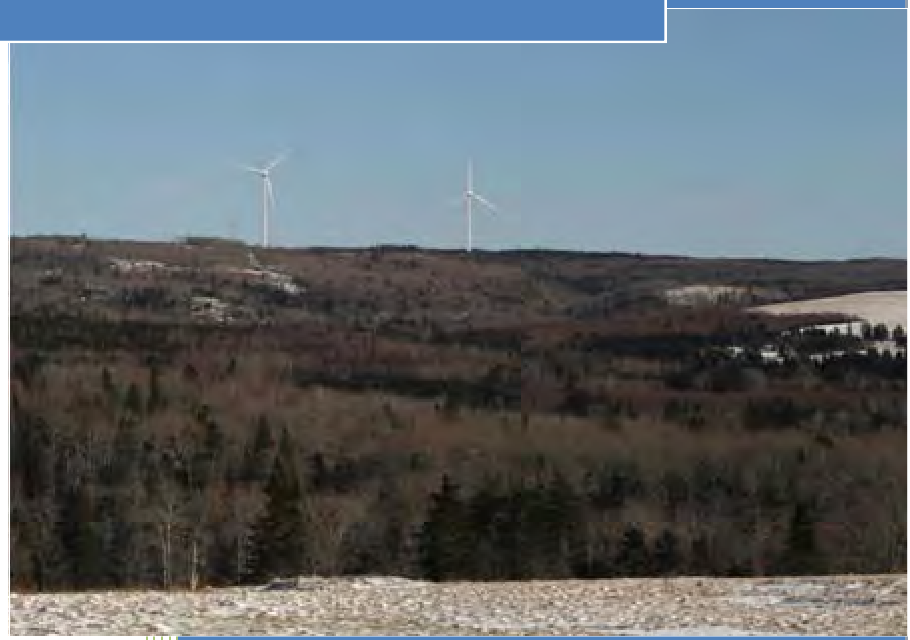
VOLUME 3
(Appendices)

July 2011

FAIRMONT WIND FARM PROPOSAL ENVIRONMENTAL ASSESSMENT



NAMEPLATE CAPACITY:
4.6 MW

LOCATION:
THE COUNTY OF ANTIGONISH, NOVA SCOTIA.

PREPARED BY:
WIND PROSPECT INC.
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APPENDIX A

CONSULTANT BIOGRAPHY AND CONTACT INFORMATION

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AMEC Earth & Environmental

Contact Details

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Company Details

- AMEC is one of the world's leading engineering, project management and consultancy companies
- Our goal is to deliver profitable, safe and sustainable projects and services for our customers in the oil and gas, minerals and metals, clean energy, water and environmental sectors, sectors that play a vital role in the global and national economies and in people's everyday lives
- We design, deliver and maintain strategic assets for our customers, offering services which extend from environmental and front end engineering design before the start of a project to decommissioning at the end of an asset's life
- Our customers, in both the private and public sector, are among the world's biggest and best in their fields - BP, Shell, EDF, National Grid and U.S. Navy to name just a few
- We are truly international, with major operations centres based in the UK and Americas and offices and projects in around 40 countries worldwide. We work in diverse and often challenging environments, from sub-zero temperatures in the north of Canada to the sweltering heat of the Persian Gulf
- We employ some 22,000 people – ranging from scientists and environmental consultants to engineers and project managers, dedicated professionals who take pride in their work. The AMEC Academy helps us to attract, develop and retain the best talent
- We are proud of our core values: believing in people, teamwork and diversity; delivering for customers in a safe and sustainable way; acting with integrity and respect; aspiring to excellence; passionate about success
- Our shares are traded on the London Stock Exchange, where the company is included in the FTSE 100 index and listed in the Oil Equipment and Services sector (LSE:AMEC)

(source : http://www.amec.com/aboutus/at_a_glance.htm)

Confederacy of Mainland Mi'kmaq

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Company Details

The CMM is Tribal Council incorporated in 1986 as a not-for-profit organization under the Societies Act of Nova Scotia. Starting with a team of two staff members, twenty years later the organization is supported by more than sixty employees. The mission statement best summarizes the objectives of the organization:

"To proactively promote and assist Mi'kmaw communities' initiatives toward self determination and enhancement of community."

From its main office located in the Millbrook First Nation, The CMM delivers a variety of community programs and advisory services to first nations communities in Nova Scotia. The staff consists of a team of professional First Nations experts who bring unique Mi'kmaw perspectives to current issues.

As a not-for-profit organization, The CMM receives financial support from various government departments (federal and provincial), as well as from the private sector. The CMM uses this funding to support programs and services primarily to its six member communities.

- Annapolis Valley
- Bear River
- Glooscap
- Millbrook
- Pictou Landing
- Paqtnkek

(Source: http://www.cmmns.com/index.php)

Davis Macintyre & Associates

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Company Details

Davis MacIntyre & Associates Limited was established in 2009 and previously operated as Davis Archaeological Consultants Limited. We are leaders in the cultural resource management discipline in the Atlantic Region. Our staff has over 50 years of combined experience in the field of archaeology. We provide comprehensive professional services in undertaking archaeological and historical cultural resource assessments for government, public, and private industry. We are committed to excellence and pride ourselves on offering our clients value-added services to meet modern environmental and development standards.

(Source: http://davismacintyre.com/Home.html)

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Company Details

The global needs for technical services related to infrastructure, environmental management, community development and buildings/facilities is enormous. From basic needs for clean water and shelter, to advanced technologies for hazardous waste management, to the policies and know-how to advance sustainable development, communities and businesses beyond North America are part of the Dillon marketplace.

But while all of our skills and services can be applied in meeting client needs in the international marketplace, our focus is on:

- infrastructure (water, wastewater, solid waste, transport)
- environmental management (water resources, waste management, land and coastal resource management, pollution control)
- energy (renewable technologies, transmission, generation)
- community development (redevelopment, new settlements, tourism, community planning)
- institutional strengthening (capacity building, organizational development, training)

Geographically, we have experience in Asia, South America, Africa, Europe and Central America/Caribbean. Our people have diverse language skills and with many, strong connections to the global community through family ties and their upbringing.

Our projects are delivered under a number of models: in-country teams assigned for extended periods, program management as executing agency for extended capacity building programs, short-term technical assistance projects, and collaborative arrangements with local consultancies.

Of particular benefit to our private sector clients is our expertise in the environmental assessment and approvals requirements of lending institutions such as the IFC.

(source: http://www.dillon.ca/html/int_intro.html)

Oldham Engineers Inc.

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Company Details

Oldham Engineers Inc. is a firmly established leader in the design of customized telecommunications systems. Since 1984 we have been providing private industry and public agencies in international community with practical communications solutions. As the pioneer developer of the "integrated system" approach, we provide efficient and affordable applications for multi-agency utilization. We are committed to supply value-engineering services providing the most cost-effective solutions that satisfy today's communications concerns, solutions that can readily evolve to meet tomorrow's communications demands. We take pride in providing professional Future-Focused Telecommunications Expertise that utilizes Leading Edge Technologies.

Oldham Engineers Inc. offers clients the entire scope of electronics engineering services - the design, development, integration, operation, technical support and maintenance of all company projects. Using advanced technologies and innovative concepts, our professional team analyzes all available options to provide clients with hassle-free solutions while partnering with them to avoid strategic miscalculations and costly delays.

(Source: http://www.oei.ns.ca/)

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APPENDIX B

Environment Management Plan

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Table of Contents

1. Introduction

It is with this plan that Wind Prospect Inc., the proponent, aims to address potential impacts that the project may have on import Valued Ecological Components, such as but not limited to water quality, wetlands, potential migratory birds, fish and wild life habitat.

The Environment Management Plan will also attend to the following:

- Mitigation methods for potential impacts
- Decommissioning and reclamation strategies
- Spill contingency plans in case of emergencies

1.1 Goals

It is a goal for this Environment Management Plan (EMP) to guide all stages of construction, operation, and decommissioning phases of the Fairmont installation so as to avoid, or minimize environmental impacts of the proposed Project. It is Wind Prospect Inc. wish that environmental impacts are addressed in an environmentally, safe and responsible manner, in compliance with all Provincial, Federal and Municipal relevant laws, bylaws and regulations.

1.2 Strategy

Due to Wind Prospect's involvement in all stages of the project development, with minimal contracting, all of the strategies in the EMP will be incorporated in the project construction, operation, decommissioning and reclamation plans. Since much of the work is performed 'in house' it will enable for all plans to be well communicated among employees. For contracted work during the construction, operations and decommissioning phases, the contractors and their employees will be notified of the procedures to be followed outlined in the EMP.

2. Erosion and Sedimentation Control

2.1 Objective

2.1.1 Wind Prospect Inc. acknowledges that proper erosion and sedimentation control is necessary to maintain water quality and reduce environmental impact on the project area. The principle objectives of the Erosion and Sediment Control Plan (ESCP) are to minimize the quantity and duration of exposed or transferred soil, as well as to mitigate potential impacts on nearby water quality.

2.1.2 The main receptors of potential erosion and sedimentation would be wetlands and watercourses in the project area, particularly near construction of the access road.

2.2 Strategy

2.1.1 The ESCP has drawn its strategies from the best management practices outlined in Nova Scotia Department of Environment's (NSE) *Erosion and Sediment Control Manual* (1998).

2.1.2 All erosion and sediment control (ESC) measures will be in place *prior* to site disturbance. The ESC measures will be maintained *during* project activities and shall remain in place once area is stabilized.

2.1.3 The ESC plan strategy focuses on preventing erosion by minimizing the disturbed area, stabilizing exposed soil and re-vegetating slopes. Once such measures are deemed adequate, they will be enhanced by further immediate sediment control measures focussing on intercepting sediment-laden runoff that has escaped the erosion control measures

2.2 *Mitigation*

2.2.1 To ensure that the ESC measures are enforced, as well as environmental, health and safety standards are met, Wind Prospect Inc. will have an on-site Project Supervisor who will provide appropriate oversight of all project activities. The following procedures hope to provide adequate erosion and sedimentation control.

2.2.2 **ESC Measures used could include the following:**

- Straw-bale filter barriers and silt fences
- Hydro-seeding or re-vegetation planting to maintain roads, ditches and crane pads
- Check dams
- Sediment traps/fences and sediment basins/pools

2.2.2.1 The selection of the best ESC measures to be used will depend on a number of factors, including but not limited to the size of the disturbed area, the type of runoff (concentrated or sheet-flow), and the volume of runoff.

2.2.2.2 The following should also be noted:

- The placement of the erosion protection material will be carried out by starting at the upstream end of the watercourse and will progress downstream.
- All ESC materials used will be clean, durable, non-ore bearing, non-toxic and obtained from a non-watercourse source.
- During high water flow seasons watercourses and wet areas may be flooded, to prevent impact on the hydrological conditions of the area, erosion and sediment barriers will be removed.

2.2.3 Temporary ESC measures:

2.2.3.1 Best Management Practices:

- Steep slopes and erodible soils near watercourses or wet areas will be avoided where possible and practical due to their high erosion potential.
- If steep slopes are not avoidable, they will be covered with mulch, or matting to reduce the velocity of surface runoff.
- The quantity and exposure time of fine soils will be minimized where possible by minimizing grubbing, timing of construction to avoid wet periods, and staging construction.
- Topsoil stockpiles locations will be prepared and used as early as possible.
- Responsible travel practices on access roads will be promoted by employees and contractors to reduce habitat damage and soil loss.
- Existing culvert passages will be maintained.
- Accumulated sediment will be cleaned out at regular intervals after heavy rain falls.
- Collected sediment will be held in a covered stockpile 30 m away from a wetland or water course which is deemed safe by project manager and public authorities.
- Damaged ESC measures (ex. fallen fence) will be repaired immediately.

2.2.3.2 Surface Run-Off Measures:

- If it is deemed necessary to limit surface run-off during construction, sediment pools will be installed and maintained to the requirements of NSE. Any water with large sediment concentrations will be directed to such basins and released when appropriates and safely.
- Turbine pad slopes in sensitive areas will be covered with straw or mulch to stabilize and minimize silt run-off.

2.2.3.3 Monitoring:

- Erosion control measures will be regularly checked 6-12 months after construction to ensure their effectiveness.

2.2.4 **Permanent ESC measures:**

- The majority of construction activities will occur in the winter as the frozen ground generally limits erosion.
- Slope grades will be minimized during construction. Unprotected slopes will be stabilized by gravel or geo-textile fabric if it is deemed likely to erode.

2.2.4.1 Re-vegetation Program:

- Wind Prospect Inc. understands that re-establishing vegetation in disturbed areas is important. Vegetation intercepts and reduces runoff velocity, filters out sediment, increases infiltration to the soil and holds the soil in place. A re-vegetation program will therefore be undertaken in the areas disturbed by construction.
- Particularly disturbed or disturbance prone areas (ex. stream banks) will be hydro-seeded as soon as it is possible, to increase stabilization. Hydro-seeding consists of applying a mixture of seed, fertilizer, mulch, binder and water on areas cleared of vegetation to accommodate construction and to produce a uniform cover of grasses.

3. Domestic & Hazardous Waste Management

3.1 Waste

3.1.1 The construction and decommissioning phases of the project will most likely incur waste. Potential wastes may include:

- Work site and construction site domestic wastes (ex. paper, card board, plastics, food)
- Sanitary wastes
- Construction activities waste (scrap steel, metals, wood debris and excess soils from cleared areas).

3.2 Hazardous materials

3.2.1 Wind Prospect Inc. recognizes that hazardous materials (e.g. fuels, lubricants, hydraulic oil) and wastes (e.g. garbage, waste oil) should be managed so as to minimize the risk of chronic and/or accidental releases. For this reason, proper procedures are in place for activities that are prone to accidental release of hazardous materials, such as re-fuelling and maintenance activities. Hazardous petroleum wastes are classified as deleterious in Nova Scotia, and their disposal into the environment and water is illegal. For this reason, along with mitigation strategies for proper waste disposal, a spill contingency plan has been created.

3.2.2 Possible hazardous materials present on site are:

- Fuel, lubricants
- Paints and solvents
- Hydraulic fluids

3.3 Potential Impacts

3.3.1 Exposure or accidental spillage of domestic and hazardous wastes might affect employee health and safety, as well as have adverse effects on Valued Ecological Components (VEC) in the project area. In particular, hazardous materials can contaminate soils, surface and groundwater, and endanger vegetation, fish and wildlife.

3.4 Mitigation

3.4.1 This section aims to outline mechanisms to mitigate potential accidental releases of hazardous wastes and manage their safe disposal.

3.4.2 The mitigation procedures to protect employees and the environment are in compliance with the *Workplace Hazardous Materials Information System (WHMIS)* program. The WHMIS procedures and requirements outline best management strategies in proper handling, storage, disposal and control of hazardous materials, thereby reducing the potential for accidental release and consequent potential environmental effects.

3.4.3 The following efforts will be taken to minimize and mitigate potential impacts from accidental waste spillage:

3.4.3.1 Hazardous waste mitigation:

- Equipment and vehicles will only operate on cleared right-of-ways or areas designated for construction activities.
- Routine maintenance, refuelling and inspection of machinery will be performed off-site whenever possible, 30 m away from wetlands or watercourses and in a contained and safe area.
- Used oil filters, grease cartridge containers and other products associated with equipment maintenance shall be collected and disposed of in accordance with regulatory guidelines.
- Contractors will be required to make daily inspections of hydraulic and fuel systems on machinery, to ensure there are no leaks. If leaks are present then it will be made a priority to repair the leak immediately. All leaks and spills will abide by the procedures outline in the subsequent Spill Contingency plan.
- No fuel oil or other hazardous materials will be stored near watercourses, and will be restricted to the construction storage compound.
- All potentially hazardous materials present on site shall be handled, labelled and stored responsibly to avoid any spillage or contamination.
- Spill response kits will be provided on site to ensure immediate response to a potential waste release.

3.4.3.2 Domestic Waste mitigation:

- All effort will be made to ensure that the project area remains clear of waste. All construction sites will be equipped with numerous waste and recycling disposal facilities.
- Weekly, or more frequent, waste collection and disposal will be organized.
- All waste bins will be securely closed, so as to not attract rodents, bugs or other animals.

4. Wetland, Watercourse Alteration and Water quality Protection

4.1 Wetlands

4.1.1 Upon greater investigation, a small wetland area, approximately .16 ha in size was identified in the project area. In compliance to Nova Scotia Department of the Environment (NSE) wetland policy, a three tiered approach to wetland conservation will be in place. In this strategy the primary objective is avoidance of wetland habitat. If avoidance is not possible, then minimization of impacts and wetland habitat compensation planning will be done in consultation with NSE and/or Department of Fisheries and Ocean (DFO) to ensure no net loss of wetlands.

4.1.2 Once wetland delineation is conducted during the summer of 2011, information about the location, size and class of wetland will be provided to the NSE or other relevant government departments.

4.1.3 If a wetland, for some unforeseeable event, cannot be avoided then Wind Prospect will apply for and abide by the Terms and Conditions of NSE *Wetland Alteration Approvals.*

4.1.4 In light of the proposed mitigation measures, including: avoiding wetland, maintaining existing site drainage conditions, and using erosion or sediment controls, it is not anticipated that significant Project-related effects on wetlands are likely to occur.

4.1.5 **Potential impacts**

4.1.5.1 During the construction or decommissioning phases, possible impacts to wetlands may arise from clearing, grubbing, infilling and excavation of the soil needed for constructing or widening of the access road. Such activities might induce silt run-off, alter flow into to the wetlands or see them become repositories of significantly increased water flow, nutrients, or sediments.

4.1.5.2 It is expected that only one wetland of 0.16 ha might be indirectly affected by project activities. Potential impacts might include changes in hydrology, nutrients, or sediment input. However, upon consultation with local environmental offices, project activities and mitigation measures outlined below are deemed to have limited impact on nearby wetlands.

4.1.6 **Mitigation**

4.1.6.1 Avoidance of wetland area.

4.1.6.2 Flow retention structures and energy dissipation measures are to be taken.

4.1.6.3 Excavation in wetland is to be avoided, unless deemed absolutely necessary to meet engineering requirements. If necessary, the Nova Scotia Wetland Alteration policy will be followed.

4.1.6.4 In wetlands associated with sensitive water-crossings, grubbing shall be minimized by the placement of geo-grid and geo-textile prior to the placement of fill.

4.1.6.5 Vegetation will be retained where possible to provide wildlife habitat. Where applicable, no work near wetlands will be scheduled during wildlife breeding seasons.

4.1.6.6 Contractors and recipients of the surplus excavated materials from other project activities will ensure that no surplus fill will be placed in the wetland.

4.1.6.7 Water control shall be maintained at all times. Water removed from the excavation shall be pumped to an approved sediment control measure (*e.g.*, settlement pond, adjacent vegetated area or filter bag). The contractor shall ensure that no discharge to adjacent watercourses will occur when total suspended sediment (TSS) concentrations exceed 25 mg/L, or other level noted by NSE and the DFO permits and letters of advice.

4.1.6.8 Ditches constructed shall not drain directly into wetlands. Outflows will be directed away from wetlands to settling ponds.

4.1.6.9 Construction of the access road will attempt to create a 30m natural buffer surrounding the wetland, if possible. In locations where preservation of a 30m buffer is unattainable, mitigation measures to prevent wetland habitat alteration will be followed.

4.2 Watercourses

4.2.1 Potential Impact

4.2.1.1 Watercourses crossings will not result in permanent diversion restriction or blockage of natural drainage. All work to be conducted will follow the Terms and Conditions of NSEL *Watercourse and Alteration Approvals.*

4.2.2 Mitigation

4.2.3.1 Where watercourses cannot be avoided, a *Watercourse and Alteration approval* will be sough, and follow-up analyses and monitoring will be conducted as required by approval application.

4.2.3.2 Crossings will be located in areas with stable soil types and where it will not be too steep.

4.2.3.3 Crossings will be restricted to a single location and occur at right angles to the watercourse or wetland.

4.2.3.4 The approaches to watercourse crossings will be stabilized with brush mats, where necessary.

4.2.3.5 Fording will not be permitted, unless the watercourse is dry, and streambed rutting and bank deterioration cannot occur.

4.3 Water Quality

4.3.1 Potential Impacts

4.3.1.1 The following activities during the construction of the power line, collector lines, and access road might induce sediment run-off, riverbank erosion or accidental spills, washouts from rainwater:

- Vegetation clearing
- Grubbing
- Ground stripping and excavation
- Equipment entering the water during replacement or installation of culverts and or temporary bridge works.

4.3.2 Such activities might impact surface water quality, quantities, or flow.

4.3.3 Mitigation

4.3.3.1 To minimize affects on drainage and water quality the following efforts will be initiated:

- Where possible, all clearing shall take place during the winter months on frozen ground.
- When permitted, crossings will be restricted to a single location and will occur at a narrow point on the watercourse.
- Brush or swamp matting shall be used at vehicle crossing when necessary, to limit sedimentation.
- Equipment shall be in good working order and maintained so as to reduce risk of spill/leaks and avoid water contamination. Refer to the hazardous waste and spill contingency plans for greater detail on mitigation strategies.

- Erosion control strategies (ie. settling ponds, straw bales, and geo-textiles) outlined in the Erosion and sedimentation Control plan hopes to maintain baseline water quality conditions in the watercourses and wetlands at the site. Wind Prospect Inc. will maintain and adapt these erosion/sedimentation control systems to ensure their effectiveness.
- Stream flow will be observed during and after construction period, which will then be compared to baseline conditions. If hydrology is identified to be abnormal, then the local NSE representatives will be informed. It is expected that once the local NSE office investigates the cause of abnormal hydrology, any mitigation or adaptive procedures that might be required will be adopted.
- Any water which must be pumped out of excavations will not be discharged directly into any wetland or watercourse. If pumped water contains total suspended solids (TSS) at a concentration exceeding 25 mg/l above the background watercourse conditions, then such water will be pumped to a settling pool. Once sediment is settled, water will be directed to source via natural topography, provided that the discharge does not erode or entrain of soil particles in its flow.
- Settlement areas will be designated in an area up-gradient and downstream of construction of access road.
- As mentioned above, the intention is to adhere to the buffer zones when working near water bodies. However, in the unlikely event that a buffer zone is breached or a spill occurs, emergency response procedures will be in place to prevent potential impacts on aquatic habitat.

4.4 Preservation of Fish and Fish habitat

During construction of the Fairmont wind farm, fish habitat located further downstream might be affected through: increased sedimentation; accidental leaks of deleterious substances (e.g., fuel, oil leaks); loss of riparian habitat. However, in conjunction with the mitigation strategies outlined in this plan, it is expected that impacts to fish and fish habitat will be negligible.

4.4.1 Department of Fisheries and Oceans Canada (DFO) is responsible for protecting fish and fish habitat across Canada. Under the Fisheries Act no one may carry out a work or undertaking that will cause the harmful alteration, disruption or destruction (HADD) of fish habitat unless it has been authorized by DFO.

4.4.2 By following the conditions and measures set out by DFO’s Operational Statement, we will be in compliance with subsection 35(1) of the Fisheries Act. The Operational Statement outlined for a Temporary Stream Crossing describes the conditions and the measures applicable to the Fairmount wind project in order to avoid negative impacts to fish habitat. Below are the conditions and the measures needed to mitigate impacts that will be met. For this reason, this project will not require a review by DFO nor a HADD.

Table 1: Summary of the Operational Statement outlined for a Temporary Stream Crossing.

Conditions to proceed with a temporary stream without a DFO review	**Measures to Protect Fish and Fish Habitat when Carrying Out a Temporary Stream Crossing**
o the project is not located on a Class A stream according to the *Alberta Water Act - Code of Practice* o the bridge is no greater than one lane in width, and no part of its structure is placed within the wetted portion of the stream o the work does not include realigning the watercourse o for fording in flowing waters and temporary bridges, the channel width at the crossing site is no greater than 5 meters from ordinary high water mark to ordinary high water mark (HWM) (see definition below) o disturbance to riparian vegetation is minimized o the work does not involve dredging, infilling, grading or excavating the bed or bank of the watercourse o all crossing materials will be removed prior to the spring freshet, or immediately following project completion if this occurs earlier	1. Use existing trails, roads or cut lines wherever possible, as access routes to avoid disturbance to the riparian vegetation. 2. Locate crossings at straight sections of the stream, perpendicular to the bank, whenever possible. Avoid crossing on meander bends, braided streams, alluvial fans, or any other area that is inherently unstable and may result in the erosion and scouring of the stream bed. 3. While this Operational Statement does not cover the clearing of riparian vegetation, the removal of select plants may be necessary to access the construction site. This removal should be kept to a minimum and within the road or utility right-of-way or approved work space. When practicable, prune or top the vegetation instead of uprooting. 4. Generally, there are no restrictions on timing for the construction of bridge structures or fording seasonally dry streambeds, as they do not involve in-water work. However, if there are any activities with the potential to disrupt sensitive fish life stages (e.g., fording of the watercourse by machinery) these should adhere to appropriate fisheries timing widows (see *Alberta Water Act - Code of Practice* restricted activity periods, which can be found at: **http://environment.alberta.ca/1411.html**). 5. Machinery fording a flowing watercourse to bring equipment required for construction to the opposite side is limited to a one-time event (over and back) and is to occur only if an existing crossing at another location is not available or practical to use. o If minor rutting is likely to occur, stream bank and bed protection methods (e.g., swamp mats, pads) should be used, provided they do not constrict flows or block fish passage. o Grading of the stream banks for the approaches should not occur. o If the stream bed and banks are steep and highly erodible (e.g., dominated by organic materials and silts) and erosion and degradation

o fording involves a one-time event (over and back) and will not occur in areas that are known fish spawning sites o the crossing will not result in erosion and sedimentation of the stream, or alteration (e.g., compaction or rutting) of the bed and bank substrates o the crossing does not involve installation of a temporary culvert, and o Incorporate the *Measures to Protect Fish and Fish Habitat when Carrying Out a Temporary Stream Crossing*	are likely to occur as a result of equipment fording, then a temporary bridge should be used in order to protect these areas. o The one-time fording should adhere to fisheries timing windows (see Measure 4). o Fording should occur under low flow conditions, and not when flows are elevated due to local rain events or seasonal flooding. 6. Install effective sediment and erosion control measures before starting work to prevent the entry of sediment into the watercourse. Inspect them regularly during the course of construction and make all necessary repairs if any damage occurs. 7. For temporary bridges also employ the following measures: o Use only clean materials (e.g., rock or coarse gravel fill, wood, or steel) for approaches to the bridge (i.e., not sand, clay or organic soil) and install in a manner that avoids erosion and sedimentation. o Design temporary bridges to accommodate any expected high flows of the watercourse during the construction period. o Restore the bank and substrate to pre-construction condition. o Completely remove all materials used in the construction of the temporary bridge from the watercourse following the equipment crossing, and stabilize and re-vegetate the banks. 8. Operate machinery in a manner that minimizes disturbance to the watercourse bed and banks. o Protect entrances at machinery access points (e.g., using swamp mats) and establish single site entry and exit. o Machinery is to arrive on site in a clean condition and is to be maintained free of fluid leaks. o Wash, refuel and service machinery and store fuel and other materials for the machinery away from the water to prevent deleterious substances from entering the water. o Keep an emergency spill kit on site in case of fluid leaks or spills from machinery. 9. Stabilize any waste materials removed from the work site, above the HWM, to prevent them from entering any watercourse. This could include covering spoil piles with biodegradable mats or

	tarps or planting them with preferably native grass or shrubs. 10. Vegetate any disturbed areas by planting and seeding preferably with native trees, shrubs or grasses and cover such areas with mulch to prevent soil erosion and to help seeds germinate. If there is insufficient time remaining in the growing season, the site should be stabilized (e.g., cover exposed areas with erosion control blankets to keep the soil in place and prevent erosion) and vegetated the following spring. o Maintain effective sediment and erosion control measures until re-vegetation of disturbed areas is achieved.

5. Migratory Bird and Habitat Protection

5.1 Potential Impacts

5.1.1 Potential impacts to migratory birds might occur during the construction of the access road, and during the transportation or operation of the turbines. During construction and transportation some vegetation might be cleared that might be habitat to some migratory birds. During the operational phase of the wind farm, it is unlikely that migratory birds will collide with the turbines.

5.1.2 In addition, Wind Prospect Inc. acknowledges that lights on the turbines can result in adverse impacts on birds. It has been brought to Wind Prospect Inc. attention that in Atlantic Canada, nocturnal migrant and night-flying seabirds (e.g. storm-petrels) are the birds most at risk of attraction to lights especially during periods of fog, drizzle, and haze. Attraction to lights may result in collision with lit structures or their support structures, or with other birds. Disoriented birds are prone to circling a light source and may deplete their energy reserves and either die of exhaustion or drop to the ground where they are at risk of depredation.

5.2 Mitigation

5.2.1 Construction is anticipated to commence in the winter and continue until the early spring of 2012. This time period does not coincide with the time period in which migratory birds (ie. The Canada Warbler and Bobolink) would possibly be in the area.

5.2.2 Best management practices for turbine lighting will be followed:

- 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 (e.g., as allowed by strobes and modern LED lights) will be installed on tall structures.

5.2.3 Lights will operate at the minimum intensity and minimum number of flashes per minute (longest duration between flashes) allowable by Transport Canada.

- The least number of lights will be used as possible.
- The use of solid-burning or slow pulsing warning lights at night will be avoided.
- The time of operation for spotlights and floodlights will be minimized, and used only in cases where such lights are needed.
- Caution will be taken when using such lights on humid, foggy or rainy nights and during migratory seasons.

- Task lighting, as well as lighting for the safety of the employees, will be shielded to shine down only to where it is needed, without compromising safety.

5.2.4 Moreover, after the first six months of the wind farm's operations, a follow-up avian mortality survey will be conducted. If any migratory bird or a SARA species is identified, Environment Canada and the appropriate regional wildlife biologist at the Department of Natural Resources will be contacted at: (902) 863-7523. If required, a *Significant Species & Habitat Reporting Form* will be filled out.

5.2.5 Post-construction follow-up studies will be conducted for Mainland Moose, bats and birds for a duration of 2 years after the construction phase has ended.

5.2.6 Sampling protocols for breeding evidence will be followed as outlined in *Recommended protocols for monitoring impacts of wind turbines on birds.*

5.2.7 The monitoring protocols established in this document were designed using information from personal communication with Dan Busby of CWS and two documents published by CWS:

- Canadian Wildlife Service. (2006). *Recommended protocols for monitoring impacts of wind turbines on birds.* Environment Canada
- Canadian Wildlife Service. (2006). *Wind turbines and birds: A guidance document for environmental assessment.* Environment Canada

5.3 Protecting the Canada Warbler and Bobolink

5.3.1 In 2007, Canada Warbler was assessed as a threatened species by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). More recently in 2010 COSEWIC classified the Bobolink as a threatened species as well.

5.3.2 Both the Canada Warbler (*Wilsonia Canadensis*) and the Bobolink (*Dolichonyx Oryzivorus*) live in dense vegetation and lay nests on the ground. In particular, the Canada Warbler resides in dense and wet deciduous forest habitat, similar to that found south of the Fairmount wind installation. The Bobolink prefers wetland and grassy areas, possibly similar to areas near the intermediate stream located in the project area.

5.3.3 During the winter, the Canada Warbler migrates and stays in South America (Ontario Ministry of Natural Resources; 2009). However, the Bobolink can be found in freshwater marshes, grasslands and rice fields during the fall and summer migration as well as in the winter. In the spring, the Canada Warbler breed near the ground on mossy logs or roots, and along stream banks (Ontario Ministry of Natural Resources;

2009). The Bobolink breeds in open and semi-open grassy areas, and are easier to identify.

5.3.4 Potential Impacts

5.3.4.1 The Canada Warbler and the Bobolink identified in the study were not residents of the project area, nor was the identification site classified as habitat for either species. Nevertheless, potential impacts might occur during the construction of the access road and the underground collector network system, as well as during the transportation of the turbines.

5.3.5 Mitigation

5.3.5.1 It is anticipated that construction will take place during the winter, which will avoid the migratory and breeding season for both species. However, it is understood that both the Canada Warbler and the Bobolink "nest close to the ground, and rely on the dense shrub layer to conceal their nests during the spring" (Ontario Ministry of Natural Resources; 2009). For this reason, care will be made to not disturb low lying shrub areas during construction and transportation of wind turbines. If it is necessary to clear such vegetation, it will be communicated to the construction workers or supervisors to inspect the vegetation for any signs of nesting or bird habitat before removal.

5.3.5.2 If signs of a potential Canada Warbler, Bobolink or other migratory bird nests and/or habitat are identified, the local DNR biologist, the appropriate regional wildlife biologist at the Department of Natural Resources will be contacted at: (902) 863-7523. If necessary, a *Significant Species & Habitat Reporting Form* will be filled out.

5.4 Mature forest and plant protection

5.4.1 Potential impacts

5.4.1.1 It is understood that mature forest and wooded or grassy areas are important habitat for migratory bird species, as it provides much needed food and shelter. It is not anticipated that large patches of forested area will be removed, only a few trees will be selectively cut, when necessary, for following activities: construction of the access road and the underground collection system; widening of current roads; transporting the turbines.

5.4.1.2 Through correspondence with Sean Blaney, a botanist working at the Atlantic Canada Conservation Data Centre, it is understood that there is no evidence of mature inferior forest in the June 2011 footprint of the project. Only a very young regenerating forest is anticipated to be impacted.

5.4.1.3 There is a mature ravine forest down south of the turbines, along the stream, as well as a moderately mature forest in north western part of the project area, which is up against the edge of some moderately mature forest. Refer to Figure 1 below.

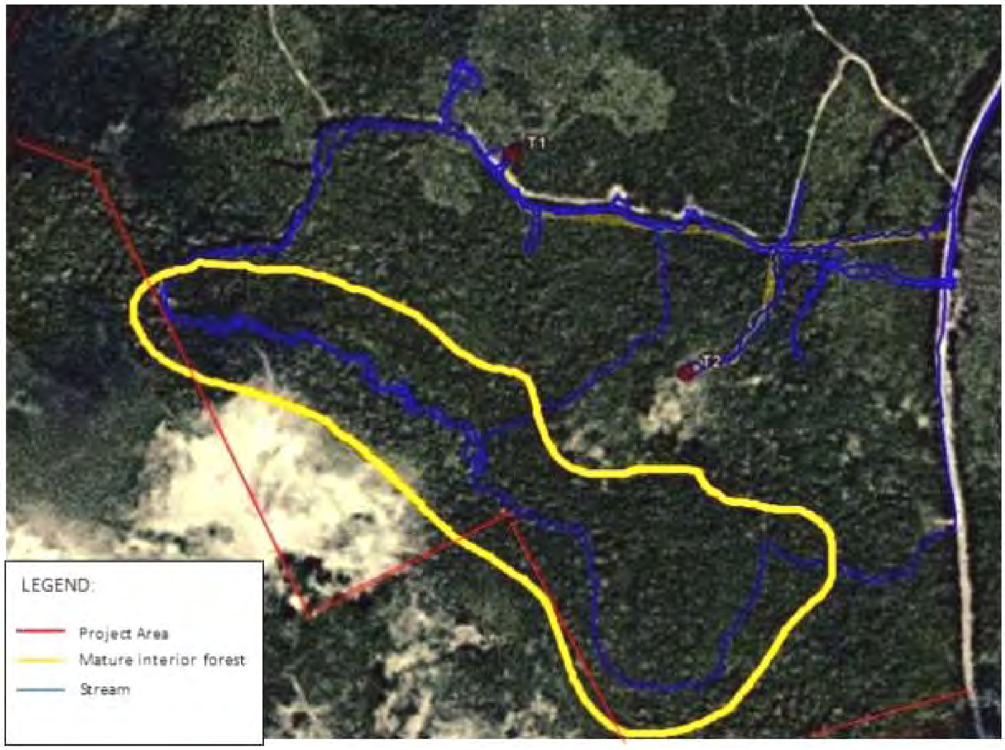

Figure 1: Aerial picture demonstrating the mature ravine forest within the project area (photo courtesy of Sean Blaney).

5.4.1.4 Overall, potential impacts to mature forest vegetation and important plant species are unlikely to occur during the construction of the access road and the underground collector network system, nor during the transportation of the turbines.

5.4.2 Mitigation

5.4.2.1 Foremost, to mitigate the potential loss of interior forest habitat, vegetation clearing will be kept to a minimum and project activities near mature forest habitat will be avoided. All effort will be made to use existing roads or cleared areas as well as the access road, whenever possible, to further limit the amount of vegetation cut.

5.5 Plant Protection

5.5.1 In compliance with Environment Canada's recommendation measures to diminish the risk of introducing invasive species will be developed and implemented. These measures include:

- Construction equipment will be cleaned prior to transportation and use to ensure that no plant matter is attached to the machinery nor transferred, and;
- Equipment will be inspected prior to, during and immediately following construction near areas found to support invasive species (ie. Himalayan balsam (*Impatiens glandulifera*); giant hogweed (*Heracleum mantegazzianum*); Oriental bittersweet (*Celastrus orbiculatus*) to ensure that plant matter is not transported from one construction area to another

6. Spill Contingency Plan

6.1 Objective

6.1.1 This contingency plan reflects on potential accidents, malfunctions that may occur throughout the life-span of the project. The Canadian Standards Association publication, *Emergency Preparedness and Response,* was used in developing this plan.

6.1.2 This contingency plans to address accidents through:

- Spill response procedures, and;
- Emergency contacts and staff training.

6.2 Spill response procedures

6.2.1 Spill response kits (which include absorbents that allow for quick containment and recovery) will be made available onsite to ensure immediate response to a release.

6.2.2 Within 24 hours of the spill being identified, it will be immediately reported to the 24-hour environmental emergencies reporting system.

6.2.3 All effort will be made to promptly contain and clean up the spill or leak.

6.2.4 Within a week of the accidental spill or leakage, a written report will be submitted to the Administrator at the Nova Scotia Department of the Environment. The report will outline:

- The cause of the release,
- Adequacy of the response to the release by the persons responsible,
- Plans to remediate land that was directly impacted,
- Manners of collection and dispose of the contaminant, and;
- Plans to prevent a reoccurrence of the unauthorized release.

6.3 Emergency contacts and staff training

6.3.1 All accidental spills and leaks shall be reported to the Nova Scotia Department of the Environment at (902) 426-6030 and the environmental emergencies reporting system (Maritime Provinces 1-800-565-1633).

7. Environmental Impact on the Project

7.1 Objective

7.1.1 This section assesses the potential ways that the environmental can affect the project. The potential effects of the environment on the Project include:

- Climate and meteorological conditions (*e.g.*, precipitation, storms and extreme weather events, and climate change), and;
- Natural disasters such as earthquakes or floods.

7.2 Potential impacts

7.2.1 **Climate and meteorological conditions**:

7.2.1.1 According to Abraham, Canavan, Shaw & Environment Canada (1997) the Atlantic Region has been experiencing an overall warming trend of 0.4 ºC since 1895 and increasing precipitation since 1948. Such increased precipitation, snow and extreme weather may cause temporary delays in construction and transportation activities. It is also speculated that an increase in extreme conditions is likely to be accompanied by increases in wind speeds. For this reason, the turbines to be installed will have a cut out speed (i.e. shut off) of 25 m/s to prevent operating in hazardous weather conditions.

7.2.2 **Extreme events**

7.2.2.1 Extreme events include rain, hail, ice storms, fire, tornadoes, earthquakes, and lightning strikes. The following events have been considered:

- Rain,
- Lightening,
- Hail – the turbine blades, nacelle, and tower are constructed of materials to with stand damage from the impact of hail,
- Ice storms/freezing rain – the turbines are designed to automatically shut down when there is any significant ice load on the blades,
- Tornadoes – Turbines are designed to withstand the forces of a Level 2 tornado (i.e., 200 km/hr), and the foundation design can withstand similar forces, and;
- Earthquakes – structures are designed to meet the earthquake loads.

7.2.2.2 Nevertheless, if the magnitude of unforeseen extreme event were to occur at the project site, the condition of the wind turbines might be compromised, thus potentially resulting in damage to the rotor blades, the tower, or the aboveground electrical collection lines. The occurrence of an extreme event during the construction phase it might lead to an increase in sedimentation and erosion.

7.3 Mitigation

7.3.1 Although the potential impacts listed above are unlikely to occur, potential environmental impacts could be mitigated through a number of planning, designs, and construction strategies intended to reduce the risk of damage to the Project or interruption of operation.

7.3.2 Mitigation measures include, but are not limited to:

- **Design**: Designing the structure to withstand site runoff and groundwater flows resulting from precipitation.

- **Rescheduling**: Weather conditions will be considered when scheduling construction, monitoring and transportation activities. If necessary, such activities will be rescheduled to accommodate weather interruptions and avoid possibility of erosion and sedimentation.

- **Lightening**: The turbines and substation will be equipped with lightning protection systems designed to withstand electrical charges and ground them. The systems may be equipped with lightning strike sensors to determine the number of strikes and whether it is necessary to send out an inspector prior to placing the turbines back in service.

- **Monitoring and maintenance**: The wind turbines at the Fairmont location will be regularly monitored. Any damage to the project site equipment, turbines, or infrastructure will be reported, repaired and maintained so as to avoid any potential impact to the environment.

8. Decommissioning and Site Reclamation Strategy

8.1 Objective

8.1.1 This Decommissioning and Site Reclamation strategy refers to the procedures to be taken once the Fairmont installation is deemed to have reached the end of its operational life. Procedures in place will outline the phases in terminating operations and dismantling the two wind turbines and its associated infrastructure.

8.1.2 Decommissioning will commence within six months after the land lease has been terminated. Decommissioning will likely be completed within twelve months after its commencement.

8.1.3 The first phase identifies the anticipated lifecycle of the project; the second phase will outline the specific Project components that will be removed; the third phase outlines the costs associated with the removal of the components and associated scrap value.

8.2 Phase I: Anticipated Life Cycle of the Project

8.2.1 The proposed wind farm has an operational life of approximately 20 years. The wind turbines will be continually maintained and replaced if necessary, throughout the life of the Project.

8.3 Phase II: Decommissioning Strategy & Design

8.3.1 The principles underlying the decommissioning strategy and design is to recondition and reuse equipment or infrastructure whenever possible, or salvage and recycle materials that cannot be reused, or appropriately dispose of any material that cannot be reused or recycled.

8.3.2 The components and material that will be transported to the appropriate facilities for reuse, salvage, recycling, or disposal may include components of above-ground structures (turbines, transformers overhead collection lines, and the substation.

- *Wind turbines*: Wind turbine tower, nacelle and blades, will be dissembled and resold. If materials are unable to be resold, they shall be transported and disposed to an offsite disposal facility. Tower sections and rotors will be dissembled and transported in the same manner as their construction, so cranes and heavy equipment; transportation permits will all be required.
- *Aboveground Electrical Collection lines:* Aboveground electrical collection lines and associated components (ie. Copper cables, poles) will be dismantled and the

materials will be salvaged, recycled or sold. Once poles are removed, their holes will be filled with topsoil.

- *Transformers:* The removal of the transformer will entail disconnecting the electrical connection system from the base transformer. Electrical components of high value and that are in good condition will be removed and sold.
- *Substation/switchgear :* Where feasible, the steel, conductors, switches, transformers and other materials from the substation will be reconditioned and reused or sold as scrap.

8.3.3 Removal of below-ground structures (turbine foundations)

- *Turbine and Substation Foundations:* As per the land lease agreement, any equipment or infrastructure deeper that 1 metre below ground level will not be removed. It is likely that this will only involve leaving the concrete foundation of the turbine in place.
- *Underground Collection System Cables:* The underground collection network cables will be cut back and abandoned in place. Removal of the cables could have greater environmental impacts. No known hazards are known to exist from the presence of unused cables. Land owners will be made aware of any materials left in place.

8.3.4 Restoration of topsoil

- Topsoil will be necessary to restore the Project Area to pre-construction conditions
- Crane pads used to disassemble the turbines are will likely compress soil in surrounding area.. The crane pad areas will likely be decomposed and restored to pre-existing conditions.

8.3.5 Re-vegetation and seeding

- Where appropriate, vegetation will be replanted with native vegetation.

References

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Gehring, J. et al. (2009). "Communication towers, lights, and birds: successful methods of reducing the frequency of avian collisions." Ecological Applications 19(2): 505-514.

Ontario Ministry of Natural Resources. 2009. The Canada Warbler. Retrieved at http://www.mnr.gov.on.ca/stdprodconsume/groups/lr/@mnr/@species/documents/document/276679.pdf

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APPENDIX C

AVIAN SURVEY

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July 7, 2011

WIND PROSPECT INC.
1791 Barrington Street, Suite 1030
Halifax, Nova Scotia
B3J 3L1

ATTENTION: Mr. Andy MacCallum
Development Manager

Summary of Avian Surveys Completed in 2010 and 2011 at the Fairmont 4 MW Wind Farm in the Antigonish Highlands, Nova Scotia

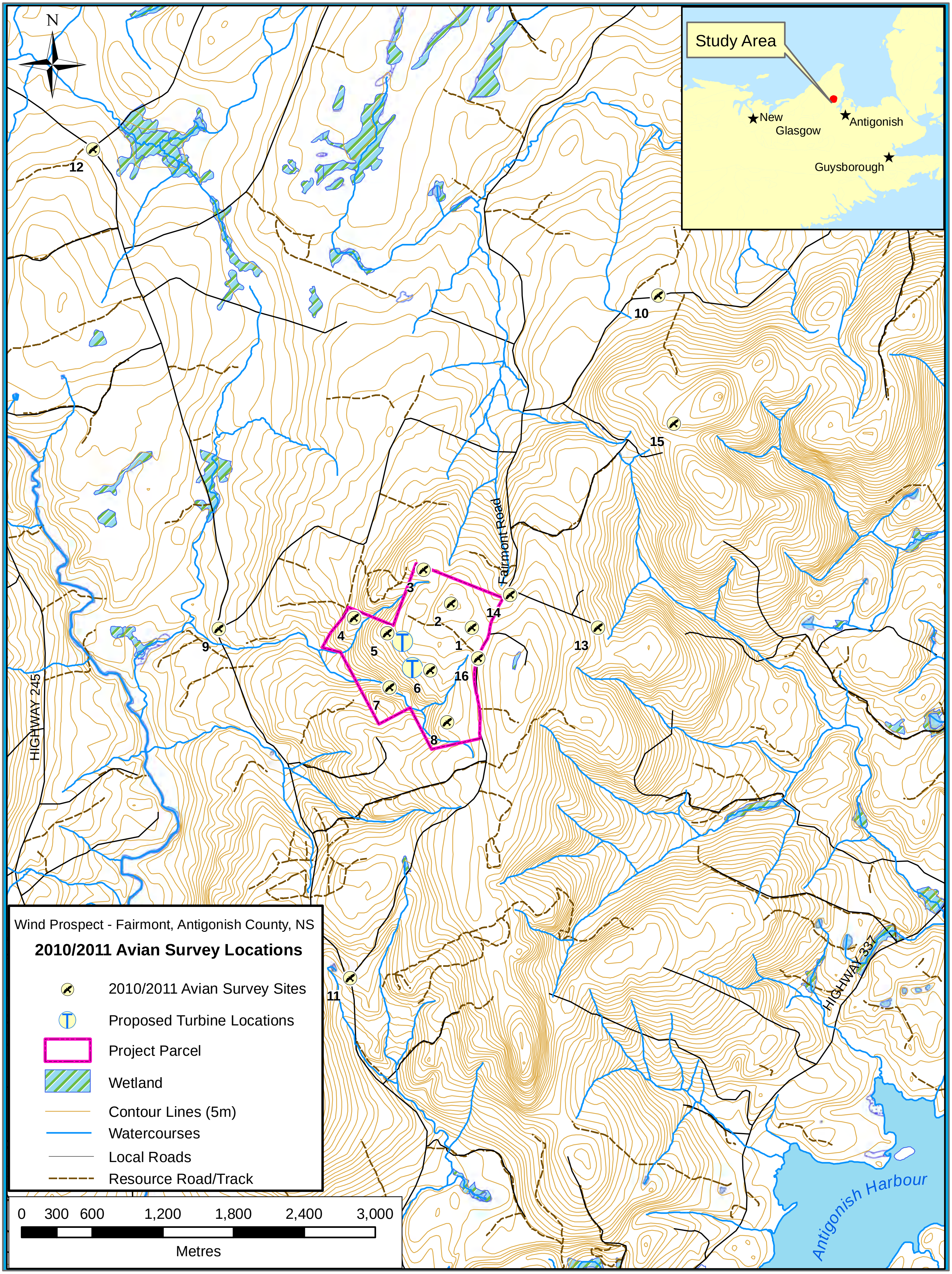
INTRODUCTION

The following letter report provides a summary of the 2010 and 2011 avian surveys completed in support of the environmental assessment for the Fairmont 4 MW Wind Farm to be located in the Antigonish Highlands, Antigonish County, Nova Scotia. Dillon completed the avian surveys during peak breeding (June/July 2010), early/peak and late fall migration (August – December 2010), winter (Jan/Feb 2011), early spring migration (March – April 2011), and peak spring/early passerine migration (May – early June 2011). The surveys were scheduled to provide one year of data collection. The following report summarizes the species encountered during these events and identifies bird sightings of the species listed on Schedule 1 of the federal *Species at Risk Act* (SARA) and/or the species listed as "Red" or "Yellow" with the Nova Scotia Department of Natural Resources (NSDNR).

