initial response, the complaint will be referred to a higher authority within the company to further resolve the issue.

Appendix M:

Stakeholder Consultation

FIRST NATIONS CONSULTATION				
Date	**Person Contacted**	**Band/Organization**	**Method of Communication**	**Content**
December 2011	KMK Representative	KMK	Meeting	Amherst project introduction
September 2012	KMK Assembly	KMK	Presentation	Project introduction & partnership opportunity
September 2012	Members of Membertou	Membertou	Presentation	Proponent introduction
October 2012	Chief & Council	Chapel Island	Meeting	Project introduction & partnership opportunity
October 2012	Chief & Council	Paq'tnkek	Meeting	Project introduction & partnership opportunity
November 2012	Chief & Council	MIllbrook	Meeting	Project introduction & partnership opportunity
November 2012	Chief & Council	Bear River	Meeting	Project introduction & partnership opportunity
November 2012	Chief & Council	Pictou Landing	Meeting	Project introduction & partnership opportunity
April 2013	KMK Representative	KMK	Meeting	Amherst site details presentation
December 2014	Office of Aboriginal Affairs Representative	Office of Aboriginal Affairs	Letter	Update on Environmental Assessment
December 2014	KMK Representative	KMK	Letter	Update on Environmental Assessment
December 2014	Chief and President Grace Conrad	Native Council of Nova Scotia	Email	Update on Project and Environmental Assessment

MUNICIPAL CONSULTATION				
Date	**Person Contacted**	**Department / Agency**	**Method of Communication**	**Content**
May 2014	Warden Keith Hunter	Municipality of Cumberland County	Email	Introduction to Natural Forces and change of project site location from Comfit Application Invitation to meet
May 2014	Councillor Emery	Municipality of Cumberland County	Email	Introduction to Natural Forces and change of project site location from Comfit Application Invitation to meet
May 2014	Councillor Smith	Municipality of Cumberland County	Email	Introduction to Natural Forces and change of project site location from Comfit Application Invitation to meet
May 2014	Councillor Kellegrew	Municipality of Cumberland County	Email	Introduction to Natural Forces and change of project site location from Comfit Application Invitation to meet
June 2014	Warden Keith Hunter	Municipality of Cumberland County	In person meeting	Personal introductions and introduction of the project
June 2014	Councillor Smith	Municipality of Cumberland County	In person meeting	Personal introductions and introduction of the project
June 2014	Rennie Bugley	Municipality of Cumberland County	In person meeting	Personal introductions and introduction of the project
June 2014	Planner	Municipality of Cumberland County	In person meeting	Personal introductions and introduction of the project
June 2014	Mayor Small	Town of Amherst	Letter	Invitation to attend public meeting

MUNICIPAL CONSULTATION

Date	Person Contacted	Department / Agency	Method of Communication	Content
June 2014	MLA Terry Farrel	Nova Scotia Liberal Party	Letter	Introduction to Natural Forces and project Invitation to meet
June 2014	All town councillors	Town of Amherst	Letter	Invitation to public meeting
June 2014	All county councillors	Municipality of Cumberland County	Letter	Invitation to public meeting
July 2014	Councillor Smith	Municipality of Cumberland County	Calls	Update on the project and invitation to the public meeting
July 2014	Warden Hunter	Municipality of Cumberland County	Calls	Update on the project and invitation to the public meeting
August 2014	Councillor Smith	Municipality of Cumberland County	Calls	Update on the project Discuss concerns of the community
August 2014	Warden Hunter	Municipality of Cumberland County	Calls	Update on the project Discuss concerns of the community
August 2014	Cumberland Renewable Energy Authority	Municipality of Cumberland County	Presentation	Introduction of Natural Forces and to the project. Explained to the board of members the benefits this project will have to the County and local residents
September 2014	Warden Keith Hunter	Municipality of Cumberland County	Call	Update on the project and invitation to the public meeting Discuss the concerns in the community

MUNICIPAL CONSULTATION

Date	Person Contacted	Department / Agency	Method of Communication	Content
September 2014	Councillor Smith	Municipality of Cumberland County	Call	Update on the project and invitation to the public meeting Discuss the concerns in the community
September 2014	Rennie Bugley	Municipality of Cumberland County	Call	Update on the project Invitation to the public meeting
September 2014	Mayor Small			Invitation to the public meeting
September 2014	All town councillors	Town of Amherst	Email	Invitation to the public meeting
September 2014	All county councillors	Municipality of Cumberland County	Email	Invitation to the public meeting
October 2014	Warden Hunter	Municipality of Cumberland County	Call	Update on the project and invitation to the public meeting
October 2014	Councillor Smith	Municipality of Cumberland County	Call	Update on the project and invitation to the public meeting
October 2014	Rennie Bugley	Municipality of Cumberland County	Call	Update on the project
November 2014	Amherst Division	Ducks Unlimited	Letter	Intention to submit an Environmental Assessment in the coming weeks

PROVINCIAL AND FEDERAL CONSULTATION				
Date	**Person Contacted**	**Department / Agency**	**Method of Communication**	**Content**
Provincial				
February 2013	Steve Sanford Mark Elderkin	NS Environment (Steve). NS Department of Natural Resources (Mark)	Meeting	Project update and discussed environmental assessment
July 2013	Mark Elderkin	NS Department of Natural Resources	Call	Discussed avian radar work
May 2014	Mark Elderkin	NS Department of Natural Resources	Call	Discussed avian radar work
July 2014	Birdget Tutty Mark Elderkin	NS Environment (Bridget). NS Department of Natural Resources (Mark)	Meeting	Discussed development of environmental assessment, site design and radar work
September 2014	Peter MacDonald	NS Department of Natural Resources	Phone Call	General info regarding moose movement around the site.
November 2014	Kim George	NS Department of Natural Resources	Phone Call	Information regarding moose and Wood turtle.
Federal				
July 2013	Beck Whitam	Canada Wildlife Service	Call	Discuss scoping of avian studies for environmental assessment
October 2014	Scott English	Nav Canada	Email	Consultation to receive clearance for 3 turbines
November 2014	Atlantic Region Offices	Canadian Wildlife Services	Letter	Intention to submit an Environmental Assessment in the coming weeks
December 2014	Mario Lavoie	Department of National Defence	Email	Consultation to confirm no impact to DND communication systems