METHODOLOGY

The study area boundaries for the avian surveys were located west of Fairmont Road in the Antigonish Highlands, Antigonish County, Nova Scotia. In order to determine site selection for point count locations, Dillon conducted a brief scoping exercise in June 2010, prior to the avian surveys, in order to focus assessments to areas that would provide the best representative coverage of the project footprint and the highest potential for habitat suitability. Dillon established 12 point count locations during this exercise and added an additional 4 in order to gather additional baseline data from around the project site. These sites are provided on Figure 1. Point count locations 5 and 6 correspond to the proposed turbine locations.

The surveys were completed by an experienced birder, Mr. Fulton Lavender, with assistance from biologists and technical support from Dillon. The design of the avian survey program was determined based on professional experience, knowledge of the project area and migratory bird activity in that area of Nova Scotia, and review of guidance documents including the following Environment Canada publications: *Wind Turbines and Birds – A Guidance Document for Environmental Assessment* (2007), and *Recommended Protocols for Monitoring Impacts of Wind Turbines on Birds* (2007).


N
Study Area
New Glasgow
Antigonish
Guysborough
Fairmont Road
HIGHWAY 245
HIGHWAY 337
Antigonish Harbour
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Wind Prospect - Fairmont, Antigonish County, NS
2010/2011 Avian Survey Locations
2010/2011 Avian Survey Sites
Proposed Turbine Locations
Project Parcel
Wetland
Contour Lines (5m)
Watercourses
Local Roads
Resource Road/Track
0 300 600 1,200 1,800 2,400 3,000
Metres

The Nova Scotia Department of Natural Resources (NSDNR), Mr. Mark Elderkin, was also consulted in association with the design of the avian surveys. Sixteen (16) different surveys were conducted from June 2010 to June 2011. The data sheets detailing the number of individuals at each point count location is included in Attachment A. Table 1 summarizes the avian survey schedule.

At each of the point count locations, except number 15 – the Fall observation location, the observation period was 10 minutes in length. During the breeding season, surveys were conducted from 30 minutes prior to sunrise and no more than 4 hours following sunrise. Typically, one (1) hour was spent at point count 15. Observations at point count location 15 were completed in the late morning or early afternoon.

Table 1 – Avian Survey Schedule

Description of Activity	Survey/Activity Period
Peak breeding surveys	June 25/10 - 26/10, July 16/10
Early autumn migration	August 2010, Sept. 7/10,
Peak autumn migration	Sept. 27/10, Oct. 12/10
Late autumn migration	Nov. 11/10
Winter Survey	Jan. 26/11, Feb. 18/11, Mar. 24/11,
Early spring migration/early breeding surveys (owls, hawks, woodpeckers)	Apr. 25-26/11
Peak spring migration/early passerine migration	May 9/11 and 27/11*, June 1/11 and 5/11

* Note: This survey was completed late in the month because of consistently poor weather for surveying during previous 10 days. Seasonal Variation: Movements and patterns are approximately 10 days behind (for May 27/11), as seen from density assessment.

OBSERVATIONS

The following observations were made during the course of the avian surveys completed at the Fairmont site:

- Point count location 15 was added during the September 2010 migratory survey. The location was selected for hawk viewing, and is located immediately north-east of the study area at approximately 222 m above sea level (ASL). It is located within relatively close proximity to Cape George and the Northumberland Strait, an area anticipated to be significant migration zone. There was no indication from the Fall migratory surveys that the study area is on the path of a significant migratory course. Based on the field observations and site knowledge, it is anticipated that the most likely migratory course would be through St. Georges Bay (perhaps crossing over Cape George) and northwards through the Northumberland Strait.

- It was noted that the migratory survey results from the Sept. 27, 2010 event were atypical. There was no significant migratory wave as a result of winds, tropical storm activity and relatively steady low pressure systems. Migration was irregular and unpredictable.

- A significant Common Raven roosting period was noted during January 2011. This may have affected absence of other species in the area.

- Turbine site locations will not likely be a roosting site for small owls because of the dominant hardwood tree species and presence of open, cleared areas.

- No species at the survey locations were at turbine blade heights during the winter surveys.

- During the winter, most species will move down from higher regional elevations (including predators) returning to their usual areas in late March and April 2011.

- There were no snags for nesting of Northern Saw-whet Owls observed at the turbine locations. The owls are unlikely to be breeding at or near proposed turbine locations but may hunt in this vicinity.

- Based on observations, the overall study area is not a breeding area for Northern Saw-whet Owls, but it has shown to be a migratory location.

- Rain and light winds were likely responsible for keeping woodpecker species quiet and not drumming, as well as smaller species list overall for the May 9, 2011 sampling event.

- The proposed location of the wind farm is in an area that has been disturbed by significant forestry activity.

- Access roads (e.g. standard woods/forestry roads) already exist throughout site and can be incorporated into the overall site design/layout. Minimal clearing would be required at point count location 5 (proposed turbine location) since clearing has already taken place for the existing meteorological tower. Clearing of an approximate 15-20 year old mixed-forest stand would be required for pad construction at point count location 6 (proposed turbine location).

RESULTS

Based on the survey results from each activity period, a total of 98 bird species were noted within the avian study area for the Fairmont Wind Farm, of which eight (8) were identified as a species of conservation concern. Refer to Table 2 for the complete list of bird species observed. Of these species of concern, three (3) species are listed on Schedule 1 of SARA: Canada Warbler (Threatened), Northern Goshawk (Threatened), and, Savannah Sparrow (Special Concern). Six (6) species have an NSDNR status of Yellow: Bobolink, Boreal Chickadee, Canada Warbler, Gray Jay, Northern Goshawk, and Rusty Blackbird. There were no species with an NSDNR status of Red.

There were no species of conservation concern noted at point counts 4, 7, 11, 13, 15, or 16 during the avian surveys (refer to Figure 1). The following text describes when the species of conservation concern were noted on the project area. Table 3 summarizes this information:

- Bobolink was noted (as a Migrant) at point count 5 during the peak autumn migration in 2010. Point count 5 is located in a recent (<10 year) clear cut area, with surrounding mature and mixed-softwood dominant stands. There is also a meteorological tower located here. This area is not suitable Bobolink habitat. Bobolink habitat (breeding) is large, open grasslands and hayfields. Large hayfields and grass fields exist approximately 10 km N/NW of the Fairmont study area in Maryvale and Big Marsh. Recent avian surveys associated with another project have found considerable numbers of Bobolink in this area (i.e., up to 15/point count location).

- Boreal Chickadee was noted at point count 2 during the breeding period in 2010; at point counts 2, 12, and 14 (as a Resident and Migrant) during the peak autumn migration period of 2010; at point count 2 (as a Resident) during the late autumn migration of 2010; point count 8 during the early spring migration/breeding period in 2011; and point counts 2, 3, 9, and 12 during the peak spring migration/early passerine migrations in 2011. Boreal Chickadees typically breed in large softwood-dominant forests. Point count locations 12, 9, 1 are representative habitats. Point count 2, where they were found on six surveys, is a young (<10 year since clear-cut), mixed-softwood dominant area.

- Common Nighthawk was noted at point count 9 during the peak breeding surveys in 2010. They were seen in mixed-softwood dominant areas along Cloverville Road, located approximately 2.5 km from proposed wind turbines and outside of the defined study area. They typically breed (and hunt) in open gravel areas (e.g. roads, gravel pits).

Table 2 - Species of Conservation Concern Identified from 2010 and 2011 Surveys

Species	Status	
	SARA Schedule 1 Status[1]	NSDNR Status[2]
Alder Flycatcher		
American Crow		
American Goldfinch		
American Kestrel		
American Redstart		
American Robin		
American Woodcock		
Bald Eagle		
Barred Owl		
Bay Breasted Warbler		
Black and White Warbler		
Blackburnian Warbler		
Black-backed Woodpecker		
Black-capped Chickadee		
Blackpoll Warbler		
Black-throated Blue Warbler		
Black-throated Green Warbler		
Blue Jay		
Blue-headed Vireo		
Blue-winged Warbler		
Bobolink		Yellow
Boreal Chickadee		Yellow
Brown Creeper		
Canada Warbler	Threatened	Yellow
Cedar Waxwing		
Chestnut-sided Warbler		
Common Grackle		
Common Goldeneye		
Common Nighthawk	Threatened	Yellow
Common Raven		
Common Redpole		
Common Yellowthoat		
Connecticut Warbler		
Downy Woodpecker		
Dark-eyed Junco		
Eastern Wood-Pewee		
European Starling		
Evening Grosbeak		
Fox Sparrow		
Golden-crowned Kinglet		
Gray Jay		Yellow
Gray-Cheeked Thrush		
Great Horned Owl		
Greater Yellowlegs		
Grey Catbird		
Hairy Woodpecker		
Hermit Thrush		
Indigo Bunting		
Least Flycatcher		
Least Sandpiper		
Lesser Yellowlegs		
Lincoln's Sparrow		
Long-eared Owl		
Magnolia Warbler		
Mallard Duck		
Merlin		
Mourning Dove		
Mourning Warbler		
Nashville Warbler		
Northen Saw-whet Owl		
Northern Flicker		
Norhern Goshawk	Threatened	Yellow
Northern Harrier		
Northern Parula Warbler		
Northern Saw-whet Owl		
Northern Shrike		
Northern Waterthrush		
Osprey		
Ovenbird		
Palm Warbler		
Philadelphia Warbler		
Pileated Woodpecker		
Pine Grosbeak		
Pine Siskin		
Purple Finch		
Red-eyed Vireo		
Red-tailed Hawk		
Ring-necked Pheasant		
Rose-breasted Grosbeak		
Rose-breasted Nuthatch		
Ruby-crowned Kinglet		
Ruffed Grouse		
Rusty Blackbird		Yellow
Savannah Sparrow	Special Concern	
Sharp-shinned Hawk		
Snow Bunting		
Song Sparrow		
Swamp Sparrow		
Swainson's Thrush		
Tennessee Warbler		
Veery		
White-breasted Nuthatch		
White-throated Sparrow		
Wilson's Snipe		
Winter Wren		
Yellow-rumped Warbler		
Yellow-bellied Flycatcher		
Yellow-bellied Sapsucker		

1

Endangered	A wildlife species that is facing imminent extirpation or extinction
Threatened	A wildlife species that is likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction.
Special Concern	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.

2

Red	Known or thought to be at risk
Yellow	Sensitive to human activities or natural events

- Canada Warbler was noted (as a Migrant) at point count 5 during the peak autumn migration in 2010. Canada Warblers have recently been documented in several locations about 10 km north of the study area. In this area of Nova Scotia, they are most likely to be breeding in large wetland/swamp areas (they also breed in high alpine forests). These habitats do not exist in the Fairmont study area.

- Gray Jay was noted (as both a Resident and Migrant) at point count 9 during the peak autumn migration in 2010, point count 2 during the winter survey (January) 2011, at point counts 2, 10, and 12 during the winter (February) survey 2011, and point counts 11, and 12 during the early spring migration in 2011. Typical Gray Jay habitat is in large spruce and pine stands. This habitat exists at point counts 9, 10, and12. Each of these locations range from 2 - 5 km away from proposed turbine locations. During winter surveys (both January and February), the Gray Jay was observed in a young clear cut area (i.e., conifer-dominated regeneration) and was likely feeding.

- Northern Goshawk was noted at point count 9 (as a Resident) during the early spring migration/early breeding surveys in 2011. Northern Goshawk were documented at point counts 9 and 12. These are both areas at intersecting gravel roadways, and located between 2-8 km from the proposed turbines. They were likely hunting during both surveys, as they will often hunt along clear and open forest edges. They are not likely to be breeding in the study area, as they prefer mature, older growth stands, which are not located in the study area.

- Rusty Blackbird was noted during the early spring migration survey in April 2011 at point count 14. One individual was noted in the project area during the 12 month survey. Preferred habitat for the Rusty Blackbird includes wet coniferous forest. Nesting occurs at the edges or ponds, slow streams or wetland complexes. This type of habitat was not observed in the project area.

- Savannah Sparrow was noted (as a Resident) at point count 6 during the peak autumn migration in 2010. Savannah Sparrows have been observed in larger numbers approximately 10 km N/NW of the study area (in the same large grassy/hay farm fields as the Bobolink). There is no habitat in the study area that is ideally suited for Savannah Sparrow breeding.

Table 3 – Avian Species of Concern Observed at the Fairmont Site

Species of Conservation Concern Noted	Federal Status	Provincial Status	Point Count Location Observed
Bobolink	Threatened (**<u>not</u>** Schedule 1)	Yellow	5 (September 2010)
Boreal Chickadee	Not listed	Yellow	2, 12, 14 (September 2010) 2 (October 2010) 2 (November 2010) 2 (July 2010) 8 (April 2011) 2, 9, 12 (May 2011) 2, 3, 9, 12 (June 2011)
Common Nighthawk	Threatened (Schedule 1)	Yellow	9 (July 2010)
Canada Warbler	Threatened (Schedule 1)	Yellow	5 (September 2010 [early and late])
Gray Jay	Not Listed	Yellow	9 (September 2010) 9 (October 2010) 2 (January 2011) 2, 10, 12 (February 2011) 12 (April 2011)
Northern Goshawk	Threatened	Yellow	12 (Feb. 2011) 9 (April 2011)
Rusty Blackbird	Not Listed	Yellow	14 (April 2011)
Savannah Sparrow	Special Concern (Schedule 1)	Not Listed	6 (September 2010)

CONCLUSIONS

The majority of bird species observed during the year long avian survey program were species common in Nova Scotia. Of the 98 species observed, seven (7) have conservation status under either federal or provincial legislation. The Bobolink (as a Migrant) and Canada Warbler (as a Resident) were observed at point count 5. The Savannah Sparrow (as a Resident) was observed at point count 6. These point count locations correspond with the proposed turbine locations. In each of the cases, between 1 and 6 individuals were noted at the time of the survey. The remainder of the species of concern were noted both inside and outside the project parcel (property). Refer to Table 3 and Figure 1 for detailed information regarding these species.

The presence of species of concern at the proposed turbine locations and/or within the project parcel/property does not automatically preclude the project from proceeding at this location. Clearing activities outside the migratory bird season (May 1 to August 31) will lessen the potential impacts to migratory birds. For species that breed outside this standard window, a pre-clearing survey may be required. Liaison with Canadian Wildlife Service and NDNR may result in additional detailed mitigation to avoid affecting migratory birds in the area of the project.

The presence of the species of conservation concern in the area of the project confirms the site status as a Category 4 and indicates that the project may pose a moderate level of potential risk to species and/or their habitats.

CLOSING

We trust the information in this letter report meets your requirements at this time.

If you have any questions, please do not hesitate to contact Andrea Youssef at (506) 444-8820, or via email at ayoussef@dillon.ca.

Yours truly,

DILLON CONSULTING LIMITED

Andrea Youssef, M.Sc. (C.E., Environment)
Associate, Project Manager

AJY:
Our File: 10-3608

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APPENDIX D

BAT IMPACT ASSESSMENT

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FAIRMONT WIND FARM
BAT MONITORING PROTOCOL
AND SURVEY REPORT

Prepared for
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January 2011

Project No.: TV01048

TABLE OF CONTENTS

PAGE

List of Figures

List of Photos

List of Tables

1.0 INTRODUCTION

Wind Prospect Inc has engaged the services of AMEC Earth and Environmental to provide an assessment of the potential effects of a wind farm in Fairmont Novas Scotia on local and migratory bat populations. In order to provide a complete assessment AMEC E&E has compiled all relevant information on bats in the region, reviewed existing bat monitoring protocols and developed a cost efficient and effective monitoring protocol to meet the specific needs on Wind Prospect Inc, and implemented this monitoring protocol to collect and analyze the occurrence of bats in the project area.

1.1 WIND POWER IN NS

In 2008, the Nova Scotia Government predicts that by 2013, 18.5% of the power used by provincial residents and industry will be generated from renewable resources. It is expected that increase will be supplied largely by new wind power projects.

In the NS Government's Wind Integration Study it was reported that "…in 2007, Nova Scotia created a Renewable Energy Standard (RES). The RES requires that by 2013, 10% of the province's electricity requirement must be supplied by new renewable energy sources post 2001 (5% by 2010 and an additional 5% by 2013). Hatch estimates the 2013 RES requirement will bring the total provincial renewable supply to approximately 22% (581 MW). DOE expects most of this supply to be met with commercial-scale wind energy projects, and estimates the number of utility wind turbines in the province may grow from the current 41 to over 300" (Hatch, 2008).

By the beginning of 2010 there were 41 wind turbines in Nova Scotia with an installed capacity of 60 MW; by 2013, it was anticipated that there may be more than 300. In light of the increased interest and activity related to Wind Energy development, the Nova Scotia Government established a new development plan for Wind Energy in Nova Scotia.

> *This plan commits the 2015 target of 25 percent renewable electricity to law. By that date, Nova Scotia's total renewable electricity content will have more than doubled from 2009 levels—and the equivalent of more than 300,000 homes will be powered by clean, local sources.*
>
> *The 2020 goal (of 40%) places Nova Scotia in a position of global leadership. It may require expanded grid connections with our neighbours, and may include a greatly expanded role for tidal energy as we learn more. By 2020, this goal means Nova Scotia will have the equivalent of more than 500,000 homes running on renewable power—more than enough energy for every residential customer in the province.(NSE, Renewable Electricity Plan, 2010)*

Commercial wind farms usually use three-bladed turbines that are oriented towards the wind by computer-controlled motors. The blades range in length from 20 to 40 metres, and are painted light gray for aesthetic reasons, though they may appear to be white. The turbine unit is mounted on a tubular steel tower (monopole) that can range in height from 60 to 90 metres.

The turbine blades rotate at 10-22 revolutions per minute and the tips can have speeds of over 320 km/h. The generator speed is commonly increased through use of a gear box. Some wind turbines operate at a constant speed, but some higher efficiency units employ variable-speed turbines, which use a solid-state power converter that interfaces with the transmission system.

1.2 LEGISLATION/REGULATORY ENVIRONMENT

An environmental assessment (EA) is a planning tool that assists decision-makers in determining whether a Project will promote or undermine sustainable development. There are two levels of environmental assessment legislation that govern the environmental assessment process. At the provincial level, the *Nova Scotia Environment Act* (and the ensuing regulations) provides the mandate to the NS Department of Environment to review and assess environmental assessment documents prior to the approval of projects that meets certain "trigger" conditions. Similarly, the *Canadian Environmental Protection Act* (CEPA), and the *Canadian Environmental Assessment Act* (CEAA) provide the mandates and authorities to various government departments to perform a similar function at the federal level (including the Canadian Environmental Assessment Agency, Environment Canada, and the Department of Fisheries and Oceans Canada).

Depending upon the source of funding and the location of the wind farm (private land, federal or provincial crown land), the source of funding (private investment, federal government, or private funding) and the size of the wind farm, an environmental assessment will need to be completed for review and approval by either the NS Department of Environment, or the relevant federal department or agency. One area of concern that is addressed in an EA is the potential effect a project may have on local wildlife and the habitats these species depend upon. As a result, the federal *Species at Risk Act* (SARA) and the *Nova Scotia Endangered Species Act* (NSESA) may have an impact on the EA process. Under the terms of the Acts, no project can have or potentially have a negative effect on a species listed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as endangered, threatened or of concern, under a listed within the NS General Status of Wild Species as species of conservation concern.

Bats are a matter of special interest in the EA process since most species are poorly known, and little knowledge exists of the long term effects that past developments have had upon their well-being. Several federal and provincial government departments and agencies have legislative and regulatory responsibility of wildlife species and habitats in Nova Scotia, including bats.

Federally, the Canadian Wildlife Service of Environment Canada is responsible for all migratory birds and for <u>all</u> wildlife on federally owned land. (The Department of Fisheries and Oceans Canada has responsibility for some species of wildlife and habitat, although not bats specifically). Within the Provincial government the Department of Natural Resources, Wildlife Division is responsible for all wildlife other than that managed by federal government.

There are several other government Departments and Agencies with an interest in wildlife resources, and while they do not have regulatory responsibility, they may provide useful and important information on bats suitable for inclusion in an EA. Examples include the Wildlife

Division of the Nova Scotia Department of Natural Resources; the Heritage Division of Nova Scotia Tourism, Culture & Heritage; and local universities. Non-profit organizations such as the Atlantic Canada Conservation Data Centre and local naturalist groups can also provide valuable information.

Since wind energy development activities have commenced in Nova Scotia, the Nova Scotia Department of Environment has issued a consistent condition of approval for environmental assessment of wind farms projects in the province. These conditions have been:

a) The Proponent must develop and implement a program to monitor for birds and bats to the standards as defined by the Nova Scotia Department of Natural Resources (NSDNR) and Canadian Wildlife Service (CWS). Based on the results of monitoring programs, the Proponent must make necessary modifications to mitigation plans and/or wind farm operations to prevent any unacceptable environmental effects to the satisfaction of NSE, based on consultation with NSDNR and CWS.

b) The Proponent must document accidental mortalities of bats and birds and submit an annual report to the Director of Wildlife, NSDNR, and CWS. The report shall be submitted in January of each operating year unless otherwise approved by NSE.

2.0 FAIRMONT WIND FARM

Wind Prospect Inc, operates globally in all aspects of renewable energy development, construction, operation and advisory services. The company has developed and engineered wind-energy projects around the world since building their first wind farm in 1992. Wind Prospect Inc intends to develop a new facility in Fairmont, Nova Scotia.

2.1 PROJECT DESCRIPTION

Wind Prospect Inc is developing a site for the construction of a 4 Megawatt wind farm consisting of 2 turbines. This facility is located on approximately 280 acres of private land at Fairmont which is 6 kilometers north of Antigonish, Nova Scotia. The facility will involve the erection of two wind turbines of a maximum height of approximately 150m; one on land that has been previously cleared, and the other in close proximity within an area presently covered with mixed forest.

2.2 PROJECT ENVIRONMENT

The project site is located within the Pictou-Antigonish Highlands Ecodistrict. Soils in this ecodistrict are well drained course textured soils on hilly terrain (Neily *et al*. 2003). Vegetation in the ecodistrict is characterized by shade-tolerant hardwoods, with yellow birch (*Betula alleghaniensis*), sugar maple (*Acer saccharum*), and American beech (*Fagus grandifolia*) being the most common. Red spruce (*Picea rubrum*), white spruce (*P. glauca*), eastern hemlock (*Tsuga canadensis*), and balsam fir (*Abies balsamea*) are scattered on the flat upland surfaces and form coniferous stands on lower slopes and valley bottoms (Webb and Marshall, 1999). High elevations influence the climate of the Pictou-Antigonish Highlands Ecodistrict. This ecodistrict is characterized by late, cool springs, cold winters, and the lowest mean annual temperature in Nova Scotia (5.4°C). It experiences about 1409 mm of precipitation annually and receives about 505 mm of this in the form of rain between May and September (Webb and Marshall, 1999).

The project site is located in Fairmont, a rural area just outside the community of Antigonish, in Antigonish County. The Project Site is located on a partially-forested parcel of land, which appears to have historically consisted of farmland. Old farm roads and over mature apple trees still exist on the site. Some areas appear to have been logged a decade or so ago. Cleared areas are being recolonized by brambles (*Rubus* spp.), white birch (*Betula papyrifera*), white spruce and balsam fir. This is typical of this ecodistrict, in which much previously cleared and settled land has reverted to successional forest (Davis and Browne, 1996). Ground vegetation in the cleared areas is dominated by grass species and goldenrods (*Solidago* spp.).

3.0 INTRODUCTION TO BATS

Bats are one of the most abundant group of mammals on Earth, with over 1100 known species (Tudge 2000). Members of the Order Chiroptera, bat species are divided into two main families, the Microchiroptera (insectivorous bats) and the Megachiroptera (fruit bats). They are also among the most misunderstood mammals, with general misunderstanding and irrational fears common worldwide. Worldwide, bats play vital roles in insect control and the life cycles of fruiting plants. Despite their important ecological roles and diversity, bats in general remain poorly understood and are often unfairly reviled by the public.

The only mammals which truly fly, all bats species have wings consisting of webbing stretched between their elongated fingers. The Microchiroptera (insectivorous bats) typically have small eyes, sharp pointed teeth, and distinctly-shaped ears. This group is also unique in that it utilizes ultrasonic noise, inaudible to humans, to navigate by echolocation. Echolocating bats produce high-pitched calls which bounce off objects in their path. The bat then uses its highly sensitive ears to detect the resulting echo, and interprets it to provide information on size, shape and direction of travel of objects in its path. These calls are usually fairly species-specific, and scientists can use the characteristics of these calls to identify bat species in an area. This ability to navigate by sound results in bats being able to fly and hunt in complete darkness, and in fact most bat species are primarily nocturnal. Megabats do not echolocate, and tend to be larger. They feed mostly on fruit and are found in tropical regions.

In temperate climes such as Nova Scotia, bat species deal with the inhospitable conditions of winter by either hibernating or migrating to warmer areas until spring. Larger, fast-flying species tend to migrate, while smaller species, which tend to be weaker fliers, usually hibernate. Some bat species may fly up to several hundred kilometers to a suitable hibernating site, known as a hibernaculum. Many species begin gathering at their chosen hibernaculum several weeks before hibernation actually begins, and many species mate at this time.

The colonial hibernation behavior of many species results in a high level of vulnerability during the winter months. While bats may arouse naturally and move around within their hibernaculum (Tuttle 1991), unintentional arousals during hibernation (such as being disturbed by humans entering their hibernaculum) can cause bats to rapidly deplete their stored fat reserves, eventually leading to starvation (Thomas, 1995). A small number of visits to a winter hibernaculum of colonial species can have serious effects on the bat population utilizing that hibernaculum. Another dramatic example of this winter vulnerability is the current white-nose syndrome (WNS) situation in the American Northeast. This recently discovered condition is decimating bat populations in the Northeast. The condition, named for a distinctive fungal growth around the muzzles and on the wings of affected bats, was first identified in a cave in New York, USA, in February 2006 (Blehert *et al.* 2008). It has since spread to many other states and in 2010 was confirmed in Ontario (Ontario Ministry of Natural Resources 2010) and Quebec (Frick *et al.* 2010.). The fungus responsible has been identified as a news species, *Geomyces destructans,* a cold-loving fungus that grows at temperatures below 20 °C (68 °F) and grows on the bats when they are hibernating in caves and mines during winter (Blehert *et* *al.* 2008). The fungus appears to disrupt the normal patterns of hibernation, causing bats to arouse too frequently from torpor and starve to death. The symptoms associated with WNS include loss of body fat, unusual winter behavior (including flying outside), and death. The mortality rate from white nose syndrome in some caves has exceeded 90% (Frick *et al.* 2010). To date, seven hibernating bat species have been confirmed with infection of *Geomyces destructans* in the Northeast USA, and several of these species have suffered major mortality (Frick *et al*., 2010). Some of these species, like the Indiana bat (*Myotis sodalis*), were already considered endangered. The U.S Fish and Wildlife Service maintains a website documenting the current status of the WNS situation (http://www.fws.gov/whitenosesyndrome).

All of the species known to occur in NS have reported to exhibit white nose syndrome in other parts of their ranges. In the northeastern United States, the once common little brown bat (*Myotis lucifugus*), has suffered a major population collapse and may be at risk of rapid extirpation in the Northeast within 20 years, due to mortality associated with WNS (Frick *et al*. 2010). Dzal *et al.* (2100) reported a 78 per cent decline in the summer activity of the little brown bat in an area affected by WNS, as evidenced by echolocation surveys. The long-term impact of the reduction in bat populations may be an increase in insect populations as they become subject to decreased bat predation, possibly leading to crop damage or increased pesticide requirements.

3.1 BATS IN NOVA SCOTIA

All the bat species known to occur in Nova Scotia belong to the Vespertilionidae, a family of bats variously known as the vesper bats, evening bats or common bats. This family is the most speciose and best-known family of bats, and is part of the suborder Microchiroptera (microbats). Seven species have been reliably reported to occur in Nova Scotia (Hebda 2010, NSDNR General Status website, ACCDC website). Two of these belong to the genus *Myotis,* known as the mouse-eared bats. These are the little brown bat, and northern long-eared bat (*Myotis septentrionalis*). Two *Lasuirus* species, red bat (*Lasiurus borealis*), and hoary bat (*Lasiurus cinereus*) are also known to occur. Three other species are the only representatives of their genera known to occur in NS: tri-coloured bat (*Perimyotis subflavus)* (formerly known as the eastern pipistrelle *(Pipistrellus subflavus)*), silver-haired bat (*Lasionycteris noctivagans*), and big brown bat (*Eptesicus fuscus*).

Of these species, only little brown bat, northern long-eared bats and tri-coloured bat are thought to have significant populations in Nova Scotia (Broders *et al.* 2003). The other four species are considered likely to be at the northern edge of their ranges (Broders *et al.* 2003).

Brief life history overviews of the bats known to occur in NS are provided in the following subsections.

3.1.1 Little Brown Bat

The little brown bat is a small species which is probably the most common bat species in North America, ranging from Alaska to California (Barbour and Davis 1969). While individuals migrate from summering to wintering areas, they are not considered long-distance migrants. They are considered the most abundant and widespread bat species in NS (Scott and Hebda 2004). In

NS, the Atlantic Canada Conservation Data Centre (ACCDC) lists them as S4, meaning they are considered to be widespread and fairly common. This S4 ranking indicates they are apparently secure with many occurrences, but are of longer-term concern. It is one of three bat species considered to have significant populations in Nova Scotia (Broders *et al.* 2003). The Nova Scotia Department of Natural Resources (NSDNR) lists the little brown bat as Yellow, meaning they are sensitive to human or natural impacts. In the case of little brown bats, this sensitivity is due to their vulnerability at winter hibernacula, when large numbers congregate in caves or mines to hibernate. This species has been shown to be seriously affected by white-nose syndrome in other parts of its range and may be at risk of rapid extirpation in the Northeast USA within 20 years, due to WNS mortality (Frick *et al*. 2010).

Throughout their range, little brown bats are usually abundant in forested areas, and are often associated with human settlement. In summer, reproductive females may form nursery colonies containing hundreds, sometimes thousands of individuals in buildings, attics, and other man-made structures. Females generally give birth to single young. Males and non-reproductive females roost alone or in smaller groups and may be found in buildings, caves, trees, under rocks, behind shutters, in crevices, and under tree bark (Barbour and Davis 1969, Fenton and Barclay 1980). Broders and Forbes (2004) noted that in New Brunswick, roost selection by male little brown bats appears highly dependent on the number of snags (dead trees) in the area.

Little brown bats often forage over water (Fenton and Bell 1979), as well as in woodlands and developed areas (van Zyll de Jong 1985). They eat a wide variety of insects, including Diptera (flies),Coleoptera (beetles), Lepidoptera (butterflies and moths), Trichoptera (caddis flies), Hemiptera (cicadas,leafhoppers, aphids, scales), and Hymenoptera (ants, bees, and wasps) (Whitaker 1972, Anthony and Kunz 1977, Whitaker 2004). A single little brown bat can catch up to 1,200 insects in just one hour during peak feeding activity (BatCon, 2006).

While many bat species mainly hunt flying insects (a behavior known as hawking), little brown bats and northern long-eared bats can also take prey off foliage, other surfaces or the ground, a behavior known as gleaning (Ratcliffe and Dawson 2003). Their large ears, characteristically short, high frequency, soft echolocation call (Faure *et al*. 1993), and ability to hover in flight make this gleaning behavior possible (Ratcliffe and Dawson 2003).

In late summer, little brown bats may travel hundreds of kilometers to swarm around caves and abandoned mines (Fenton and Barclay 1980). Their hibernation sites tend to be extremely humid (>90%) and to maintain temperatures above-freezing (i.e., 1-5°C) (Fenton 1983, Fenton and Barclay 1980). In NS, this species is known to hibernate in several caves or abandoned mine openings (Moseley 2007b). Tuttle (1991) has reported that this species may arouse at intervals during hibernation to move about in response to temperature fluctuations. This behavior has been observed among hibernating bats in a cave in Hants County, NS (Hebda 2006, cited in Moseley 2007). Little brown bats have also been observed to use underground sites as summer roosts in NS (Moseley 2007b).

3.1.2 Northern Long-eared Bat

The Northern long-eared bat is a small non-migratory species which is widely distributed across North America, with a range from Newfoundland and the eastern United States to coastal British Columbia (Barbour and Davis 1969). The ACCDC lists them as an S2 species in NS, meaning they are considered rare in the province. It is considered uncommon in NS, but is one of three bat species considered to have significant populations in Nova Scotia (Broders *et al.* 2003). DNR lists them as Yellow, meaning they are sensitive to human or natural impacts, In the case of northern long-eared bats, this is due to their vulnerability at winter hibernacula, when large numbers congregate to hibernate. This species has been shown to be affected by white-nose syndrome in other parts of its range (Frick *et al.* 2009.).

The Northern long-eared bat is considered a forest-interior species (Broders *et al*. 2006, Caceres and Barclay 2000) and occurs in both hardwood and softwood forests (Foster and Kurta 1999). Northern long-eared bats have been observed foraging along forest edges, over forest clearings, at tree-top level, and occasionally over ponds (BatCon, 2006). Similar to little brown bats, northern long-eared bats eat a variety of insects, including Coleoptera (beetles), Diptera (true flies), Lepidoptera (butterflies and moths) and Trichoptera (caddis flies) (Brack and Whitaker 2001, Carter *et al*. 2003, Whitaker 2004). They also exhibit hawking behavior in addition to gleaning (Ratcliffe and Dawson 2003).

Little is known about the population dynamics and reproductive biology of this species. In New Brunswick, maternity colonies appear to occur most often in mature, shade tolerant deciduous tree stands (Broders and Forbes 2004) where females generally give birth to single young. Males and non-reproductive females typically roost in tree cavities and beneath peeling bark. Such individuals may switch roosts every two days and have roosts up to two kilometers apart (Foster and Kurta 1999, Jung *et al*. 2004). Henderson *et al.* (2008) documented differences in variables influencing the distribution of male and female northern long-eared bats in forest fragments in a forest-agricultural landscape of Prince Edward Island. This species is generally more solitary than the little brown bat and is most often found singly or in very small groups. Unlike the little brown bat, the northern long-eared bat has not yet been observed to use underground sites as summer roosts in NS, though it is possible (Moseley 2007).

They swarm in mines and caves in the fall, and hibernate in many of these same spaces, although not in large numbers. Northern long-eared bats are said to prefer cooler hibernation temperatures than little brown bats (van Zyll de Jong 1985). In Nova Scotia, they are known to hibernate at most caves used by little brown bats (Scott and Hebda 2004), where they often squeeze into small crevices within the cave. They often hibernate solitarily or in small clusters. They may be overlooked in hibernation caves due to their physical similarity to little brown bats and their tendency to squeeze into small crevices. Recent harp trapping studies at several hibernacula in NS have shown that this species often makes up a substantial proportion of bats trapped (Garroway 2004). It is currently felt that this species may be more common than previously believed.

3.1.3 Tricoloured Bat/Eastern Pipistrelle

This species was formerly known as the eastern pipistrelle (*Pipistrellus subflavus*), however, recent genetic analysis indicates that the tricoloured bat is only distantly related to the true pipistrelles, and it has been placed in its own genus, *Perimyotis* (Hoofer and Van Den Bussche 2003). The tricoloured bat is a widespread species, and southeast Canada is considered the northern limit of their range (van Zyll de Jong, 1985; Broders *et al*., 2001, 2003). The ACCDC lists them as S1? in NS, meaning their status in the province is possibly extremely rare. NSDNR lists them as Yellow, meaning they are sensitive to human or natural impacts. Tricoloured bat is one of three bat species considered to have significant populations in Nova Scotia (Broders *et al.* 2003), and is thought to be restricted to the southern end of the province (Rockwell, 2005, Farrows and Broders, in press). This species has been shown to be affected by white-nose syndrome in other parts of its range (Frick *et al.* 2009).

Tri-coloured bats usually forage over watercourses and open spaces such as clearings and fields (Davis and Mumford 1962). Little is known about their diet, although they appear to feed mostly on moths (Barbour and Davis 1969). Females usually have two pups each year (Barbour and Davis 1969). They are known to roost in summer in rock crevices, caves and mines. In some parts of their range, tri-coloured bats are known to roost in buildings, and Hoying and Kunz (1998) reported a maternity roost of about 20 adult females with young in a barn. In Nova Scotia maternity colonies primarily utilize clumps of *Usnea* spp. lichen for roosting, typically in mature spruce trees (Poissant, 2009). Tricoloured bats will also occasionally roost in woodpecker holes and the hollows of old trees, but most often they roost in foliage (Findley 1964, Davis and Mumford 1962, Veilleux *et al*. 2003). Farrow and Broders (in press) stated that this forest-associated bat species appears to be negatively impacted by landscape practices that remove forest cover

Tri-coloured bats are weak fliers (sometimes called 'butterfly bats') and have longer hibernation periods, which may result in them not dispersing from winter hibernacula as far as other hibernating species (OMNR 2006). They hibernate in caves and abandoned mines, which are also used as swarming sites during the autumn mating season (Barbour and Davis 1969). They hibernate at higher temperatures than most bats, and though this means they metabolize fat reserves more rapidly, they apparently compensate for the loss by reducing the frequency of arousal episodes (Tuttle 1991). The ability to hibernate at higher temperatures than other bat species enables them to use a wider variety of caves as hibernacula. Tri-coloured bats also tend to hibernate singly, and have been shown in NS to show fidelity to small roost areas both within and between years (Poissant, 2009).

3.1.4 Hoary Bat

The hoary bat is a migratory tree bat, which ranges throughout North America from Alaska south into Brazil and Guatemala (Barbour and Davis 1969). It is said to be the most widespread bat species in North America (Shump and Shump, 1982). The ACCDC lists the hoary bat as S2? in NS, meaning its status in the province is possibly rare. DNR lists this species as Undetermined, meaning the status of the population in Nova Scotia has not been fully studied. Broders *et al.* (2003) determined that Nova Scotia is at this species is at, or beyond, the northern edge of this species' usual range.

These large solitary bats are high, strong and fast fliers (Larrison and Johnson 1981), reaching an average speed of 7.7 m/s while foraging (Salcedo *et al.* 1995). Banfield (1974) and van Zyll de Jong (1985) reported that hoary bats often forage in open spaces over glades or lakes in forested areas. They also appear to be more active above the forest canopy than within or below it (Menzel *et al*. 2005), and some authors state they are positively associated with edge habitats (Furlonger *et al*. 1986). Barclay (1984) reported that hoary bats forage on nightly round-trip flights of up to 40km. Hoary bats are thought to feed primarily on Lepidoptera (butterflies and moths) (Black 1974, Whitaker 1972, Carter *et al*. 2003), although they may consume a wide variety of insects. They are said to be an obligate tree-roosting species, roosting in elm, plum, and cherry trees throughput their range (Shump and Shump 1982).

During the summer, some segregation based on sex has been observed, with females concentrated in eastern North America and males concentrated in the western North America (Findley and Jones 1964, Cryan 2003). Females give birth in spring (i.e., mid-May to late June); usually litters of two, but may have up to four pups (Bogan 1972, Koehler and Barclay 2000). Adult females roost alone or with their dependent young, usually 3-12 m above the ground (van Zyll de Jong 1985). Mating occurs in late summer and autumn (Bouchard *et al.* 2001).

As a migratory species (Barclay 1984), hoary bats do not overwinter in NS. Bats from eastern North America are thought to winter primarily in southeastern USA, Mexico, and Guatemala (Barbour and Davis 1969, Cryan 2003) although individuals have been found in Michigan, New York and Ontario during the winter (Shump and Shump 1982, Bouchard *et al*. 2001). Migrants often travel in groups while moving south in the fall (Shump and Shump 1982). In the spring, a northern migration occurs, with females preceding males by about a month (Valdez and Cryan 2009, Findley and Jones 1964).

Garroway (2004) reported a single echolocation sequence attributable to this species from near the entrance to a Nova Scotia cave (Hayes Cave). Broders *et al.* (2003) reported fewer than five echolocation sequences attributable to hoary bats in 2001 acoustic surveys conducted in Kejimikujik Park, Brier Island, and Bon Portage Island. Eight specimens or reliable sight records exist for hoary bats in NS (NS Museum Collections, cited in Broders *et al*. 2003), reinforcing the fact that while hoary bats do occur in NS, they are by no means a common species.

3.1.5 Silver-haired Bat

The silver-haired bat is a migratory tree bat species (Barclay 1984, Griffin 1970). This species is thought to be widespread in Canada in summer (van Zyll de Jong 1985), though other sources consider them scarce through most of their range (Barbour and Davis 1969). The ACCDC lists this species as S1 in NS, meaning their status in the province is extremely rare. DNR lists them as Undetermined, meaning the status of their population in Nova Scotia is unknown. Broders *et al*. (2003) determined that this species is at, or beyond, the northern edge of its range in Nova Scotia. They are irregular visitors, primarily during migration season.

Throughout their range, silver-haired bats are usually found in forested areas. During the day they roost under loose bark (Barbour and Davis 1969). There is some evidence that males and females segregate during the summer and mate in the fall, but little is known about the reproductive behaviour of this species (Barbour and Davis 1969). Females form small maternity colonies (~10 adult females) in hollows in rotting trees (Parsons *et al*. 1986, Crampton and Barclay 1998).

As a migratory species (Barclay 1984), silver-haired bats do not overwinter in NS. Little is known about their migration behaviour. Populations in Ontario are thought to overwinter in the Ohio River Valley (Barbour and Davis 1969, Cryan 2003). Barbour and Davis (1969) stated that bird banders have captured groups of silver-haired bats on the east coast of Canada, suggesting they migrate in groups.

Little is known about the diet of this species. Studies have shown they feed on Trichoptera (caddisflies) and Lepidoptera (butterflies and moths) (Whitaker 1972, Black (1974). Carter *et al*. (2003) also found they feed on Diptera (flies) and some Homoptera (cicadas, leafhoppers, aphids, scales); however these observations were based on very small sample sizes.

Broders *et al.* (2003) recorded less than 5 echolocation sequences attributable to this species during their survey of bat species of southwestern NS, reinforcing the idea that the silver-haired bat is at the northern limit of its range in Nova Scotia. Two specimen or reliable sight records exist for this species in NS. A sight record of a silver haired bat in a manmade cave in NS (Peddler's Tunnel) in February 1996 is considered likely to be a storm-blown individual (Hebda 2006, cited in Moseley 2007). A silver-haired bat was also photographed on Brier Island in September 2004 (H. Broders, pers. comm.).

3.1.6 Eastern Red Bat

The eastern red bat is a migratory tree bat species (Barclay 1984, Griffin 1970), ranging from southern Canada south to Argentina and Chile (Shump and Shump, 1982). The ACCDC lists them as S2? in NS, meaning their status in the province is possibly rare. DNR lists them as Undetermined, meaning their population status in Nova Scotia is unknown.

As a migratory species, eastern red bats are high, fast fliers, reaching average speeds of 6.7 m/s while foraging (LaVal and LaVal 1979, Salcedo *et al*. 1995). They often forage around streams, ponds, forest ridges, and streetlamps (Hickey and Fenton 1990, Hickey *et al*. 1996, Acharya and Fenton 1999, Reddy and Fenton 2003). They are well camouflaged while roosting and tend to be seen more frequently seen in flight than at rest. Eastern red bats feed primarily on Lepidoptera (butterflies and moths), but have also been shown to feed on Coleoptera (beetles), Diptera (true flies), and other insects (Hickey *et al*. 1996, Whitaker *et al*. 1997, Carter *et al*. 2003).

Female eastern red bats typically roost alone in the foliage of trees and vines during summer. Mating takes place in late summer/early fall and may occur in flight (Barbour and Davis 1969). They give birth to 1-5 young in early summer and have average litter sizes of 3.2 (Barbour and Davis 1969). It has been suggested eastern red bats have large litters to compensate for the high predation risk of tree-roosting (van Zyll de Jong 1985). Eastern red bats tend to be faithful to roost areas, but not to specific roosts (Mager and Nelson 2000). Menzel *et al*. (1998) recorded eastern red bats spending an average of 1-2 nights in an individual tree before moving to another location in the surrounding area. Roosts are usually more than 5 metres above the ground (Mager and Nelson 2000).

This migratory species is rarely found in caves. A study in Missouri found that eastern red bats found in caves usually die (Myers 1960). Red bats have never been observed swarming with other species at cave entrances in autumn in NS (Moseley 2007). Individuals in some areas of the United States hibernate in leaf litter and emerge to forage during warmer periods (Moorman *et al*. 1999, Mormann *et al*. 2004). In warmer areas, eastern red bats may fly regularly throughout the winter and forage at locations where insects are present (Whitaker *et al*. 1997), such as in North Carolina and southeastern Virginia. In Ontario, there are recent winter records of these bats roosting in leaf litter and under the shingles of houses (Mager and Nelson 2000).

Eight specimens or reliable sight records exist for eastern red bat in NS (Nova Scotia Museum of Natural History Collections). While documenting the first breeding record of this species in NS, Broders *et al.* (2003) also determined that the eastern red bat is likely at, or beyond, the northern edge of its range in Nova Scotia.

3.1.7 Big Brown Bat

The big brown bat is a non-migratory species (Davis *et al*. 1968, Mills *et al*. 1975), which is common across southern Canada (van Zyll de Jong 1985). This species will soon be listed on the ACCDC website as SR, meaning its status has not yet been ranked (J. Klymko, ACCDC Zoologist, pers. comm., Oct. 29 2101). NSDNR lists the big brown bat as Undetermined in Nova Scotia. It is considered to be at the northern limit of its range in southern NB (van Zyll de Jong 1985), and NS (Broders *et al.* 2003). This species has only very recently been shown to overwinter and breed in NB (MacAlpine *et al.* 2002). A single provincial sight record of a big brown bat in NS exists (Hebda 2006, cited in Moseley 2007).

Big brown bats appear to be habitat generalists when foraging (Furlonger *et al*. 1987, Krusic and Neefus 1996) and are often seen foraging around streetlights (Geggie and Fenton 1985, Furlonger *et al*. 1987). They eat a wide variety of insects. Some reports say they specialize on Coleoptera (beetles) (Hamilton 1933, Phillips 1966, Whitaker 1972, Black 1974, Griffith and Gates 1975, Brigham and Saunders 1990, Whitaker 1995, Hamilton and Barclay 1998), while others have found they also feed on Diptera (true flies) and Hemiptera (true bugs). Moths are less often eaten by big brown bats (Whitaker *et al*. 1977, Whitaker *et al*. 1981, Warner 1985, Hamilton and Barclay 1998). Menzel *et al*. (2005) reported this species as being more active above the forest canopy rather than within or below it, suggesting this species prefers to forage in more open areas.

This species appears to use a wide range of habitats for rearing young. Throughout their range, big brown bats have been reported to form maternity roosts in natural habitats such as hollow trees (Barbour and Davis 1969, Brigham 1991, Vonhof 1996, Vonhof and Barclay 1996, Kalcounis and Brigham 1998) and rock crevices (Brigham 1988, cited in Kurta and Baker, 1990), to unnatural ones such as buildings (Rysgaard 1942, Davis *et al*. 1968, Brigham and Fenton 1986), storm sewers (Goehring 1972) and specially-made bat houses (Brittingham and Williams 2000). Females in eastern North America usually give birth to two young (Barbour and Davis, 1969). Little is known about the summer roost preferences of males and non-reproductive females (Agosta 2002).

Big brown bats do not appear to make seasonal migrations (Davis *et al*. 1968, Mills *et al*. 1975). In winter, they may hibernate in buildings, rock crevices, caves or mines (Fenton 1972, Lausen and Barclay 2006), and will select areas with good air circulation (Raesly and Gates 1987). However, Whitaker and Gummer (2000) have suggested that this species originally hibernated in hollow trees trunks, and that this preference has been transferred to attics of heated buildings. They also suggest that this species may be spreading northward due to the increased prevalence of this relatively new type of hibernaculum.

3.2 RESEARCH STUDIES ON BATS IN NOVA SCOTIA AND THE MARITIMES

Then majority of recent research on bats in Nova Scotia and the rest of the Maritimes has been conducted by the research lab of Dr. Hugh Broders at St. Mary's University, in Halifax. Distribution studies have provided valuable information on species status, and the spatial and temporal patterns of activity of bats in southwest Nova Scotia (Broders *et al.* 2003) and the summer distribution and status of the bats of Prince Edward Island (Henderson *et al.* 2009). Broders has also published research on various aspects of using ultrasonic bat detecting equipment (Broders *et al.* 2004, Broders 2003).

Dr. Broders and his students have also published research on topics such as social networks of female northern long-eared bats (Patriquin *et al.* 2010), roost behavior and selection of northern long-eared bats (Garroway and Broders 2007, 2008) and little brown bats (Broders and Forbes, 2004), and studies on ectoparasites of bat species (Poissant and Broders 2008). Other projects have examined the effects of forest loss on bats species distribution (Henderson *et al.* 2008) and movements and resource selection of the northern long-eared bat in forest-agriculture landscapes (Henderson and Broders 2008).

Max Moseley, a research associate at the NS Museum of Natural History, has also published various articles on caves and cave fauna of the Maritimes, including some relevant to bats (*i.e.* Moseley 2007a). He has also recently prepared a summary of bat records at cave and mines in Nova Scotia (Moseley, 2007b).

A paper summarizing the bat species reported in NS is currently in preparation by Andrew Hebda, Curator of Zoology at the NS Museum of Natural History, and Zoe Lucas.

4.0 POTENTIAL INTERACTIONS BETWEEN WIND FARMS AND BATS

The ability of bats to fly results in their being subject to many of the same potential wind turbine impacts as the other flying vertebrates, the birds, for which the potential impacts of wind turbines have long been recognized and studied (Johnson *et al.* 2002, Erickson *et al.* 2002, Anderson *et al.* 2004) . In recent years, however impacts to bats have been recognized, and the issue of wind power and bat impacts has been receiving considerable attention (Arnett *et al*. 2008, Kunz *et al.* 2007, and Johnson *et al*. 2003, Barclay *et al*, 2007, Baerwald *et al*., 2008, Baerwald and Barclay, 2008, Horn *et al.* 2008). It has lately been recognized that, in general, mortality at wind turbines is much more a bat issue than a bird issue (Barclay *et al*., 2007). As bats tend to be nocturnal, their presence near wind turbines is not as easily noticed as that of day-flying birds, and they may have suffered, from a conservation standpoint, by the public's often-negative perception of them. At least 11 species have been found dead at U.S wind turbines (Illinois Department of Natural Resources, 2007), including all seven species reported to occur in NS.

4.1 TYPES OF IMPACTS

Potential impacts on bat species include both direct effects (such as death of individuals related to project infrastructure and activities), and indirect impacts (i.e., loss and/or alteration of habitat). The significance of an impact depends on the degree of impact to individuals, the number of bats impacted, and the vulnerability of the species. While many of the impacts to birds can be extrapolated to bats, recent evidence has suggested that bats may also be impacted via different mechanisms than birds. Three main types of potential impacts to bats are discussed in the following subsections.

4.1.1 Collisions

As for birds, there is a potential risk to bats from collisions with operating wind turbines. Bats have been shown to be killed by the collision with the turning rotor blades of turbines (Horn *et al.* 2004). The reasons for these collisions remain unclear. As bats are thought to detect moving objects better than stationary ones (Jen and McCarty, 1978), their relatively high fatality rate is poorly understood. While bats have been shown to fly and feed in close proximity to the wind turbines (Ahlen 2003, Horn *et al.* 2008) via radar, echolocation is relatively ineffective at distances greater than 10m for most bats species, so bats foraging around turbines may fail to predict rotor velocity or to detect the large rapidly moving turbine blades (Ahlen 2003). There is nothing in a bat's natural habitat which is comparable to a turbine, so they may not recognize it as a threat.

It has been suggested that turbines may attract bats in some way, leading to increased risk of collision. It has been postulated that land clearing for construction of access roads, turbine foundations, and power transmission lines might attract bats by mimicking natural linear landscape features, such as natural forest edges, along which foraging and commuting bats may regularly travel (Kunz *et al*. 2007b; Verboom and Huitema 1997). Several authors have suggested that tree-roosting bats may mistake the turbine monopoles for roost trees and fly into the rotor blades (Ahlen 2003, von Hensen 2004, cited in Baerwald *et al.* 2008). Cryan (2008) suggested that tree bats collide with turbines while engaging in mating behaviors that center on the tallest' trees' in the landscape, (in this case, the turbines).

Many other hypotheses involve the attraction of insects. Turbines are often situated at the highest points in the landscape, where some flying insects tend to gather (''hilltopping'', see Thornhill and Alcock 1983), potentially attracting foraging bats. Published studies in North America reveal a surprising lack of correlation between local landscape features and fatalities at wind energy sites (Arnett *et al*. 2008). An example is the relatively high fatality rates of bats reported from sites in open, treeless, relatively unmodified landscapes (e.g., Alberta, Canada—Baerwald 2008). Other authors have suggested that insects may be attracted to aviation lights or the warmth (Ahlen 2003, von Hensen 2004 cited in Baerwald *et al.* 2008) or color of turbines, in turn drawing in hungry bats (Kunz *et al*. 2007b). It has also been suggested that the clearing of treed areas around turbine sites creates habitat conducive to the aerial insects which most bats feed upon (Grindal and Brigham 1998, von Hensen 2004 cited in Baerwald *et al.* 2008), thereby indirectly attracting foraging bats (Limpens and Kaptyen 1991, Verboom and Spoelstra 1999,, Menzel *et al.* 2005).

4.1.2 Barotrauma

Recent evidence has come to light which indicates an additional threat to bats. It has long been recognized that spinning turbine blades create vortices at the turbine blade tips, causing rapid changes in atmospheric pressure as the rotor blades rotate downward. The decompression hypothesis suggests that bats are killed by lung injuries (barotrauma) due to the rapid reductions in air pressure near the moving turbine blades (Kunz *et al.* 2008; Dürr and Bach 2004 and von Hensen (2004), both cited in Baerwald *et al.* 2008). This rapid change in air pressure causes damage to bat lungs, resulting in death. Evidence for this effect, known as barotrauma, comes from the fact that some bats killed at wind turbines show no sign of external injury, but necropsies have shown signs of internal organ damage consistent with decompression (Baerwald *et al*. 2008, Durr and Bach 2004, von Hensen 2004 cited in Baerwald *et al.* 2008). Baerwald *et al.* (2009) provided the first evidence that barotrauma is the cause of death in a high proportion of bat deaths around a wind turbine. Their study found that 90% of all bat fatalities (nearly half of which showed no external injury) at a wind turbine in Alberta involved internal hemorrhaging consistent with barotrauma, and that direct collision with turbine blades only accounted for 50% of fatalities. The faster a turbine blade is spinning, the greater the pressure drop in the vortex. Modern turbines blades reach speeds of 55-80 m/s, resulting in pressure drops of 5-10 KPa, sufficient to cause serious damage in small mammals (Dreyfuss *et al*.1985). It appears that birds, with their unique respiratory systems of compact, rigid lungs, are less susceptible to barotrauma than mammals, which have larger, more pliant lungs (Baerwald *et al.* 2009).

4.1.3 Disturbance/ Noise Impacts

During the construction and operational phases of wind projects, bats may also be impacted by a variety of disturbances, such as noise emitted by the turbines. It is possible that turbine noise could affect bat foraging. As bats use ultrasound (20 kHz and up) for echolocation of prey, there could potentially be interference with foraging activities, if the sounds from the turbine cover the frequencies that bats use for echolocation. The frequencies and volume of sound in the 20 – 60 kHz range are of particular interest. Sounds emanating from wind farms could potentially result in bats avoiding the area, or conversely, may attract bats to the turbines (Keeley *et al*., 2001, Schmidt and Joermann 1986), potentially increasing the risk of collisions. However, since bats were found to forage at distances as close as 1 m from a moving turbine blade (Bach *et al*., 1999, in Keeley *et al*., 2001), it appears unlikely that bats would avoid a wind farm because of noise. They have been shown via thermal imaging to fly and feed in close proximity to the wind turbines (Ahlen 2003, Horn *et al*. 2004). Erickson *et al*. (2002) stated there is no impact of turbine noise on echolocation of bats.

Increased human presence in a formerly undisturbed area on a regular basis could potentially affect bats. Since bats are nocturnal, it is not likely that foraging would be negatively affected by the infrequent presence of humans during the day. Construction, turbine inspections, maintenance and general visits to the wind farm would only occur during the day. However, such daytime disturbance near roosting sites could have an effect on roosting bats (Garcia *et al*., 1995) and could lead to abandonment of summer roosts. Disturbance of bats from roosting areas is discussed further in the Habitat Loss and Modification section.

4.1.4 Habitat Loss and Modification

Worldwide, habitat loss has been identified a main cause of declines in bat populations (Mickleburgh *et al*. 2002). Bats need several types of habitat to survive. These are 1) foraging areas, 2) summer roosting areas, and 3) hibernation areas. Loss or alteration of any of these habitats types can have impacts on bats. Wind power developments can potentially impact these crucial habitats in a variety of ways.

Tree clearing activities remove or alter foraging and roosting sites, and detrimental to local bat populations (Waldien *et al*. 2000*a*, 2000*b*; Hayes 2003, Humphrey 1982). This can also affect bat species which hibernate in hollow trees or on the ground. In particular, removal of large diameter snags and/ or hollow trees can be detrimental to maternity colonies and local populations (Bringham *et al.* 1997; Waldien *et al*. 2000*a*, 2000*b*). Alteration or degradation of riparian areas could also affect foraging habitats. Replacement of mature forest areas with younger regenerating forest can also affect bats. Broders and Forbes (2004) noted that in New Brunswick, roost selection by male little brown bats appeared highly dependent on the number of snags (dead trees) in the area.

Other impacts to foraging areas are less direct. Pesticide use, intended to kill insects, results in fewer insects or bats to feed on (Clark 1981, cited in Miller *et al.* 2005) and may poison bats (Henny *et al*. 1982) and cause declines in bat populations (Cockrum 1970; Geluso and Altenbach 1976; Clark and Kroll 1977). Pesticide use is not expected to occur at the Fairmont wind farm.

4.2 IMPACT VARIABLES

In general, the nature and degree of potential impacts of wind turbines on bats vary depending on a variety of factors. The most notable of these factors to date are season, species behavior patterns, and meteorological conditions.

4.2.1 Season

It has been observed that few fatalities of bats occur at wind turbines during spring, when long-distance migrant bats species are likely migrating to summering areas. Instead, most are documented during late summer and autumn, during migration (Arnett *et al*. 2008; Bach and Rahmel 2004; Cryan and Brown 2007; Durr and Bach 2004; Johnson 2005). Reviews of bat fatality data (Arnett *et al*. 2008, Erickson *et al*. 2002) have found that bat fatalities, although highly variable and periodic, consistently peak in late summer and fall, coinciding with migration of lasiurines and other species. A few exceptions have been observed, such as documented fatalities of pregnant female Brazilian freetailed bats (*Tadarida brasiliensis*) in May and June at a facility in Oklahoma, USA (Piorkowski, 2006, cited in Arnett *et al.* 2008.) and female silver-haired bats during spring in Tennessee, USA ((Fiedler 2004, cited in Arnett *et al.* 2008), and Alberta, Canada (Brown and Hamilton. 2002, 2006a , 2006b)

Fall also corresponds with the mating season of bats. This is discussed further in the following section on behaviour.

4.2.2 Behaviour

Bat species exhibit a wide range of behaviors, including differences in winter behaviour, roost selection (tree vs. cave vs. buildings) and prey preferences. They also forage at different heights, and may migrate at different heights, though specific behaviors of migrating bats are very poorly known. Differences in behavior patterns of bat species appear to strongly affect their risk of wind turbine impacts. Many studies have shown that turbine risk for migratory bats is greater than for resident non-migratory bats (Keeley *et al.* 2001; Erickson *et al.* 2002). Bat species most affected by turbines also tend to undertake long-distance, latitudinal migrations (Cryan 2003). These species also tend to be tree bats, which rely heavily on trees for roosting (tree bats, Griffin 1970) and are the species most consistently affected by wind turbines, both in terms of overall numbers and geographic distribution. In North America, migratory tree bats have been shown to account for 75% of documented fatalities to date, of which about half are hoary bats (Arnett *et al*. 2008). Examination of some fatality data also suggests biases between sexes, with adult males dominating samples for several affected species in North America (Arnett *et al*. 2008).

It has been suggested that the increased risk to migratory bats may be because they rely on sight more than echolocation while migrating (Curry and Kerlinger 2005; Van Gelder, 1956 in Keeley *et al.* 2001). Also, long distance migrants such as hoary or red bats (*Lasiurus* spp.) may be more likely to fly through open areas, and to fly at heights that would bring them into contact with turbine blades or cables used for anchoring turbines or communication towers than short distance migrants such as *Myotis* spp. (Keeley *et al.* 2001). Unfortunately, very little is known about the specific behaviors of bats during migration (Cryan and Diehl 2009).

It has also been suggested that migratory tree bats may migrate by following landscape features such as windy places such as mountain ridges, passes, coastal areas, and river valleys (Cryan and Diehl 2009; Furmankiewicz and Kucharska 2009), all places where wind turbines tend to be built. Baerwald and Barclay (2009) found that autumn activity and fatality of migrating species in Alberta is concentrated near the foothills of the Rocky Mountains, suggesting that migrating bats follow particular routes on their way south. However, other studies in North America reveal a surprising lack of correlation between local landscape features and fatalities at wind energy sites (Arnett *et al*. 2008). In addition, reports of relatively high fatality rates of bats at sites in open, treeless, scarcely modified landscapes (such as Baerwald's 2008 report from Alberta) suggest that this does not explain all patterns, if any.

Many of the species affected by wind turbines engage in mating activity during the same period when their carcasses are found in the greatest numbers beneath turbines (Cryan 2008). Little is known of the specifics of bat mating. Most bat species mate in fall during swarming events at hibernacula.

Cryan and Brown (2007) have suggested that the dominance of migratory tree bats among summer and fall turbine fatalities is related to flocking and mating behaviors exhibited by tree bats, which may be attracted to, and use, tall prominent landscape features as meeting locations. This is supported by the idea that flocking behavior in migratory bats during migration increases the chance of finding mates (Cryan, 2008, Fleming and Eby 2003). Male and female adult hoary bats have been shown exhibit different geographical distributions during spring and summer (Findley and Jones 1964, Cryan 2003), but they reunite during fall migration to wintering grounds (Cryan 2003). The mating hypothesis also explains why adult bats dominate fatalities, not juveniles as would be expected if fatalities were due to juvenile inexperience.

Though there is a risk of fatal collisions with turbines when any bats are present, most published reports show that mortality of resident bats is generally low, though numbers may vary with the location of the wind farm. Many studies have shown that resident species tend to be killed at wind turbines less frequently than migratory species, even in areas where the resident species are common throughout the summer (Arnett *et al*. 2008; Johnson *et al*. 2003; Kunz *et al*. 2007b). Erickson *et al.* (2002) stated that the collision risk for resident breeding bats is virtually nil, resulting in no apparent impact on resident breeding bats. Collision risk is low because bats generally forage below 25 m height (Erickson *et al.* 2002), below the height of most turbine blades, however bats will occasionally fly to the height of the blades. A review by OMNR (2006) stated that general observations to date indicate that bats do not typically collide with the stationary turbine towers, transmission structures, guy wires, or meteorological towers (i.e., stationary structures) associated with wind turbines.

4.2.3 Meteorological conditions

Fatality rates of bats at turbines often increase with the passage of storm fronts (Arnett *et al*. 2008). These observations, combined with the fact that most fatalities occur during a few weeks in late summer and autumn, suggest that migrating bats may utilize certain weather conditions during late summer and autumn that put them at risk (Cryan and Barclay 2009). Almost nothing is known about the effects of weather on the behavior of most migrating bat species (Cryan and Brown 2007).

Cryan and Brown (2007) found evidence to suggest that hoary bats may be more likely to arrive on remote islands with passing storm fronts in autumn. They also found that relatively low wind speeds, low moon illumination, and relatively high degrees of cloud cover were important predictors of bat arrivals and departures. Low barometric pressure also aided in predicting arrivals.

There is also considerable evidence that bat fatality rates at turbines are affected by wind speed. More bats appear to be killed on nights exhibiting low wind speeds (Fiedler, 2004, and von Hensen, 2004 (both cited in Baerwald *et al.* 2009), Arnett 2005, Arnett *et al*. 2008, Horn *et al*. 2008).

5.0 BAT SURVEY METHODOLOGY

5.1 REVIEW OF AVAILABLE DATA

The baseline bat monitoring survey began with a detailed desktop review of existing data. As the Nova Scotia Department of Environment (NSE) regards wind farm sites within 25 km of a known bat hibernaculum as having a ‘very high’ site sensitivity (NSE 2009), it is imperative to determine whether the bat hibernacula are known to occur within this radius.

A review of geological mapping of the area was conducted to determine the likelihood of possible bat hibernacula, in the form of natural caves. NSDNR’s Mine Openings database was also consulted to determine if there are abandoned mines in the area which could also serve as hibernacula. As many parts of Nova Scotia have historically supported various types of mining activities, a review of the geology and mining history of the site can be beneficial in determining the likely presence of natural caves and/ or abandoned mines.

Bat species occurring in the Antigonish area were discussed with NSDNR’s Regional Biologist for Antigonish. A biologist at the local university (St Francis Xavier University), was also contacted in the search for local information on bats. Discussions were also held with Dr. Hugh Broders of Saint Mary’s University.

5.2 ACOUSTIC SURVEYS

Electronic detection of bats has advanced considerably enabling researchers to detect and monitor bats without capturing bats with mist nets. One particular company, Titley Electronics of Australia, has established themselves as a significant provider of cost effective, high quality monitoring equipment that is used as the standard for most environmental assessment studies on bats. Titley’s Anabat is used throughout North America to identify and survey bats by detecting and analyzing their echolocation calls.

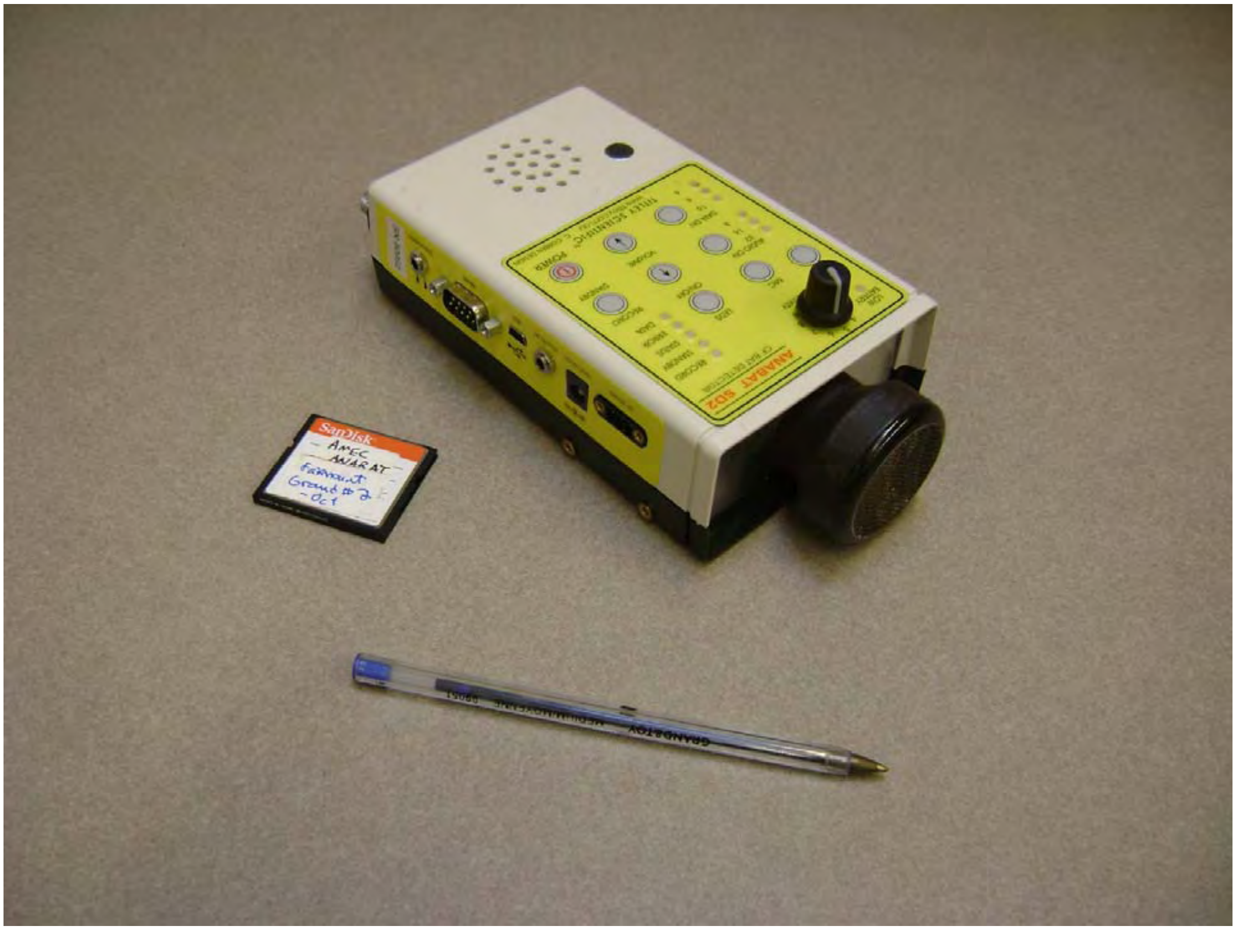


Photo 5-1. An Anabat acoustic bat detector and compact flash card.

The Anabat system consists of a bat detector, a ZCAIM (Zero-Crossings Analysis Interface Module) and software. The Anabat detector unit contains an ultrasonic microphone, an electronic amplifier, and a digital signal divider. The bat detector will produce an audible output from the inaudible ultrasonic echolocation signals produced by the bats. The ZCAIM is an interface that is used to read the Anabat recorded data on a computer, and the software is used to present the data in a useable format. In most recent versions of the Anabat system, the ZCAIM will record data directly onto a compact flash card, which can then be used to transfer data to a computer.

The Anabat system is a passive detection system that monitors bat activity without human presence and intervention. AMEC developed the bat monitoring strategy for the Fairmont Wind Farm based on the acquisition and use of Anabat detectors.

Weller (2002) noted that there is a considerable variability in signals recorded by Anabat detectors depending upon their orientation. Based on Weller's research it was determined that multiple bat detectors should be deployed. While two detectors may record the same individuals, the redundancy will enable continued detection in the event one system fails due to battery depletion, weather events, or animal disturbance. Efforts must be made to ensure continuous detection for a complete picture of potential bat activity.

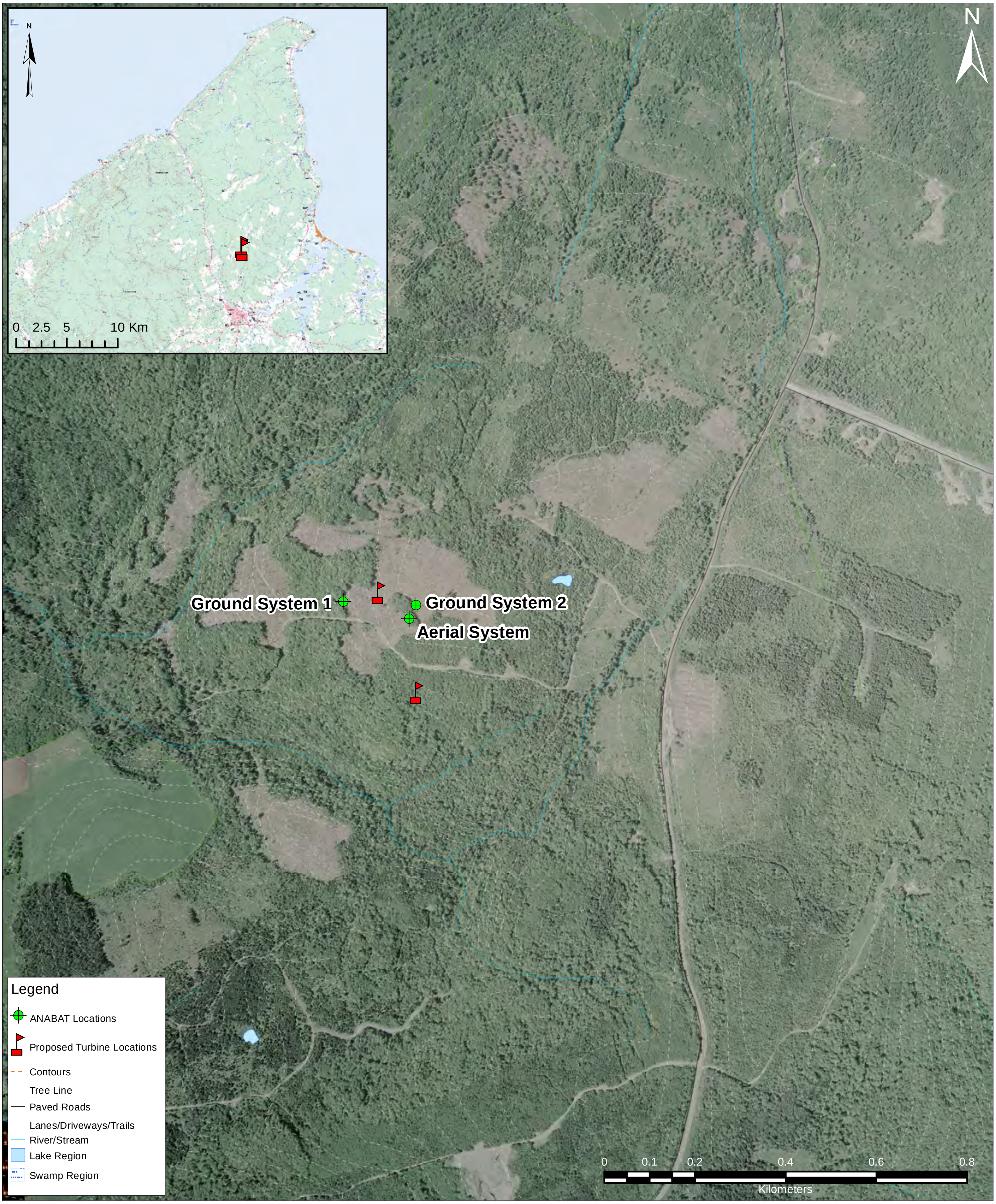
Based on the literature review of previous acoustic bat surveys, it was determined that an aerial detector should be set with an orientation to detect bats along the tree line at the edge of the cleared site. This will permit detection of bats foraging near the tree canopy at the edge of the clearing and detect bats that may be migrating above the canopy.

It was also determined that a second ground-system should be set with an orientation of 45° from horizontal should be deployed at the site to detect bats that forage low flying insects in cleared areas. This detector should be situated at right angles to the aerial system to maximize detection area. Use of the dual acoustic systems with a combination of ground and aerial orientation would provide effective cross coverage and ensure redundancy in the event one system failed (due to battery failure or animal intervention)

Dr. Hugh Broders provided an expert review of the monitoring program prior to implementation. Anabat acoustical bat detection systems were in place on the Project site, in accordance with the monitoring strategy, from the end of August to mid-October. Locations of both ground and elevated systems are shown on Figure 5.1.

5.2.1 Aerial Systems Deployment

AMEC erected a 10m pole at the project site in advance of the construction of a tower by Wind Prospect. This tower was situated at the edge of the cleared site adjacent to the treeline (see Figure 5.1). Coordinates were 578568 E, 5059307 N (UTM NAD 83) and the location is depicted on Figure 5.1 (Aerial System).



CLIENT: **Wind Prospect Inc.**	AMEC Earth & Environmental 32 Troop Avenue, Unit 301 Dartmouth, NS, B3B 1Z1 (P) 902-468-2848 (F) 902-468-1314		amec
PROJECT: Fairmont Wind Farm Bat Monitoring Protocol and Survey Report	DWN BY: DS	DATUM: UTM Zone 20	DATE: December 2010
TITLE: ANABAT Locations	CHK BY: BC	PROJECTION: NAD83	PROJECT No: TV01048
	REV NO: N/A	SCALE: As Shown	FIGURE: 5.1

Source: Aerial Photo provided by Service Nova Scotia Municipal Relations, Photo No. 2007400_103, 2007

Photo 5-2. Pole erected on site for aerial Anabat system, showing detail of cleared area and forest edge.

A high-sensitivity ANABAT microphone was mounted on a half-section of 12 inch diameter PVC pipe, within a tubular waterproof housing (also made of PVC) which was open at the base (based on the ‘Bat- hat’ design). The microphone faced downwards, and a 45° Lexan plate reflected incoming sounds into the waterproof housing. This allowed sampling of a horizontal section of the sky at treetop height. The microphone setup was raised via a pulley to the top of the pole, and was fastened snugly against the pole via additional lines. A microphone extension cable ran down the pole to the main body of the detector, which was placed in a waterproof housing at the base of the pole, along with the power supply. The waterproof housing was covered in brush to minimize visibility and potential vandalism (Photo 5.2). The pole was erected within 5m of the tree line on the site, with the microphone assembly pointing parallel to the tree line (north) to allow sampling of the forest edge. The detector was programmed to record all ultrasonic sounds between 7 pm and 7 am.

The remote amplified microphone was fixed to the top of the pole and connected to an Anabat II acoustic bat detector on Sept 10, 2010. This system remained in operation until Oct 14 2010, and was frequently checked (approximately weekly) to download data, check batteries, and verify that the system was intact and functioning properly.

5.2.2 Ground Systems Deployment

An Anabat II acoustic bat detector was deployed on Fairmont site from Aug 30 to Sept 12 2010. Coordinates were 578422 E, 5059345 N (UTM NAD 83) and the location is depicted on Figure 5.1 (Ground System 1). The detector was deployed, along with its power supply, on the ground in a waterproof housing fitted with a microphone tube, which allowed sampling of a section of the sky approximately 45 degrees from horizontal. The detector was programmed to record all ultrasonic sounds between 7 pm and 7 am.

This setup was placed within 5m of the tree line on the site, with the microphone tube pointing parallel to the tree line (northeast) to allow sampling of the forest edge (Figure 5.1). The waterproof housing was covered in brush to minimize visibility and potential vandalism (Photo 5.2).

Photo 5-3 Anabat Ground system 1, covered in brush (viewed from treeline)

A second Anabat SD2 bat detector was deployed in a similar fashion for the dates Sept 21-23 and Oct 3-14 near the aerial system, also within 5m of and parallel to the tree line (facing south). Coordinates were 578676 E, 5059148 N (UTM NAD 83), and the location is depicted on Figure 5.1 (Ground System 2).

5.2.3 ANABAT Data Format and Analysis

While deployed at the site, the ANABAT detectors recorded all ultrasonic frequencies detected onto a compact flash card. This data was then interpreted via AnalookW software (version 3.7w) using zero-crossing analysis. All ultrasonic frequencies recorded were then displayed graphically as sonograms, and bat echolocation sequences were identified based on the minimum, maximum, and characteristic frequencies, in addition to the slope of the calls (O'Farrell *et al.* 1999). Sequences were identified to species using the Analook W software and published information on the calls of bat species native to eastern North America (Barclay 1989, Barclay *et al.* 1999, Betts 1998, Broders *et al.* 2001, Fenton and Bell 1981, Fenton *et al.* 1983, MacDonald *et al.* 1994). It should be noted that bats of the genus *Myotis* (little brown bat and northern long-eared bat) generally cannot be distinguished using these acoustic survey methods.

6.0 SURVEY RESULTS

6.1 REVIEW OF AVAILABLE DATA

Within 25 km of the Project site, there are 74 known mine openings, according to the Nova Scotia Abandoned Mine Openings (AMO) Database (NSDNR, 2010). None of these mine openings correspond to caves known to support bats in Nova Scotia, as summarized in Moseley (2007a/b). Total depths of the majority of these mine openings are not provided, however, three are reported to be deeper than 10m. Discussions with the NSDNR Regional Biologist for Antigonish, Mark Pulsifer, indicate that there are no bat hibernacula known to occur in any mines or caves in the general area of Antigonish. Pulsifer stated that the closest known winter hibernacula he was aware of occur in Sonora and Glenelg, in Guysborough County. There is one (possibly two) abandoned mines in Sonora where little brown bats have been known to winter, and there is a hibernaculum at the Lead Mine Cave near Glenelg. He has also been told of the possibility of another site (abandoned mine) on the St. Mary's River at Waternish. Sonora is over 60 km south of the community of Antigonish.

Bats are also known to hibernate in natural caves or caverns associated with karst topography. Karst, a unique landscape feature caused by dissolution of calcareous sedimentary rock, has the potential to develop caverns and sinkholes suitable for bat hibernation. Karst is known to occur in parts of Antigonish County. Local geology mapping indicates that deposits of sedimentary rock, such as gypsum and anhydrite occur approximately 5 km to the south of the proposed Project site, and gypsum cliffs occur along the coast at Crystal Cliffs, approximately 10km northeast of the site. Bat hibernacula have not been reported from karst in Antigonish County.

An abandoned house in South Side Harbour has been reported to contain a few hundred roosting bats (Randy Lauff, Biology Department, St Francis Xavier University, pers. comm. 2010).

6.2 ANABAT DATA

6.2.1 Ground System

The first ground system, which was deployed for the first half of September (Aug 31-Sept 12), recorded bat activity during 12 of the 13 deployment nights, for a total of 77 bat echolocation sequences. The number of bat echolocation sequences recorded per night ranged from 0 to 13 (average (5.5), and all were made by *Myotis* species. While it is difficult to confidently assign *Myotis* echolocation sequences to a particular species, the calls recorded show characteristics of both species, and it is assumed that both species are present on the site.

The second ground system, which was deployed from Sept 21 to Sept 23 and from Oct 3 to 14, 2010, recorded bats on only 4 of 15 deployment nights, with a total of 14 sequences. Of these sequences, 13 were recorded between 21 and 23 Sept, while the remaining sequence was recorded on 5 Oct 2010. All were made by *Myotis* species.

The decrease in bat echolocation sequences as the fall season progresses matches the seasonal behaviour of *Myotis* species in NS. This data suggests a low level of bat activity on the Wind Prospect site

Table 6.1: Number of bat echolocation sequences detected per night by ground-based ANABAT systems at proposed Wind Prospect wind turbine site in Fairmont, Antigonish Co.

System	Evening of	*Myotis* spp.
System 1	30-Aug-10	7
	31-Aug-10	13
	1-Sep-10	7
	2-Sep-10	8
	3-Sep-10	3
	4-Sep-10	3
	5-Sep-10	6
	6-Sep-10	3
	7-Sep-10	7
	8-Sep-10	3
	9-Sep-10	10
	10-Sep-10	5
	11-Sep-10	2
	12-Sep-10	0
	13-20 Sep-10	ND
System 2	21-Sep-10	8
	22-Sep-10	2
	23-Sep-10	3
	24-Sep-Oct 2-10	ND
	3-Oct-10	0
	4-Oct-10	0
	5-Oct-10	1
	6-Oct-10	0
	7-Oct-10	0
	8-Oct-10	0
	9-Oct-10	0
	10-Oct-10	0
	11-Oct-10	0
	12-Oct-10	0

ND= No Data

6.2.2 Aerial System

Of the 29 days for which the aerial unit was active, bat echolocation sequences were detected on 24 deployment nights, resulting in 63 recorded sequences. Data are not available for the period Sept 12-16, when a card error resulted in the unit failing to record. The number of bat echolocation sequences recorder per night ranged from 0 to 8 (mean 3.9), and were almost entirely (>98.4%) made by *Myotis* species (little brown bats and northern–long eared bats). While it is difficult to confidently assign *Myotis* echolocation sequences to a particular species, the calls recorded show characteristics of both species, and it is assumed that both species are present on the site.

A single echolocation sequence recorded on Sept 28 2010 appears to be a hoary bat, a migratory tree bat species.

Overall, the data from the aerial system suggests a low level of bat activity on the Wind Prospect site. This may in part be due to the lateness of the period during which the aerial system was deployed.

Table 6.2: Number of bat echolocation sequences detected per night by aerial ANABAT system at proposed Wind Prospect wind turbine site in Fairmont, Antigonish Co.

Evening of	*Myotis* spp.	Hoary Bat
10-Sep-10	5	0
11-Sep-10	2	0
12-Sep-10	ND	ND
13-Sep-10	ND	ND
14-Sep-10	ND	ND
15-Sep-10	ND	ND
16-Sep-10	ND	ND
17-Sep-10	2	0
18-Sep-10	6	0
19-Sep-10	8	0
20-Sep-10	1	0
21-Sep-10	2	0
22-Sep-10	1	0
23-Sep-10	1	0
24-Sep-10	0	0
25-Sep-10	6	0
26-Sep-10	3	0
27-Sep-10	1	0
28-Sep-10	2	1
29-Sep-10	3	0
30-Sep-10	2	0
1-Oct-10	2	0
2-Oct-10	2	0
3-Oct-10	3	0
4-Oct-10	1	0
5-Oct-10	2	0
6-Oct-10	1	0
7-Oct-10	0	0
8-Oct-10	0	0
9-Oct-10	0	0
10-Oct-10	0	0
11-Oct-10	2	0
12-Oct-10	2	0
13-Oct-10	2	0
14-Oct-10	0	0

7.0 ANALYSIS

7.1 POTENTIAL IMPACTS

Both migratory and resident bat species are known to occur in NS. Migratory tree bat species present in NS include hoary bats, eastern red bats, and silver-haired bats. Resident bat species in NS include the little brown bat and northern long-eared bats (though these species may travel a few hundred kilometers to hibernacula (Davis and Hitchcock 1965) they are not considered long-distance migrants). The tricoloured bat, while it may be characterized as a tree bat (Findley 1954; Veilleux *et al*. 2004), is considered a resident species in NS as it hibernates in the province (Broders, unpublished).

The vast majority of the bat echolocation sequences detected (>99.3%) with the ground and aerial detectors at the proposed Wind Prospect wind turbine site are attributable to the two *Myotis* species widespread in NS, little brown bat and northern long-eared bat. A single sequence appears to be from a hoary bat, which is a migratory tree bat species, which in NS is considered to be at the northern limits of its range (Broders *et al.* 2003).

Impacts from the proposed wind turbines on the two *Myotis* species, both resident, are expected to be low. Though there is a risk of fatal collisions with turbines when any bats are present, most published reports show that mortality of resident bats is generally low, though numbers may vary with the location of the wind farm. Many studies have shown that resident species tend to be killed at wind turbines less frequently than migratory species, even in areas where the resident species are common throughout the summer (Arnett *et al*. 2008; Johnson *et al*. 2003; Kunz *et al*. 2007b). Erickson *et al.* (2002) stated that the collision risk for resident breeding bats is virtually nil, resulting in no apparent impact on resident breeding bats. Collision risk is low because resident bats generally forage below 25 m height (Erickson *et al.* 2002), below the height of most turbine blades, however bats will occasionally fly to the height of the blades.

Most bat studies agree that the potential impact of wind turbines is greater to migratory bats than resident one. The low number of migratory tree bats detected in this study indicates that few migratory tree bats are likely to pass through the Wind Prospect study site area during the fall migratory period, when risk is considered highest. As all migratory tree bats ever reported in NS are considered to be at the northern limit of their geographic ranges, impacts from this project on migratory tree bats are predicted to be very low.

There is a very low likelihood that this project will have an impact on bat hibernating areas, as the two *Myotis* species occurring on the site hibernate underground, in habitats which the project will not affect, and hoary bats do not hibernate in NS. None of the four other bats species reported to occur in NS will lose any hibernating habitat due to this project.

Depending on how much additional land will be cleared, the project may cause loss of some foraging and roosting habitat on the Project site via clearing of treed areas. It may also cause minor disturbance of bats roosting on or near the project site, via construction and maintenance activities. Clearing of vegetation will add slightly to the cumulative effect of loss of bat habitat that is occurring throughout the province.

7.2 RECOMMENDATIONS

Based on above, there may be some impacts to bats in the vicinity of the project site. These are not expected to be significant. Mitigation measures to minimize these potential effects are outlined in the following subsection.

7.2.1 Mitigation

Two main types of mitigation are recommended for this project. These are discussed in the following paragraphs.

Minimize Habitat Disturbance

The project will aim to disturb the existing habitat as little as is reasonably possible. To protect bat roosting areas it is recommended that the removal of forested areas, tall trees and snags be limited to the areas where it is absolutely necessary for project construction.

In addition, the timing of any clearing activities must consider bats. Avoidance of clearing and grubbing activities during the late spring and summer months (May 1 to August 30) will minimize impact to breeding and roosting bats potentially on the site.

To avoid poisoning bats or reducing their food supply, no pesticides are to be used on the site.

Monitor for Fatalities

In previous wind farm developments it has been recommended that monitoring of the turbines for bat strikes be carried out for at least two years during the construction and operation phase. In the first couple of years they should consist of full season surveys. Surveys should occur throughout the migration period in spring and late summer, early fall (i.e., April/May and August/September). Surveys should be conducted by a person with knowledge of bat identification, early in the morning around the bases of the turbines, extending outward from the base to a 50 m radius. If dead bats are found, they should be identified to species, photographed, given an identification number, collected, and provided to the NS Museum of Natural History. Information on the location and condition of all carcasses, the season, and of weather conditions the previous night should also be recorded. All fatality data must be submitted to both Nova Scotia Department of Environment and to NSDNR's Wildlife Division.

In consideration of the increased effectiveness of acoustic monitoring systems, and the potential for bat mortalities to occur undetected due to timeliness of surveys (bats carcasses taken by scavengers) and/or lack of trained monitors, it is suggested that consideration be given to an acoustic survey program with a randomized survey of bat mortality to augment and verify acoustic data.

Prior to initiation of bat monitoring surveys, the monitoring program shall be submitted to Nova Scotia Department of Natural Resources (NSDNR) and Canadian Wildlife Service (CWS) for their comment and approval. Should bat fatalities become an issue, Wind Prospect will work with NSDNR and CWS to seek advice and to determine acceptable methods of minimizing and mitigating any impacts.

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APPENDIX E

VASCULAR PLANT SURVEY

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A vascular plant inventory of the proposed wind turbine site, Fairmont, Nova Scotia with notes on plant communities

Plant communities at the northern (above) and southern (below) turbine sites

Conducted by Sean Blaney for Andy MacCallum, Wind Prospect Inc.

June 21, 2011

METHODS

Vascular Plant Inventory

Fieldwork was conducted by Sean Blaney on October 22, 2010 and June 19, 2011. I covered all areas proposed for development in the site plans of October 2010 and June 2011. These were: i) the ~215 m new road segment proposed between the Fairmont Road and the landowner's existing private access road, ii) the 600 m of existing access road which is proposed for widening and upgrading, and iii) the two turbine sites and their proposed access roads branching off the main access road. Site coverage was on foot and all portions of the above were covered at least twice, with one segment of the existing access road covered four times.

In order to increase total diversity of species recorded, I extended site coverage beyond the areas proposed for development. Aerial photographs of the site showed that the only concentration of mature forest on the property in question was along the streambed running south of the proposed development footprint and the associated steep slopes of the stream valley. I thus added extra coverage along the stream bed in the vicinity of the point where the proposed access road crosses the stream (extending 200 m downstream and about 50 m upstream), as well as more extensive coverage of the higher quality forested valley to the southwest of the turbine sites. To reach that area, I followed the existing access road 500 m southwestward (downslope) beyond the northern turbine site to the stream bed, followed the streambed upstream for 500 m, and then followed a smaller tributary streambed upslope for 300 m back to the main access road. I also covered 940 m of roadside habitat along Fairmont Road, north and south of the point where the proposed new access road branched off to the west.

I recorded the track taken in the field with a GPS unit set to record position approximately every 15 seconds while moving (the "more often" track recording setting on a Garmin GPS 76Cx unit). I pre-programmed the proposed turbine sites into the GPS unit before fieldwork and at each turbine site I took photographs and recorded notes on species composition, stand age of forested sites and any obvious disturbance history of the plant community present. I compiled a full vascular plant list for the site as a whole, with estimates of species' relative abundance as follows: *rare* – seen in in 2 or fewer locations; *uncommon* – seen in small numbers in several locations; fairly common – seen in approximately five locations, generally in small numbers; common – seen at more than five locations (estimated). These categories are not intended to represent precise descriptions of abundance but do provide some measure of relative abundance.

For plant species tracked by the Atlantic Canada Conservation Data Centre (those ranked S1, S2, S3 or S3S4 in Nova Scotia, for which all locations are databased), I recorded GPS locations along with habitat descriptions and more detailed estimates of local abundance.

Definitions for S-ranks and for Nova Scotia National General Status ranks (the primary ranks by which species' significance is determined by Nova Scotia Department of Natural Resources), are given below. Both sets of ranks for Nova Scotia were developed through the consensus of the NS Flora Ranking Committee, led through the cooperation of NS Department of Natural Resources (NS DNR) and Atlantic Canada Conservation Data Centre. 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.

S2 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.

S4 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

RESULTS and DISCUSSION

I. Site Coverage

Over the October 2010 and June 2011 visits, I spent ten hours and walked 10.7 km on site. GPS tracks of areas covered are mapped in Figure 1. Between the two site visits, coverage for vascular plants is quite complete. I covered all habitat types present within the proposed development footprint and with the extra coverage in areas not proposed to be impacted, the current species list should represent a very high proportion of all vascular plant species present in the development footprint area.

II. Plant Communities and Natural Heritage Values

Descriptions of the plant communities at the proposed turbine sites are given in Table 1 and photographs of the turbine sites are given in Figures 2 and 3, with a photograph of the existing access trail given in Figure 4. None of the plant communities within the proposed development footprint are rare or uncommon in Nova Scotia nor do they represent mature, high quality examples of provincially common plant communities. The community most noteworthy relative to the proposed development is the spring and seepage wetland along the first portion of the proposed access road between Fairmont Road and the existing access road. A significant spring and large area of very wet groundwater seepage at this site will be covered by upcoming provincial wetland policy and (independent of wetland policy) may be difficult to build upon. Almost all of the remainder of the development footprint area has been heavily altered by human activities. The recently clearcut area along the proposed new access road (Figure 2) heading west off Fairmont Road appears to have been forest that regenerated following agricultural use (probably cattle pasturing) and at least some of the young forest habitat along the existing access road (Figure 3) has had a similar history, judging by the existence of apple trees and the composition of the roadside plant community. Almost all of the forest within the proposed development footprint is either clearcut within the past 10 years (as is the case at the North Turbine site, Figure 5), or has regenerated from clearcutting in the past 20-40 years (as is the case at the South Turbine site (Figure 6). There are also several small clearings along the existing access road caused by small scale gravel extraction or forestry-related activities.

As noted above, the natural heritage value of the project area is not high. Avoidance of the seepage area and spring on the proposed new access road off Fairmont Road might reduce the project's impacts on the natural heritage values of the site, but depending on the availability of alternate routes through upland habitats, avoiding the wetland might just involve trading a smaller area of impact on a slightly more significant area (the seepage wetland) for a larger area of impact on a slightly less significant area (whatever alternate upland route might be chosen).

Figure 1. Map of on-foot site coverage (blue tracks, recorded by GPS) during the October 24, 2010 and June 18, 2011 surveys, with proposed turbine locations (red dots, T1 and T2), proposed access roads (broad yellow lines), and property boundary (narrow red line). contours within area of coverage. The dark blue line is the track recorded by GPS while on foot. Map from Google Earth.

Table 1. Community descriptions of proposed turbine sites. Sites match those mapped in Figure 1. Cover value percentages in are absolute values, whereas tree species composition percentages are relative to the total tree cover (i.e. 85% of the 35% tree cover at turbine X was balsam fir).

Tur-bine#	Stand Age	Community Description	Tree Composition	% Tree Cover	Tall Shrub/ Sapling Spp.	Tall Shrub/ Sapling % Cover	Low Shrub/ Seedling Spp.	Low Shrub/ Sapling % Cover	Dominant Herb Spp.	Herb % Cover
T1 (North)	a) ~10 b) ~15-20	a) Slowly regenerating open upland clearcut with moist patches b) very young regenerating upland deciduous and mixed forest	a) minimal tree cover b) red maple 70%, white birch 20%, balsam fir 10%	a) <2% b) 80% Overall ~20%	balsam fir,red maple, white spruce, yellow birch, gray birch, sugar maple	Overall 25%	*Rubus idaeus* ssp. *strigosus,* balsam fir,red maple, white spruce, yellow birch, gray birch, sugar maple	Overall 25%	a) *Solidago rugosa, Doellingeria umbellata, Carex debilis var. rudgei, Carex brunnescens ssp. sphaerostachya, Carex arctata, Juncus effusus, Danthonia spicata, Agrostis cf. capillaris, Anaphalis margaritacea, Fragaria virginiana, Hieracium aurantiacum, Hieracium x floribundum*	a) 70%
T2 (South)	30	Young, mesic deciduous upland forest	Red maple 80%, balsam fir 20% (small amounts of yellow birch, white birch, white ash)	80%	Balsam fir, red maple, Corylus cornuta	10%	*Sambucus racemosa*, red maple, white ash	5%	*Dennstaedtia punctilobula, Maianthemum canadense, Aralia nudicaulis, Dryopteris intermedi, Carex novae-angliae, Carex deweyana, Carex arctata, Carex brunnescens ssp. sphaerostachya, Trientalis borealis*	75%

III. Vascular Plants – Non-rare and Rare

Table 2 lists the 269 vascular plant taxa (216 native or potentially native, 53 exotic) identified during fieldwork, with estimates of their abundance within the site and their provincial status under both the S-rank system used continent-wide by all conservation data centres and the National General Status ranks, which have been developed by each province and territory. Of the above 269 taxa, 197 taxa (155 native or potentially native, 42 exotic) were found within the proposed development footprint and 72 taxa (61 native, 11 exotic) were found only in areas outside the development footprint (the roadside along Fairmont Road, the access road south and west of the north turbine site or along the stream south and west of the turbine sites. The species observed only outside the proposed development footprint are identified in Table 2.

None of the observed vascular plants were of concern under the NS DNR General Status ranks. Two observed species, Early Coralroot (*Corallorhiza trifida*) and Hooker's Orchid (Platanthera hookeri) are of concern based on AC CDC status ranks, with a marginally rare ranks of S3 and provincial General Status ranks of Secure. These species were both observed only in seepy, mossy microsites within floodplain forest along the stream in the southwest corner of the property, well away from proposed construction impacts. The nearest proposed impact was the access road to the North turbine site, 350-450 m away. Similar habitats were only present within the proposed development footprint near the stream crossing of the proposed new access road. Early Coralroot can also sometimes occur in young, dense conifer forest as occurred in places along the existing access road, although in my experience this is more likely on highly calcareous bedrock. Hooker's Orchid is infrequent or absent from very early successional habitats. No other vascular plant species of conservation concern were noted.

Table 2. Vascular plants recorded in the study area, with abundance estimates and provincial status ranks. Site Status codes and provincial S-ranks are defined above. Taxonomy follows Kartesz (1999) – *Synthesis of the North American Flora*, CD-ROM. Status ranks in square brackets refer to an indefinite identification for which all potential species have the same rank. Location column indicates whether the species was observed within the proposed development footprint ("footprint"), or only within an area outside the development footprint ("stream", logging road = "log. rd.", "roadside" = margin of Fairmont Road). Columns labeled "1" and "2" indicate whether species were seen on site visit 1 (October 2010) and site visit 2 (June 2011).

Species / Family	Species / Family Common Name	S-rank	GS rank	Site Status	ID Note	Location	1	2
Lycopodiaceae	**Clubmoss Family**							
Huperzia lucidula	Shining Fir-Clubmoss	S5	Secure	f		stream	x	x
Lycopodium annotinum	Stiff Clubmoss	S5	Secure	f		footprint	x	x
Lycopodium clavatum	Running Pine	S5	Secure	r	ID in the broad sense, potentially including L. lagopus	footprint		x
Lycopodium dendroideum	Treelike Clubmoss	S5	Secure	u		footprint	x	x
Lycopodium lagopus	One-Cone Gound-Pine	S4	Secure	u		footprint	x	
Equisetaceae	**Horsetail Family**							
Equisetum arvense	Field Horsetail	S5	Secure	c		footprint	x	x
Equisetum sylvaticum	Woodland Horsetail	S5	Secure	r		log. rd.		x
Osmundaceae	**Flowering Fern Family**							

Species / Family	Species / Family Common Name	S-rank	GS rank	Site Status	ID Note	Location	1	2
Osmunda cinnamomea	Cinnamon Fern	S5	Secure	c		footprint	x	x
Osmunda claytoniana	Interrupted Fern	S5	Secure	c		footprint	x	x
Dennstaedtiaceae	**Hay-Scented Fern Family**							
Dennstaedtia punctilobula	Eastern Hay-Scented Fern	S5	Secure	c		footprint	x	x
Pteridium aquilinum	Bracken Fern	S5	Secure	c		footprint	x	x
Thelypteridaceae	**Marsh-Fern Family**							
Phegopteris connectilis	Northern Beech Fern	S5	Secure	r		log. rd.	x	x
Thelypteris noveboracensis	New York Fern	S5	Secure	c		footprint	x	x
Dryopteridaceae	**Wood-Fern Family**							
Athyrium filix-femina	Lady-Fern	S5	Secure	c		footprint	x	x
Deparia acrostichoides	Silvery Spleenwort	S4	Secure	c		stream	x	x
Dryopteris campyloptera	Mountain Wood-Fern	S5	Secure	c		footprint	x	x
Dryopteris campyloptera x cristata	Hybrid Wood-Fern	[native]	[Not Assessed]	r	ID uncertain; potentially another hybrid involving D. cristata	footprint		x
Dryopteris carthusiana	Spinulose Shield Fern	S5	Secure	r		footprint		x
Dryopteris cristata	Crested Shield-Fern	S5	Secure	u		footprint	x	x
Dryopteris intermedia	Evergreen Woodfern	S5	Secure	c		footprint	x	x
Gymnocarpium dryopteris	Northern Oak Fern	S5	Secure	c		stream		x
Matteuccia struthiopteris	Ostrich Fern	S5	Secure	u		footprint	x	x
Onoclea sensibilis	Sensitive Fern	S5	Secure	c		footprint	x	x
Polystichum acrostichoides	Christmas Fern	S5	Secure	f		footprint	x	x
Taxaceae	**Yew Family**							
Taxus canadensis	Canadian Yew	S5	Secure	u		stream		x
Pinaceae	**Pine Family**							
Abies balsamea	Balsam Fir	S5	Secure	c		footprint	x	x
Picea glauca	White Spruce	S5	Secure	c		footprint	x	x
Picea rubens	Red Spruce	S5	Secure	c		footprint	x	
Pinus strobus	Eastern White Pine	S5	Secure	r		footprint	x	x
Tsuga canadensis	Eastern Hemlock	S4S5	Secure	f		log. rd.	x	x
Ranunculaceae	**Buttercup Family**							
Actaea rubra	Red Baneberry	S5	Secure	r		footprint	x	x
Coptis trifolia	Goldthread	S5	Secure	c		footprint	x	x
Ranunculus abortivus	Kidney-Leaved Buttercup	S4S5	Secure	r		stream	x	x
Ranunculus acris	Tall Butter-Cup	SNA	Exotic	f		footprint		x
Ranunculus repens	Creeping Butter-Cup	SNA	Exotic	c		footprint	x	x
Hamamelidaceae	**Witch-Hazel Family**							
Hamamelis virginiana	American Witch-Hazel	S5	Secure	r		stream	x	
Myricaceae	**Bayberry Family**							
Morella pensylvanica	Northern Bayberry	S5	Secure	r		footprint	x	x
Fagaceae	**Beech Family**							
Fagus grandifolia	American Beech	S5	Secure	c		footprint	x	x
Betulaceae	**Birch Family**							
Alnus incana ssp. rugosa	Speckled Alder	S5	Secure	r		roadside		x
Alnus viridis ssp. crispa	Green Alder	S5	Secure	c		footprint	x	x
Betula alleghaniensis	Yellow Birch	S5	Secure	c		footprint	x	x
Betula papyrifera var. cordifolia	Heart-Leaved Paper Birch	S5	Secure	r		log. rd.	x	x

Species / Family	Species / Family Common Name	S-rank	GS rank	Site Status	ID Note	Location	1	2
Betula papyrifera var. papyrifera	Heart-Leaved Paper Birch	S5	Secure	c		footprint	x	x
Betula populifolia	Gray Birch	S5	Secure	c		footprint	x	x
Betula x caerulea	a hybrid Birch [papyrifera X populifolia]	SNA	Not Assessed	r		footprint		x
Corylus cornuta	Beaked Hazelnut	S5	Secure	c		footprint	x	x
Ostrya virginiana	Eastern Hop-Hornbeam	S5	Secure	f		log. rd.	x	x
Caryophyllaceae	**Pink Family**							
Cerastium fontanum ssp. vulgare	Common Mouse-Ear Chickweed	SNA	Exotic	f		footprint	x	x
Sagina procumbens	Procumbent Pearlwort	S5	Exotic	r		log. rd.		x
Stellaria graminea	Little Starwort	SNA	Exotic	r		footprint	x	
Stellaria media	Common Starwort	SNA	Exotic	r		footprint	x	
Polygonaceae	**Smartweed Family**							
Polygonum cilinode	Fringed Black Bindweed	S5	Secure	r		footprint	x	x
Polygonum sagittatum	Arrow-Leaved Tearthumb	S5	Secure	r		footprint		x
Rumex acetosella	Sheep Sorrel	SNA	Exotic	c		footprint	x	x
Rumex obtusifolius	Bitter Dock	SNA	Exotic	r		log. rd.		x
Rumex sp.	Dock sp. (exotic)	[SNA]	[Exotic]	r	non-native Rumex sp.; looks like crispus x obtusifolius but could be another sp.	footprint		x
Clusiaceae	**St. John's-wort Family**							
Hypericum boreale	Northern St. John's-Wort	S5	Secure	r	ID probable only vs. H. mutilum	footprint		x
Hypericum canadense	Canadian St. John's-Wort	S5	Secure	r		stream	x	
Hypericum perforatum	A St. John's-Wort	SNA	Exotic	c		footprint	x	x
Triadenum fraseri	Marsh St. John's-Wort	S5	Secure	r		roadside	x	
Violaceae	**Violet Family**							
Viola blanda var. palustriformis	Large-Leaf White Violet	S5	Secure	f		footprint	x	x
Viola cucullata	Marsh Blue Violet	S5	Secure	c		footprint	x	x
Viola macloskeyi ssp. pallens	Smooth White Violet	S5	Secure	f		footprint	x	x
Viola sororia	Woolly Blue Violet	S5	Secure	f		footprint	x	x
Salicaceae	**Willow Family**							
Populus tremuloides	Quaking Aspen	S5	Secure	f		footprint	x	x
Salix bebbiana	Bebb's Willow	S5	Secure	c		footprint	x	x
Salix discolor	Pussy Willow	S5	Secure	r		footprint	x	
Salix eriocephala	Heart-Leaved Willow	S5	Secure	r		log. rd.	x	
Salix humilis	Prairie Willow	S5	Secure	u		footprint	x	
Brassicaceae	**Mustard Family**							
Cardamine diphylla	Two-Leaf Toothwort	S4	Secure	f		stream		x
Ericaceae	**Heath Family**							
Kalmia angustifolia	Sheep-Laurel	S5	Secure	r		stream		x
Vaccinium angustifolium	Late Lowbush Blueberry	S5	Secure	c		footprint	x	x
Vaccinium myrtilloides	Velvetleaf Blueberry	S5	Secure	f		footprint	x	
Pyrolaceae	**Pyrola Family**							

Species / Family	Species / Family Common Name	S-rank	GS rank	Site Status	ID Note	Location	1	2
Moneses uniflora	One-Flower Wintergreen	S5	Secure	r		stream		x
Pyrola elliptica	Shinleaf	S5	Secure	f		footprint	x	x
Monotropaceae	**Indian Pipe Family**							
Monotropa uniflora	Indian Pipe	S5	Secure	r		footprint	x	x
Primulaceae	**Primrose Family**							
Trientalis borealis	Northern Starflower	S5	Secure	c		footprint	x	x
Grossulariaceae	**Gooseberry Family**							
Ribes hirtellum	Smooth Gooseberry	S5	Secure	u		footprint	x	x
Saxifragaceae	**Saxifrage Family**							
Chrysosplenium americanum	American Golden-Saxifrage	S5	Secure	u		footprint	x	x
Mitella nuda	Naked Bishop's-Cap	S5	Secure	r		stream	x	
Rosaceae	**Rose Family**							
Agrimonia striata	Woodland Agrimony	S5	Secure	u		footprint	x	x
Amelanchier laevis	Allegheny Service-Berry	S5	4 Secure	r	ID probable only	footprint	x	x
Fragaria virginiana	Virginia Strawberry	S5	Secure	c		footprint	x	x
Geum macrophyllum	Large-Leaved Avens	S5	Secure	u		footprint	x	
Malus pumila	Common Apple	SNA	Exotic	u		footprint	x	x
Potentilla simplex	Old-Field Cinquefoil	S5	Secure	c		footprint	x	x
Prunus pensylvanica	Fire Cherry	S5	Secure	c		footprint	x	x
Prunus virginiana	Choke Cherry	S5	Secure	u		footprint	x	x
Rosa virginiana	Virginia Rose	S5	Secure	f		footprint	x	x
Rubus allegheniensis	Allegheny Blackberry	S5	Secure	r		log. rd.		x
Rubus canadensis	Smooth Blackberry	S5	Secure	c		footprint	x	x
Rubus idaeus ssp. strigosus	American Red Raspberry	S5	Secure	c		footprint	x	x
Rubus pubescens	Dwarf Red Raspberry	S5	Secure	c		footprint	x	x
Sorbus americana	American Mountain-Ash	S5	Secure	u		footprint		x
Sorbus aucuparia	European Mountain-Ash	SNA	Exotic	r		roadside		x
Sorbus decora	Northern Mountain-Ash	S4	Secure	r		footprint	x	
Spiraea alba var. latifolia	Northern Meadow-Sweet	S5	Secure	c		footprint	x	x
Spiraea tomentosa	Hardhack Spiraea	S5	Secure	r		footprint	x	x
Fabaceae	**Bean Family**							
Lotus corniculatus	Birds-Foot Trefoil	SNA	Exotic	r		roadside	x	
Melilotus albus	White Sweetclover	SNA	Exotic	r		roadside	x	
Trifolium pratense	Red Clover	SNA	Exotic	u		footprint	x	x
Trifolium repens	White Clover	SNA	Exotic	f		footprint	x	x
Vicia cracca	Tufted Vetch	SNA	Exotic	c		footprint	x	x
Onagraceae	**Evening-Primrose Family**							
Chamerion angustifolium	Fireweed	S5	Secure	f		footprint	x	x
Circaea alpina	Small Enchanter's Nightshade	S5	Secure	r		stream		x
Epilobium ciliatum	Hairy Willow-Herb	S5	Secure	f		footprint	x	x
Epilobium leptophyllum	Linear-Leaved Willow-Herb	S5	Secure	r		footprint	x	x
Epilobium palustre	Marsh Willow-Herb	S5	Secure	r	ID probable vs. leptophyllum (very small individual)	log. rd.	x	
Oenothera perennis	Small Sundrops	S5	Secure	f		footprint	x	x

Species / Family	Species / Family Common Name	S-rank	GS rank	Site Status	ID Note	Location	1	2
Oenothera sp. (biennis / parviflora)	evening-primrose sp.	[native]	[Secure]	r		footprint	x	
Cornaceae	**Dogwood Family**							
Cornus alternifolia	Alternate-Leaf Dogwood	S5	Secure	c		footprint	x	x
Cornus canadensis	Dwarf Dogwood	S5	Secure	c		footprint	x	x
Cornus sericea	Red-Osier Dogwood	S5	Secure	f		footprint	x	x
Aquifoliaceae	**Holly Family**							
Nemopanthus mucronatus	Mountain Holly	S5	Secure	u		footprint	x	
Aceraceae	**Maple Family**							
Acer pensylvanicum	Striped Maple	S5	Secure	c		footprint	x	x
Acer rubrum	Red Maple	S5	Secure	c		footprint	x	x
Acer saccharum	Sugar Maple	S5	Secure	c		footprint	x	x
Acer spicatum	Mountain Maple	S5	Secure	f		footprint	x	x
Oxalidaceae	**Wood-Sorrel Family**							
Oxalis montana	White Wood-Sorrel	S5	Secure	f		stream	x	x
Oxalis stricta	Upright Yellow Wood-Sorrel	S5	Secure	r		footprint		x
Geraniaceae	**Geranium Family**							
Geranium robertianum	Herb-Robert	S4	Secure	r		stream	x	
Balsaminaceae	**Touch-Me-Not Family**							
Impatiens capensis	Spotted Jewel-Weed	S5	Secure	c		footprint	x	x
Araliaceae	**Sarsaparilla Family**							
Aralia hispida	Bristly Sarsaparilla	S5	Secure	r		footprint	x	x
Aralia nudicaulis	Wild Sarsaparilla	S5	Secure	c		footprint	x	x
Apiaceae	**Carrot Family**							
Cicuta maculata	Spotted Water-Hemlock	S5	Secure	r		stream	x	x
Daucus carota	Wild Carrot	SNA	Exotic	r		footprint	x	x
Hydrocotyle americana	American Water-Pennywort	S5	Secure	c		footprint	x	x
Solanaceae	**Nightshade Family**							
Solanum dulcamara	Climbing Nightshade	SNA	Exotic	r		stream		x
Boraginaceae	**Borage Family**							
Myosotis laxa	Small Forget-Me-Not	S5	Secure	r		stream		x
Lamiaceae	**Mint Family**							
Clinopodium vulgare	Field Basil	S5	Secure	u		log. rd.	x	
Galeopsis tetrahit	Brittle-Stem Hempnettle	SNA	Exotic	c		footprint	x	x
Lycopus americanus	American Bugleweed	S5	Secure	u		footprint		x
Lycopus uniflorus	Northern Bugleweed	S5	Secure	c		footprint	x	x
Mentha spicata	Spearmint	SNA	Exotic	u	ID uncertain; possibly a hybrid involving M. spicata	footprint	x	
Prunella vulgaris	Self-Heal	S5	Secure	f		footprint	x	x
Plantaginaceae	**Plantain Family**							
Plantago lanceolata	English Plantain	SNA	Exotic	c		footprint	x	x
Plantago major	Nipple-Seed Plantain	SNA	Exotic	c		footprint	x	x
Oleaceae	**Olive Family**							
Fraxinus americana	White Ash	S5	Secure	c		footprint	x	x
Scrophulariaceae	**Snapdragon Family**							
Chelone glabra	White Turtlehead	S5	Secure	u		footprint	x	x

Species / Family	Species / Family Common Name	S-rank	GS rank	Site Status	ID Note	Location	1	2
Euphrasia sp.	eyebright sp.	[origin undet.]	[Secure]	f		footprint	x	x
Rhinanthus minor	Little Yellow-Rattle	S5	Secure	f		footprint	x	x
Veronica officinalis	Gypsy-Weed	S5	Exotic	c		footprint	x	x
Veronica serpyllifolia ssp. serpyllifolia	Thyme-Leaved Speedwell	SNA	Exotic	r		footprint		x
Campanulaceae	**Bellflower Family**							
Lobelia inflata	Indian-Tobacco	S5	Secure	r		log. rd.	x	
Rubiaceae	**Bedstraw Family**							
Galium asprellum	Rough Bedstraw	S5	Secure	c		footprint	x	x
Galium palustre	Marsh Bedstraw	S5	Secure	c		footprint	x	x
Galium trifidum	Small Bedstraw	S5	Secure	r	ID refers to the species in the broad sense	roadside	x	
Galium triflorum	Sweet-Scent Bedstraw	S5	Secure	r		stream	x	x
Mitchella repens	Partridge-Berry	S5	Secure	u		footprint	x	x
Caprifoliaceae	**Honeysuckle Family**							
Linnaea borealis	Twinflower	S5	Secure	r		log. rd.		x
Lonicera canadensis	American Fly-Honeysuckle	S5	Secure	c		footprint	x	x
Sambucus racemosa	Red Elderberry	S5	Secure	c		footprint	x	x
Viburnum lantanoides	Alderleaf Viburnum	S5	Secure	u		stream	x	x
Viburnum nudum var. cassinoides	Wild Raisin	S5	Secure	f		footprint	x	x
Asteraceae	**Aster Family**							
Achillea millefolium	Common Yarrow	S5	Secure	c		footprint	x	x
Anaphalis margaritacea	Pearly Everlasting	S5	Secure	c		footprint	x	x
Antennaria howellii	Small Pussytoes	S4?	Secure	r	ID probable	roadside	x	
Arctium minus	Lesser Burdock	SNA	Exotic	r		stream	x	
Bidens cernua	Nodding Beggar-Ticks	S5	Secure	r		roadside	x	
Centaurea cyanus	Corn-Flower	SNA	Exotic	r		roadside		x
Centaurea nigra	Black Starthistle	SNA	Exotic	c		footprint	x	x
Cirsium arvense	Creeping Thistle	SNA	Exotic	r		footprint	x	
Doellingeria umbellata	Parasol White-Top	S5	Secure	c		footprint	x	x
Erigeron strigosus	Daisy Fleabane	S5	Secure	r		footprint	x	x
Eupatorium maculatum	Spotted Joe-Pye Weed	S5	Secure	u		footprint	x	x
Eupatorium perfoliatum	Common Boneset	S5	Secure	f		footprint		x
Euthamia graminifolia	Flat-Top Fragrant-Golden-Rod	S5	Secure	c		footprint	x	x
Hieracium aurantiacum	Orange Hawkweed	SNA	Exotic	c	H. caespitosum likely also present but not flowering, so not identifiable	footprint	x	x
Hieracium canadense	Canada Hawkweed	S4S5	Secure	r	ID refers to the species in the broad sense	footprint	x	
Hieracium lachenalii	Common Hawkweed	SNA	Exotic	c		footprint	x	x
Hieracium pilosella	Mouseear	SNA	Exotic	c		footprint	x	x
Hieracium piloselloides	Tall Hawkweed	SNA	Exotic	u	ID probable	footprint	*x*	y
Hieracium scabrum	Rough Hawkweed	S5	Secure	r		footprint	x	
Hieracium sp.	hawkweed sp. (leafy stem with basal rosette)	SNA	Exotic	r	possibly Hieracium sabaudum	footprint	x	
Hieracium x floribundum	Smoothish Hawkweed	SNA	Exotic	c	ID probable only to sp.	footprint	x	x
Lactuca biennis	Tall Blue Lettuce	S5	Secure	f		footprint	x	x

Species / Family	Species / Family Common Name	S-rank	GS rank	Site Status	ID Note	Location	1	2
Lactuca canadensis	Canada Lettuce	S5	Secure	f		footprint	x	x
Leontodon autumnalis	Autumn Hawkbit	SNA	Exotic	r		footprint	x	
Leucanthemum vulgare	Oxeye Daisy	SNA	Exotic	r		footprint	x	
Matricaria discoidea	Pineapple-Weed Chamomile	SNA	Exotic	r		footprint	x	x
Oclemena acuminata	Whorled Aster	S5	Secure	c		footprint	x	x
Omalotheca sylvatica	Woodland Cudweed	S4S5	Secure	f		footprint	x	
Prenanthes altissima	Tall Rattlesnake-root	S5	Secure	c		footprint	x	x
Senecio jacobaea	Tansy Ragwort	SNA	Exotic	r		footprint	x	x
Solidago canadensis	Canada Goldenrod	S5	Secure	c		footprint	x	x
Solidago flexicaulis	Broad-Leaved Goldenrod	S5	Secure	f		footprint	x	x
Solidago gigantea	Smooth Goldenrod	S5	Secure	r		footprint		x
Solidago juncea	Early Goldenrod	S5	Secure	u		footprint	x	x
Solidago puberula	Downy Goldenrod	S5	Secure	c		footprint	x	x
Solidago rugosa	Rough-Leaf Goldenrod	S5	Secure	c		footprint	x	x
Solidago uliginosa	Bog Goldenrod	S5	Secure	r		footprint	x	x
Sonchus arvensis	Field Sowthistle	SNA	Exotic	r		log. rd.	x	x
Symphyotrichum lateriflorum	Farewell-Summer	S5	Secure	c		footprint	x	x
Symphyotrichum novi-belgii	New Belgium American-Aster	S5	Secure	c		footprint	x	x
Symphyotrichum puniceum	Swamp Aster	S5	Secure	f		footprint	x	x
Taraxacum officinale	Common Dandelion	SNA	Exotic	c		footprint	x	x
Tussilago farfara	Colt's Foot	SNA	Exotic	c		footprint	x	x
Juncaceae	**Rush Family**							
Juncus articulatus	Jointed Rush	S5	Secure	r		log. rd.	x	
Juncus brevicaudatus	Narrow-Panicled Rush	S5	Secure	r		log. rd.	x	
Juncus effusus	Soft Rush	S5	Secure	c		footprint	x	x
Juncus tenuis	Slender Rush	S5	Secure	f		footprint	x	x
Luzula acuminata	Hairy Woodrush	S5	Secure	r		stream	x	x
Luzula multiflora	Common Woodrush	S5	Secure	c		footprint	x	x
Cyperaceae	**Sedge Family**							
Carex arctata	Black Sedge	S5	Secure	c		footprint	x	x
Carex brunnescens ssp. sphaerostachya	Brownish Sedge	S5	Secure	c		footprint	x	x
Carex canescens	Hoary Sedge	S5	Secure	r		roadside	x	
Carex communis	Fibrous-Root Sedge	S5	Secure	c		footprint	x	x
Carex debilis var. rudgei	White-Edge Sedge	S5	Secure	c		footprint	x	x
Carex deweyana	Short-Scale Sedge	S5	Secure	f		footprint		x
Carex flava	Yellow Sedge	S5	Secure	r		footprint		x
Carex gynandra	A Sedge	S5	Secure	c		footprint	x	x
Carex interior	Inland Sedge	S4S5	Secure	r		log. rd.		x
Carex intumescens	Bladder Sedge	S5	Secure	r		stream		x
Carex leptalea	Bristly-Stalk Sedge	S5	Secure	f		footprint		x
Carex leptonervia	Finely-Nerved Sedge	S5	Secure	u-f		footprint		x
Carex lurida	Shallow Sedge	S5	Secure	r		log. rd.	x	
Carex nigra	Black Sedge	S5	Secure	u		footprint	x	x
Carex novae-angliae	New England Sedge	S5	Secure	c		footprint	x	x
Carex pallescens	Pale Sedge	S5	Secure	f		footprint		x
Carex panicea	A Sedge	SNA	Exotic	u		footprint	x	x
Carex scabrata	Rough Sedge	S5	Secure	f		footprint	x	x

Species / Family	Species / Family Common Name	S-rank	GS rank	Site Status	ID Note	Location	1	2
Carex scoparia	Pointed Broom Sedge	S5	Secure	f		footprint	x	x
Carex stipata	Stalk-Grain Sedge	S5	Secure	r		log. rd.		x
Carex trisperma var. trisperma	Three-Seed Sedge	S5	Secure	r		stream	x	
Scirpus cyperinus	Cottongrass Bulrush	S5	Secure	c		footprint	x	x
Scirpus microcarpus	Small-Fruit Bulrush	S5	Secure	f		footprint		x
Poaceae	**Grass Family**							
Agrostis capillaris	Colonial Bentgrass	SNA	Exotic	c		footprint	x	
Agrostis gigantea	Black Bentgrass	SNA	Exotic	r		footprint	x	
Agrostis perennans	Perennial Bentgrass	S4S5	Secure	r	ID probable	stream	x	
Agrostis scabra	Rough Bentgrass	S5	Secure	r		roadside	x	
Anthoxanthum odoratum	Sweet Vernal Grass	SNA	Exotic	c		footprint	x	x
Calamagrostis canadensis	Blue-Joint Reedgrass	S5	Secure	r		footprint		x
Cinna latifolia	Slender Wood Reedgrass	S5	Secure	u		stream	x	x
Dactylis glomerata	Orchard Grass	SNA	Exotic	u		footprint	x	x
Danthonia spicata	Poverty Oat-Grass	S5	Secure	c		footprint	x	x
Dichanthelium acuminatum	Panic Grass	S5	Secure	c		footprint	x	x
Dichanthelium boreale	Northern Witchgrass	S5	Secure	r		log. rd.		x
Elymus repens	Quackgrass	SNA	Exotic	r		roadside	x	
Festuca filiformis	Hair Fescue	SNA	Exotic	c		footprint	x	x
Festuca rubra	Red Fescue	S5	Secure	f		footprint		x
Glyceria canadensis	Canada Manna-Grass	S5	Secure	r		roadside	x	
Glyceria striata	Fowl Manna-Grass	S5	Secure	c		footprint	x	x
Lolium arundinaceum	Tall Rye Grass	SNA	Exotic	r		roadside	x	
Panicum capillare	Old Witch Panic-Grass	SNA	Exotic	r		roadside	x	
Phleum pratense	Meadow Timothy	SNA	Exotic	c		footprint	x	x
Poa annua	Annual Bluegrass	SNA	Exotic	u		footprint	x	x
Poa compressa	Canada Bluegrass	SNA	Exotic	c		footprint	x	x
Poa palustris	Fowl Bluegrass	S5	Secure	r		footprint	x	
Poa pratensis	Kentucky Bluegrass	S5	Secure	c		footprint	x	x
Sparganiaceae	**Bur-Reed Family**							
Sparganium sp.	bur-reed sp.	[native]	[Secure]	r		roadside	x	
Typhaceae	**Cattail Family**							
Typha latifolia	Broad-Leaf Cattail	S5	Secure	u		footprint	x	x
Liliaceae	**Lily Family**							
Clintonia borealis	Clinton Lily	S5	Secure	c		footprint	x	x
Maianthemum canadense	Wild Lily-of-The-Valley	S5	Secure	c		footprint	x	x
Maianthemum racemosum	Solomon's-Plume	S4S5	Secure	r		stream		x
Medeola virginiana	Indian Cucumber-Root	S5	Secure	u		stream	x	x
Polygonatum pubescens	Downy Solomon's-Seal	S4S5	Secure	f		footprint		x
Streptopus amplexifolius	Clasping Twisted-Stalk	S4S5	Secure	r		stream		x
Streptopus lanceolatus	Rosy Twistedstalk	S5	Secure	u		stream		x
Trillium cernuum	Nodding Trillium	S4	Secure	r	ID probable only vs. T. erectum	stream		x
Trillium undulatum	Painted Trillium	S5	Secure	r		stream		x
Iridaceae	**Iris Family**							
Iris versicolor	Blueflag	S5	Secure	f		footprint	x	x

Species / Family	Species / Family Common Name	S-rank	GS rank	Site Status	ID Note	Location	1	2
Sisyrinchium montanum	Strict Blue-Eyed-Grass	S5	Secure	c		footprint	x	x
Orchidaceae	**Orchid Family**							
Corallorhiza maculata	Spotted Coralroot	S4	Secure	r		stream		x
Corallorhiza trifida	Early Coralroot	S3	Secure	r		stream	x	
Cypripedium acaule	Pink Lady's-Slipper	S5	Secure	f		footprint		x
Platanthera clavellata	Small Green Woodland Orchid	S5	Secure	r		roadside	x	
Platanthera hookeri	Hooker Orchis	S3	Secure	r	ID probable only vs. P. orbiculata - small, vegetative specimens	stream		x
Platanthera lacera	Green-Fringe Orchis	S4S5	Secure	r		log. rd.	x	
Platanthera psycodes	Small Purple-Fringe Orchis	S4	Secure	c		footprint		x

Figure 2. Two views from the proposed site of Turbine 1 (the northern of the two proposed turbines).

Figure 3. Two views from the proposed site of Turbine 2 (the southern of the two proposed turbines).

A vascular plant inventory of the proposed wind turbine site, Fairmont, Nova Scotia with notes on plant communities


View from northern turbine site at margin of regenerating cut-over and intermediate-aged hardwood stand

October 30, 2010

Conducted by Sean Blaney

for Andy MacCallum, Wind Prospect Inc.

METHODS

Vascular Plant Inventory

Fieldwork was conducted by Sean Blaney on October 22, 2010. I covered all areas proposed for development in the current site plan. These were: i) the ~215 m new road segment proposed between the Fairmont Road and the landowner's existing private access road, ii) the 600 m of existing access road which is proposed for widening and upgrading, and iii) the two turbine sites and their short (~60-70 m), proposed access roads branching off the main access road. Site coverage was on foot and all portions of the above were covered at least twice, with one segment of the existing access road covered four times.

In order to increase total diversity of species recorded, and to provide an idea of what species might have been missed within the proposed development footprint because of the late date of the site survey, I extended site coverage beyond the areas proposed for development. Aerial photographs of the site showed that the only concentration of mature forest on the property in question was along the streambed running south of the proposed development footprint and the associated steep slopes of the stream valley. I thus added extra coverage along the stream bed in the vicinity of the point where the proposed access road crosses the stream (extending 200 m downstream and about 50 m upstream), as well as more extensive coverage of the higher quality forested valley to the southwest of the turbine sites. To reach that area, I followed the existing access road 500 m southwestward (downslope) beyond the northern turbine site to the stream bed, followed the streambed upstream for 500 m, and then followed a smaller tributary streambed upslope for 300 m back to the main access road. I also covered 500 m of roadside habitat along Fairmont Road, north of the point where the proposed new access road branched off to the west.

I recorded the track taken in the field with a GPS unit set to record position approximately every 15 seconds while moving (the "more often" track recording setting on a Garmin GPS 76Cx unit). I pre-programmed the proposed turbine sites into the GPS unit before fieldwork and at each turbine site I took photographs and recorded notes on species composition, stand age of forested sites and any obvious disturbance history of the plant community present. I compiled a full vascular plant list for the site as a whole, with estimates of species' relative abundance as follows: *rare* – seen in in 2 or fewer locations; *uncommon* – seen in small numbers in several locations; fairly common – seen in approximately five locations, generally in small numbers; common – seen at more than five locations (estimated). These categories are not intended to represent precise descriptions of abundance but do provide some measure of relative abundance.

For plant species tracked by the Atlantic Canada Conservation Data Centre (those ranked S1, S2, S3 or S3S4 in Nova Scotia, for which all locations are databased), I recorded GPS locations along with habitat descriptions and more detailed estimates of local abundance.

Definitions for S-ranks and for Nova Scotia National General Status ranks (the primary ranks by which species' significance is determined by Nova Scotia Department of Natural Resources), are given below. Both sets of ranks for Nova Scotia were developed through the consensus of the NS Flora Ranking Committee, led through the cooperation of NS Department of Natural Resources (NS DNR) and Atlantic Canada Conservation Data Centre. The ranks reflect the best understanding of plant status at the time of ranking, but are subject to revision as new information becomes available.

<u>Definitions of provincial (subnational) ranks (S-ranks):</u>

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.
S2	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.
S4	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).

<u>Definitions of National General Status Ranks (from</u> *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

Results and Discussion

I. Site Coverage

I spent five hours and walked 6.1 km on site. GPS tracks of areas covered are mapped in Figure 1. Despite the late survey date, coverage for vascular plants is fairly complete. I covered all habitat types present within the proposed development footprint and with the extra coverage in areas not proposed to be impacted, the current species list likely represents approximately 80% of all vascular plant species that could be recorded in the development footprint area in a mid-summer survey. It impossible to know exactly what might be found in additional site visits, but based on extensive fieldwork in nearby sites in similar landscapes in the Ardness and Fitzpatrick Mountain areas (Blaney 2008a, 2008b), as well as extensive field experience throughout the Maritimes, I would not expect further surveys to reveal many provincially rare species within the development footprint. The provincially rare species that would be most likely to occur would be disturbance-associated ones, because there is almost no mature forest within the proposed development footprint and there are no rare habitat types that would be likely to support specialist rare plant species.

II. Plant Communities and Natural Heritage Values

Descriptions of the plant communities at the proposed turbine sites are given in Table 1. None of the plant communities within the proposed development footprint are rare or uncommon in Nova Scotia nor do they represent mature, high quality examples of provincially common plant communities. Almost all of the development footprint area has been heavily altered by human activities. The recently clearcut area along the proposed new access road (Figure 2) heading west off Fairmont Road appears to have been forest that regenerated following agricultural use (probably cattle pasturing) and at least some of the young forest habitat along the existing access road (Figure 3) has had a similar history, judging by the existence of apple trees and the composition of the roadside plant community. With the exception of a narrow band along the stream which is crossed by the proposed new access road (Figure 4), and a remnant stand just west of the North Turbine site (Figure 5), all of the forest within the proposed development footprint is either clearcut within the past 10 years (as is the case at the North Turbine site, Figure 5), or has regenerated from clearcutting in the past 20-40 years (as is the case at the South Turbine site (Figure 6). There are also several small clearings along the existing access road caused by small scale gravel extraction or forestry-related activities.

As noted above, the natural heritage value of the project area is not high. Nonetheless, some slight alterations to the site plan could reduce the proposed project's impacts on the site's natural heritage value. These could include:

1) Avoiding impacts on the remnant intermediate-aged deciduous forest stand immediately west of the North Turbine site, either by keeping the existing location and restricting turbine assembly to the clearcut area, or by a slight modification of the turbine location to allow more room for construction away from the remaining forest.
2) Moving the location of the South Turbine upslope slightly so that more of the turbine construction footprint falls within the already cleared area of the existing access road and associated disturbed ground.

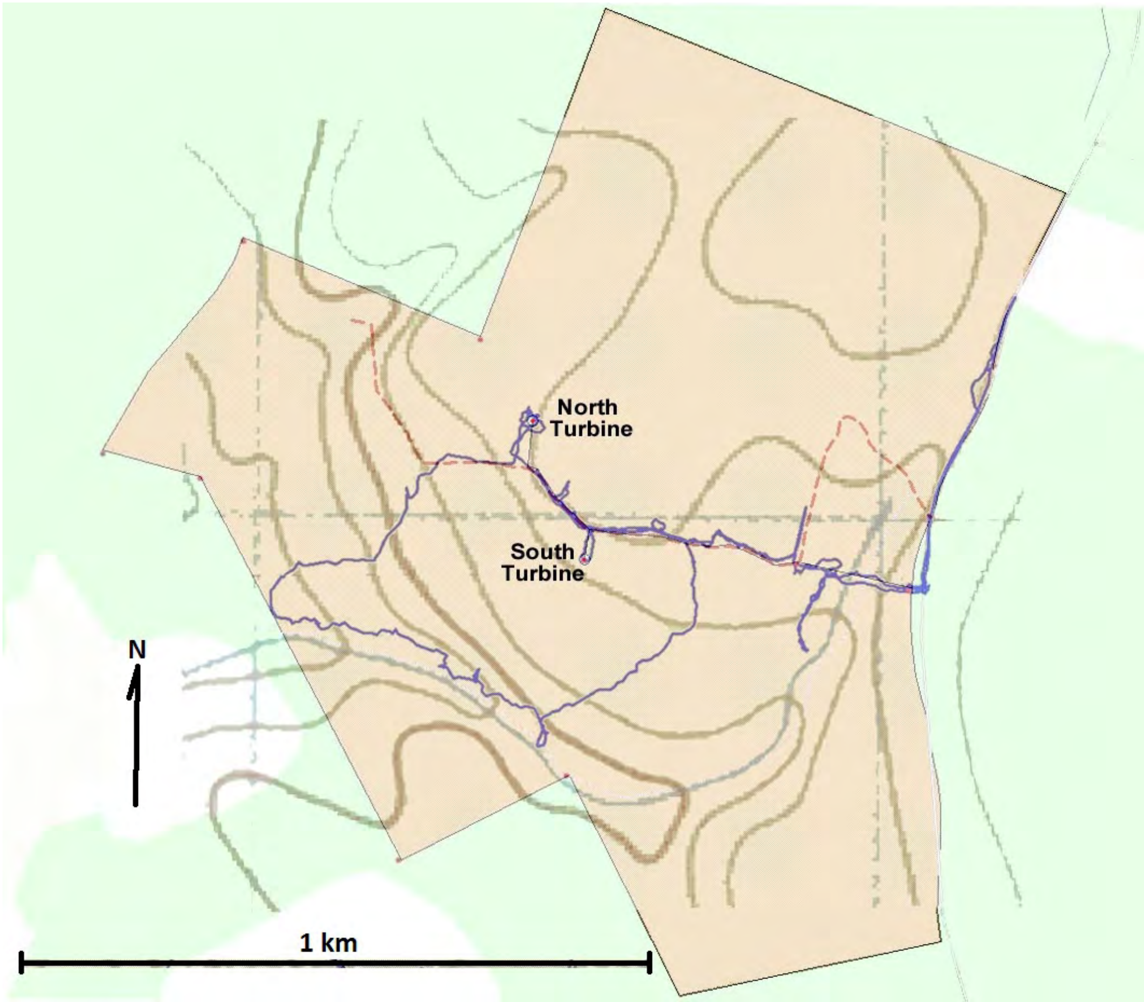

Figure 1. Map of on-foot site coverage during the October 24, 2010 survey, with proposed turbine locations and elevation contours within area of coverage. The dark blue line is the track recorded by GPS while on foot. The orange-shaded area marks the property boundary and the red dashed line is the existing access road.

Table 1. Community descriptions of proposed turbine sites. Sites match those mapped in Figure 1. Cover value percentages in are absolute values, whereas tree species composition percentages are relative to the total tree cover (i.e. 85% of the 35% tree cover at turbine X was balsam fir). The North Turbine community description includes both the clearcut in which the proposed turbine is located and the immediately adjacent intermediate-aged deciduous forest.

Tur-bine#	Stand Age	Community Description	Tree Composition	% Tree Cover	Tall Shrub/ Sapling Spp.	Tall Shrub/ Sapling % Cover	Low Shrub/ Seedling Spp.	Low Shrub/ Sapling % Cover	Herb Spp.	Herb % Cover
South	15-20	Regenerating clearcut – conifer-dominated mixed forest	Balsam fir 60%, red maple 20%, gray & white birch 10%, pin cherry & sugar maple 10%	75% (much barely above sapling size)	Balsam fir, red maple, gray & white birch, pin cherry & sugar maple	25%	*Rubus idaeus* ssp. *strigosus*, *Rubus canadensis*, balsam fir	15%	*Lycopodium annotinum*, *Lycopodium clavatum*, *Dennstaedtia punctilobula*, *Dryopteris intermedia*	5%
North	a) 5-10 b) 60 (+a few trees to 90+)	a) Slowly regenerating open clearcut b) Intermediate-aged sugar maple – beech – red maple forest	a) minimal tree cover b) sugar maple 40%, beech 40%, red maple 10%, yellow birch & balsam fir 10%	a) <2% b) 80%	a) balsam fir, gray birch, white birch, red maple b) balsam fir, beech, striped maple, yellow birch	a) 35% b) 15%	a) balsam fir, gray birch, white birch, *Rubus idaeus* ssp. *strigosus* b) balsam fir, beech, striped maple, yellow birch	a) 30% b) 10%	a) *Cornus canadensis*, *Danthonia spicata*, *Carex arctata*, *Carex debilis* var. *rudgei*, *Carex novae-angliae*, *Doellingeria umbellata*, *Solidago canadensis*, *Solidago rugosa*, *Euthamia graminifolia*, *Poa pratensis* b) *Dennstaedtia punctilobula*, *Dryopteris intermedia*, *Lycopodium dendroideum*, *Carex communis*, *Carex arctata*, *Carex novae-angliae*, *Oclemena acuminate*, *Cornus canandensis*, *Maianthemum canadense*	a) 80% b) 20%

III. Vascular Plants – Non-rare and Rare

Table 2 lists the 217 vascular plant taxa (171 native or potentially native, 46 exotic) identified during fieldwork, with estimates of their abundance within the site and their provincial status under both the S-rank system used continent-wide by all conservation data centres and the National General Status ranks, which have been developed by each province and territory. Of the above 217 taxa, 156 taxa (121 native or potentially native, 35 exotic) were found within the proposed development footprint and 61 taxa (50 native, 11 exotic) were found only in areas outside the development footprint (the roadside along Fairmont Road, the access road south and west of the north turbine site or along the stream south and west of the turbine sites. The species observed only outside the proposed development footprint are identified in Table 2.

None of the observed vascular plants were of concern under the NS DNR General Status ranks. One observed species, Early Coralroot (*Corallorhiza trifida*) was of concern based on AC CDC status ranks, with a marginally rare rank of S3 and a provincial General Status rank of Secure. This species was observed at two locations in seepy, mossy microsites within floodplain forest along the stream in the southwest corner of the property, well away from proposed construction impacts. The nearest proposed impact was the access road to the North turbine site, 350-450 m away. Similar habitats were only present within the proposed development footprint near the stream crossing of the proposed new access road. Early Coralroot can also sometimes occur in young, dense conifer forest as occurred in places along the existing access road, although in my experience this is more likely on highly calcareous bedrock. Aside from the relatively minor concern presented by the Early Coralroot, no other vascular plant species of conservation concern were noted.

Table 2. Vascular plants recorded in the study area, with abundance estimates and provincial status ranks. Site Status codes and provincial S-ranks are defined above. Taxonomy follows Kartesz (1999) – *Synthesis of the North American Flora*, CD-ROM. Status ranks in square brackets refer to an indefinite identification for which all potential species have the same rank.

Species / Family	Common Name	S-rank	GS rank	Site Status	ID Note	Location
Lycopodiaceae	**Clubmoss Family**					
Huperzia lucidula	Shining Fir-Clubmoss	S5	Secure	r		stream
Lycopodium annotinum	Stiff Clubmoss	S5	Secure	f		within footprint
Lycopodium dendroideum	Treelike Clubmoss	S5	Secure	u		within footprint
Lycopodium lagopus	One-Cone Gound-Pine	S4	Secure	u		within footprint
Equisetaceae	**Horsetail Family**					
Equisetum arvense	Field Horsetail	S5	Secure	r		stream
Osmundaceae	**Flowering Fern Family**					
Osmunda cinnamomea	Cinnamon Fern	S5	Secure	c		within footprint
Osmunda claytoniana	Interrupted Fern	S5	Secure	r		stream
Dennstaedtiaceae	**Hay-Scented Fern Family**					
Dennstaedtia punctilobula	Eastern Hay-Scented Fern	S5	Secure	c		within footprint

Species / Family	Common Name	S-rank	GS rank	Site Status	ID Note	Location
Pteridium aquilinum	Bracken Fern	S5	Secure	r		logging road
Thelypteridaceae	**Marsh-Fern Family**					
Phegopteris connectilis	Northern Beech Fern	S5	Secure	r		logging road
Thelypteris noveboracensis	New York Fern	S5	Secure	c		within footprint
Dryopteridaceae	**Wood-Fern Family**					
Athyrium filix-femina	Lady-Fern	S5	Secure	c		within footprint
Deparia acrostichoides	Silvery Spleenwort	S4	Secure	r		stream
Dryopteris campyloptera	Mountain Wood-Fern	S5	Secure	r		within footprint
Dryopteris cristata	Crested Shield-Fern	S5	Secure	r		within footprint
Dryopteris intermedia	Evergreen Woodfern	S5	Secure	c		within footprint
Matteuccia struthiopteris	Ostrich Fern	S5	Secure	u		within footprint
Onoclea sensibilis	Sensitive Fern	S5	Secure	f		within footprint
Polystichum acrostichoides	Christmas Fern	S5	Secure	u		within footprint
Pinaceae	**Pine Family**					
Abies balsamea	Balsam Fir	S5	Secure	c		within footprint
Picea glauca	White Spruce	S5	Secure	c		within footprint
Picea rubens	Red Spruce	S5	Secure	c		within footprint
Pinus strobus	Eastern White Pine	S5	Secure	r		within footprint
Tsuga canadensis	Eastern Hemlock	S4S5	Secure	f		logging road
Ranunculaceae	**Buttercup Family**					
Actaea rubra	Red Baneberry	S5	Secure	r		within footprint
Coptis trifolia	Goldthread	S5	Secure	c		within footprint
Ranunculus abortivus	Kidney-Leaved Buttercup	S4S5	Secure	r		stream
Ranunculus repens	Creeping Butter-Cup	SNA (Exotic)	Exotic	c		within footprint
Hamamelidaceae	**Witch-Hazel Family**					
Hamamelis virginiana	American Witch-Hazel	S5	Secure	r		stream
Myricaceae	**Bayberry Family**					
Morella pensylvanica	Northern Bayberry	S5	Secure	r		within footprint
Fagaceae	**Beech Family**					
Fagus grandifolia	American Beech	S5	Secure	c		within footprint
Betulaceae	**Birch Family**					
Alnus viridis ssp. crispa	Green Alder	S5	Secure	u		roadside
Betula alleghaniensis	Yellow Birch	S5	Secure	c		within footprint
Betula papyrifera var. cordifolia	Heart-Leaved Paper Birch	S5	Secure	r		logging road
Betula papyrifera var. papyrifera	Heart-Leaved Paper Birch	S5	Secure	c		within footprint
Betula populifolia	Gray Birch	S5	Secure	c		within footprint
Corylus cornuta	Beaked Hazelnut	S5	Secure	c		within footprint
Ostrya virginiana	Eastern Hop-Hornbeam	S5	Secure	f		logging road
Caryophyllaceae	**Pink Family**					
Cerastium fontanum ssp. vulgare	Common Mouse-Ear Chickweed	SNA (Exotic)	Exotic	r		logging road
Stellaria graminea	Little Starwort	SNA (Exotic)	Exotic	r		within footprint
Stellaria media	Common Starwort	SNA (Exotic)	Exotic	r		within footprint
Polygonaceae	**Smartweed Family**					
Polygonum cilinode	Fringed Black Bindweed	S5	Secure	r		within footprint
Rumex acetosella	Sheep Sorrel	SNA (Exotic)	Exotic	u		within footprint
Clusiaceae	**St. John's-wort Family**					

Species / Family	Common Name	S-rank	GS rank	Site Status	ID Note	Location
Hypericum canadense	Canadian St. John's-Wort	S5	Secure	r		stream
Hypericum perforatum	A St. John's-Wort	SNA (Exotic)	Exotic	c		within footprint
Triadenum fraseri	Marsh St. John's-Wort	S5	Secure	r		roadside
Violaceae	**Violet Family**					
Viola blanda var. palustriformis	Large-Leaf White Violet	S5	Secure	f		within footprint
Viola cucullata	Marsh Blue Violet	S5	Secure	f		within footprint
Viola macloskeyi	Smooth White Violet	S5	Secure	r		logging road
Viola sororia	Woolly Blue Violet	S5	Secure	f		within footprint
Salicaceae	**Willow Family**					
Populus tremuloides	Quaking Aspen	S5	Secure	u		within footprint
Salix bebbiana	Bebb's Willow	S5	Secure	u		within footprint
Salix discolor	Pussy Willow	S5	Secure	r		within footprint
Salix eriocephala	Heart-Leaved Willow	S5	Secure	r		logging road
Salix humilis	Prairie Willow	S5	Secure	u		within footprint
Ericaceae	**Heath Family**					
Vaccinium angustifolium	Late Lowbush Blueberry	S5	Secure	f		within footprint
Vaccinium myrtilloides	Velvetleaf Blueberry	S5	Secure	f		within footprint
Pyrolaceae	**Pyrola Family**					
Pyrola elliptica	Shinleaf	S5	Secure	r		within footprint
Monotropaceae	**Indian Pipe Family**					
Monotropa uniflora	Indian Pipe	S5	Secure	r		within footprint
Primulaceae	**Primrose Family**					
Trientalis borealis	Northern Starflower	S5	Secure	f		within footprint
Grossulariaceae	**Gooseberry Family**					
Ribes hirtellum	Smooth Gooseberry	S5	Secure	r		within footprint
Saxifragaceae	**Saxifrage Family**					
Chrysosplenium americanum	American Golden-Saxifrage	S5	Secure	u		within footprint
Mitella nuda	Naked Bishop's-Cap	S5	Secure	r		stream
Rosaceae	**Rose Family**					
Agrimonia striata	Woodland Agrimony	S5	Secure	r		within footprint
Amelanchier sp.	serviceberry sp.	[native]		f		within footprint
Fragaria virginiana	Virginia Strawberry	S5	Secure	c		within footprint
Geum macrophyllum	Large-Leaved Avens	S5	Secure	u		within footprint
Malus pumila	Common Apple	SNA (Exotic)	Exotic	u		within footprint
Potentilla simplex	Old-Field Cinquefoil	S5	Secure	c		within footprint
Prunus pensylvanica	Fire Cherry	S5	Secure	c		within footprint
Prunus virginiana	Choke Cherry	S5	Secure	r		within footprint
Rosa virginiana	Virginia Rose	S5	Secure	f		within footprint
Rubus canadensis	Smooth Blackberry	S5	Secure	c		within footprint
Rubus idaeus ssp. strigosus	American Red Raspberry	S5	Secure	c		within footprint
Rubus pubescens	Dwarf Red Raspberry	S5	Secure	c		within footprint
Sorbus decora	Northern Mountain-Ash	S4	Secure	r		within footprint
Spiraea alba var. latifolia	Northern Meadow-Sweet	S5	Secure	f		within footprint
Spiraea tomentosa	Hardhack Spiraea	S5	Secure	r		within footprint
Fabaceae	**Bean Family**					
Lotus corniculatus	Birds-Foot Trefoil	SNA (Exotic)	Exotic	r		roadside
Melilotus albus	White Sweetclover	SNA (Exotic)	Exotic	r		roadside

Species / Family	Common Name	S-rank	GS rank	Site Status	ID Note	Location
Trifolium pratense	Red Clover	SNA (Exotic)	Exotic	u		within footprint
Trifolium repens	White Clover	SNA (Exotic)	Exotic	f		within footprint
Vicia cracca	Tufted Vetch	SNA (Exotic)	Exotic	r		roadside
Onagraceae	**Evening-Primrose Family**					
Chamerion angustifolium	Fireweed	S5	Secure	f		within footprint
Epilobium ciliatum	Hairy Willow-Herb	S5	Secure	r		within footprint
Epilobium leptophyllum	Linear-Leaved Willow-Herb	S5	Secure	r		roadside
Epilobium palustre	Marsh Willow-Herb	S5	Secure	r	ID probable vs. leptophyllum (very small individual)	logging road
Oenothera perennis	Small Sundrops	S5	Secure	r		logging road
Oenothera sp. (biennis / parviflora)	evening-primrose sp.	[native]	[Secure]	r		within footprint
Cornaceae	**Dogwood Family**					
Cornus alternifolia	Alternate-Leaf Dogwood	S5	Secure	u		within footprint
Cornus canadensis	Dwarf Dogwood	S5	Secure	c		within footprint
Cornus sericea	Red-Osier Dogwood	S5	Secure	f		within footprint
Aquifoliaceae	**Holly Family**					
Nemopanthus mucronatus	Mountain Holly	S5	Secure	u		within footprint
Aceraceae	**Maple Family**					
Acer pensylvanicum	Striped Maple	S5	Secure	c		within footprint
Acer rubrum	Red Maple	S5	Secure	c		within footprint
Acer saccharum	Sugar Maple	S5	Secure	c		within footprint
Acer spicatum	Mountain Maple	S5	Secure	f		within footprint
Oxalidaceae	**Wood-Sorrel Family**					
Oxalis montana	White Wood-Sorrel	S5	Secure	u		stream
Geraniaceae	**Geranium Family**					
Geranium robertianum	Herb-Robert	S4	Secure	r		stream
Balsaminaceae	**Touch-Me-Not Family**					
Impatiens capensis	Spotted Jewel-Weed	S5	Secure	r		within footprint
Araliaceae	**Sarsaparilla Family**					
Aralia hispida	Bristly Sarsaparilla	S5	Secure	r		within footprint
Aralia nudicaulis	Wild Sarsaparilla	S5	Secure	r		within footprint
Apiaceae	**Carrot Family**					
Cicuta maculata	Spotted Water-Hemlock	S5	Secure	r		stream
Daucus carota	Wild Carrot	SNA (Exotic)	Exotic	r		logging road
Hydrocotyle americana	American Water-Pennywort	S5	Secure	f		within footprint
Lamiaceae	**Mint Family**					
Clinopodium vulgare	Field Basil	S5	Secure	u		logging road
Galeopsis tetrahit	Brittle-Stem Hempnettle	SNA (Exotic)	Exotic	r		within footprint
Lycopus uniflorus	Northern Bugleweed	S5	Secure	u		within footprint
Mentha spicata	Spearmint	SNA (Exotic)	Exotic	u	ID uncertain; possibly a hybrid involving M. spicata	within footprint
Prunella vulgaris	Self-Heal	S5	Secure	u		within footprint
Plantaginaceae	**Plantain Family**					

Species / Family	Common Name	S-rank	GS rank	Site Status	ID Note	Location
Plantago lanceolata	English Plantain	SNA (Exotic)	Exotic	r		within footprint
Plantago major	Nipple-Seed Plantain	SNA (Exotic)	Exotic	c		within footprint
Oleaceae	**Olive Family**					
Fraxinus americana	White Ash	S5	Secure	c		within footprint
Scrophulariaceae	**Snapdragon Family**					
Chelone glabra	White Turtlehead	S5	Secure	u		within footprint
Euphrasia sp.	eyebright sp.	[origin undet.]	[Secure]	f		within footprint
Rhinanthus minor	Little Yellow-Rattle	S5	Secure	r		within footprint
Veronica officinalis	Gypsy-Weed	S5	Exotic	u		within footprint
Campanulaceae	**Bellflower Family**					
Lobelia inflata	Indian-Tobacco	S5	Secure	r		logging road
Rubiaceae	**Bedstraw Family**					
Galium asprellum	Rough Bedstraw	S5	Secure	u		within footprint
Galium palustre	Marsh Bedstraw	S5	Secure	f		within footprint
Galium trifidum	Small Bedstraw	S5	Secure	r	ID refers to the species in the broad sense	roadside
Galium triflorum	Sweet-Scent Bedstraw	S5	Secure	r		stream
Mitchella repens	Partridge-Berry	S5	Secure	u		within footprint
Caprifoliaceae	**Honeysuckle Family**					
Lonicera canadensis	American Fly-Honeysuckle	S5	Secure	c		within footprint
Sambucus racemosa	Red Elderberry	S5	Secure	c		within footprint
Viburnum lantanoides	Alderleaf Viburnum	S5	Secure	u		stream
Viburnum nudum var. cassinoides	Wild Raisin	S5	Secure	f		within footprint
Asteraceae	**Aster Family**					
Achillea millefolium	Common Yarrow	S5	Secure	f		within footprint
Anaphalis margaritacea	Pearly Everlasting	S5	Secure	c		within footprint
Antennaria howellii	Small Pussytoes	S4?	Secure	r	ID probable	roadside
Arctium minus	Lesser Burdock	SNA (Exotic)	Exotic	r		stream
Bidens cernua	Nodding Beggar-Ticks	S5	Secure	r		roadside
Centaurea nigra	Black Starthistle	SNA (Exotic)	Exotic	f		within footprint
Cirsium arvense	Creeping Thistle	SNA (Exotic)	Exotic	r		within footprint
Doellingeria umbellata	Parasol White-Top	S5	Secure	c		within footprint
Erigeron strigosus	Daisy Fleabane	S5	Secure	r		roadside
Eupatorium maculatum	Spotted Joe-Pye Weed	S5	Secure	u		within footprint
Euthamia graminifolia	Flat-Top Fragrant-Golden-Rod	S5	Secure	f		within footprint
Hieracium canadense	Canada Hawkweed	S4S5	Secure	r	ID refers to the species in the broad sense	within footprint
Hieracium lachenalii	Common Hawkweed	SNA (Exotic)	Exotic	c		within footprint
Hieracium pilosella	Mouseear	SNA (Exotic)	Exotic	f	or x flagellare	within footprint
Hieracium piloselloides	Tall Hawkweed	SNA (Exotic)	Exotic	u	ID probable	within footprint
Hieracium scabrum	Rough Hawkweed	S5	Secure	r		within footprint

Species / Family	Common Name	S-rank	GS rank	Site Status	ID Note	Location
Hieracium sp.	hawkweed sp. (small, exotic sp.)	[SNA (Exotic)]	[Exotic]	c	likely one of Hieracium praealtum or H. x floribundum	within footprint
Hieracium sp.	hawkweed sp. (leafy stem with basal rosette)	SNA (Exotic)	Exotic	r	possibly Hieracium sabaudum	within footprint
Hieracium sp. (caespitosum / aurantiacum)	hawkweed sp. (Orange or Field)	[SNA (Exotic)]	[Exotic]	u	need flowers to distinguish these two species	within footprint
Lactuca biennis	Tall Blue Lettuce	S5	Secure	f		within footprint
Lactuca canadensis	Canada Lettuce	S5	Secure	r		within footprint
Leontodon autumnalis	Autumn Hawkbit	SNA (Exotic)	Exotic	r		within footprint
Leucanthemum vulgare	Oxeye Daisy	SNA (Exotic)	Exotic	r		within footprint
Matricaria discoidea	Pineapple-Weed Chamomile	SNA (Exotic)	Exotic	r		roadside
Oclemena acuminata	Whorled Aster	S5	Secure	c		within footprint
Omalotheca sylvatica	Woodland Cudweed	S4S5	Secure	f		within footprint
Prenanthes altissima	Tall Rattlesnake-root	S5	Secure	u		within footprint
Senecio jacobaea	Tansy Ragwort	SNA (Exotic)	Exotic	r		within footprint
Solidago canadensis	Canada Goldenrod	S5	Secure	c		within footprint
Solidago flexicaulis	Broad-Leaved Goldenrod	S5	Secure	f		within footprint
Solidago juncea	Early Goldenrod	S5	Secure	r		roadside
Solidago puberula	Downy Goldenrod	S5	Secure	c		within footprint
Solidago rugosa	Rough-Leaf Goldenrod	S5	Secure	c		within footprint
Solidago uliginosa	Bog Goldenrod	S5	Secure	r		roadside
Sonchus arvensis	Field Sowthistle	SNA (Exotic)	Exotic	r		logging road
Symphyotrichum lateriflorum	Farewell-Summer	S5	Secure	c		within footprint
Symphyotrichum novi-belgii	New Belgium American-Aster	S5	Secure	c		within footprint
Symphyotrichum puniceum	Swamp Aster	S5	Secure	u		within footprint
Taraxacum officinale	Common Dandelion	SNA (Exotic)	Exotic	c		within footprint
Tussilago farfara	Colt's Foot	SNA (Exotic)	Exotic	c		within footprint
Juncaceae	**Rush Family**					
Juncus articulatus	Jointed Rush	S5	Secure	r		logging road
Juncus brevicaudatus	Narrow-Panicled Rush	S5	Secure	r		logging road
Juncus effusus	Soft Rush	S5	Secure	f		within footprint
Juncus tenuis	Slender Rush	S5	Secure	f		within footprint
Luzula acuminata	Hairy Woodrush	S5	Secure	r		stream
Luzula multiflora	Common Woodrush	S5	Secure	r		within footprint
Cyperaceae	**Sedge Family**					
Carex arctata	Black Sedge	S5	Secure	c		within footprint
Carex brunnescens	Brownish Sedge	S5	Secure	u		within footprint
Carex canescens	Hoary Sedge	S5	Secure	r		roadside
Carex communis	Fibrous-Root Sedge	S5	Secure	r		within footprint
Carex debilis var. rudgei	White-Edge Sedge	S5	Secure	c		within footprint
Carex gynandra	A Sedge	S5	Secure	f		within footprint
Carex lurida	Shallow Sedge	S5	Secure	r		logging road
Carex nigra	Black Sedge	S5	Secure	r	ID probable	roadside

Species / Family	Common Name	S-rank	GS rank	Site Status	ID Note	Location
Carex novae-angliae	New England Sedge	S5	Secure	c		within footprint
Carex panicea	A Sedge	SNA (Exotic)	Exotic	u		within footprint
Carex scabrata	Rough Sedge	S5	Secure	f		within footprint
Carex scoparia	Pointed Broom Sedge	S5	Secure	f		within footprint
Carex trisperma var. trisperma	Three-Seed Sedge	S5	Secure	r		stream
Scirpus cyperinus	Cottongrass Bulrush	S5	Secure	c		within footprint
Poaceae	**Grass Family**					
Agrostis capillaris	Colonial Bentgrass	SNA (Exotic)	Exotic	c		within footprint
Agrostis gigantea	Black Bentgrass	SNA (Exotic)	Exotic	r		within footprint
Agrostis perennans	Perennial Bentgrass	S4S5	Secure	r	ID probable	stream
Agrostis scabra	Rough Bentgrass	S5	Secure	r		roadside
Anthoxanthum odoratum	Sweet Vernal Grass	SNA (Exotic)	Exotic	u		within footprint
Cinna latifolia	Slender Wood Reedgrass	S5	Secure	u		stream
Dactylis glomerata	Orchard Grass	SNA (Exotic)	Exotic	u		within footprint
Danthonia spicata	Poverty Oat-Grass	S5	Secure	c		within footprint
Dichanthelium acuminatum	Panic Grass	S5	Secure	c		within footprint
Elymus repens	Quackgrass	SNA (Exotic)	Exotic	r		roadside
Festuca filiformis	Hair Fescue	SNA (Exotic)	Exotic	f		within footprint
Glyceria canadensis	Canada Manna-Grass	S5	Secure	r		roadside
Glyceria striata	Fowl Manna-Grass	S5	Secure	c		within footprint
Lolium arundinaceum	Tall Rye Grass	SNA (Exotic)	Exotic	r		roadside
Panicum capillare	Old Witch Panic-Grass	SNA (Exotic)	Exotic	r		roadside
Phleum pratense	Meadow Timothy	SNA (Exotic)	Exotic	u		within footprint
Poa annua	Annual Bluegrass	SNA (Exotic)	Exotic	u		within footprint
Poa compressa	Canada Bluegrass	SNA (Exotic)	Exotic	c		within footprint
Poa palustris	Fowl Bluegrass	S5	Secure	r		within footprint
Poa pratensis	Kentucky Bluegrass	S5	Secure	f		within footprint
Sparganiaceae	**Bur-Reed Family**					
Sparganium sp.	bur-reed sp.	[native]	[Secure]	r		roadside
Typhaceae	**Cattail Family**					
Typha latifolia	Broad-Leaf Cattail	S5	Secure	r		logging road
Liliaceae	**Lily Family**					
Clintonia borealis	Clinton Lily	S5	Secure	f		within footprint
Maianthemum canadense	Wild Lily-of-The-Valley	S5	Secure	c		within footprint
Medeola virginiana	Indian Cucumber-Root	S5	Secure	r		stream
Iridaceae	**Iris Family**					
Iris versicolor	Blueflag	S5	Secure	u		within footprint
Sisyrinchium montanum	Strict Blue-Eyed-Grass	S5	Secure	u		within footprint
Orchidaceae	**Orchid Family**					
Corallorhiza trifida	Early Coralroot	S3	Secure	r		stream
Platanthera clavellata	Small Green Woodland Orchid	S5	Secure	r		roadside
Platanthera lacera	Green-Fringe Orchis	S4S5	Secure	r		logging road

Figure 2. Site of proposed new access road, taken from near Fairmont Road looking west-northwest along proposed track. The proposed new access road cuts through densely regenerating clearcut forest, most of which had regenerated from old-field prior. The proposed access road also cuts across a small, seepy streambed which had remnant tree cover along its margins.

Figure 3. Existing access road looking west-northwest toward the North Turbine site (near the meteorological tower visible in the left-centre of the photo). The existing access road cut through dense, young forest composed primarily of balsam fir, red maple and white and red spruce, much of which likely had an agricultural history judging by the presence of apple trees in some areas and by the vegetation composition of the roadside margin.

Figure 4. Seepy streambed about 150 m upstream of proposed crossing of new access road. The access road crossing is proposed for an area with slightly less remnant forest cover and slightly narrower floodplain bottomland than is in this picture but is otherwise quite similar. The same streambed further upstream in the southwest corner of the property was similar within its floodplain but within more mature forest and a much deeper, steep-sided ravine.

Figure 5. North Turbine site, looking westward into remnant intermediate-aged sugar maple – beech dominated forest within a large, slowly regenerating clearcut area. The turbine site was proposed for the central area of the photo close to the margin of the remnant forest. Avoiding impacts on the remnant forest would reduce the project's impacts on the natural heritage values of the site.

Figure 4. Existing access road looking west-northwest toward the North Turbine site (near the meteorological tower visible in the left-centre of the photo). The existing access road cut through dense, young forest composed primarily of balsam fir, red maple and white and red spruce, much of which likely had an agricultural history judging by the presence of apple trees in some areas and by the vegetation composition of the roadside margin.

APPENDIX F

SPECIES AT RISK AND RARE SPECIES DATABASE SEARCH RESULTS

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Results from Nova Scotia Department of Natural Ressources Significant Species deatabase within a 100km radius of Fairmont wind farm

scientific name	common name	GRank	NRank	SRank	COSEWIC	SProt	Provincial rank	GSrankCA	GSrank
Anas rubripes	American Black Duck	G5	N4B,N?	S5B				4 Secure	4 Secure
Corvus brachyrhynchos	American Crow	G5	N5B,N5	S5				4 Secure	4 Secure
Martes americana	American Marten				T		Red		
Sterna paradisaea	Arctic Tern	G5	N5B,NZ	S3B			Yellow	4 Secure	3 Sensitive
Haliaeetus leucocephalus	Bald Eagle	G5	N4B,N4	S5B,S4N	NAR			4 Secure	4 Secure
Riparia riparia	Bank Swallow	G5	N5B	S4B				4 Secure	4 Secure
Hirundo rustica	Barn Swallow	G5	N5B	S4B			Yellow	4 Secure	3 Sensitive
Ursus americanus	Black Bear	G5	N5	S5	NAR			4 Secure	4 Secure
Cepphus grylle	Black Guillemot	G5	N5	S3				4 Secure	4 Secure
Sympetrum danae	Black Meadowfly	G5	N5	S3				4 Secure	3 Sensitive
Alasmidonta varicosa	Brook Floater	G3	N2	S1S2	SC				3 Sensitive
Branta canadensis	Canada Goose	G5	N5B,N5	S4B				4 Secure	4 Secure
Chaetura pelagica	Chimney Swift	G5	N5B	S4B	T	Endangered	Yellow	3 Sensitive	3 Sensitive
Somateria mollissima	Common Eider								
Gavia immer	Common Loon	G5	N5B,N5	S4B,S4N	NAR		yellow	4 Secure	3 Sensitive
Mergus merganser	Common Merganser	G5	N5B,N5	S5B				4 Secure	4 Secure
Sterna hirundo	Common Tern	G5	N5B,NZ	S3B	NAR		yellow	4 Secure	3 Sensitive
Phalacrocorax auritus	Double-crested Cormoran	G5	N5B,N5	S5B	NAR			4 Secure	4 Secure
Martes pennanti	Fisher						yellow		
Sorex gaspensis	Gaspe Shrew				NAR		yellow		
Bucephala sp.	Goldeneye (unclassified)				SC		yellow		
Larus marinus	Great Black-backed Gull	G5	N5B,N5	S5B				4 Secure	4 Secure
Ardea herodias	Great Blue Heron	G5	N5B,NZ	S5B				4 Secure	4 Secure
Phalacrocorax carbo	Great Cormorant	G5	N4B,N4	S4B				4 Secure	4 Secure
Bubo virginianus	Great Horned Owl	G5	N5	S5				4 Secure	4 Secure
Aythya marila	Greater Scaup								
Rana clamitans	Green Frog	G5	N5	S5				4 Secure	4 Secure
Anas crecca	Green-winged Teal	G5	N5B,N5	S5B				4 Secure	4 Secure
Histrionicus histrionicus	Harlequin Duck				SC		yellow		
Larus argentatus	Herring Gull	G5	N5B,N5	S4				4 Secure	4 Secure
Oceanodroma leucorhoa	Leach's Storm-Petrel								
Gyraulus parvus	Lesser Ram's Horn Snail								
Enallagma minusculum	Little Bluet								
Myotis lucifugus	Little Brown Bat						yellow		
Rana septentrionalis	Mink Frog	G5	N5	S5				4 Secure	4 Secure
Enallagma cyathigerum	Northern Bluet								
Accipiter gentilis	Northern Goshawk	G5	N4B,N4	S3B	NAR		Yellow	4 Secure	4 Secure
Pandion haliaetus	Osprey	G5	N5B,NZ	S5B				4 Secure	4 Secure
Charadrius melodus	Piping Plover	G3TNR	N3B	S1B	E	Endangered	Red		1 At Risk
Alca torda	Razorbill						Yellow		
Mergus serrator	Red-breasted Merganser	G5	N5B,N5	S3B				4 Secure	4 Secure
Buteo jamaicensis	Red-tailed Hawk	G5	N5B,N5	S5B	NAR			4 Secure	4 Secure
Gavia stellata	Red-throated Loon								
Aythya collaris	Ring-necked Duck	G5	N5B,N5	S5B				4 Secure	4 Secure
Lutra canadensis	River Otter	G5	N5	S5				4 Secure	4 Secure
Microtus chrotorrhinus	Rock Vole								
Sterna dougallii	Roseate Tern				E		Red		
Ammodramus nelsoni	Sharp-tailed Sparrow	G5	N5B, N	S3B	NAR			4 Secure	4 Secure
Chelydra serpentina	Snapping Turtle	G5	N5	S5	SC			4 Secure	4 Secure
Synaptomys cooperi	Southern Bog Lemming								
Nehalennia gracilis	Sphagnum Sprite								
Actitis macularia	Spotted Sandpiper	G5	N5B,NZ	S5B				4 Secure	4 Secure

Alasmidonta undulata	Triangle Floater	G4	N4	S2S3				4 Secure
Numenius phaeopus	Whimbrel	G5	N?B,NZ	S3M			4 Secure	4 Secure
Odocoileus virginianus	White-tailed Deer							
Catoptrophorus semipalmatus	Willet	G5	N5B,NZ	S4B			4 Secure	4 Secure
Aix sponsa	Wood Duck	G5	NZN,N5	S4B			4 Secure	4 Secure
Clemmys insculpta	Wood Turtle	G4	N3	S3	T	Vulnerable	3 Sensitive	3 Sensitive

DATA REPORT 4280: Fairmont, NS

Prepared 19 November, 2010
by S.H. Gerriets

CONTENTS OF REPORT

1.0 PREFACE

The Atlantic Canada Conservation Data Centre (ACCDC) is part of a network of circa 85 NatureServe data centres and heritage programs in 50 states, 10 provinces and 1 territory, plus several Central and South American countries. The NatureServe network is more than 30 years old and shares a common conservation data methodology. The ACCDC was founded in 1997, and maintains data for the jurisdictions of New Brunswick, Nova Scotia, Prince Edward Island, Newfoundland and Labrador. Although a non-governmental agency, the ACCDC is supported by 6 federal agencies, plus 4 provincial governments, outside grants and data processing fees. URL: www.ACCDC.com.

Upon request and for a fee, the ACCDC reports known observations of rare and endangered flora and fauna, in and near a specified study area. As a supplement to that data, the ACCDC includes locations of managed areas with some level of protection, and also known sites of ecological interest. Data summarised in each report is attached as DBF files which may be opened from within data software (Excel, Access) or mapped in GIS (ArcView, MapInfo, AutoCAD).

1.1 RESTRICTIONS

The ACCDC makes a strong effort to verify the accuracy of all the data that it manages, but it shall not be held responsible for any inaccuracies in data that it provides. By receiving ACCDC data, recipients assent to the following limits of use:

a.) Data is restricted to use by trained personnel who are sensitive to its potential threat to rare and endangered taxa.
b.) Data is restricted to use by the specified Data User; any third party requiring data must make its own data request.
c.) The ACCDC requires Data Users to cease using and delete data 12 months after receipt.
d.) ACCDC data responses are restricted to that data in our Data System at the time of the data request.
e.) Data is qualified as to location (Precision) and time (SurveyDate); cf Data Dictionary for details.
f.) ACCDC data reports are not to be construed as exhaustive inventories of taxa in an area.
g.) The non-occurrence of a taxon cannot be inferred by its absence in an ACCDC data report.

1.2 ADDITIONAL INFORMATION

Please direct biological questions about ACCDC data to: Sean Blaney, ACCDC: (506) 364-2658, and technical data queries to: Stefen Gerriets, ACCDC: (506) 364-2657.
For provincial information on rare taxa and protected areas, or information on game animals, deer yards, old growth forest, archeological sites, fish habitat etc, please contact Sherman Boates, NSDNR: (902) 679-6146.

2.0 RARE AND ENDANGERED TAXA

A 100km buffer around the study area contains 2350 records of 406 taxa from 89 sources, a relatively low-to-moderate density of records (quintile 2): 0.07 rec/km2.

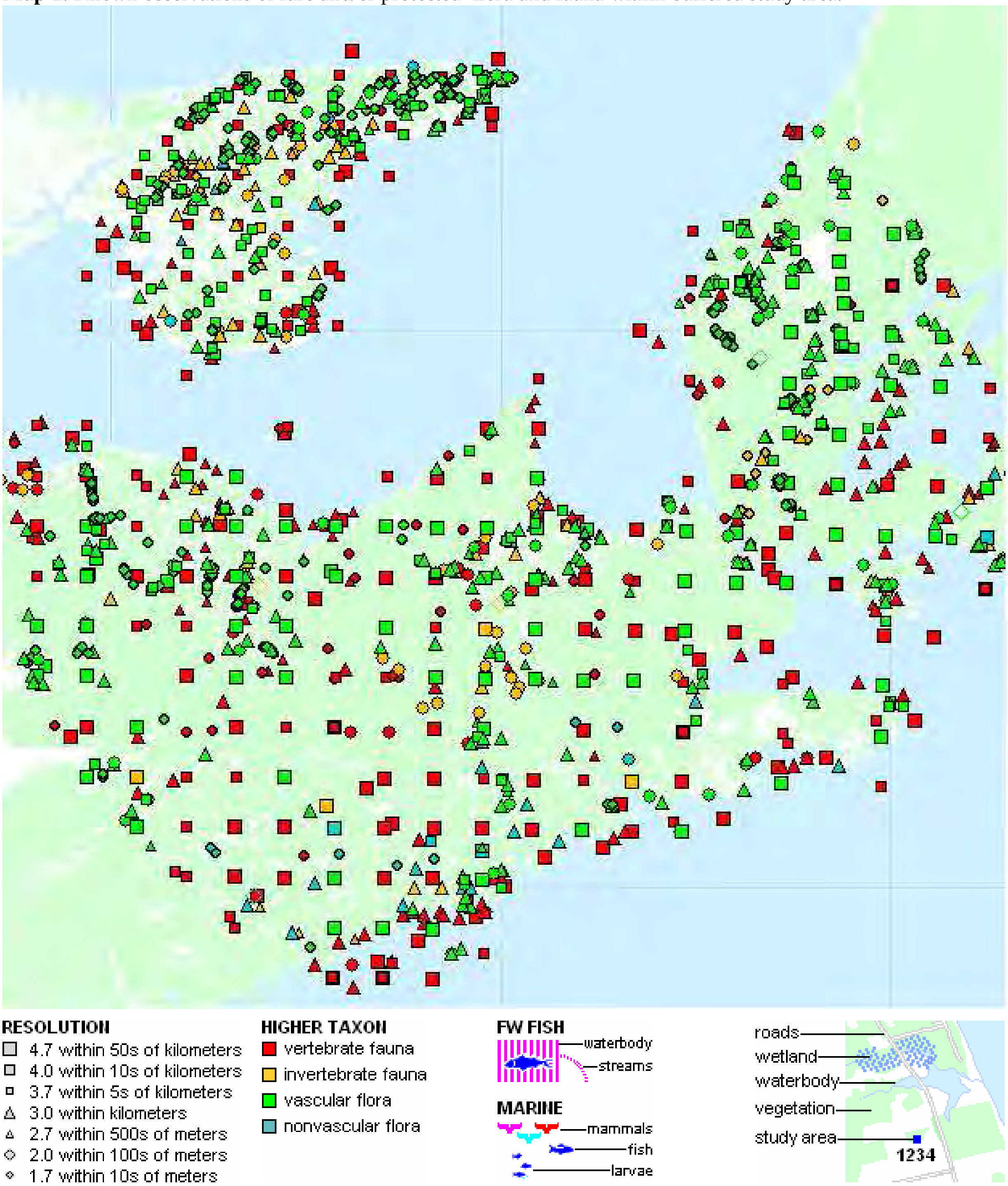
2.1 FLORA

A 100km buffer around the study area contains 1107 records of 261 vascular, 45 records of 16 nonvascular flora (see attached *ob.dbf).

2.2 FAUNA

A 100km buffer around the study area contains 924 records of 61 vertebrate, 274 records of 68 invertebrate fauna (cf attached *ob.dbf). Sensitive data: Wood Turtles are POTENTIALLY present in the study area (cf attached WOTU.rtf).

Map 1: Known observations of rare and/or protected flora and fauna within buffered study area.

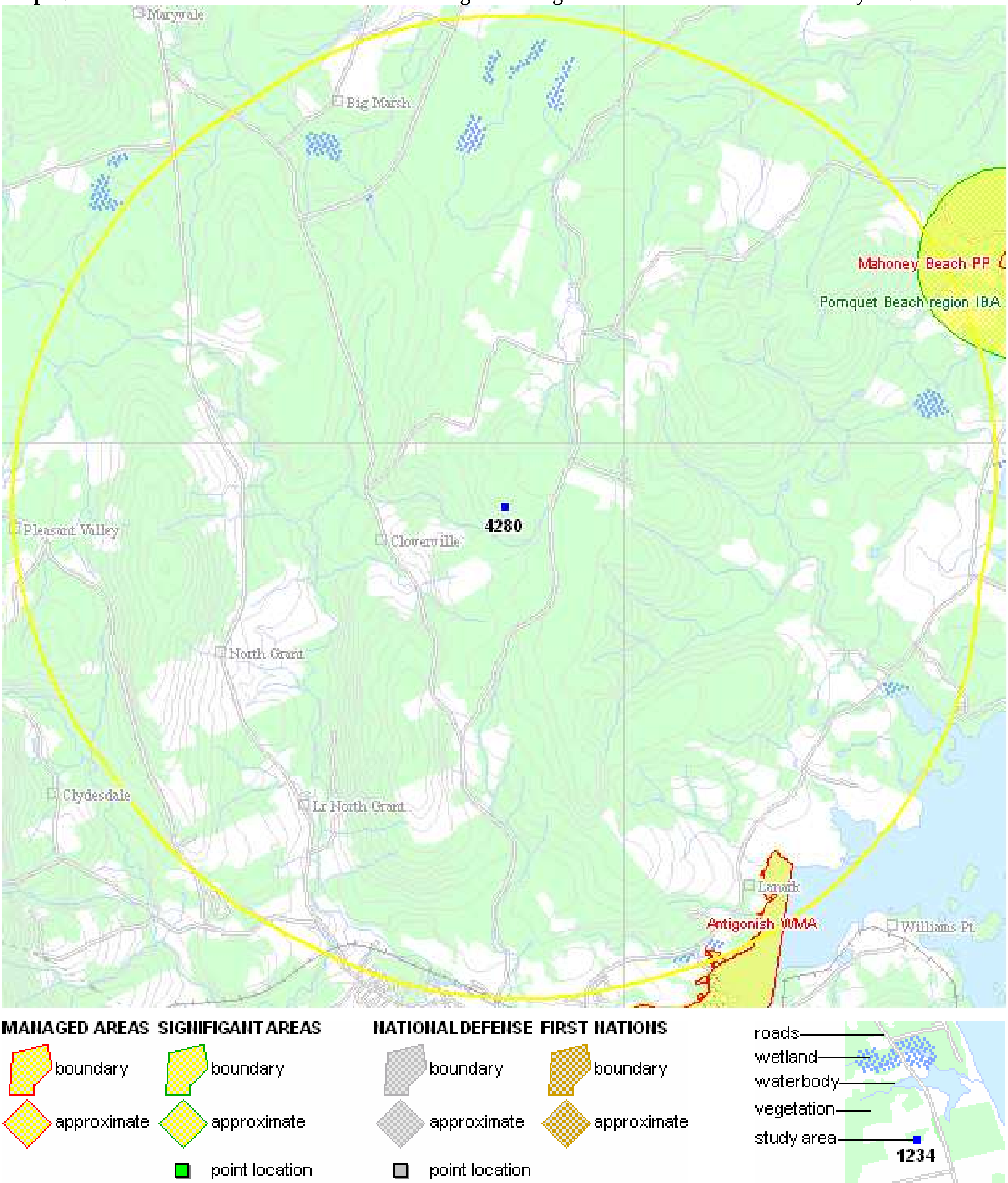


3.0 SPECIAL AREAS

3.1 MANAGED AREAS
The GIS scan identified 1 Managed Area with some degree of protected status, in the vicinity of the study area (see attached *ma.dbf).

3.2 SIGNIFICANT AREAS
The GIS scan also identified 1 biologically significant site in the vicinity of the study area; such sites are known for exceptional biotic richness but may or may not have legal status (see attached *sa.dbf).

Map 2: Boundaries and/or locations of known Managed and Significant Areas within 5km of study area.



4.0 TAXON LISTS

Rare and/or endangered taxa within the buffered area listed in order of concern, beginning with legally listed taxa, with the number of observations per taxon and the distance in kilometers from study area centroid to the closest observation. [p] = vascular plant, [n] = nonvascular plant, [a] = vertebrate animal, [i] = invertebrate animal, [c] = community.

4.1 FLORA

	scientific name	common name	prov. rarity	prov. status	COSEWIC	obs	dist.km
n	Erioderma pedicellatum (Atlantic pop.)	Boreal Felt Lichen (Atlantic pop.)	S1S2	Endangered	E	28	45 ±0
p	Juncus caesariensis	New Jersey Rush	S2	Vulnerable	SC	1	100 ±0.1
p	Floerkea proserpinacoides	False Mermaidweed	S2		NAR	12	16 ±1
p	Thuja occidentalis	Eastern White Cedar	S1S2	Vulnerable		2	74 ±10
n	Tetrodontium brownianum	Little Georgia	S1			1	88 ±0.5
n	Ditrichum rhynchostegium	a Moss	S1			1	76 ±0.1
n	Bryhnia graminicolor	a Moss	S1			1	83 ±0.5
p	Equisetum palustre	Marsh Horsetail	S1			1	58 ±0
p	Dryopteris filix-mas	Male Fern	S1			1	88 ±0
p	Cystopteris laurentiana	Laurentian Bladder Fern	S1			2	72 ±1
p	Cryptogramma stelleri	Steller's Rockbrake	S1			5	66 ±0.1
p	Sparganium fluctuans	Floating Burreed	S1			1	88 ±5
p	Potamogeton nodosus	Long-leaved Pondweed	S1			1	76 ±5
p	Sphenopholis intermedia	Slender Wedge Grass	S1			1	99 ±0
p	Elymus hystrix var. bigeloviana	Spreading Wild Rye	S1			1	55 ±1
p	Elymus wiegandii	Wiegand's Wild Rye	S1			8	55 ±0
p	Cinna arundinacea	Sweet Wood Reed Grass	S1			2	55 ±0
p	Bromus latiglumis	Broad-Glumed Brome	S1			2	55 ±0
p	Spiranthes ochroleuca	Yellow Ladies'-tresses	S1			3	83 ±0.1
p	Malaxis brachypoda	White Adder's-Mouth	S1			1	39 ±10
p	Triantha glutinosa	Sticky False Asphodel	S1			2	76 ±0
p	Allium tricoccum	Wild Leek	S1			2	87 ±0.1
p	Iris prismatica	Slender Blue Flag	S1			3	44 ±10
p	Scirpus pedicellatus	Stalked Bulrush	S1			2	55 ±0
p	Rhynchospora capillacea	Slender Beakrush	S1			4	69 ±1
p	Cyperus lupulinus ssp. macilentus	Hop Flatsedge	S1			4	6 ±10
p	Carex wiegandii	Wiegand's Sedge	S1			1	61 ±5
p	Carex viridula var. elatior	Greenish Sedge	S1			1	76 ±0
p	Carex tuckermanii	Tuckerman's Sedge	S1			1	65 ±0.1
p	Carex tribuloides	Blunt Broom Sedge	S1			1	77 ±1
p	Carex tincta	Tinged Sedge	S1			2	17 ±1
p	Carex tenuiflora	Sparse-Flowered Sedge	S1			2	74 ±1
p	Carex rostrata	Narrow-leaved Beaked Sedge	S1			1	87 ±5
p	Carex plantaginea	Plantain-Leaved Sedge	S1			2	80 ±0
p	Carex livida var. radicaulis	Livid Sedge	S1			2	90 ±5
p	Carex livida	Livid Sedge	S1			1	100 ±5
p	Carex pellita	Woolly Sedge	S1			2	56 ±0
p	Carex haydenii	Hayden's Sedge	S1			2	20 ±5
p	Carex gynocrates	Northern Bog Sedge	S1			1	77 ±0.1
p	Carex garberi	Garber's Sedge	S1			1	88 ±0
p	Carex bromoides	Bromelike Sedge	S1			3	89 ±0.1
p	Carex argyrantha	Silvery-flowered Sedge	S1			1	64 ±5
p	Carex alopecoidea	Foxtail Sedge	S1			1	17 ±0.5
p	Viola canadensis	Canada Violet	S1			2	65 ±1
p	Pilea pumila	Dwarf Clearweed	S1			4	37 ±10
p	Scrophularia lanceolata	Lance-leaved Figwort	S1			1	44 ±10
p	Salix candida	Sage Willow	S1			2	76 ±0
p	Montia fontana	Water Blinks	S1			1	50 ±1
p	Polygonum viviparum	Alpine Bistort	S1			1	86 ±1
p	Desmodium canadense	Canada Tick-trefoil	S1			2	57 ±0
p	Cuscuta cephalanthi	Buttonbush Dodder	S1			4	8 ±10
p	Hypericum majus	Large St. John's-wort	S1			2	95 ±1
p	Hudsonia tomentosa	Woolly Beach-heath	S1			5	34 ±10
p	Hudsonia ericoides	Pinebarren Golden Heather	S1			4	77 ±0
p	Suaeda maritima ssp. richii	White Sea-blite	S1			4	9 ±10
p	Lobelia kalmii	Brook Lobelia	S1			6	56 ±0
p	Cochlearia tridactylites	Limestone Scurvy-grass	S1			5	78 ±10
p	Cardamine pratensis var. angustifolia	Cuckoo Flower	S1			2	68 ±10
p	Ageratina altissima	White Snakeroot	S1			2	8 ±10
p	Hieracium umbellatum	Umbellate Hawkweed	S1			1	68 ±5
p	Pseudognaphalium obtusifolium	Eastern Cudweed	S1			1	70 ±1
p	Bidens hyperborea	Estuary Beggarticks	S1			1	7 ±1
p	Arnica lonchophylla	Northern Arnica	S1			1	77 ±10
p	Antennaria parlinii	Parlin's Pussytoes	S1			1	79 ±0
p	Zizia aurea	Golden Alexanders	S1			8	10 ±0.1
p	Sanicula odorata	Clustered Sanicle	S1			5	62 ±0
n	Sphagnum flavicomans	a Peatmoss	S1?			1	90 ±0.1
n	Dicranum leioneuron	a Moss	S1?			1	90 ±0.1
n	Dicranum bonjeanii	a Moss	S1?			1	85 ±0.1
p	Dichanthelium acuminatum var. lindheimeri	Woolly Panic Grass	S1?			1	50 ±0.1
p	Triglochin gaspensis	Gaspé Arrowgrass	S1?			5	74 ±1
p	Rubus pensilvanicus	Pennsylvania Blackberry	S1?			3	61 ±5
p	Rubus flagellaris	Northern Dewberry	S1?			1	87 ±5
p	Crataegus submollis	Quebec Hawthorn	S1?			2	14 ±10
p	Crataegus robinsonii	Robinson's Hawthorn	S1?			2	44 ±50.1
p	Amelanchier stolonifera	Running Serviceberry	S1?			6	58 ±1

p	Humulus lupulus var. lupuloides	Common Hop	S1?	3	61 ±5
p	Chenopodium rubrum	Red Pigweed	S1?	3	9 ±10
p	Atriplex acadiensis	Maritime Saltbush	S1?	1	34 ±10
p	Solidago hispida	Hairy Goldenrod	S1?	1	70 ±10
n	Campylostelium saxicola	a Moss	S1S2	1	88 ±0.5
p	Botrychium lanceolatum	Triangle Moonwort	S1S2	1	85 ±0.1
p	Sparganium hyperboreum	Northern Burreed	S1S2	3	64 ±0.1
p	Platanthera flava var. herbiola	Tubercled Orchid	S1S2	1	83 ±0
p	Juncus alpinoarticulatus ssp. nodulosus	Alpine Rush	S1S2	6	55 ±0
p	Juncus stygius ssp. americanus	Moor Rush	S1S2	3	87 ±10
p	Juncus greenei	Greene's Rush	S1S2	2	11 ±5
p	Carex tenera	Tender Sedge	S1S2	3	33 ±5
p	Carex pensylvanica	Pennsylvania Sedge	S1S2	1	22 ±0
p	Carex bebbii	Bebb's Sedge	S1S2	6	16 ±10
p	Ranunculus sceleratus	Cursed Buttercup	S1S2	1	93 ±10
p	Hepatica nobilis var. obtusa	Round-lobed Hepatica	S1S2	1	77 ±0
p	Anemone virginiana var. alba	Virginia Anemone	S1S2	5	65 ±0.1
p	Cornus suecica	Swedish Bunchberry	S1S2	1	89 ±5
p	Callitriche hermaphroditica	Northern Water-starwort	S1S2	1	100 ±0
p	Sagina nodosa ssp. borealis	Knotted Pearlwort	S1S2	2	81 ±5
p	Sagina nodosa	Knotted Pearlwort	S1S2	1	98 ±0.5
p	Carex vacillans	Estuarine Sedge	S1S3	1	17 ±0.5
p	Selaginella selaginoides	Low Spikemoss	S2	2	95 ±1
p	Equisetum pratense	Meadow Horsetail	S2	3	95 ±0
p	Woodsia glabella	Smooth Cliff Fern	S2	2	72 ±0.1
p	Polystichum lonchitis	Northern Holly Fern	S2	5	59 ±100
p	Dryopteris fragrans var. remotiuscula	Fragrant Wood Fern	S2	2	49 ±10
p	Asplenium trichomanes-ramosum	Green Spleenwort	S2	4	71 ±1
p	Asplenium trichomanes	Maidenhair Spleenwort	S2	1	48 ±0.1
p	Potamogeton friesii	Fries' Pondweed	S2	3	55 ±0
p	Spiranthes lucida	Shining Ladies'-Tresses	S2	10	54 ±1
p	Platanthera macrophylla	Large Round-Leaved Orchid	S2	2	80 ±5
p	Platanthera flava var. flava	Tubercled Orchid	S2	1	87 ±10
p	Platanthera flava	Tubercled Orchid	S2	3	83 ±0
p	Listera convallarioides	Broad-Leaved Twayblade	S2	9	83 ±0
p	Listera australis	Southern Twayblade	S2	5	58 ±10
p	Goodyera tesselata	Checkered Rattlesnake-Plantain	S2	10	81 ±0.5
p	Cypripedium reginae	Showy Lady's-Slipper	S2	18	37 ±10
p	Cypripedium parviflorum var. makasin	Yellow Lady's-slipper	S2	1	66 ±0.1
p	Cypripedium parviflorum var. pubescens	Yellow Lady's-slipper	S2	6	15 ±0
p	Allium schoenoprasum var. sibiricum	Wild Chives	S2	1	78 ±10
p	Juncus trifidus	Highland Rush	S2	1	85 ±5
p	Eriophorum gracile	Slender Cottongrass	S2	4	67 ±1
p	Eleocharis quinqueflora	Few-flowered Spikerush	S2	5	55 ±0
p	Carex hystericina	Porcupine Sedge	S2	8	55 ±0
p	Carex comosa	Bearded Sedge	S2	2	70 ±0.1
p	Carex atratiformis	Scabrous Black Sedge	S2	2	73 ±1
p	Carex atlantica ssp. capillacea	Atlantic Sedge	S2	1	38 ±10
p	Viola nephrophylla	Northern Bog Violet	S2	9	57 ±0
p	Tiarella cordifolia	Heart-leaved Foamflower	S2	7	64 ±10
p	Saxifraga paniculata ssp. neogaea	White Mountain Saxifrage	S2	1	67 ±10
p	Parnassia palustris var. parviflora	Marsh Grass-of-Parnassus	S2	3	16 ±1
p	Comandra umbellata	Bastard's Toadflax	S2	3	17 ±10
p	Salix pedicellaris	Bog Willow	S2	6	54 ±10
p	Galium labradoricum	Labrador Bedstraw	S2	5	76 ±0
p	Ranunculus gmelinii	Gmelin's Water Buttercup	S2	12	67 ±5
p	Ranunculus flammula var. flammula	Lesser Spearwort	S2	2	34 ±10
p	Caltha palustris	Yellow Marsh Marigold	S2	3	37 ±0.1
p	Anemone virginiana	Virginia Anemone	S2	5	55 ±0
p	Anemone quinquefolia	Wood Anemone	S2	5	57 ±0.5
p	Anemone canadensis	Canada Anemone	S2	2	33 ±0.1
p	Pyrola minor	Lesser Pyrola	S2	1	75 ±10
p	Samolus valerandi ssp. parviflorus	Seaside Brookweed	S2	2	7 ±1
p	Primula mistassinica	Mistassini Primrose	S2	3	86 ±10
p	Plantago rugelii	Rugel's Plantain	S2	1	60 ±0
p	Rumex salicifolius var. mexicanus	Triangular-valve Dock	S2	3	57 ±10
p	Polygonum arifolium	Halberd-leaved Tearthumb	S2	5	67 ±1
p	Oenothera fruticosa ssp. glauca	Narrow-leaved Evening Primrose	S2	2	54 ±10
p	Myriophyllum farwellii	Farwell's Water Milfoil	S2	4	34 ±10
p	Chamaesyce polygonifolia	Seaside Spurge	S2	2	66 ±1
p	Vaccinium caespitosum	Dwarf Bilberry	S2	1	99 ±1
p	Vaccinium boreale	Northern Blueberry	S2	5	67 ±10
p	Empetrum eamesii ssp. atropurpureum	Pink Crowberry	S2	2	80 ±5
p	Empetrum eamesii	Pink Crowberry	S2	4	77 ±0
p	Shepherdia canadensis	Soapberry	S2	5	53 ±0.5
p	Crassula aquatica	Water Pygmyweed	S2	1	87 ±10
p	Triosteum aurantiacum	Orange-fruited Tinker's Weed	S2	27	6 ±10
p	Stellaria humifusa	Saltmarsh Starwort	S2	6	73 ±0.1
p	Draba arabisans	Rock Whitlow-Grass	S2	1	72 ±1
p	Betula michauxii	Newfoundland Dwarf Birch	S2	9	63 ±0
p	Betula borealis	Northern Birch	S2	1	73 ±10
p	Caulophyllum thalictroides	Blue Cohosh	S2	9	50 ±10
p	Impatiens pallida	Pale Jewelweed	S2	6	9 ±10
p	Symphyotrichum boreale	Boreal Aster	S2	5	87 ±0.1
p	Senecio pseudoarnica	Seabeach Ragwort	S2	5	50 ±1
p	Rudbeckia laciniata var. gaspereauensis	Cut-Leaved Coneflower	S2	2	8 ±10

p	Rudbeckia laciniata	Cut-Leaved Coneflower	S2	4	75 ±5
p	Hieracium robinsonii	Robinson's Hawkweed	S2	1	85 ±10
p	Erigeron philadelphicus	Philadelphia Fleabane	S2	6	6 ±10
p	Panax trifolius	Dwarf Ginseng	S2	20	72 ±5
p	Osmorhiza longistylis	Smooth Sweet Cicely	S2	11	55 ±0
p	Conioselinum chinense	Chinese Hemlock-parsley	S2	1	73 ±5
n	Scorpidium scorpioides	a Moss	S2?	1	97 ±10
n	Platydictya jungermannioides	a Moss	S2?	1	55 ±0
n	Calliergon giganteum	a Moss	S2?	1	89 ±1
n	Buxbaumia aphylla	Bug On a Stick	S2?	1	86 ±0.5
n	Atrichum crispum	a Moss	S2?	2	86 ±0.5
p	Dichanthelium linearifolium	Narrow-leaved Panic Grass	S2?	1	55 ±10
p	Juncus dudleyi	Dudley's Rush	S2?	8	55 ±0
p	Eleocharis ovata	Ovate Spikerush	S2?	1	90 ±0.5
p	Amelanchier fernaldii	Fernald's Serviceberry	S2?	4	70 ±1
p	Epilobium coloratum	Purple-veined Willowherb	S2?	2	7 ±0.5
p	Hieracium kalmii var. kalmii	Kalm's Hawkweed	S2?	1	90 ±5
p	Hieracium kalmii	Kalm's Hawkweed	S2?	1	79 ±1
n	Fissidens bryoides	a Moss	S2S3	1	88 ±0.5
n	Dicranella subulata	Awl-Leaved Fork Moss	S2S3	2	71 ±1
n	Amblystegium varium	a Moss	S2S3	1	83 ±0.5
p	Botrychium simplex	Least Moonwort	S2S3	2	16 ±1
p	Botrychium lanceolatum var. angustisegmentum	Triangle Moonwort	S2S3	9	47 ±0
p	Lycopodium hickeyi	Hickey's Tree-clubmoss	S2S3	1	74 ±0.1
p	Potamogeton zosteriformis	Flat-stemmed Pondweed	S2S3	4	77 ±0
p	Potamogeton richardsonii	Richardson's Pondweed	S2S3	4	46 ±1
p	Potamogeton obtusifolius	Blunt-leaved Pondweed	S2S3	10	15 ±10
p	Stuckenia filiformis ssp. alpina	Thread-leaved Pondweed	S2S3	8	63 ±1
p	Stuckenia filiformis	Thread-leaved Pondweed	S2S3	2	65 ±10
p	Poa glauca	Glaucous Blue Grass	S2S3	2	72 ±1
p	Calamagrostis stricta var. stricta	Slim-stemmed Reed Grass	S2S3	2	83 ±0
p	Calamagrostis stricta	Slim-stemmed Reed Grass	S2S3	4	85 ±0
p	Alopecurus aequalis	Short-awned Foxtail	S2S3	6	16 ±1
p	Spiranthes romanzoffiana	Hooded Ladies'-Tresses	S2S3	5	71 ±5
p	Cypripedium parviflorum	Yellow Lady's-slipper	S2S3	10	12 ±0.5
p	Lilium canadense	Canada Lily	S2S3	28	13 ±1
p	Eleocharis olivacea	Yellow Spikerush	S2S3	2	7 ±5
p	Carex hirtifolia	Pubescent Sedge	S2S3	13	55 ±0
p	Carex adusta	Lesser Brown Sedge	S2S3	1	75 ±5
p	Salix pellita	Satiny Willow	S2S3	1	49 ±1
p	Polygonum raii	Sharp-fruited Knotweed	S2S3	6	53 ±1
p	Polygala sanguinea	Blood Milkwort	S2S3	5	52 ±1
p	Fraxinus nigra	Black Ash	S2S3	30	8 ±10
p	Hedeoma pulegioides	American False Pennyroyal	S2S3	2	13 ±5
p	Halenia deflexa	Spurred Gentian	S2S3	3	60 ±1
p	Hypericum dissimulatum	Disguised St John's-wort	S2S3	1	52 ±1
p	Suaeda calceoliformis	Horned Sea-blite	S2S3	6	54 ±5
p	Betula pumila	Bog Birch	S2S3	8	69 ±0
p	Symphyotrichum ciliolatum	Fringed Blue Aster	S2S3	2	34 ±10
p	Asclepias incarnata ssp. pulchra	Swamp Milkweed	S2S3	5	73 ±1
p	Schizaea pusilla	Little Curlygrass Fern	S3	2	63 ±0
p	Botrychium dissectum	Cut-leaved Moonwort	S3	3	31 ±1
p	Isoetes acadiensis	Acadian Quillwort	S3	1	73 ±1
p	Equisetum variegatum	Variegated Horsetail	S3	8	55 ±0
p	Sparganium natans	Small Burreed	S3	8	36 ±0.5
p	Dichanthelium clandestinum	Deer-tongue Panic Grass	S3	1	54 ±5
p	Platanthera orbiculata	Small Round-leaved Orchid	S3	14	61 ±5
p	Platanthera hookeri	Hooker's Orchid	S3	1	48 ±0.1
p	Platanthera grandiflora	Large Purple Fringed Orchid	S3	10	6 ±5
p	Goodyera repens	Lesser Rattlesnake-plantain	S3	11	56 ±0
p	Goodyera oblongifolia	Menzies' Rattlesnake-plantain	S3	3	87 ±10
p	Corallorhiza trifida	Early Coralroot	S3	8	66 ±5
p	Juncus subcaudatus	Woodland Rush	S3	2	54 ±10
p	Carex rosea	Rosy Sedge	S3	2	55 ±0
p	Carex lupulina	Hop Sedge	S3	2	60 ±0
p	Carex eburnea	Bristle-leaved Sedge	S3	1	7 ±5
p	Verbena hastata	Blue Vervain	S3	13	51 ±1
p	Laportea canadensis	Canada Wood Nettle	S3	6	55 ±0
p	Limosella australis	Southern Mudwort	S3	7	56 ±0.1
p	Geocaulon lividum	Northern Comandra	S3	2	58 ±10
p	Salix petiolaris	Meadow Willow	S3	4	65 ±0
p	Galium kamtschaticum	Northern Wild Licorice	S3	4	67 ±1
p	Agrimonia gryposepala	Hooked Agrimony	S3	11	55 ±0
p	Rhamnus alnifolia	Alder-leaved Buckthorn	S3	22	55 ±0
p	Pyrola asarifolia	Pink Pyrola	S3	6	86 ±0
p	Rumex maritimus	Sea-Side Dock	S3	5	51 ±0
p	Polygonum scandens	Climbing False Buckwheat	S3	9	8 ±10
p	Polygonum pensylvanicum	Pennsylvania Smartweed	S3	9	55 ±0
p	Epilobium strictum	Downy Willowherb	S3	6	30 ±0.5
p	Decodon verticillatus	Swamp Loosestrife	S3	1	74 ±5
p	Teucrium canadense	Canada Germander	S3	3	18 ±0
p	Proserpinaca pectinata	Comb-leaved Mermaidweed	S3	1	78 ±1
p	Proserpinaca palustris var. crebra	Marsh Mermaidweed	S3	4	55 ±0
p	Bartonia virginica	Yellow Bartonia	S3	1	87 ±0.1
p	Viburnum edule	Squashberry	S3	1	77 ±0
p	Stellaria longifolia	Long-leaved Starwort	S3	3	55 ±0

p	Campanula aparinoides	Marsh Bellflower	S3	12	19 ±1
p	Packera paupercula	Balsam Groundsel	S3	6	55 ±0
p	Megalodonta beckii	Water Beggarticks	S3	6	19 ±0.5
p	Erigeron hyssopifolius	Hyssop-leaved Fleabane	S3	5	10 ±0.1
p	Bidens connata	Purple-stemmed Beggarticks	S3	12	56 ±0.1
p	Asclepias incarnata	Swamp Milkweed	S3	17	34 ±10
p	Lycopodium sitchense	Sitka Clubmoss	S3?	3	16 ±1
p	Lycopodium sabinifolium	Ground-Fir	S3?	6	19 ±5
p	Potamogeton praelongus	White-stemmed Pondweed	S3?	9	15 ±1
p	Carex foenea	Hay Sedge	S3?	4	20 ±0
p	Lycopodiella appressa	Southern Bog Clubmoss	S3S4	2	51 ±1
p	Lycopodium complanatum	Northern Clubmoss	S3S4	2	73 ±0.1
p	Equisetum scirpoides	Dwarf Scouring-Rush	S3S4	4	62 ±5
p	Cystopteris bulbifera	Bulblet Bladder Fern	S3S4	9	5 ±1
p	Trisetum spicatum	Narrow False Oats	S3S4	1	57 ±0
p	Liparis loeselii	Loesel's Twayblade	S3S4	13	59 ±1
p	Luzula parviflora	Small-flowered Woodrush	S3S4	1	87 ±10
p	Juncus nodosus	Knotted Rush	S3S4	6	59 ±5
p	Sisyrinchium angustifolium	Narrow-leaved Blue-eyed-grass	S3S4	2	55 ±0
p	Lindernia dubia	Yellow-seeded False Pimperel	S3S4	7	55 ±0
p	Polygonum robustius	Stout Smartweed	S3S4	1	55 ±0
p	Sanguinaria canadensis	Bloodroot	S3S4	18	55 ±0
p	Utricularia gibba	Humped Bladderwort	S3S4	1	25 ±10
p	Myriophyllum sibiricum	Siberian Water Milfoil	S3S4	1	76 ±0.1
p	Atriplex franktonii	Frankton's Saltbush	S3S4	2	76 ±5
p	Isoetes lacustris	Lake Quillwort	S4	10	29 ±1
p	Piptatherum canadense	Canada Rice Grass	SH	1	100 ±5
p	Stellaria crassifolia	Fleshy Stitchwort	SH	2	77 ±1
p	Solidago simplex var. randii	Sticky Goldenrod	SH	2	52 ±5

4.2 FAUNA

	scientific name	common name	prov. rarity	prov. status	COSEWIC	obs	dist.km
a	Sterna dougallii	Roseate Tern	S1B	Endangered	E	19	69 ±10
a	Calidris canutus rufa	Red Knot rufa ssp	S2S3M	Endangered	E	6	7 ±0.5
a	Salmo salar pop. 1	Atlantic Salmon - inner Bay of Fundy pops	S2		E	4	72 ±10
a	Catharus bicknelli	Bicknell's Thrush	S1S2B	Vulnerable	T	2	87 ±5
a	Glyptemys insculpta	Wood Turtle	S3	Vulnerable	T	41	6 ±10
a	Morone saxatilis	Striped Bass	S1		T	1	8 ±10
a	Caprimulgus vociferus	Whip-Poor-Will	S1?B		T	2	6 ±5
a	Dolichonyx oryzivorus	Bobolink	S3S4B		T	131	6 ±5
a	Histrionicus histrionicus pop. 1	Harlequin Duck - Eastern pop.	S2N	Endangered	SC	9	67 ±10
a	Passerculus sandwichensis princeps	Savannah Sparrow princeps ssp	S1B		SC	1	66 ±5
a	Bucephala islandica (Eastern pop.)	Barrow's Goldeneye (Eastern pop.)	S1N		SC	2	49 ±0.1
a	Asio flammeus	Short-eared Owl	S1S2		SC	3	34 ±5
i	Alasmidonta varicosa	Brook Floater	S1S2		SC	6	24 ±10
i	Danaus plexippus	Monarch	S2B		SC	2	87 ±5
a	Euphagus carolinus	Rusty Blackbird	S2S3B		SC	64	6 ±5
a	Lynx canadensis	Canada Lynx	S1	Endangered	NAR	5	59 ±10
a	Aegolius funereus	Boreal Owl	S1B		NAR	1	29 ±0.1
a	Fulica americana	American Coot	S1B		NAR	5	72 ±5
a	Hemidactylium scutatum	Four-toed Salamander	S3		NAR	11	37 ±10
a	Sialia sialis	Eastern Bluebird	S3B		NAR	7	16 ±5
a	Sterna hirundo	Common Tern	S3B		NAR	120	6 ±5
a	Accipiter gentilis	Northern Goshawk	S3S4		NAR	25	6 ±5
a	Alces americanus	Moose	S1	Endangered		14	14 ±10
a	Martes americana	American Marten	S1	Endangered		1	81 ±10
a	Sorex dispar	Long-tailed Shrew	S1			1	84 ±10
i	Chromagrion conditum	Aurora Damsel	S1			2	66 ±1
i	Enallagma aspersum	Azure Bluet	S1			3	55 ±0.1
i	Enallagma minusculum	Little Bluet	S1			1	89 ±0.1
i	Leucorrhinia frigida	Frosted Whiteface	S1			1	89 ±0.1
i	Celithemis elisa	Calico Pennant	S1			1	89 ±0.1
i	Somatochlora minor	Ocellated Emerald	S1			2	91 ±1
i	Somatochlora kennedyi	Kennedy's Emerald	S1			1	88 ±1
i	Somatochlora incurvata	Incurvate Emerald	S1			3	78 ±1
i	Somatochlora franklini	Delicate Emerald	S1			2	71 ±1
i	Somatochlora cingulata	Lake Emerald	S1			3	89 ±0.1
i	Dorocordulia lepida	Petite Emerald	S1			2	60 ±1
i	Boyeria vinosa	Fawn Darner	S1			2	87 ±1
i	Basiaeschna janata	Springtime Darner	S1			3	85 ±1
i	Aeshna subarctica	Subarctic Darner	S1			2	60 ±1
i	Ophiogomphus mainensis	Maine Snaketail	S1			1	17 ±0.1
i	Ophiogomphus aspersus	Brook Snaketail	S1			3	53 ±0.1
i	Oeneis jutta ascerta	Jutta Arctic	S1			1	67 ±0.1
i	Polygonia gracilis	Hoary Comma	S1			1	54 ±1
i	Satyrium acadica	Acadian Hairstreak	S1			3	57 ±1
i	Lycaena hyllus	Bronze Copper	S1			1	101 ±0
a	Vireo gilvus	Warbling Vireo	S1?B			4	6 ±5
a	Toxostoma rufum	Brown Thrasher	S1?B			2	55 ±5
a	Tringa solitaria	Solitary Sandpiper	S1?B,S4S5M			2	7 ±0.5
a	Hylocichla mustelina	Wood Thrush	S1B			7	6 ±5
a	Progne subis	Purple Martin	S1B			1	73 ±0.5
a	Nycticorax nycticorax	Black-crowned Night-heron	S1B			1	9 ±5
a	Alca torda	Razorbill	S1B,S4N			1	94 ±5
a	Myotis septentrionalis	Northern Long-eared Bat	S1S2			1	61 ±1
a	Picoides dorsalis	American Three-toed Woodpecker	S1S2			4	38 ±5

i	Nymphalis vaualbum j-album	Compton Tortoiseshell	S1S2	1	93 ±1
a	Passerina cyanea	Indigo Bunting	S1S2B	1	22 ±5
a	Eremophila alpestris	Horned Lark	S1S2B,S4N	1	78 ±5
a	Charadrius semipalmatus	Semipalmated Plover	S1S2B,S5M	2	83 ±5
a	Microtus chrotorrhinus	Rock Vole	S2	1	84 ±10
a	Salmo salar	Atlantic Salmon	S2	67	8 ±10
a	Asio otus	Long-eared Owl	S2	9	9 ±5
i	Lampsilis radiata	Eastern Lampmussel	S2	18	15 ±0.1
i	Lestes eurinus	Amber-Winged Spreadwing	S2	2	60 ±1
i	Leucorrhinia glacialis	Crimson-Ringed Whiteface	S2	9	55 ±0.1
i	Somatochlora septentrionalis	Muskeg Emerald	S2	1	97 ±0.1
i	Somatochlora forcipata	Forcipate Emerald	S2	5	79 ±0.1
i	Gomphus spicatus	Dusky Clubtail	S2	5	70 ±0.1
i	Gomphus descriptus	Harpoon Clubtail	S2	7	53 ±0.1
i	Polygonia satyrus	Satyr Comma	S2	2	89 ±0.1
i	Callophrys lanoraieensis	Bog Elfin	S2	2	94 ±1
i	Callophrys niphon	Eastern Pine Elfin	S2	1	99 ±1
i	Lycaena dospassosi	Salt Marsh Copper	S2	2	96 ±0.1
i	Pieris oleracea	Mustard White	S2	13	81 ±1
i	Amblyscirtes vialis	Common Roadside-Skipper	S2	2	57 ±1
i	Thorybes pylades	Northern Cloudywing	S2	2	53 ±1
a	Vireo philadelphicus	Philadelphia Vireo	S2?B	7	6 ±5
a	Piranga olivacea	Scarlet Tanager	S2B	6	24 ±0.1
a	Myiarchus crinitus	Great Crested Flycatcher	S2B	2	65 ±5
a	Empidonax traillii	Willow Flycatcher	S2B	1	74 ±5
a	Rallus limicola	Virginia Rail	S2B	7	15 ±5
a	Anas acuta	Northern Pintail	S2B	15	16 ±10
a	Bucephala clangula	Common Goldeneye	S2B,S5N	39	7 ±10
i	Alasmidonta undulata	Triangle Floater	S2S3	5	34 ±10
i	Erynnis juvenalis	Juvenal's Duskywing	S2S3	1	10 ±1
a	Icterus galbula	Baltimore Oriole	S2S3B	18	6 ±5
a	Pooecetes gramineus	Vesper Sparrow	S2S3B	8	6 ±5
i	Amphiagrion saucium	Eastern Red Damsel	S3	3	68 ±0.1
i	Nehalennia gracilis	Sphagnum Sprite	S3	9	60 ±1
i	Sympetrum semicinctum	Band-Winged Meadowhawk	S3	6	70 ±0.1
i	Sympetrum danae	Black Meadowhawk	S3	8	6 ±0.1
i	Nannothemis bella	Elfin Skimmer	S3	2	49 ±0.1
i	Somatochlora williamsoni	Williamson's Emerald	S3	1	100 ±0.5
i	Somatochlora walshii	Brush-Tipped Emerald	S3	5	60 ±1
i	Somatochlora elongata	Ski-Tailed Emerald	S3	12	65 ±1
i	Epitheca spinigera	Spiny Baskettail	S3	3	91 ±1
i	Dorocordulia libera	Racket-Tailed Emerald	S3	12	55 ±0.1
i	Gomphaeschna furcillata	Harlequin Darner	S3	3	49 ±0.1
i	Boyeria grafiana	Ocellated Darner	S3	4	77 ±1
i	Aeshna eremita	Lake Darner	S3	11	55 ±0.1
i	Aeshna constricta	Lance-Tipped Darner	S3	1	57 ±1
i	Aeshna clepsydra	Mottled Darner	S3	2	47 ±0.1
i	Ophiogomphus carolus	Riffle Snaketail	S3	17	9 ±0.1
i	Lanthus parvulus	Northern Pygmy Clubtail	S3	4	7 ±0.1
i	Cordulegaster maculata	Twin-Spotted Spiketail	S3	16	71 ±1
i	Enodia anthedon	Northern Pearly-Eye	S3	2	57 ±1
i	Nymphalis milberti milberti	Milbert's Tortoiseshell	S3	2	85 ±1
i	Polygonia faunus	Green Comma	S3	1	93 ±1
i	Euphydryas phaeton	Baltimore Checkerspot	S3	7	62 ±1
i	Hesperia comma laurentina	Laurentian Skipper	S3	3	11 ±1
i	Hesperia comma	Common Branded Skipper	S3	2	11 ±1
a	Coccyzus erythropthalmus	Black-billed Cuckoo	S3?B	27	9 ±5
a	Mimus polyglottos	Northern Mockingbird	S3B	12	6 ±5
a	Sterna paradisaea	Arctic Tern	S3B	36	6 ±5
a	Anas clypeata	Northern Shoveler	S3B	5	86 ±5
i	Polygonia interrogationis	Question Mark	S3B	4	57 ±1
a	Tringa melanoleuca	Greater Yellowlegs	S3B,S5M	19	9 ±5
a	Mergus serrator	Red-breasted Merganser	S3B,S5N	57	6 ±5
a	Limosa haemastica	Hudsonian Godwit	S3M	2	7 ±0.5
a	Numenius phaeopus	Whimbrel	S3M	9	7 ±0.5
a	Pluvialis dominica	American Golden-Plover	S3M	7	7 ±0.5
a	Calidris maritima	Purple Sandpiper	S3N	12	53 ±10
a	Synaptomys cooperi	Southern Bog Lemming	S3S4	1	84 ±10
a	Cardinalis cardinalis	Northern Cardinal	S3S4	4	15 ±0.1
a	Cepphus grylle	Black Guillemot	S3S4	29	6 ±1
i	Polygonia progne	Gray Comma	S3S4	3	62 ±1
i	Speyeria aphrodite	Aphrodite Fritillary	S3S4	4	7 ±1
i	Callophrys polios	Hoary Elfin	S3S4	1	15 ±1
i	Feniseca tarquinius	Harvester	S3S4	2	62 ±1
a	Sayornis phoebe	Eastern Phoebe	S3S4B	22	6 ±5

4.3 RANGE MAPS

The legally protected taxa listed below are linked to the study area by predictive range maps based upon expert estimates of distribution. Ranges of rank 1 indicate possible occurrence, those of rank 2 and 3 increasingly less probable.

	scientific name	common name	prov. status	COSEWIC	range rank
a	Glyptemys insculpta	Wood Turtle	Vulnerable	T	1
p	Symphyotrichum laurentianum	Gulf of St. Lawrence Aster		T	1
a	Bucephala islandica	Barrow's Goldeneye (Eastern pop.)		SC	2
p	Lechea maritima var. subcylindrica	Beach Pinweed		SC	2
p	Symphyotrichum subulatum (Bathurst pop)	Bathurst Saltmarsh Aster		SC	1
p	Isoetes prototypus	Prototype Quillwort	Vulnerable	SC	1
p	Eriocaulon parkeri	Parker's Pipewort		NAR	2
a	Alces alces (NS mainland)	Moose	Endangered		1
p	Listera australis	Southern Twayblade			1

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APPENDIX G

MAINLAND MOOSE STUDY

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Moose Pellet Survey for Wind Prospect Wind Farm
Fairmount, Antigonish County

Prepared for:
Wind Prospect Inc.
Suite 1030
1791 Barrington Street
Halifax, NS B3J 3L1

Prepared by:
Jody Hamper

PURPOSE:

On October 27, 2003 the province of Nova Scotia classified the mainland moose (A.a. Americana subspecies) as a "red" species (at risk or potentially at risk). Consequently, the mainland moose are protected under the *Nova Scotia Endangered Species Act* (NSDNR *ESA*, 2004).

The purpose of the Moose Study conducted on April 30-May 1, 2011 is to ensure that the wind farm development in Fairmont, Antigonish will not threaten the mainland moose population in the area.

METHODS:

Moose biologist transects were set up by Forest Resources technician, Jody Hamper with advice from Mark Pulsifer, DNR biologist.

A map and aerial photo of the site was provided by Andy MacCullum. From these documents, transects from different stand types and land contours were identified and selected.

These transects were walked the weekend of April 30-May 1. Both days were overcast with a light mist in the afternoon. A total of one pellet pile was encountered and heavy browsing on striped maple and red berried elder was evident. The map attached has the lengths of each transect as well as the coordinates of the moose pellets.

FINDINGS:

Figure 1. Location of nearest moose pellet in relation to the wind farm sites

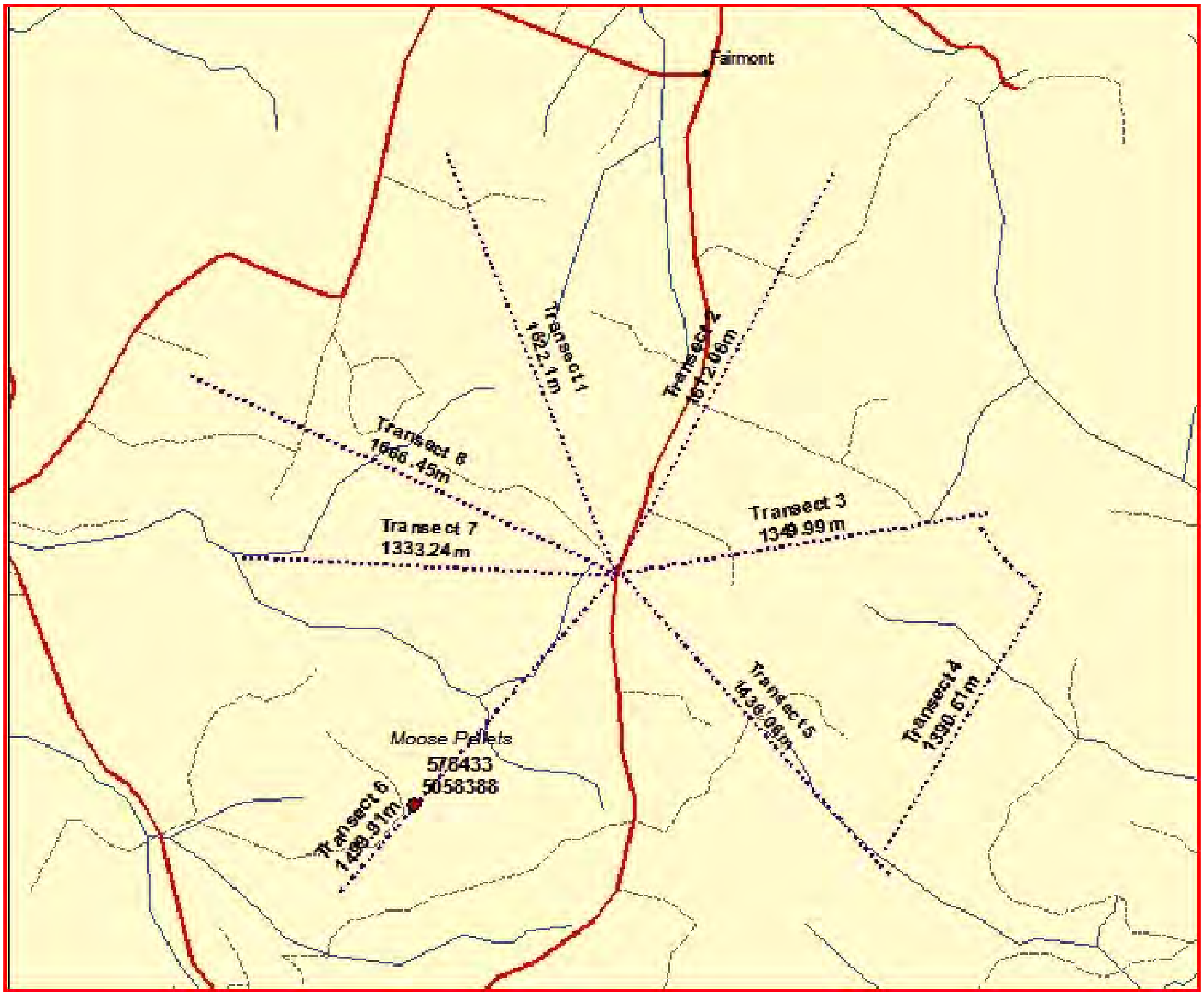

Figure 2: Location of the transects taken for the Moose study

Transect 1 - This transect went through different ages of cutovers. In between these cutovers were young stands of spruce/fir mix. There was also an over-mature hardwood stand on the transect, a gorge with brook in it, and the last of the transect was grassy, wet with young intolerant hardwood. There was some sign of browsing on the striped maple.

Transect 2- This transect crossed over a provincial road and some houses were located near the transect. Most of this transect was young softwood with scattered intolerant hardwood throughout. The back of the transect was immature-to-mature softwood and there was evidence of logging from the winter past. The red berried elder was heavily browsed on this transect.

Transect 3- The front of this transect was immature softwood. There was a fresh cutover that led into an immature stand of intolerant hardwood. The back end of this transect crossed over a stream and into a mature-to-over-mature hardwood stand. Heavy browsing was evident on the striped maple. There were signs of pre-commercial thinning on this transect, as well.

Transect 4- Half of this transect passed through an over-mature hardwood stand which crossed through a gorge with a brook running in it. The last part of the transect was through an immature intolerant hardwood stand.
Transect 5- The front of this transect was a young spruce/fir stand, wet in places. It then crossed through a mature stand of softwood with the last stretch on a side hill of over-mature hardwood.

Transect 6- The front part of this transect was an old cutover with scattered young spruce. It then went through a mature-to-over-mature mixed-wood stand and finished up in a young mixed-wood stand. Some of this transect had signs of pre-commercial thinning. There were some moose pellets discovered on this transect. They were in an open area of the young mixed wood stand.

Transect 7- The first part of this transect was through a young spruce/fir stand. The middle part of the transect passed through a mature-to-over-mature stand of hardwood. The last part of this transect was through an old cutover with young, intolerant hardwood coming up.

Transect 8 - The first part of this transect went through an immature stand of mixed-wood. There was an over-mature stand of hardwood in the middle of this transect. There was also a couple of hundred meters of young intolerant hardwood. The last section of this transect was through mature-to-over-mature mixed-wood and the ground was very wet in spots.

CONCLUSION:

Overall, based on the moose study conducted and advice from a forest resources technician and the local DNR biologist, the Fairmont wind project will not negatively impact the Mainland Moose in the area.

APPENDIX H

NOISE IMPACT ASSESSMENT

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Fairmont Wind Farm
Noise Impact Assessment Report
May 2011

CONFIDENTIALITY

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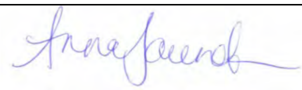
Report and Revision Information

Client		Wind Prospect Inc.			
Client Contact		Andy MacCallum			
Report Number		FMT_EA_Noise_v0			
Created By		Anna Saunders			
Signature					
Revision Control					
Revision	Date	Issue	By	Check	Appr.
N/A	May 2 2011	Initial release	AES	AK	AES
2.0	July 7 2011	Removal of irrelevant Annexes**	AM	AP	AM

** The WindPRO v2.7, Decibel Module Calculation Results for the Enercon E82-2.0 @ 78m Hub Height, Enercon E82-2.0 @ 85m Hub Height, Enercon E82-2.0 @ 98m Hub Height, Enercon E82-2.3 @ 85m Hub Height, Enercon E82-2.3 @ 98m Hub Height, and the Vestas V90-2.0 @ 80m have been omitted from the Annexes in order to save printing excessive paper.
To review omitted Annexes please contact:

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Table of Contents

List of Figures

List of Tables

List of Annexes

1. Introduction

Wind Prospect Inc. USA has undertaken a noise impact assessment for the proposed Fairmont Wind Farm site to assess the impact of the wind farm's sound emissions on the surrounding points of immission. Details outlining the project, immission receptors, prediction methodology and assumptions made for the assessment are included herein, with WindPRO results for one turbine supplied in the annexes. This assessment will be used as supporting documentation to demonstrate compliance with the Land Use By-laws for the County of Antigonish which state in Section 5.4-h) "*The mean value of sound pressure level from a wind turbine shall not exceed 40dBA or above the existing background noise, whichever is greater, at the nearest residence*;".

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 2.7.

2. General Description of Project Site and Surrounds

The proposed Fairmont Wind Farm consists of two wind turbine generators (WTGs) located in the Municipality of the County of Antigonish, Nova Scotia. Currently, three WTG types with varying hub heights are under consideration for the project, as outlined in Section 4. The project site is approximately 6 kilometers (km) due north of the town of Antigonish. The site is bounded by the Fairmont Road to the east, Cloverville Road to the west, and Walsh Post Road to the north. Land around the proposed project area is currently zoned GR-1 General Resource, however a planning application has been submitted with a request for the WTG locations to be re-zoned as WR-1 Wind Resource. A map of the site and surrounding receptors is included in Annex A.

The predominant noise sources in the area are from light road traffic along Fairmont and Cloverville roads, recreational vehicle activities, and the natural environment.

3. Description of Receptors

The points of reception taken into consideration for this noise impact assessment are residential buildings located within 1,500 metres (m) of the nearest proposed WTG, of which none are participants in the project. The receptors are located on Fairmont, Cloverville, Walsh Post and Triton Brook Roads, and Triton Brook Court. Details of receptor locations and distances to nearest WTG are detailed in Table 1. Receptor ID numbers included in Table 1 correspond with the labels on the map in Annex A as well as with the WindPRO generated map included in Annex B.

Noise level predictions at various wind speeds for the receptors are tabulated in Table 1.

Table 1 – Description of receptors

Point of Reception ID	Location (UTM Zone 20, NAD 83)		Distance from Receptor to nearest WTG (m)
	Easting	Northing	
A	578,188	5,060,329	1,126
B	578,218	5,060,207	1,001
C	579,402	5,060,222	1,274
D	579,432	5,060,026	1,156
E	579,466	5,059,899	1,105
F	579,438	5,059,752	1,001
G	577,298	5,059,063	1,279
H	577,575	5,058,595	1,192
I	577,638	5,058,353	1,298
J	577,649	5,058,258	1,357
K	577,283	5,058,662	1,412
L	577,321	5,058,617	1,399
M	577,863	5,060,341	1,281
N	577,236	5,059,152	1,329
O	577,407	5,058,515	1,376
P	577,487	5,058,425	1,363
Q	577,420	5,058,375	1,447
R	577,594	5,058,281	1,380
S	577,124	5,059,007	1,459
T	577,187	5,058,914	1,417
U	579,567	5,059,694	1,048
V	579,663	5,059,665	1,103
W	579,770	5,059,594	1,150
X	579,845	5,059,563	1,200
Y	579,915	5,059,642	1,299
Z	579,975	5,059,522	1,298

Point of Reception ID	Location (UTM Zone 20, NAD 83)		Distance from Receptor to nearest WTG (m)
	Easting	Northing	
AA	579,941	5,059,794	1,403
AB	578,251	5,060,351	1,128
AC	578,639	5,057,540	1,455
AD	580,067	5,059,494	1,371
AE	579,974	5,059,613	1,337
AF	580,111	5,059,571	1,441
AG	577,543	5,058,327	1,384
AH	577,614	5,058,168	1,436
AI	577,193	5,059,183	1,370

4. Description of Sources

4.1. Turbine Locations

A map of the project area with the proposed WTG layout is illustrated in Annex A. There are no existing or proposed wind farms nearby the project, thus there will be no cumulative noise effects. UTM coordinates of the WTGs are given below in Table 2. WTG ID numbers included in Table 2 correspond with the labels on the map in Annex A as well as with the WindPRO generated maps included Annex B.

Table 2 – Coordinates of proposed turbine locations

WTG ID Number	Proposed WTG Location (UTM Zone 20, NAD 83)	
	Easting	Northing
1	578,560	5,059,266
2	578,793	5,058,987

4.2. Turbine Types

There are three models of WTG under consideration for the proposed project; the Enercon E82-2.0, the Enercon E82-2.3, and the Vestas V90-2.0. All three are horizontal axis, upwind, 3-bladed, variable pitch turbines. Table 3 below outlines their main characteristics.

Table 3 – Turbine characteristics

WTG Type	Rotor Diameter (m)	Hub Height (m)	Rated Output (MW)	Nominal Rotational Speed (rpm)
E82-2.0	82	78, 85, 98	2.0	18
E82-2.3	82	78, 85, 98	2.3	18
V90-2.0	90	80	2.0	14.5

4.3. Power Curve Data

Power curves for the three WTGs are shown below in the following I Figures 1, 2 & 3.

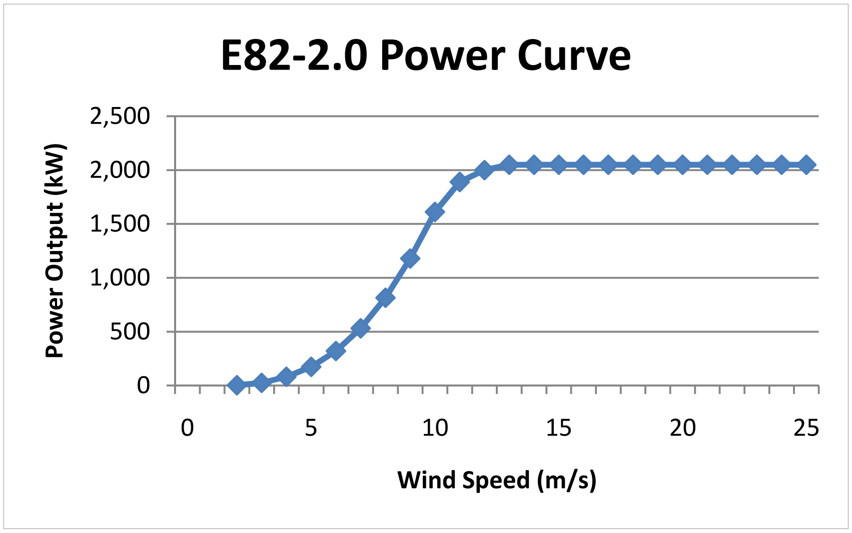

Figure 1 – Power curve for the Enercon E82-2.0

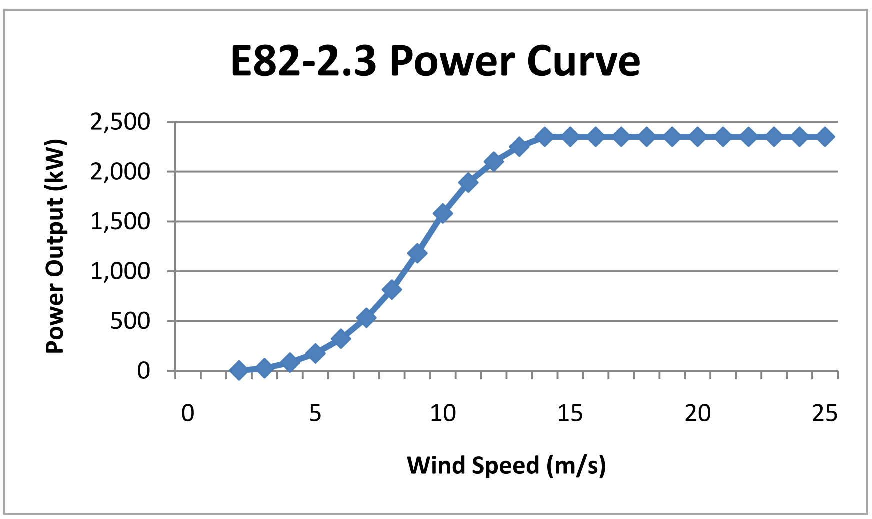

Figure 2 – Power curve for the Enercon E82-2.3

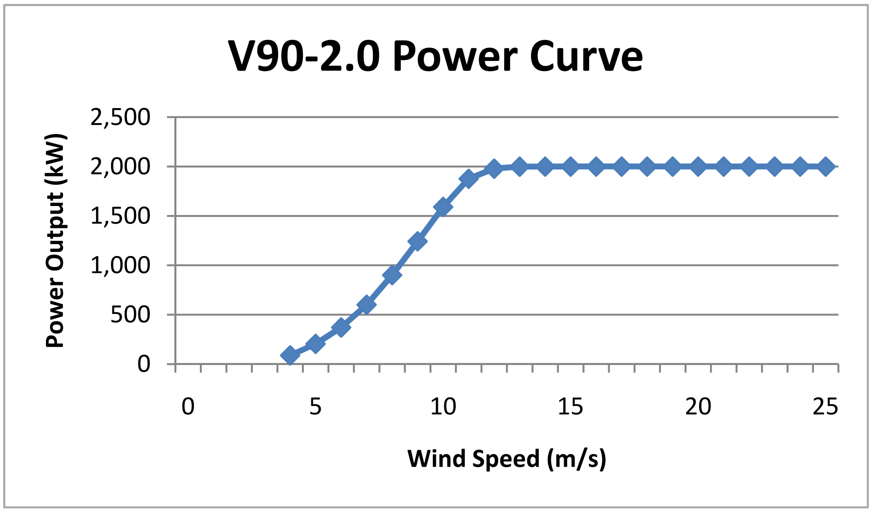

Figure 1 – Power curve for the Vestas V90-2.0

5. Wind Turbine Noise Emission Rating

5.1. Enercon E82 2.0MW

The noise emission data for the Enercon E82-2.0 WTG, shown in Table 4Table 5 & Table 6 below, was provided by Enercon Canada (2010). The SPLs 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 1.225kg/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 (SPL) values in order to complete the calculation. These source noise levels are incorporated in the prediction calculations referenced in Section 6.

5.1.1. 78m Hub Height

Table 4 – E82-2.0 noise emission data for 78m 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	95.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5	97.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6	99.5	85.2	90.4	91.5	93.9	94.6	88.3	75.3	75.3
7	101.5	85.6	91.6	93.0	96.2	96.8	91.0	77.7	76.9
8	102.4	85.3	92.6	94.3	97.2	97.4	92.2	79.5	73.8
9	102.6	85.5	92.8	94.5	97.4	97.6	92.4	79.7	72.0
10	102.2	85.4	93.4	93.0	96.1	97.5	93.5	82.1	74.2
11	101.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
12	101.4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

5.1.2. 85m Hub Height

Table 5 – E82-2.0 noise emission data for 85m 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	95.9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5	97.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6	99.7	85.4	90.6	91.7	94.1	94.8	88.5	75.5	75.5
7	101.6	85.7	91.7	93.1	96.3	96.9	91.1	77.8	77.0
8	102.4	85.3	92.6	94.3	97.2	97.4	92.2	79.5	73.8
9	102.4	85.4	93.4	93.9	97.0	97.5	92.3	80.3	73.6
10	102.1	85.3	93.3	92.9	96.0	97.4	93.4	82.0	74.1
11	101.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
12	101.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

5.1.3. 98m Hub Height

Table 6 – E82-2.0 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	96.4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5	98.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6	100.0	85.7	90.9	92.0	94.4	95.1	88.8	75.8	75.8
7	101.8	85.9	91.9	93.3	96.5	97.1	91.3	78.0	77.2
8	102.5	85.4	92.7	94.4	97.3	97.5	92.3	79.6	73.9
9	102.4	85.4	93.4	93.9	97.0	97.5	92.3	80.3	73.6
10	102.0	85.2	93.2	92.8	95.9	97.3	93.3	81.9	74.0
11	101.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
12	101.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

5.2. Enercon E82 2.3MW

The noise emission data for the Enercon E82-2.3 WTG, shown in Table 7, Table 8 Table 9 below, was provided by Enercon Canada (2010). The SPLs 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 1.225kg/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 SPL values in order to complete the calculation. These source noise levels are incorporated in the prediction calculations referenced in Section 6.

5.2.1. 78m Hub Height

Table 7 – E82-2.3 noise emission data for 78m 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	90.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5	95.3	81.2	87.2	87.7	89.9	89.7	83.4	71.0	70.3
6	99.9	84.2	89.9	91.3	95.0	95.2	88.3	75.1	74.7
7	102.2	85.1	92.4	93.8	97.2	97.3	91.0	78.1	74.0
8	103.1	85.5	93.1	94.5	98.1	98.4	92.1	79.3	73.3
9	103.4	86.7	94.7	94.4	97.4	98.8	93.9	81.6	73.5
10	103.1	87.2	94.8	93.9	96.7	98.5	94.2	82.7	75.4
11	102.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
12	102.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

5.2.2. 85m Hub Height

Table 8 – E82-2.3 noise emission data for 85m 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	90.9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5	95.5	81.4	87.4	87.9	90.1	89.9	83.6	71.2	70.5
6	100.1	84.4	90.1	91.5	95.2	95.4	88.5	75.3	74.9
7	102.3	85.2	92.5	93.9	97.3	97.4	91.1	78.2	74.1
8	103.1	85.5	93.1	94.5	98.1	98.4	92.1	79.3	73.3
9	103.4	86.7	94.7	94.4	97.4	98.8	93.9	81.6	73.5
10	103.1	87.2	94.8	93.9	96.7	98.5	94.2	82.7	75.4
11	102.9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
12	102.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

5.2.3. 98m Hub Height

Table 9 – E82-2.3 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	91.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5	96.0	81.9	87.9	88.4	90.6	90.4	84.1	71.7	71.0
6	100.4	84.7	90.4	91.8	95.5	95.7	88.8	75.6	75.2
7	102.5	85.4	92.7	94.1	97.5	97.6	91.3	78.4	74.3
8	103.2	85.6	93.2	94.6	98.2	98.5	92.2	79.4	73.4
9	103.4	86.7	94.7	94.4	97.4	98.8	93.9	81.6	73.5
10	103.0	87.1	94.7	93.8	96.6	98.4	94.1	82.6	75.3
11	102.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
12	102.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

5.3. Vestas V90 2.0MW

The noise emission data for the Vestas V90-2.0 WTG, shown in Table 10 below, was provided by Vestas (2010). The SPLs were measured to IEC 61400-11 standards which stipulate measurements at a height of 10m a.g.l., with an air density of 1.225kg/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 an appropriate SPL value in order to complete the calculation. These source noise levels are incorporated in the prediction calculations referenced in Section 6.

Table 10 – V90-2.0 noise emission data for 80m 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	96.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5	99.4	79.1	84.2	89.2	92.3	93.7	93.4	90.7	78.5
6	102.5	81.8	88.0	92.5	95.6	97.3	96.0	93.2	81.8
7	103.6	84.6	90.0	93.8	96.6	98.3	96.7	94.5	84.4
8	104.0	86.1	90.6	94.6	97.5	98.2	97.1	94.8	83.7
9	104.0	85.8	90.4	94.8	97.9	98.1	97.0	94.3	82.3
10	104.0	85.8	90.4	94.8	98.0	98.1	97.0	94.2	82.2
11	104.0	85.8	90.4	94.8	98.0	98.1	97.0	94.2	82.2
12	104.0	85.8	90.4	94.8	98.0	98.1	97.0	94.2	82.2

6. Impact Assessment

6.1. Prediction Methodology

The SPL was calculated at each point of reception (listed in Table 1) using the Decibel module of WindPRO v.2.7 which uses the ISO 9613-2 model "Attenuation of sound during propagation outdoors, Part 2: A general method of calculation". This was repeated for each WTG type and hub height outlined in Table 3. A ground attenuation factor of 0.0 was used for each scenario, which is equivalent to sound propagating over frozen ground, a concrete paved surface or otherwise non-porous and hard ground with minimal sound attenuation properties. This is a worst-case assumption and results in a conservative prediction. The WindPRO generated noise contour map for the Enercon E82-2.3 at 78m hub height can be found in Annex B

As a conservative measure, downwind propagation has been assumed to occur simultaneously in all directions and from all WTGs. Furthermore, no attenuation from topographical shielding (other buildings, barns, trees etc.) has been considered between the WTGs and receptors. In reality, noise propagation in an upwind direction would lead to a significant reduction of incident noise levels at receptors located in the upwind direction.

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 WTGs in a well designed wind farm. Furthermore, the absence of tonal noise is normally guaranteed by WTG manufacturers and 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.

6.2. Results of Noise Predictions

The results of the noise prediction model at each point of immission, as summarized in

Table 11, prove compliance with the Land Use By-laws for the County of Antigonish which state in Section 5.4-h) "*The mean value of sound pressure level from a wind turbine shall not exceed 40dBA or above the existing background noise, whichever is greater, at the nearest residence*;". As the By-law requirement has been exceeded, it was deemed unnecessary to conduct noise monitoring to establish background noise levels.

The receptor with the highest perceived noise immission for each WTG model and height was receptor F, which received a maximum emission of 35.9dB(A) from the E82 2.3MW machine, at both 78m and 85m hub heights.

The modelled noise results for a wind speed of 9m/s, the 'noisiest' operational speed of a WTG, in the form of a noise area plot is mapped in Annexe B. The receptor ID labels on the contour plot correspond with the WindPRO ID listed in Table 11.

Table 11 – Wind turbine noise impact assessment summary

Point of Reception ID	Distance from Receptor to Nearest WTG (m)	Maximum SPL Emitted by a WTG Predicted at Receptor (dB(A))							Compliance with 40dB(A) Limit (Yes/No)
		E82-2.0 @ 78m	E82-2.0 @ 85m	E82-2.0 @ 98m	E82-2.3 @ 78m	E82-2.3 @ 85m	E82-2.3 @ 98m	V90-2.0 @ 80m	
A	1,126	32.7	32.5	32.5	33.4	33.4	31.4	32.8	Yes
B	1,001	33.8	33.6	33.6	34.5	34.5	32.5	34.0	Yes
C	1,274	32.2	32.0	32.0	32.9	32.9	30.9	32.3	Yes
D	1,156	33.4	33.2	33.2	34.1	34.1	32.1	33.5	Yes
E	1,105	34.0	33.8	33.8	34.7	34.7	32.7	34.2	Yes
F	1,001	35.2	35.0	35.0	35.9	35.9	33.9	35.4	Yes
G	1,279	31.7	31.5	31.5	32.4	32.4	30.4	31.8	Yes
H	1,192	32.9	32.7	32.7	33.6	33.6	31.6	33.0	Yes
I	1,298	32.2	32.1	32.1	32.9	32.9	30.9	32.4	Yes
J	1,357	31.8	31.6	31.6	32.5	32.5	30.5	31.9	Yes
K	1,412	30.9	30.7	30.7	31.6	31.6	29.6	31.0	Yes
L	1,399	31.1	30.9	30.9	31.8	31.8	29.7	31.2	Yes
M	1,281	31.3	31.1	31.1	32.0	32.0	30.0	31.4	Yes
N	1,329	31.2	31.1	31.1	31.9	31.9	29.9	31.4	Yes
O	1,376	31.3	31.2	31.2	32.0	32.0	30.0	31.4	Yes
P	1,363	31.5	31.4	31.4	32.2	32.2	30.2	31.7	Yes
Q	1,447	30.9	30.7	30.7	31.6	31.6	29.6	31.0	Yes
R	1,380	31.6	31.4	31.4	32.3	32.3	30.3	31.7	Yes
S	1,459	30.3	30.2	30.2	31.0	31.0	29.0	30.4	Yes
T	1,417	30.7	30.5	30.5	31.4	31.4	29.4	30.8	Yes
U	1,048	34.5	34.3	34.3	35.2	35.2	33.2	34.7	Yes
V	1,103	33.8	33.7	33.7	34.6	34.5	32.5	34.0	Yes
W	1,150	33.3	33.1	33.1	34.0	34.0	32.0	33.4	Yes
X	1,200	32.8	32.6	32.6	33.5	33.5	31.5	32.9	Yes
Y	1,299	32.0	31.8	31.8	32.7	32.7	30.7	32.1	Yes
Z	1,298	31.8	31.7	31.7	32.6	32.6	30.6	32.0	Yes
AA	1,403	31.2	31.1	31.1	31.9	31.9	29.9	31.3	Yes
AB	1,128	32.7	32.5	32.5	33.4	33.4	31.4	32.8	Yes
AC	1,455	30.2	30.1	30.1	31.0	31.0	28.9	30.3	Yes
AD	1,371	31.2	31.1	31.1	31.9	31.9	29.9	31.3	Yes

Point of Reception ID	Distance from Receptor to Nearest WTG (m)	Maximum SPL Emitted by a WTG Predicted at Receptor (dB(A))							Compliance with 40dB(A) Limit (Yes/No)
		E82-2.0 @ 78m	E82-2.0 @ 85m	E82-2.0 @ 98m	E82-2.3 @ 78m	E82-2.3 @ 85m	E82-2.3 @ 98m	V90-2.0 @ 80m	
AE	1,337	31.6	31.4	31.4	32.3	32.3	30.3	31.7	Yes
AF	1,441	30.7	30.6	30.6	31.4	31.4	29.4	30.8	Yes
AG	1,384	31.5	31.3	31.3	32.2	32.2	30.2	31.6	Yes
AH	1,436	31.1	31.0	31.0	31.9	31.8	29.8	31.3	Yes
AI	1,370	30.9	30.7	30.7	31.6	31.6	29.6	31.0	Yes

7. Conclusions and Recommendations

Wind Prospect Inc. USA has completed a thorough assessment to evaluate the noise impact of the proposed Fairmont Wind Farm at residential immission locations within 1,500m of a proposed WTG. Based on the parameters used to run the WindPRO noise prediction model, it has been shown that the predicted SPLs emitted by any of the proposed WTGs are less than 40dB(A), thus demonstrating compliance with the Antigonish Land Use By-laws, Section 5.4-h) "*The mean value of sound pressure level from a wind turbine shall not exceed 40dBA or above the existing background noise, whichever is greater, at the nearest residence*;". As a result of this study, no noise mitigation strategies are recommended.

8. References

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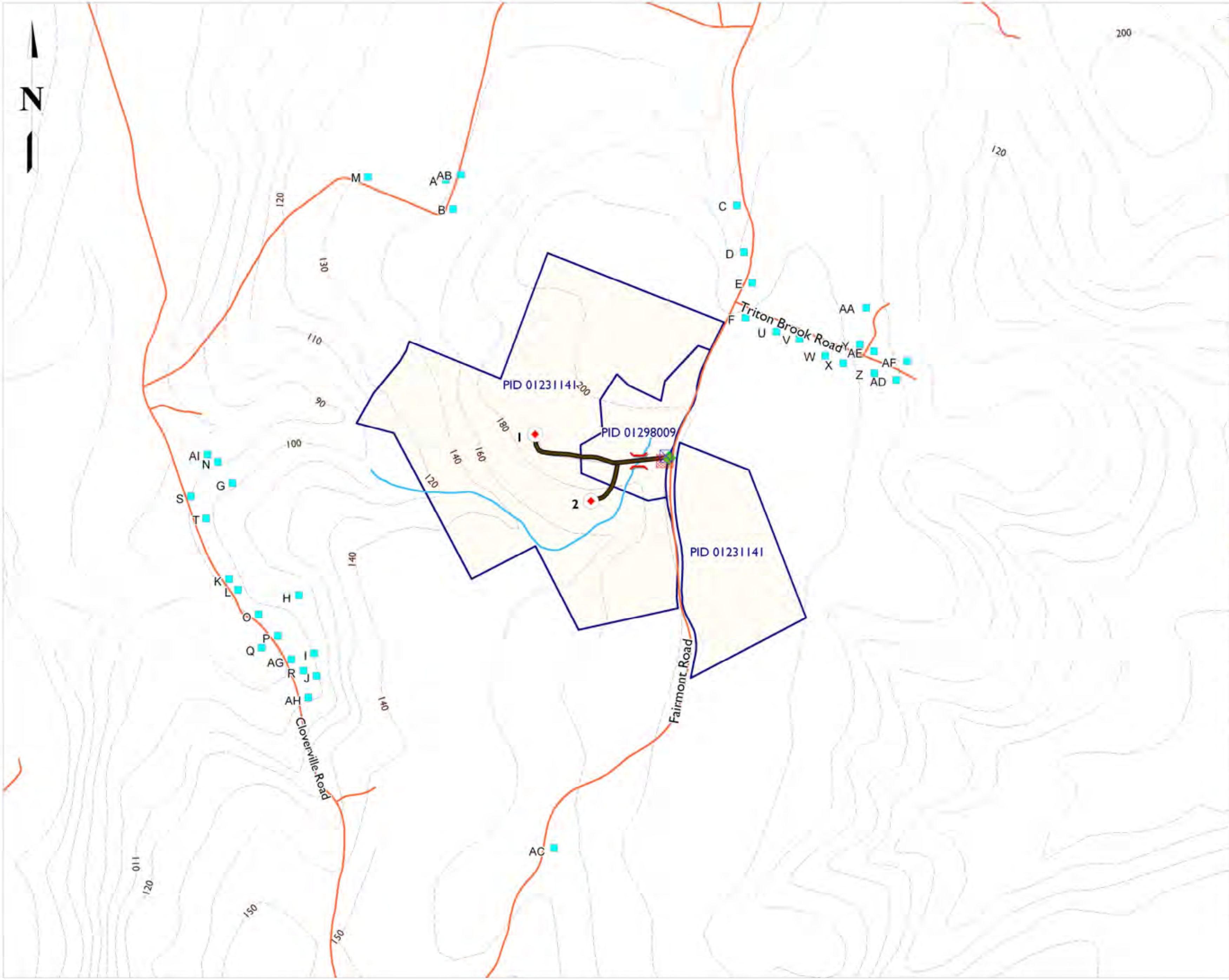
ANNEX A

Site Layout Map



LEGEND

- Project Land parcel boundary
- Turbine location
- Access road
- Collector line route
- Temporary construction compound
- Switchgear location
- Stream crossing
- Point of connection to NSPI network
- Road
- Elevation contours (metres)
- Stream
- Residence noise receptor

SCALE

0 0.5 1
kilometers

KEY MAP

County of Antigonish

PROJECT

Fairmont Wind Farm

FIGURE #

Annex A, Noise Assessment

TITLE

Site Layout

DATE

May 02 2011

Wind Prospect Inc.
1030-1791 Barrington Street
Halifax, NS B3J 3L1
Tel: 902.422.9663
Fax: 902.425.7840
Toll Free: 1.877.425.9663
www.windprospect.com

ANNEX B

WindPRO v2.7, Decibel Module Calculation Results

E82-2.3 @ 78m Hub Height

Project:
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DECIBEL - Assumptions for noise calculation

Calculation: E82 2MW @ 78.3m

Noise calculation model:
ISO 9613-2 General
Wind speed:
4.0 m/s - 12.0 m/s, step 1.0 m/s
Ground attenuation:
General, Ground factor: 0.0
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:
4.0 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	125	250	500	1,000	2,000	4,000	8,000
[db/km]	[db/km]	[db/km]	[db/km]	[db/km]	[db/km]	[db/km]	[db/km]
0.1	0.4	1.0	1.9	3.7	9.7	32.8	117.0

WTG: ENERCON E-82 2000 82.0 !O!
Noise: Noise E82-2.0 78m HH

Source	Source/Date	Creator	Edited
Enercon - Kotter Consulting Engineers (June 2010)	27/04/2011	USER	30/04/2011 11:29 AM

Status	Hub height [m]	Wind speed [m/s]	LwA,ref [dB(A)]	Pure tones		Octave data 63 [dB]	125 [dB]	250 [dB]	500 [dB]	1000 [dB]	2000 [dB]	4000 [dB]	8000 [dB]
ExtraPolated	78.3	4.0	95.5	No		84.4	88.0	88.5	89.3	90.2	82.9	70.5	72.1
Interpolated	78.3	5.0	97.5	No		84.8	89.2	90.0	91.6	92.4	85.6	72.9	73.7
From Windcat	78.3	6.0	99.5	No		85.2	90.4	91.5	93.9	94.6	88.3	75.3	75.3
From Windcat	78.3	7.0	101.5	No		85.6	91.6	93.0	96.2	96.8	91.0	77.7	76.9
From Windcat	78.3	8.0	102.4	No		85.3	92.6	94.3	97.2	97.4	92.2	79.5	73.8
From Windcat	78.3	9.0	102.6	No	From nearest other wind speed	85.5	92.8	94.5	97.4	97.6	92.4	79.7	74.0
From Windcat	78.3	10.0	102.2	No		85.4	93.4	93.0	96.1	97.5	93.5	82.1	74.2
ExtraPolated	78.3	11.0	101.8	No		85.3	94.0	91.5	94.8	97.4	94.6	84.5	74.4
ExtraPolated	78.3	12.0	101.4	No		85.2	94.6	90.0	93.5	97.3	95.7	86.9	74.6

NSA: Noise sensitive point: User defined (66)-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: 40.0 dB(A)
Distance demand: 1,000.0 m

NSA: Noise sensitive point: User defined (67)-B
Predefined calculation standard:
Imission height(a.g.l.): Use standard value from calculation model

Noise demand: 40.0 dB(A)

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DECIBEL - Assumptions for noise calculation

Calculation: E82 2MW @ 78.3m

Ambient noise: 0.0 dB(A)
Margin or Allowed additional exposure: 0.0 dB(A)
Sound level always accepted: 40.0 dB(A)
Distance demand: 1,000.0 m

NSA: Noise sensitive point: User defined (68)-C
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: 40.0 dB(A)
Distance demand: 1,000.0 m

NSA: Noise sensitive point: User defined (69)-D
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: 40.0 dB(A)
Distance demand: 1,000.0 m

NSA: Noise sensitive point: User defined (70)-E
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: 40.0 dB(A)
Distance demand: 1,000.0 m

NSA: Noise sensitive point: User defined (71)-F
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: 40.0 dB(A)
Distance demand: 1,000.0 m

NSA: Noise sensitive point: User defined (72)-G
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: 40.0 dB(A)
Distance demand: 1,000.0 m

NSA: Noise sensitive point: User defined (73)-H
Predefined calculation standard:
Imission height(a.g.l.): Use standard value from calculation model

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DECIBEL - Assumptions for noise calculation

Calculation: E82 2MW @ 78.3m

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: 40.0 dB(A)
Distance demand: 1,000.0 m

NSA: Noise sensitive point: User defined (74)-I
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: 40.0 dB(A)
Distance demand: 1,000.0 m

NSA: Noise sensitive point: User defined (75)-J
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: 40.0 dB(A)
Distance demand: 1,000.0 m

NSA: Noise sensitive point: User defined (76)-K
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: 40.0 dB(A)
Distance demand: 1,000.0 m

NSA: Noise sensitive point: User defined (77)-L
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: 40.0 dB(A)
Distance demand: 1,000.0 m

NSA: Noise sensitive point: User defined (78)-M
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: 40.0 dB(A)
Distance demand: 1,000.0 m

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DECIBEL - Assumptions for noise calculation

Calculation: E82 2MW @ 78.3m

NSA: Noise sensitive point: User defined (79)-N
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: 40.0 dB(A)
Distance demand: 1,000.0 m

NSA: Noise sensitive point: User defined (80)-O
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: 40.0 dB(A)
Distance demand: 1,000.0 m

NSA: Noise sensitive point: User defined (81)-P
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: 40.0 dB(A)
Distance demand: 1,000.0 m

NSA: Noise sensitive point: User defined (82)-Q
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: 40.0 dB(A)
Distance demand: 1,000.0 m

NSA: Noise sensitive point: User defined (83)-R
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: 40.0 dB(A)
Distance demand: 1,000.0 m

NSA: Noise sensitive point: User defined (84)-S
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: 40.0 dB(A)
Distance demand: 1,000.0 m

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DECIBEL - Assumptions for noise calculation

Calculation: E82 2MW @ 78.3m

NSA: Noise sensitive point: User defined (85)-T
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: 40.0 dB(A)
Distance demand: 1,000.0 m

NSA: Noise sensitive point: User defined (86)-U
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: 40.0 dB(A)
Distance demand: 1,000.0 m

NSA: Noise sensitive point: User defined (87)-V
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: 40.0 dB(A)
Distance demand: 1,000.0 m

NSA: Noise sensitive point: User defined (88)-W
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: 40.0 dB(A)
Distance demand: 1,000.0 m

NSA: Noise sensitive point: User defined (89)-X
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: 40.0 dB(A)
Distance demand: 1,000.0 m

NSA: Noise sensitive point: User defined (90)-Y
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: 40.0 dB(A)
Distance demand: 1,000.0 m

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DECIBEL - Assumptions for noise calculation

Calculation: E82 2MW @ 78.3m

NSA: Noise sensitive point: User defined (91)-Z
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: 40.0 dB(A)
Distance demand: 1,000.0 m

NSA: Noise sensitive point: User defined (92)-AA
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: 40.0 dB(A)
Distance demand: 1,000.0 m

NSA: Noise sensitive point: User defined (93)-AB
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: 40.0 dB(A)
Distance demand: 1,000.0 m

NSA: Noise sensitive point: User defined (94)-AC
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: 40.0 dB(A)
Distance demand: 1,000.0 m

NSA: Noise sensitive point: User defined (95)-AD
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: 40.0 dB(A)
Distance demand: 1,000.0 m

NSA: Noise sensitive point: User defined (96)-AE
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: 40.0 dB(A)
Distance demand: 1,000.0 m

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DECIBEL - Assumptions for noise calculation

Calculation: E82 2MW @ 78.3m

NSA: Noise sensitive point: User defined (97)-AF
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: 40.0 dB(A)
Distance demand: 1,000.0 m

NSA: Noise sensitive point: User defined (98)-AG
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: 40.0 dB(A)
Distance demand: 1,000.0 m

NSA: Noise sensitive point: User defined (99)-AH
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: 40.0 dB(A)
Distance demand: 1,000.0 m

NSA: Noise sensitive point: User defined (100)-AI
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: 40.0 dB(A)
Distance demand: 1,000.0 m

Project:
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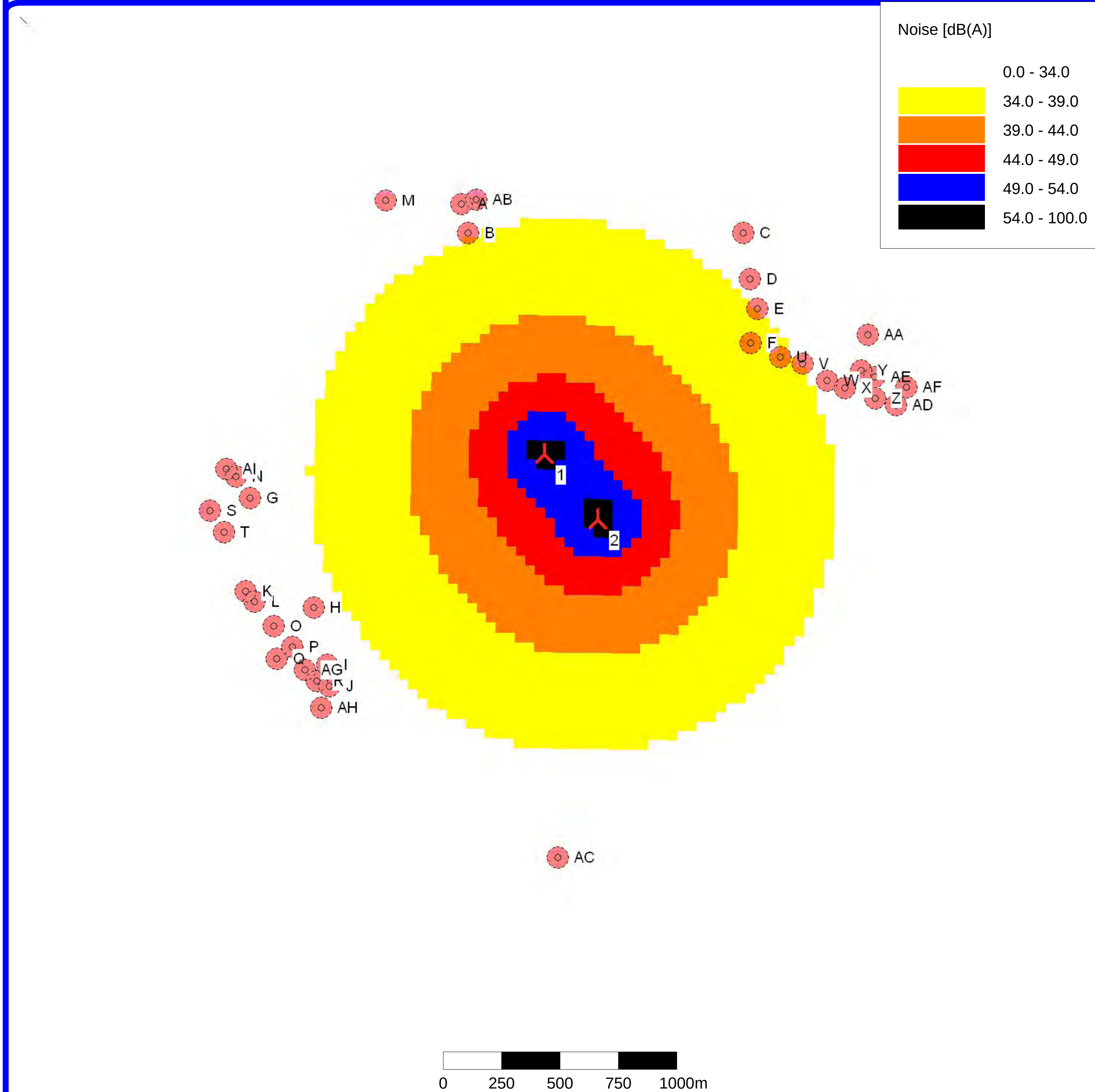
DECIBEL - Map 9.0 m/s

Calculation: E82 2MW @ 78.3m



Map: Blank map , Print scale 1:25,000, Map center UTM NAD 83 Zone: 20 East: 578,595 North: 5,058,892
Noise calculation model: ISO 9613-2 General. Wind speed: 9.0 m/s

New WTG   Noise sensitive area

APPENDIX I

SHADOW FLICKER ASSESSMENT

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Fairmont Wind Farm
Shadow Flicker Assessment Report
May 2011

CONFIDENTIALITY

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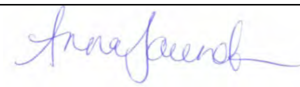
Report and Revision Information

Client	Wind Prospect Inc.
Client Contact	Andy MacCallum
Report Number	FMT_EA_Shadow_v0
Created By	Anna Saunders
Signature	

Revision Control

Revision	Date	Issue	By	Check	Appr.
N/A	May 2 2011	Initial release	AES	AK	AES
2.0	July 7 2011	Removal of irrelevant Annexes**	AM	AP	AM

** The WindPRO v2.7, Shadow Module Calculation Results for the Enercon E82-2.0 @ 78m Hub Height, Enercon E82-2.0 @ 85m Hub Height, Enercon E82-2.0 @ 98m Hub Height, Enercon E82-2.3 @ 85m Hub Height, Enercon E82-2.3 @ 98m Hub Height, and the Vestas V90-2.0 @ 80m have been omitted from the Annexes in order to save printing excessive paper.

To review omitted Annexes please contact:

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Table of Contents

List of Tables

List of Annexes

1. Introduction

Wind Prospect Inc. USA has undertaken a shadow flicker impact assessment for the proposed Fairmont Wind Farm site 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 some 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 2.7.

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 turbines, 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 wind turbine must be facing directly towards, or away from, the sun such that the rotational plane of the blades (rotor plane) is perpendicular to the azimuth of incident sun rays. For this to occur, the wind direction would have to perpetually be parallel to the azimuth of the incident sun rays throughout the day.
4. 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.
5. 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 very few federal, provincial or municipal 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 which 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 Fairmont Wind Farm consists of two wind turbine generators (WTGs) located in the Municipality of the County of Antigonish, Nova Scotia. Currently, three WTG types with varying hub heights are under consideration for the project, as outlined in Section 6. The project site is approximately 6 kilometers (km) due north of the town of Antigonish. The site is bounded by the Fairmont Road to the east, Cloverville Road to the west, and Walsh Post Road to the north. Land around the proposed project area is currently zoned GR-1 General Resource, however a planning application has been submitted with a request for the (WTG) locations to be re-zoned as WR-1 Wind Resource. A map of the site and receptors is included in Annex A.

5. Description of Receptors

The points of reception taken into consideration for this shadow flicker impact assessment are any residential buildings located within 2km of the nearest proposed wind turbine, of which none are participants in the project. The receptors are located on Fairmont, Cloverville, Walsh Post and Triton Brook Roads, and Triton Brook Court. Details of receptor locations and distances to nearest turbine are detailed in Table 1.

Shadow flicker predictions can be found in Table 4 through Table 7.

A map showing the project area, the proposed turbine layout and the shadow receptors is shown in Annex A.

Table 1 – Description of receptors

Point of Reception ID	Location (UTM Zone 20, NAD 83)		Distance from Receptor to nearest WTG (m)
	Easting	Northing	
A	578,188	5,060,329	1,126
B	578,218	5,060,207	1,001
C	579,402	5,060,222	1,274
D	579,432	5,060,026	1,156
E	579,466	5,059,899	1,105
F	579,438	5,059,752	1,001
G	577,298	5,059,063	1,279
H	577,575	5,058,595	1,192
I	577,638	5,058,353	1,298
J	577,649	5,058,258	1,357
K	577,283	5,058,662	1,412
L	577,321	5,058,617	1,399
M	577,863	5,060,341	1,281
N	577,236	5,059,152	1,329
O	577,407	5,058,515	1,376
P	577,487	5,058,425	1,363
Q	577,420	5,058,375	1,447
R	577,594	5,058,281	1,380
S	577,124	5,059,007	1,459
T	577,187	5,058,914	1,417
U	579,567	5,059,694	1,048
V	579,663	5,059,665	1,103
W	579,770	5,059,594	1,150
X	579,845	5,059,563	1,200

Point of Reception ID	Location (UTM Zone 20, NAD 83)		Distance from Receptor to nearest WTG (m)
	Easting	Northing	
Y	579,915	5,059,642	1,299
Z	579,975	5,059,522	1,298
AA	579,941	5,059,794	1,403
AB	578,251	5,060,351	1,128
AC	578,639	5,057,540	1,455
AD	580,067	5,059,494	1,371
AE	579,974	5,059,613	1,337
AF	580,111	5,059,571	1,441
AG	577,543	5,058,327	1,384
AH	577,614	5,058,168	1,436
AI	577,193	5,059,183	1,370
AJ	578,784	5,061,147	1,894
AK	578,413	5,057,261	1,768
AL	578,617	5,057,413	1,584
AM	579,421	5,061,002	1,938
AN	579,086	5,060,686	1,514
AO	579,072	5,060,714	1,536
AP	578,483	5,061,218	1,953
AQ	578,481	5,061,239	1,975
AR	578,401	5,057,215	1,814
AS	578,586	5,057,364	1,636
AT	578,405	5,057,179	1,849
AU	578,373	5,057,133	1,901
AV	577,440	5,058,188	1,555
AW	577,367	5,058,251	1,566
AX	577,850	5,057,444	1,808
AY	577,430	5,058,269	1,507

6. Description of Sources

6.1. Turbine Locations

A map of the project area with the proposed turbine layout is illustrated in Annex A. There are no existing or proposed wind farms nearby the project, thus there will be no cumulative shadow effects. UTM coordinates of the wind turbines are given below in Table 2. Turbine ID numbers included in Table 2 correspond with the labels on the map in Annex A as well as with the WindPRO generated figures included Annex B.

Table 2 – Coordinates of proposed turbine locations

Wind Turbine ID Number	Proposed Turbine Location (UTM Zone 20, NAD 83)	
	Easting	Northing
1	578,560	5,059,266
2	578,793	5,058,987

6.2. Turbine Types

There are three models of turbine under consideration for the proposed project; the Enercon E82-2.0, the Enercon E82-2.3, and the Vestas V90-2.0. All three are horizontal axis, upwind, 3-bladed, variable pitch turbines. Table 3 below outlines their main characteristics. Note that due to identical geometry, the E82-2.0 and E82-2.3 machines have shared results.

Table 3 – Turbine characteristics

WTG Type	Rotor Diameter (m)	Hub Height (m)	Rated Output (MW)	Nominal Rotational Speed (rpm)	Swept Area (m^2)
E82-2.0	82	78, 85, 98	2.0	18	5,281
E82-2.3	82	78, 85, 98	2.3	18	5,281
V90-2.0	90	80	2.0	14.5	6,362

7. Impact Assessment

7.1. Prediction Methodology

The shadow flicker impact was calculated at each point of reception (listed in Table 1) using the Shadow module of the software package, WindPRO version 2.7. 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. 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, where it can be seen that the closest residence to a WTG is 1,001m.

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.

The analysis was repeated for each WTG type and hub height outlined in Table 3. Table 4 through Table 7 provide results of the analysis for each WTG scenario at each point of immission. A full list of parameters assumed for the prediction are provided in Annex B.

7.2. Results of Shadow Flicker Predictions

The results of the shadow flicker prediction model at each point of immission, as summarized in Table 4 through Table 7, 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). Furthermore, some receptors within 2km of the WTGs will not encounter any shadow flicker impacts.

While all receptors are subject to less than 30hrs/year or 30mins/day, the worst affected receptors are D on Fairmont Rd, F and U on Triton Brook Rd, and K on Cloverville Rd. Tabulated results for each WTG scenario can be found below in Table 4 through Table 7, while modelled results representing shadow flicker hours per year and WindPRO generated shadow flicker calendars are mapped in Annex B. The calendars demonstrate the time intervals during which shadow flicker is experienced throughout the day (y-axis) and at what time of year (x-axis), referencing which turbine(s) the shadow is attributed to via colour coding. Receptor ID labels on the results in Annex B correspond with the WindPRO ID listed in Table 4 through Table 7.

Table 4 – Shadow immission values for E82-2.0 and E82-2.3 @ 78m

Point of Reception ID	Predicted Shadow Flicker at Receptors Astronomical Worst Case		
	Total hrs/yr (hr : min)	Days/year	Max mins/day (hr : min)
A	0:00	0	0:00
B	0:00	0	0:00
C	0:00	0	0:00
D	13:24	50	0:19
E	7:58	39	0:19
F	7:00	32	0:20
G	7:18	38	0:16
H	5:50	29	0:16
I	5:31	31	0:14
J	0:00	0	0:00
K	12:12	58	0:15
L	11:02	58	0:15
M	0:00	0	0:00
N	3:48	20	0:15
O	4:36	25	0:14
P	7:18	39	0:15
Q	7:10	40	0:14
R	0:00	0	0:00
S	3:32	20	0:14
T	4:12	24	0:15
U	8:38	50	0:16
V	10:20	75	0:14
W	6:15	44	0:14
X	5:19	40	0:13
Y	4:31	36	0:12
Z	4:24	36	0:13
AA	0:00	0	0:00
AB	0:00	0	0:00
AC	0:00	0	0:00
AD	3:57	31	0:12
AE	4:18	34	0:12
AF	2:14	18	0:12
AG	8:23	40	0:15
AH	0:00	0	0:00

Point of Reception ID	Predicted Shadow Flicker at Receptors Astronomical Worst Case		
	Total hrs/yr (hr : min)	Days/year	Max mins/day (hr : min)
AI	3:38	20	0:15
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	0:00	0	0:00
AQ	0:00	0	0:00
AR	0:00	0	0:00
AS	0:00	0	0:00
AT	0:00	0	0:00
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	8:31	43	0:14

Table 5 – Shadow immission values for E82-2.0 and E82-2.3 @ 85m

Point of Reception ID	Predicted Shadow Flicker at Receptors Astronomical Worst Case		
	Total hrs/yr (hr : min)	Days/year	Max mins/day (hr : min)
A	0:00	0	0:00
B	0:00	0	0:00
C	0:00	0	0:00
D	14:12	52	0:19
E	8:33	40	0:19
F	7:28	32	0:21
G	7:22	39	0:16
H	5:50	28	0:16
I	4:08	27	0:12
J	0:00	0	0:00
K	12:10	56	0:15
L	10:06	56	0:14
M	0:00	0	0:00
N	3:56	20	0:15
O	4:41	26	0:14
P	7:40	41	0:15
Q	7:23	42	0:14
R	0:00	0	0:00
S	3:31	20	0:14
T	4:16	23	0:15
U	10:58	54	0:17
V	12:00	78	0:15
W	7:14	47	0:15
X	6:10	42	0:15
Y	5:21	38	0:13
Z	5:06	38	0:14
AA	0:00	0	0:00
AB	0:00	0	0:00
AC	0:00	0	0:00
AD	4:32	33	0:13
AE	4:58	36	0:13
AF	2:35	19	0:13
AG	7:22	38	0:14
AH	0:00	0	0:00
AI	3:38	20	0:15
AJ	0:00	0	0:00
AK	0:00	0	0:00

Point of Reception ID	Predicted Shadow Flicker at Receptors Astronomical Worst Case		
	Total hrs/yr (hr : min)	Days/year	Max mins/day (hr : min)
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	0:00	0	0:00
AQ	0:00	0	0:00
AR	0:00	0	0:00
AS	0:00	0	0:00
AT	0:00	0	0:00
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	7:50	40	0:14

Table 6 – Shadow immission values for E82-2.0 and E82-2.3 @ 98m

Point of Reception ID	Predicted Shadow Flicker at Receptors Astronomical Worst Case		
	Total hrs/yr (hr : min)	Days/year	Max mins/day (hr : min)
A	0:00	0	0:00
B	0:00	0	0:00
C	0:00	0	0:00
D	15:25	58	0:19
E	9:08	38	0:19
F	8:14	32	0:21
G	7:20	39	0:16
H	6:00	29	0:16
I	1:15	14	0:07
J	0:00	0	0:00
K	11:17	51	0:15
L	7:34	47	0:13
M	0:00	0	0:00
N	3:55	20	0:15
O	4:43	27	0:14
P	8:27	45	0:15
Q	8:28	49	0:14
R	0:00	0	0:00
S	3:36	20	0:14
T	4:19	24	0:15
U	15:45	66	0:19
V	15:23	87	0:18
W	9:25	52	0:17
X	7:57	45	0:17
Y	6:59	44	0:15
Z	6:29	40	0:15
AA	2:58	19	0:14
AB	0:00	0	0:00
AC	0:00	0	0:00
AD	5:40	36	0:14
AE	6:21	40	0:15
AF	3:10	20	0:14
AG	5:11	31	0:12
AH	0:00	0	0:00
AI	3:41	20	0:15
AJ	0:00	0	0:00
AK	0:00	0	0:00

Point of Reception ID	Predicted Shadow Flicker at Receptors Astronomical Worst Case		
	Total hrs/yr (hr : min)	Days/year	Max mins/day (hr : min)
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	0:00	0	0:00
AQ	0:00	0	0:00
AR	0:00	0	0:00
AS	0:00	0	0:00
AT	0:00	0	0:00
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	6:15	35	0:13

Table 7 – Shadow immission values for V90-2.0 @ 80m

Point of Reception ID	Predicted Shadow Flicker at Receptors Astronomical Worst Case		
	Total hrs/yr (hr : min)	Days/year	Max mins/day (hr : min)
A	0:00	0	0:00
B	0:00	0	0:00
C	0:00	0	0:00
D	15:30	52	0:21
E	9:26	43	0:20
F	8:15	34	0:22
G	5:21	24	0:17
H	6:58	30	0:18
I	6:27	33	0:15
J	0:00	0	0:00
K	13:56	59	0:17
L	8:31	39	0:16
M	0:00	0	0:00
N	4:44	22	0:17
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	11:48	56	0:17
V	12:41	80	0:16
W	7:40	50	0:15
X	6:32	42	0:15
Y	5:42	41	0:13
Z	3:03	21	0:14
AA	0:00	0	0:00
AB	0:00	0	0:00
AC	0:00	0	0:00
AD	2:47	19	0:13
AE	3:09	22	0:14
AF	0:00	0	0:00
AG	9:29	42	0:16
AH	0:00	0	0:00
AI	4:21	22	0:16
AJ	0:00	0	0:00
AK	0:00	0	0:00

Point of Reception ID	Predicted Shadow Flicker at Receptors Astronomical Worst Case		
	Total hrs/yr (hr : min)	Days/year	Max mins/day (hr : min)
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	0:00	0	0:00
AQ	0:00	0	0:00
AR	0:00	0	0:00
AS	0:00	0	0:00
AT	0:00	0	0:00
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	0:00	0	0:00

8. Conclusions and Recommendations

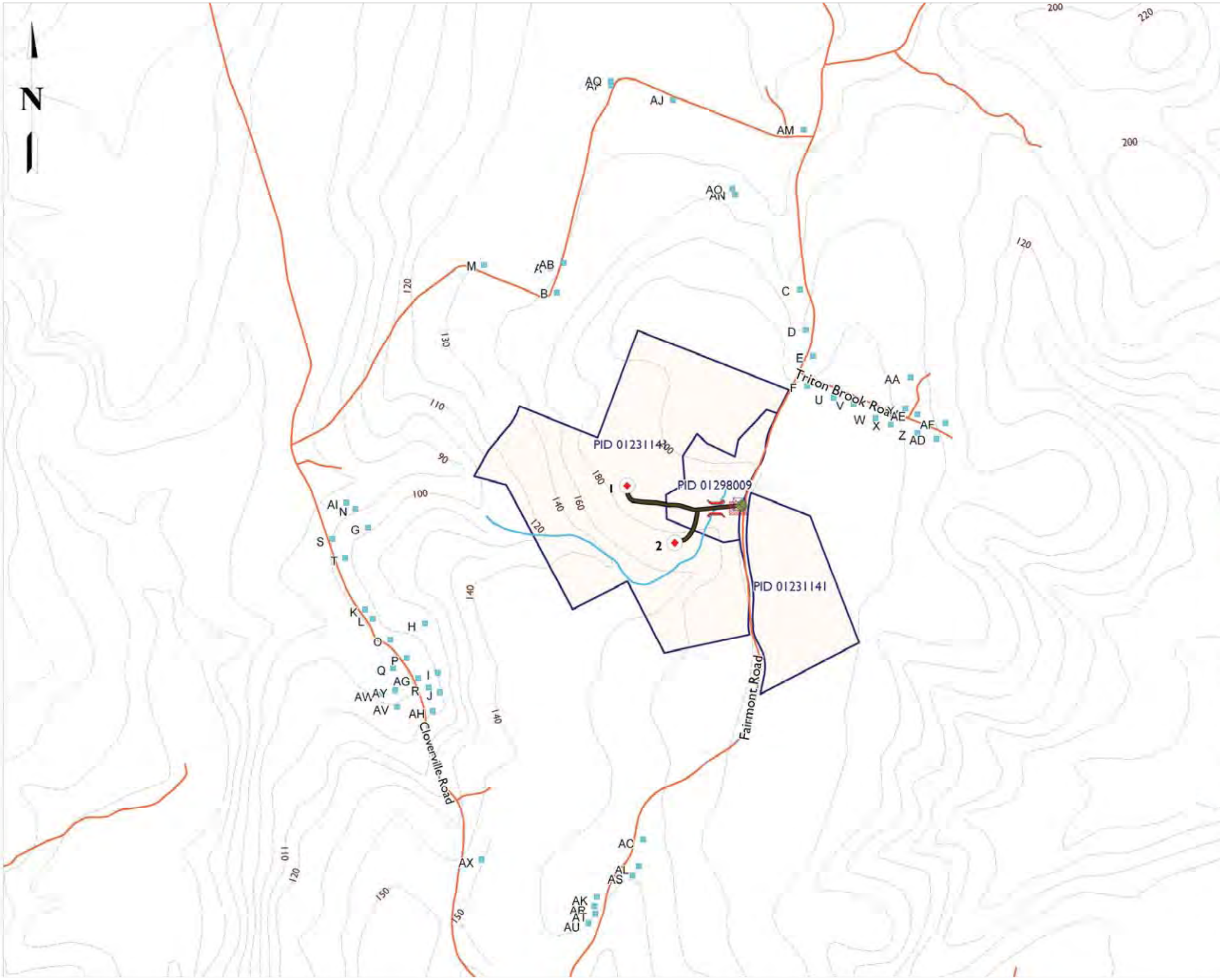
Wind Prospect Inc. USA has completed a thorough assessment to evaluate the astronomical worst case shadow flicker impact of the proposed Fairmont Wind Farm at receptor locations within 2km of a proposed WTG. Based on the parameters used to run the shadow flicker prediction model via WindPRO, it has been shown that the predicted duration of shadow flicker emitted by the WTGs at all points of reception is significantly less than the German guidelines, adopted for this assessment. As a result of this study, no mitigation strategies are recommended.

9. References

WEA-Schattenwurf-Hinweise (2002). *Hinweise zur Ermittlung und Beurteilung der optischen Immissionen von Windenergianlagen (Notes on the identification and assessment of the optical pollutions of Wind Turbines).* WindPRO

ANNEX A

Site Layout Map



LEGEND

- Project Land parcel boundary
- Turbine location
- Access road
- Collector line route
- Temporary construction compound
- Switchgear location
- Stream crossing
- Point of connection to NSPI network
- Road
- Elevation contours (metres)
- Stream
- Residence shadow receptor

SCALE

0 0.5 1
kilometers

KEY MAP

County of Antigonish

PROJECT

Fairmont Wind Farm

FIGURE #

Annex A, Shadow Assessment

TITLE

Site Layout

DATE

May 02 2011

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ANNEX B

WindPRO v2.7, Shadow Module Calculation Results

E82-2.0/2.3 @ 78m Hub Height

Project:
FMT_EA_110418_AES

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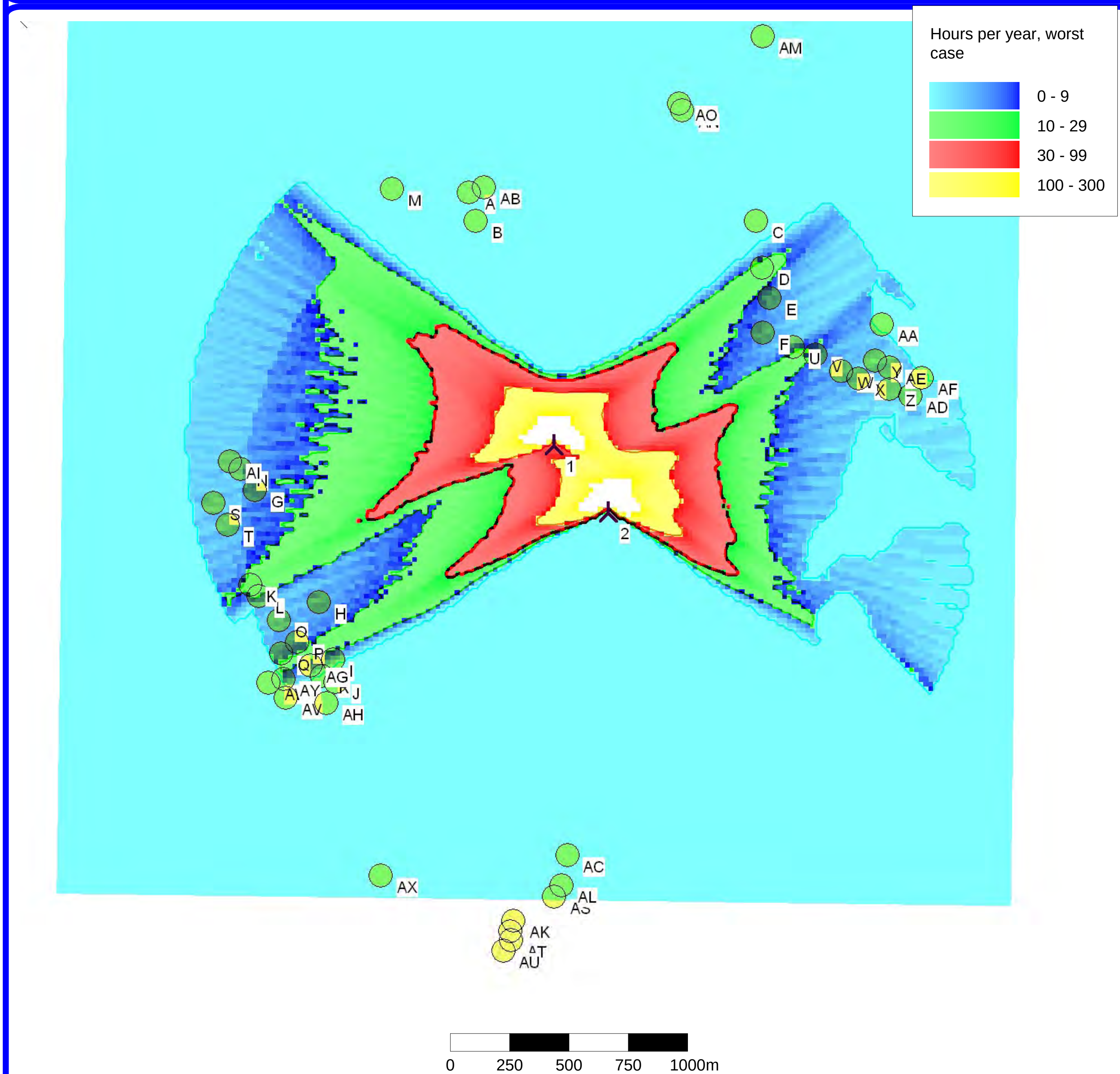
30/04/2011 8:06 PM / 1

Licensed user:
Wind Prospect Limited
7, Berkeley Square, Clifton
GB-BS8 1HG Bristol
+44 0117 910 5980
Anna Saunders / anna.saunders@windprospect.com

Calculated:
30/04/2011 7:55 PM/2.7.486

SHADOW - Map

Calculation: Shadow E82-2.0 @ 78m Greenhouse; glass walls



Map: Blank map , Print scale 1:25,000, Map center UTM NAD 83 Zone: 20 East: 578,595 North: 5,058,892

New WTG   Shadow receptor

Isolines showing shadow in Hours per year, worst case

0   10   30   100

Project:
FMT_EA_110418_AES

Printed/Page
29/04/2011 7:31 PM / 1

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Anna Saunders / anna.saunders@windprospect.com

Calculated:
29/04/2011 7:25 PM/2.7.486

SHADOW - Main Result

Calculation: Shadow E82-2.0 @ 78m Greenhouse; glass walls

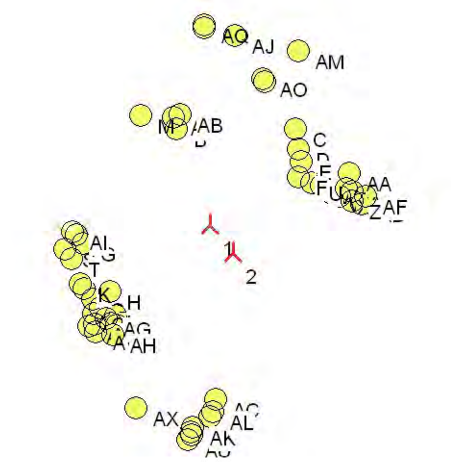
Assumptions for shadow calculations

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: FMT_ASTER_6x6_UTM_5m contours_
Obstacles not used in calculation
Eye height: 1.5 m
Grid resolution: 10 m



Scale 1:75,000
New WTG   Shadow receptor

WTGs

	UTM NAD83 Zone: 20 East	North	Z [m]	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Shadow data Calculation distance [m]	RPM [RPM]
1	578,560	5,059,266	190.6	ENERCON E-82 2000 8...	Yes	ENERCON	E-82-2,000	2,000	82.0	78.3	1,552	19.5
2	578,793	5,058,987	179.6	ENERCON E-82 2000 8...	Yes	ENERCON	E-82-2,000	2,000	82.0	78.3	1,552	19.5

Shadow receptor-Input

No.	UTM NAD83 Zone: 20 East	North	Z [m]	Width [m]	Height [m]	Height a.g.l. [m]	Degrees from south cw [°]	Slope of window [°]	Direction mode
A	578,188	5,060,329	133.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
B	578,218	5,060,207	136.4	3.0	3.0	1.0	0.0	90.0	"Green house mode"
C	579,402	5,060,222	167.4	3.0	3.0	1.0	0.0	90.0	"Green house mode"
D	579,432	5,060,026	174.6	3.0	3.0	1.0	0.0	90.0	"Green house mode"
E	579,466	5,059,899	183.5	3.0	3.0	1.0	0.0	90.0	"Green house mode"
F	579,438	5,059,752	190.3	3.0	3.0	1.0	0.0	90.0	"Green house mode"
G	577,298	5,059,063	90.3	3.0	3.0	1.0	0.0	90.0	"Green house mode"
H	577,575	5,058,595	101.3	3.0	3.0	1.0	0.0	90.0	"Green house mode"
I	577,638	5,058,353	90.7	3.0	3.0	1.0	0.0	90.0	"Green house mode"
J	577,649	5,058,258	89.1	3.0	3.0	1.0	0.0	90.0	"Green house mode"
K	577,283	5,058,662	82.3	3.0	3.0	1.0	0.0	90.0	"Green house mode"
L	577,321	5,058,617	83.9	3.0	3.0	1.0	0.0	90.0	"Green house mode"
M	577,863	5,060,341	122.6	3.0	3.0	1.0	0.0	90.0	"Green house mode"
N	577,236	5,059,152	83.1	3.0	3.0	1.0	0.0	90.0	"Green house mode"
O	577,407	5,058,515	85.3	3.0	3.0	1.0	0.0	90.0	"Green house mode"
P	577,487	5,058,425	79.4	3.0	3.0	1.0	0.0	90.0	"Green house mode"
Q	577,420	5,058,375	75.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
R	577,594	5,058,281	85.5	3.0	3.0	1.0	0.0	90.0	"Green house mode"
S	577,124	5,059,007	78.2	3.0	3.0	1.0	0.0	90.0	"Green house mode"
T	577,187	5,058,914	82.7	3.0	3.0	1.0	0.0	90.0	"Green house mode"
U	579,567	5,059,694	198.4	3.0	3.0	1.0	0.0	90.0	"Green house mode"

To be continued on next page...

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SHADOW - Main Result

Calculation: Shadow E82-2.0 @ 78m Greenhouse; glass walls

...continued from previous page

UTM NAD83 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	579,663	5,059,665	200.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
W	579,770	5,059,594	194.3	3.0	3.0	1.0	0.0	90.0	"Green house mode"
X	579,845	5,059,563	190.4	3.0	3.0	1.0	0.0	90.0	"Green house mode"
Y	579,915	5,059,642	186.8	3.0	3.0	1.0	0.0	90.0	"Green house mode"
Z	579,975	5,059,522	182.2	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AA	579,941	5,059,794	176.4	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AB	578,251	5,060,351	136.7	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AC	578,639	5,057,540	157.6	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AD	580,067	5,059,494	175.8	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AE	579,974	5,059,613	182.6	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AF	580,111	5,059,571	170.6	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AG	577,543	5,058,327	81.7	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AH	577,614	5,058,168	85.7	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AI	577,193	5,059,183	80.6	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AJ	578,784	5,061,147	128.8	3.0	3.0	0.0	0.0	90.0	"Green house mode"
AK	578,413	5,057,261	155.0	3.0	3.0	0.0	0.0	90.0	"Green house mode"
AL	578,617	5,057,413	154.9	3.0	3.0	0.0	0.0	90.0	"Green house mode"
AM	579,421	5,061,002	123.6	3.0	3.0	0.0	0.0	90.0	"Green house mode"
AN	579,086	5,060,686	139.4	3.0	3.0	0.0	0.0	90.0	"Green house mode"
AO	579,072	5,060,714	138.0	3.0	3.0	0.0	0.0	90.0	"Green house mode"
AP	578,483	5,061,218	125.8	3.0	3.0	0.0	0.0	90.0	"Green house mode"
AQ	578,481	5,061,239	125.0	3.0	3.0	0.0	0.0	90.0	"Green house mode"
AR	578,401	5,057,215	154.3	3.0	3.0	0.0	0.0	90.0	"Green house mode"
AS	578,586	5,057,364	153.1	3.0	3.0	0.0	0.0	90.0	"Green house mode"
AT	578,405	5,057,179	151.8	3.0	3.0	0.0	0.0	90.0	"Green house mode"
AU	578,373	5,057,133	150.7	3.0	3.0	0.0	0.0	90.0	"Green house mode"
AV	577,440	5,058,188	80.0	3.0	3.0	0.0	0.0	90.0	"Green house mode"
AW	577,367	5,058,251	78.9	3.0	3.0	0.0	0.0	90.0	"Green house mode"
AX	577,850	5,057,444	136.3	3.0	3.0	0.0	0.0	90.0	"Green house mode"
AY	577,430	5,058,269	77.9	3.0	3.0	0.0	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	13:24	50	0:19
E	7:58	39	0:19
F	7:00	32	0:20
G	7:18	38	0:16
H	5:50	29	0:16
I	5:31	31	0:14
J	0:00	0	0:00
K	12:12	58	0:15
L	11:02	58	0:15
M	0:00	0	0:00
N	3:48	20	0:15
O	4:36	25	0:14
P	7:18	39	0:15

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SHADOW - Main Result

Calculation: Shadow E82-2.0 @ 78m Greenhouse; glass walls

...continued from previous page

No.	Shadow, worst case Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]
Q	7:10	40	0:14
R	0:00	0	0:00
S	3:32	20	0:14
T	4:12	24	0:15
U	8:38	50	0:16
V	10:20	75	0:14
W	6:15	44	0:14
X	5:19	40	0:13
Y	4:31	36	0:12
Z	4:24	36	0:13
AA	0:00	0	0:00
AB	0:00	0	0:00
AC	0:00	0	0:00
AD	3:57	31	0:12
AE	4:18	34	0:12
AF	2:14	18	0:12
AG	8:23	40	0:15
AH	0:00	0	0:00
AI	3:38	20	0:15
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	0:00	0	0:00
AQ	0:00	0	0:00
AR	0:00	0	0:00
AS	0:00	0	0:00
AT	0:00	0	0:00
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	8:31	43	0:14

Total amount of flickering on the shadow receptors caused by each WTG

No.	Name	Worst case [h/year]	Expected [h/year]
1	ENERCON E-82 2000 82.0 !O! hub: 78.3 m (3)	72:31	
2	ENERCON E-82 2000 82.0 !O! hub: 78.3 m (4)	55:52	

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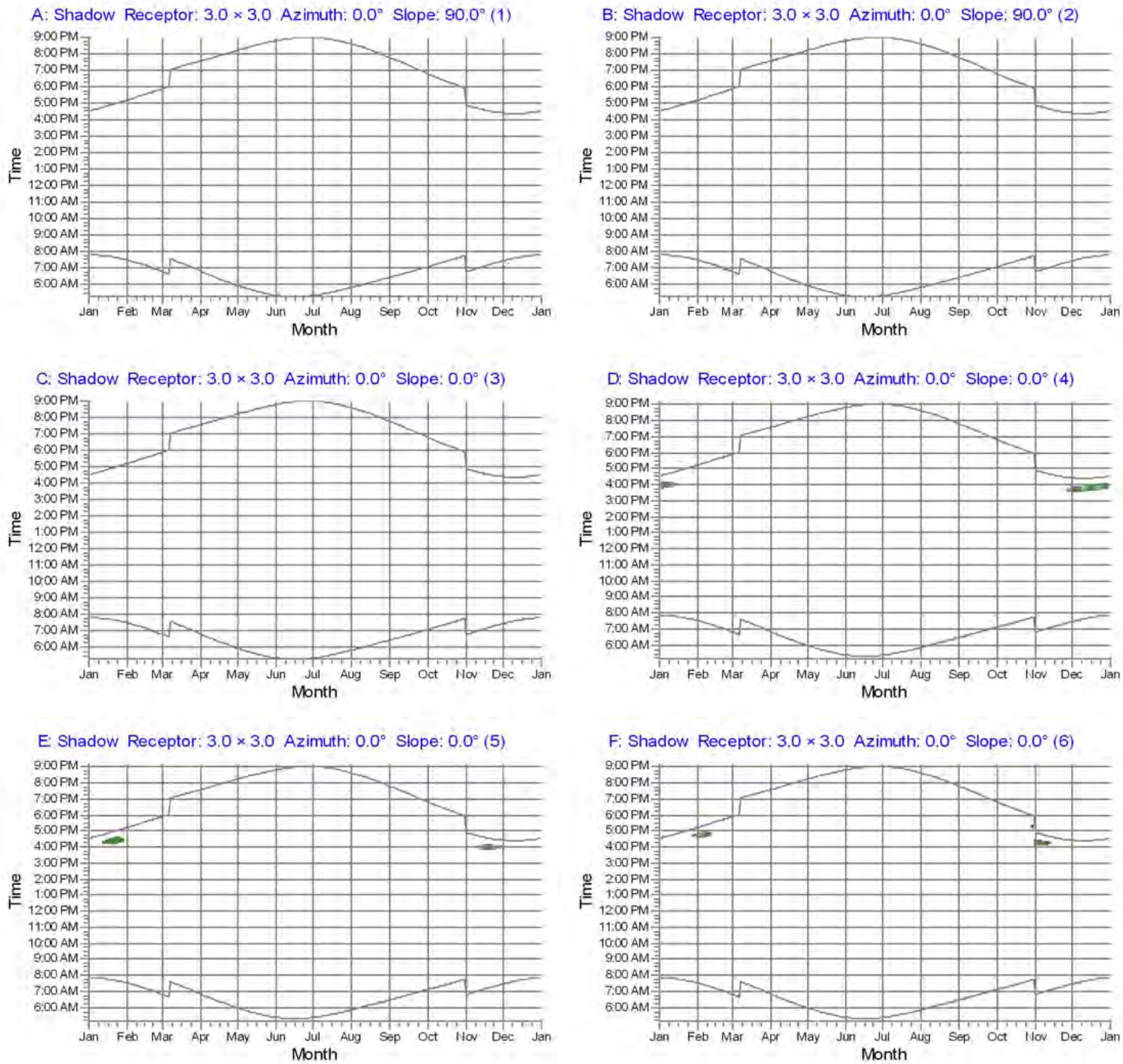
SHADOW - Calendar, graphical

Calculation: Shadow E82-2.0 @ 78m Greenhouse; glass walls



WTGs

1: ENERCON E-82 2000 82.0 !O! hub: 78.3 m (3)

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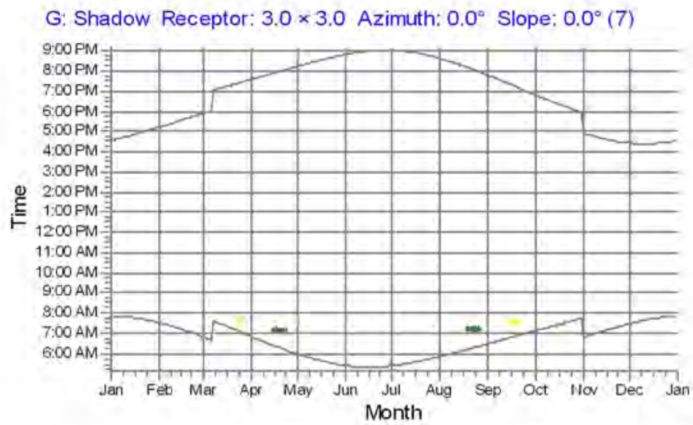
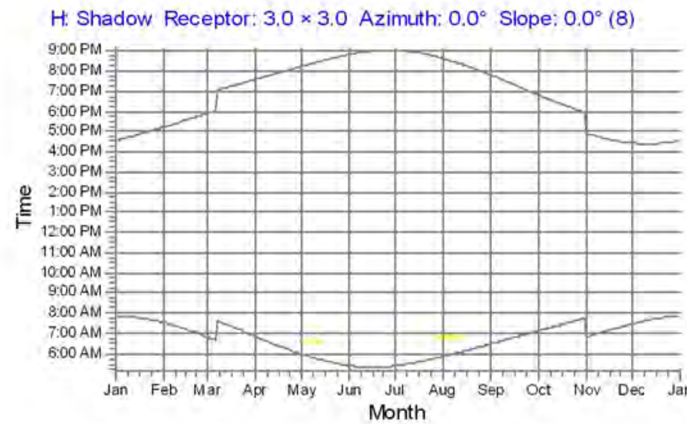
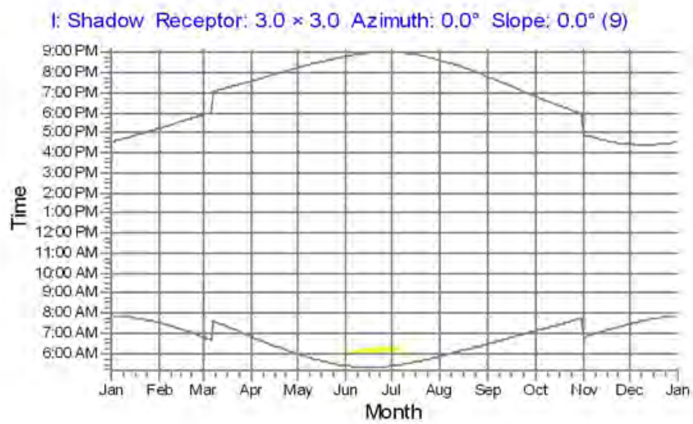
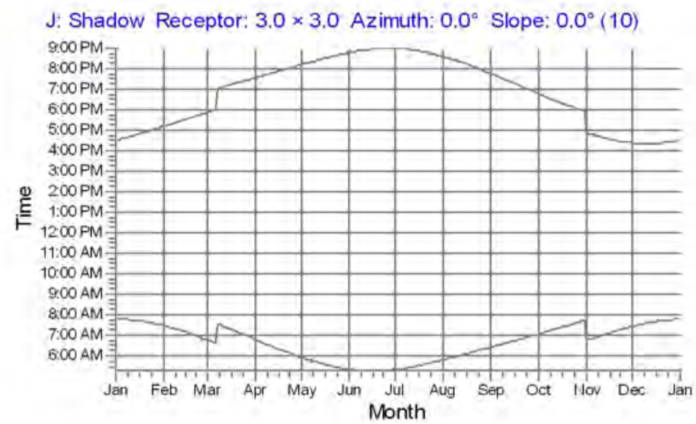
SHADOW - Calendar, graphical

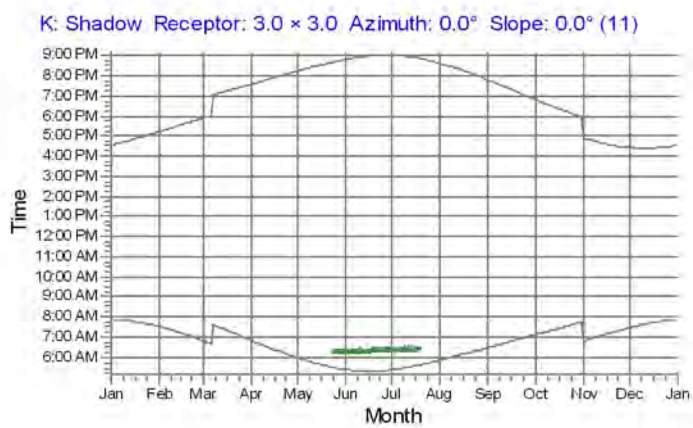
Calculation: Shadow E82-2.0 @ 78m Greenhouse; glass walls

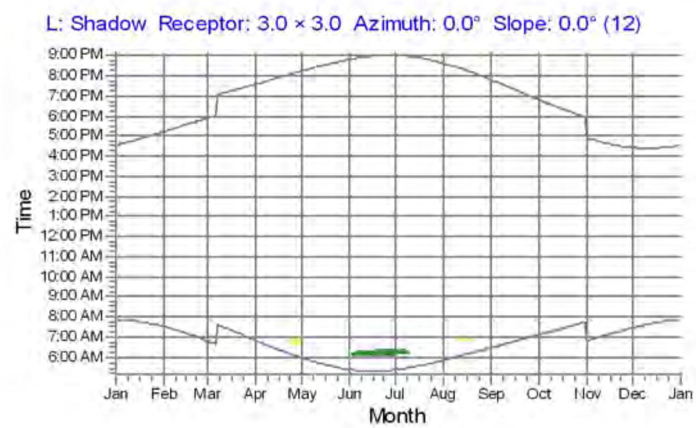












WTGs

1: ENERCON E-82 2000 82.0 !O! hub: 78.3 m (3)

2: ENERCON E-82 2000 82.0 !O! hub: 78.3 m (4)

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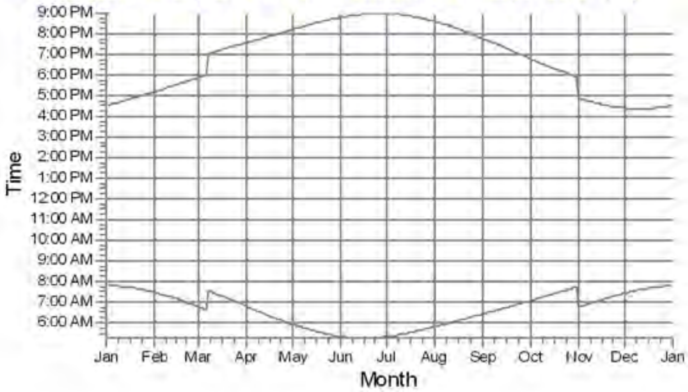
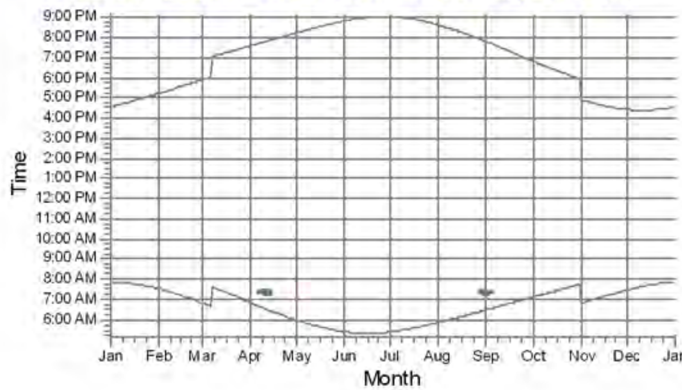
SHADOW - Calendar, graphical

Calculation: Shadow E82-2.0 @ 78m Greenhouse; glass walls

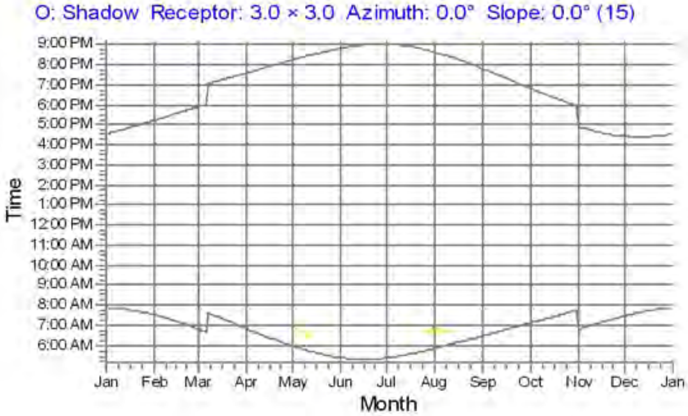
M: Shadow Receptor: 3.0 × 3.0 Azimuth: 0.0° Slope: 90.0° (13)



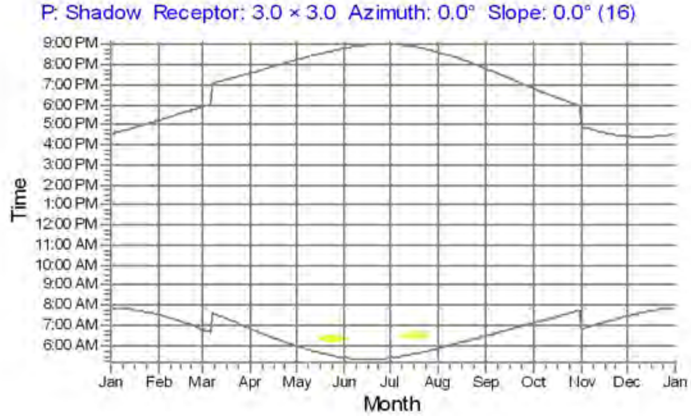
N: Shadow Receptor: 3.0 × 3.0 Azimuth: 0.0° Slope: 0.0° (14)



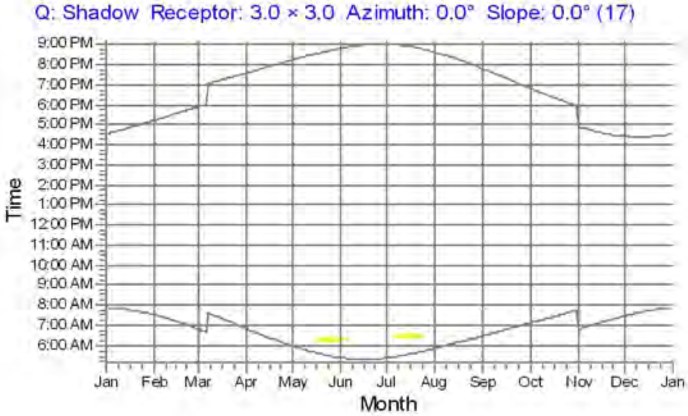
O: Shadow Receptor: 3.0 × 3.0 Azimuth: 0.0° Slope: 0.0° (15)



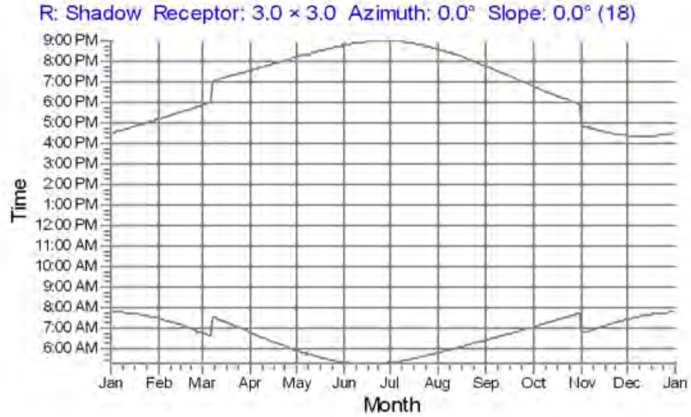
P: Shadow Receptor: 3.0 × 3.0 Azimuth: 0.0° Slope: 0.0° (16)



Q: Shadow Receptor: 3.0 × 3.0 Azimuth: 0.0° Slope: 0.0° (17)



R: Shadow Receptor: 3.0 × 3.0 Azimuth: 0.0° Slope: 0.0° (18)



WTGs

1: ENERCON E-82 2000 82.0 !O! hub: 78.3 m (3)

2: ENERCON E-82 2000 82.0 !O! hub: 78.3 m (4)

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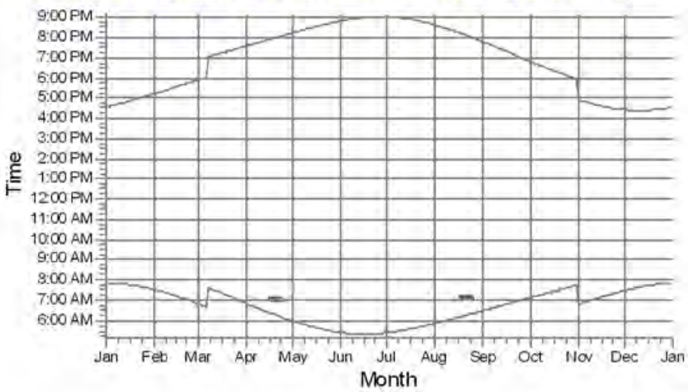
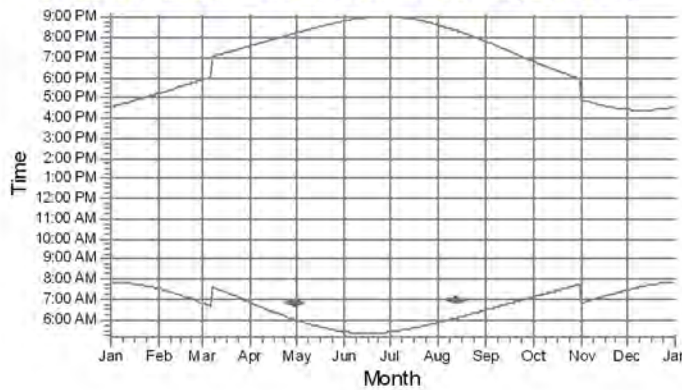
SHADOW - Calendar, graphical

Calculation: Shadow E82-2.0 @ 78m Greenhouse; glass walls

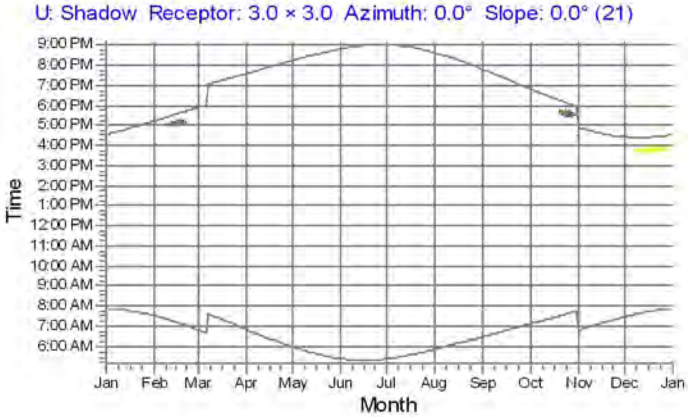
S: Shadow Receptor: 3.0 × 3.0 Azimuth: 0.0° Slope: 0.0° (19)



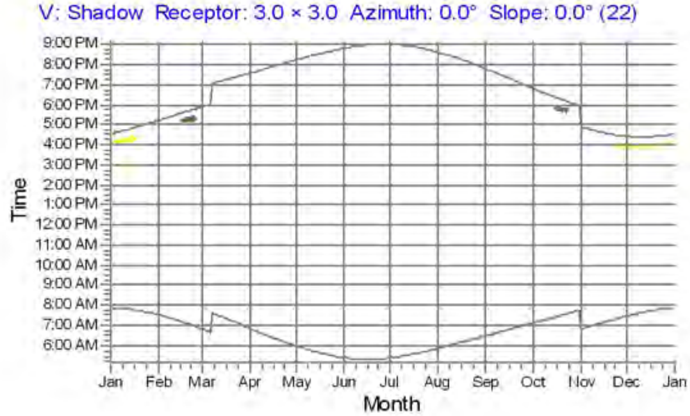
T: Shadow Receptor: 3.0 × 3.0 Azimuth: 0.0° Slope: 0.0° (20)



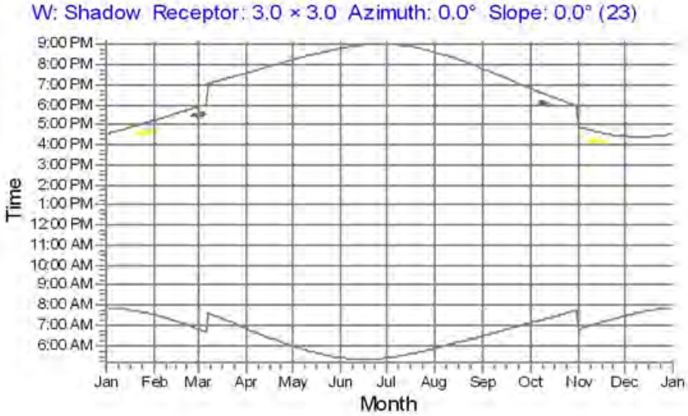
U: Shadow Receptor: 3.0 × 3.0 Azimuth: 0.0° Slope: 0.0° (21)



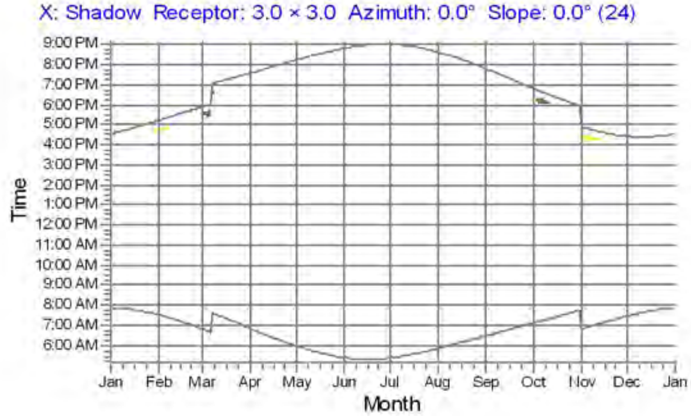
V: Shadow Receptor: 3.0 × 3.0 Azimuth: 0.0° Slope: 0.0° (22)



W: Shadow Receptor: 3.0 × 3.0 Azimuth: 0.0° Slope: 0.0° (23)



X: Shadow Receptor: 3.0 × 3.0 Azimuth: 0.0° Slope: 0.0° (24)



WTGs

1: ENERCON E-82 2000 82.0 !O! hub: 78.3 m (3)

2: ENERCON E-82 2000 82.0 !O! hub: 78.3 m (4)

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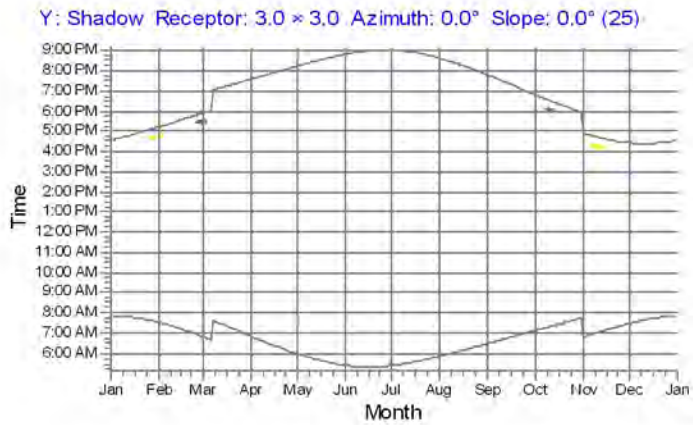
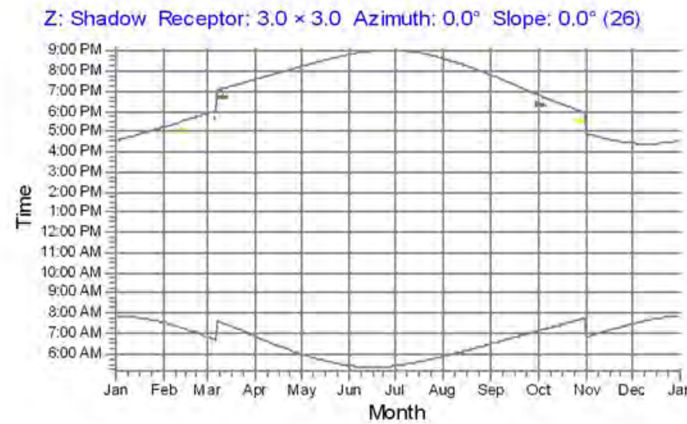
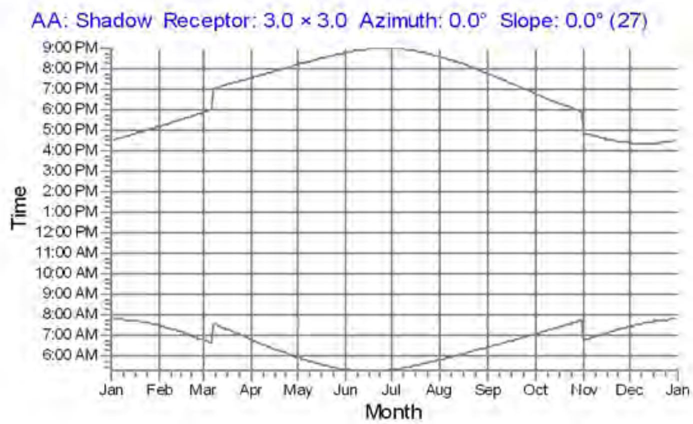
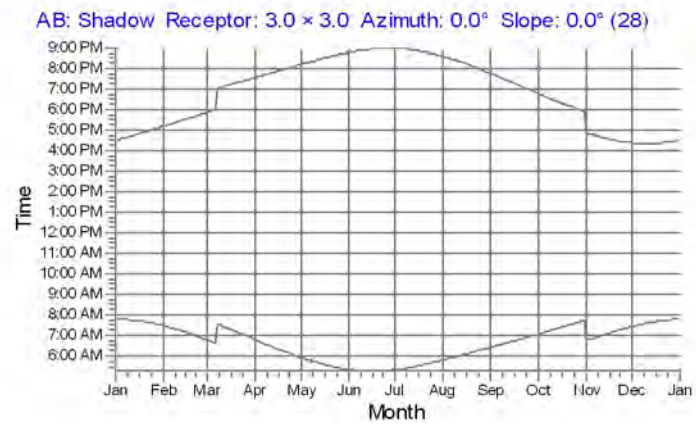
SHADOW - Calendar, graphical

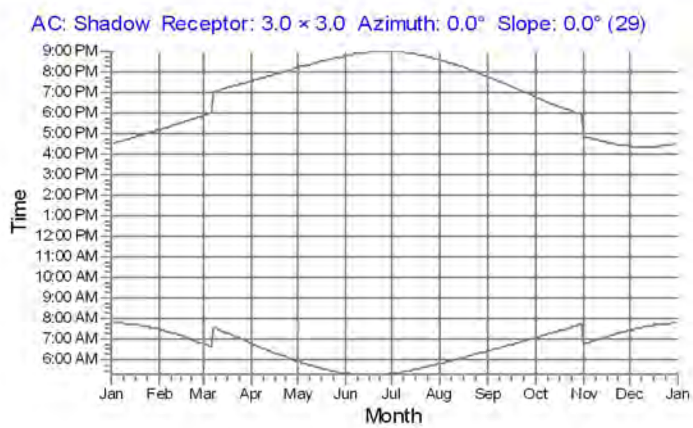
Calculation: Shadow E82-2.0 @ 78m Greenhouse; glass walls

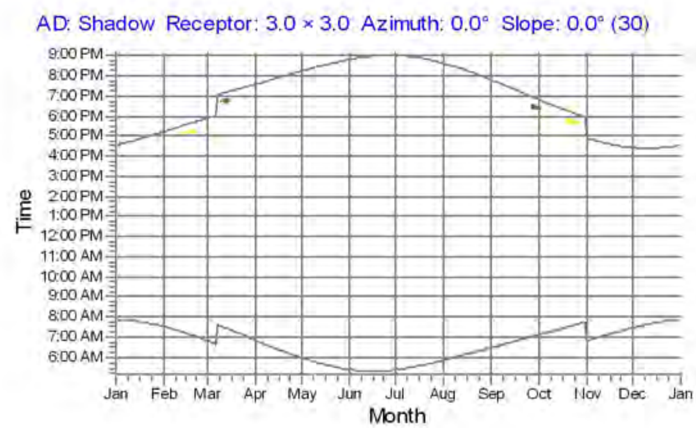












WTGs

1: ENERCON E-82 2000 82.0 !O! hub: 78.3 m (3)

2: ENERCON E-82 2000 82.0 !O! hub: 78.3 m (4)

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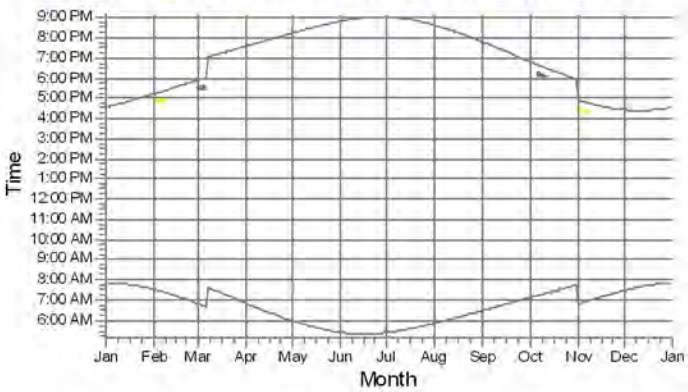
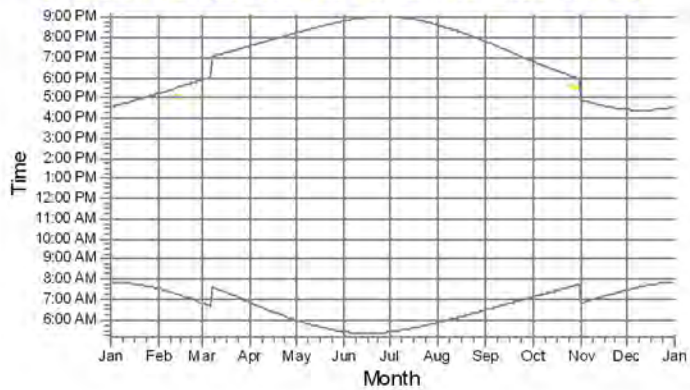
SHADOW - Calendar, graphical

Calculation: Shadow E82-2.0 @ 78m Greenhouse; glass walls

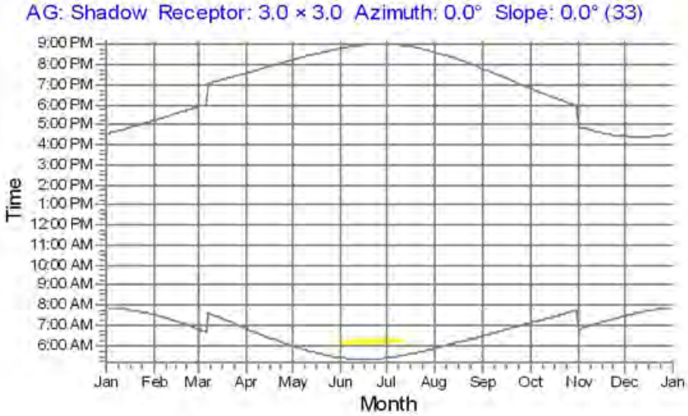
AE: Shadow Receptor: 3.0 × 3.0 Azimuth: 0.0° Slope: 0.0° (31)



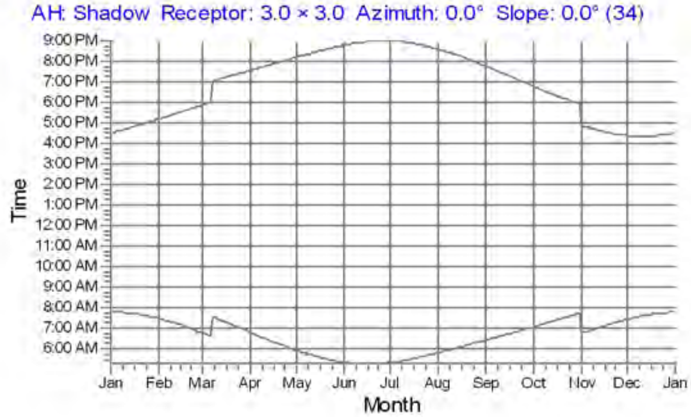
AF: Shadow Receptor: 3.0 × 3.0 Azimuth: 0.0° Slope: 0.0° (32)



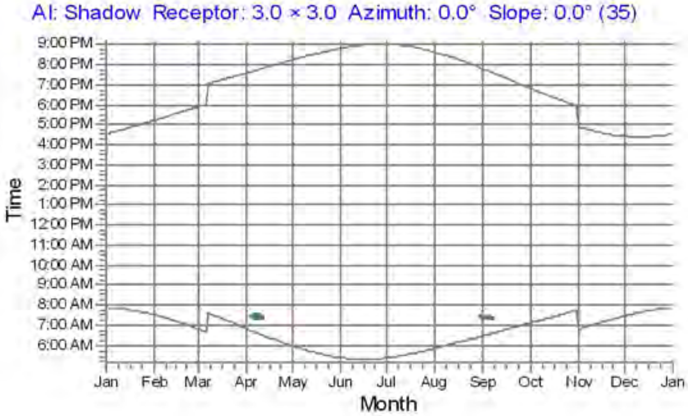
AG: Shadow Receptor: 3.0 × 3.0 Azimuth: 0.0° Slope: 0.0° (33)



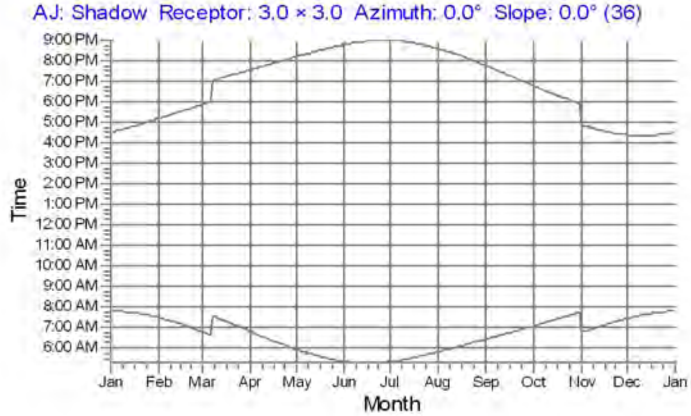
AH: Shadow Receptor: 3.0 × 3.0 Azimuth: 0.0° Slope: 0.0° (34)



AI: Shadow Receptor: 3.0 × 3.0 Azimuth: 0.0° Slope: 0.0° (35)



AJ: Shadow Receptor: 3.0 × 3.0 Azimuth: 0.0° Slope: 0.0° (36)



WTGs

1: ENERCON E-82 2000 82.0 !O! hub: 78.3 m (3)

2: ENERCON E-82 2000 82.0 !O! hub: 78.3 m (4)

Project:
FMT_EA_110418_AES

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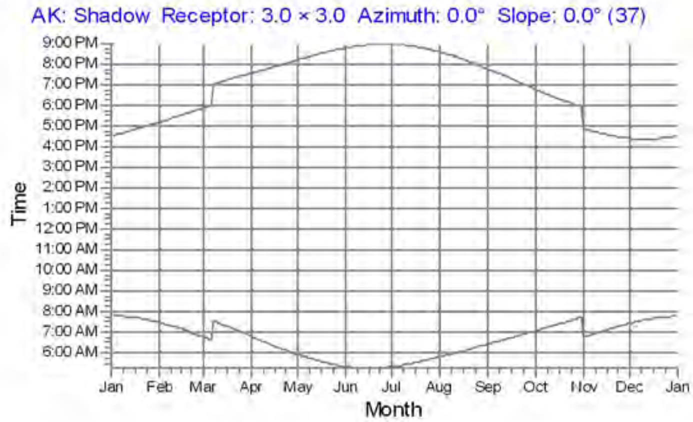
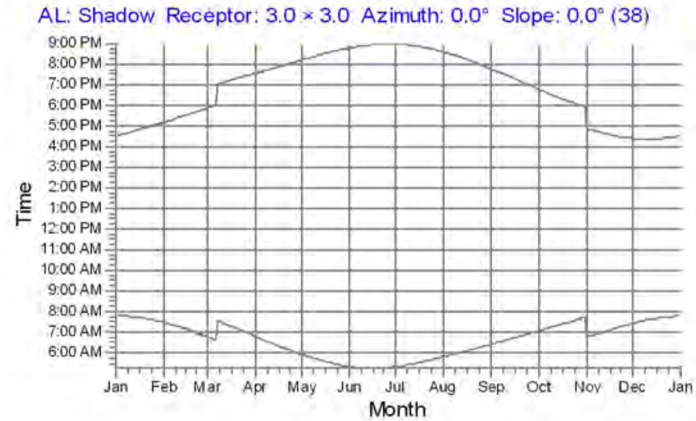
Anna Saunders / anna.saunders@windprospect.com

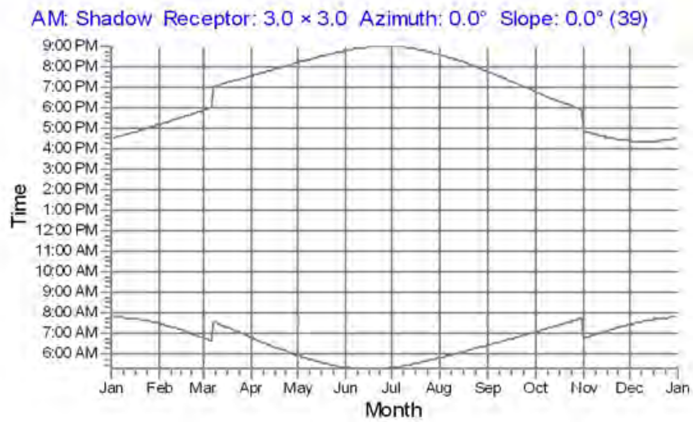
Calculated:
29/04/2011 7:25 PM/2.7.486

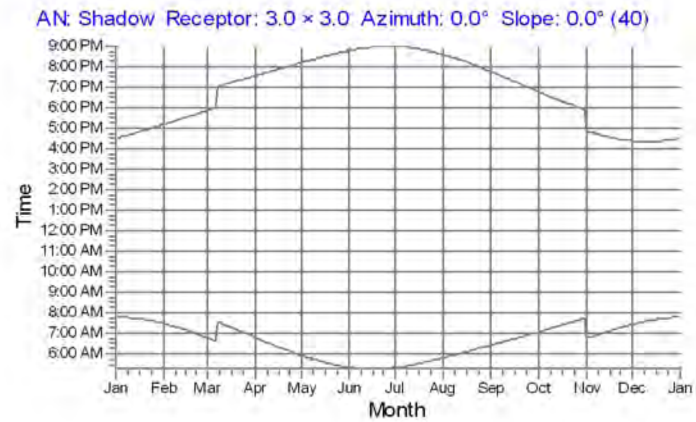
SHADOW - Calendar, graphical

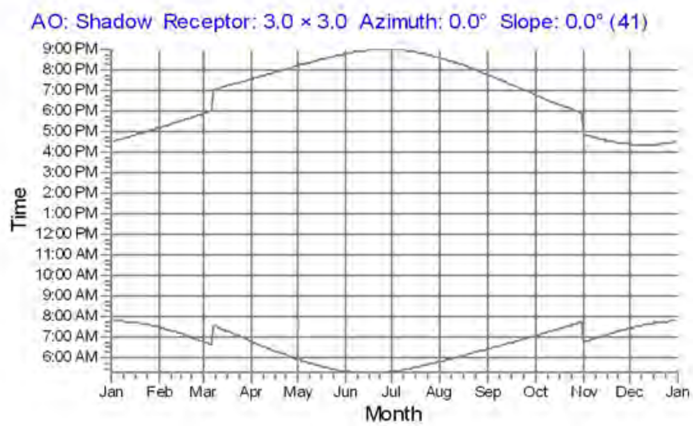
Calculation: Shadow E82-2.0 @ 78m Greenhouse; glass walls

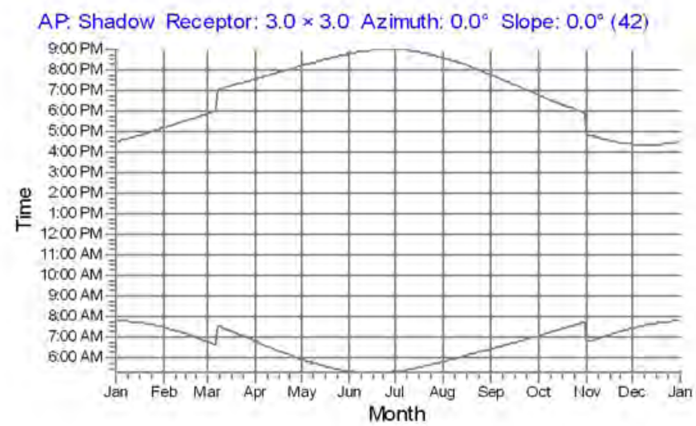












WTGs

Project:
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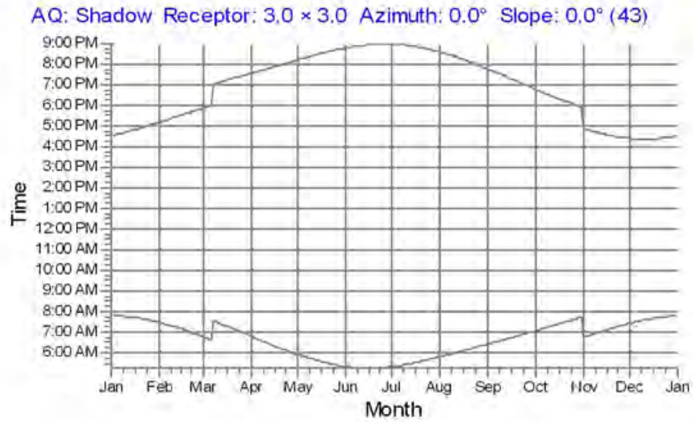
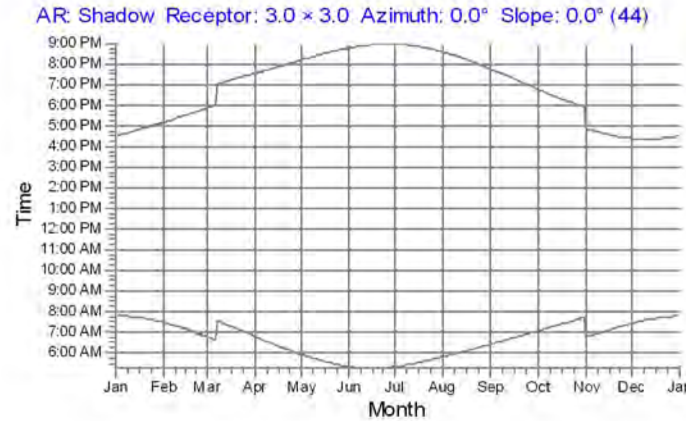
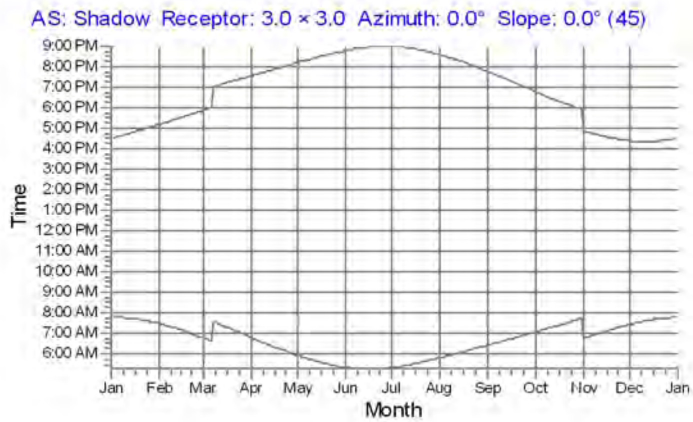
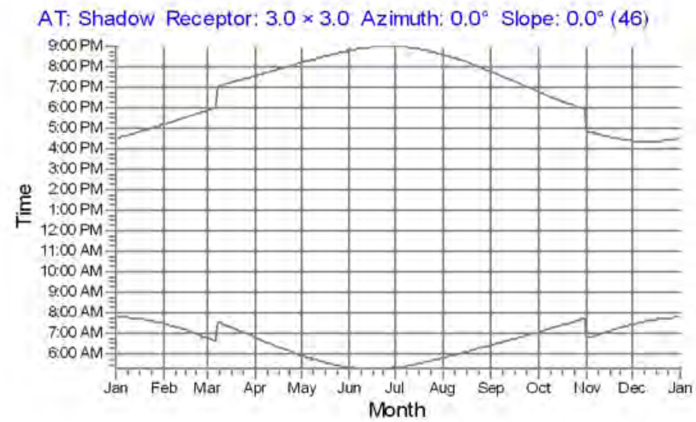
SHADOW - Calendar, graphical

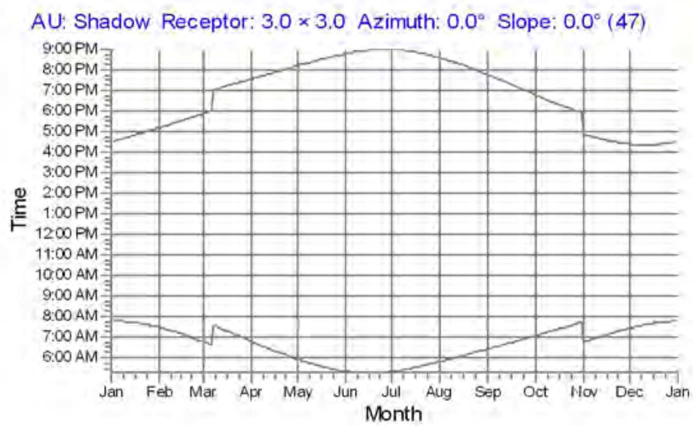
Calculation: Shadow E82-2.0 @ 78m Greenhouse; glass walls

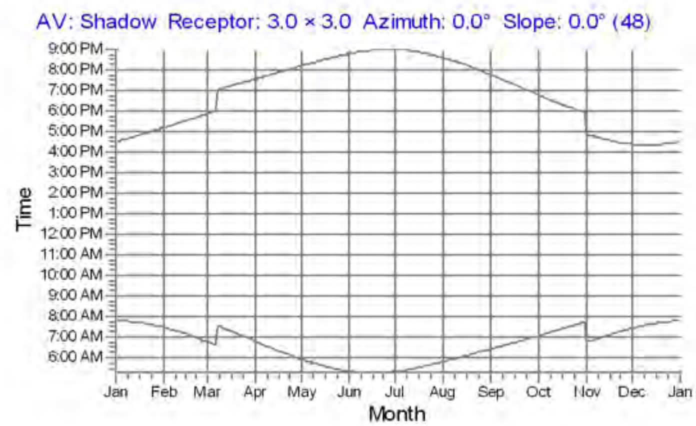












WTGs

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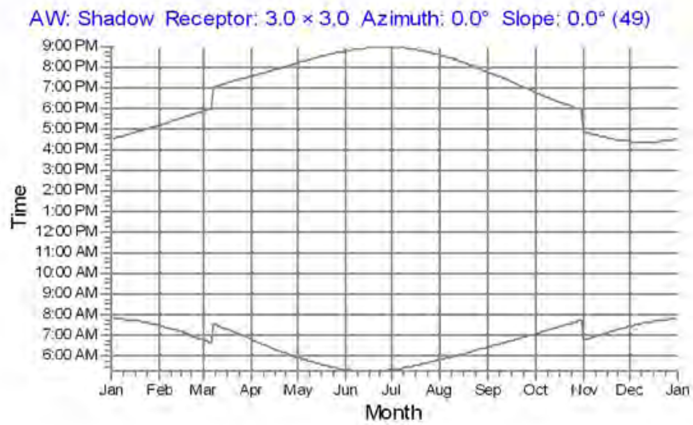
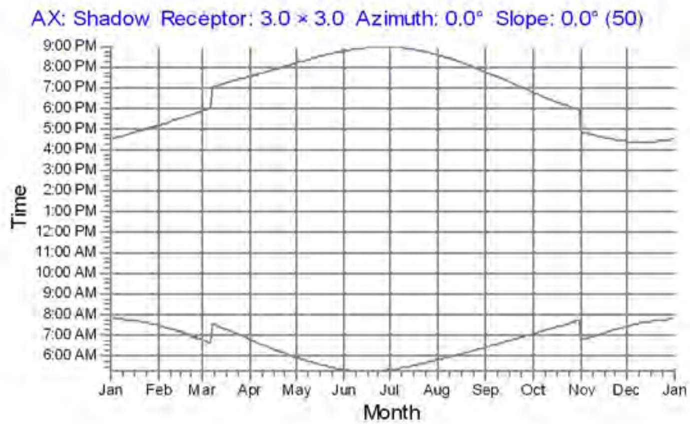
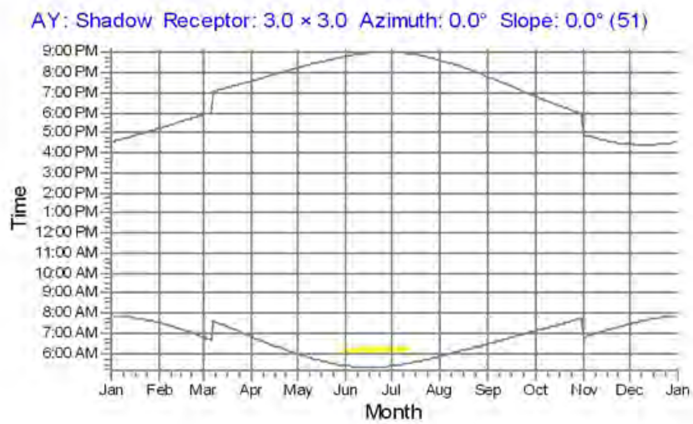
SHADOW - Calendar, graphical

Calculation: Shadow E82-2.0 @ 78m Greenhouse; glass walls







WTGs

2: ENERCON E-82 2000 82.0 !O! hub: 78.3 m (4)

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