6.0 Environmental Effects Assessment

6.1 AQUATIC ENVIRONMENT

The Aquatic Environment was selected as a VEC because of the potential for Project activities to interact with the freshwater environment and regulatory protection of fish and fish habitat. The Aquatic Environment VEC addresses water quality and fish and fish habitat within the Project Study Area with special consideration given to the freshwater species at risk and habitats of high productivity/ecological sensitivity.

In the context of the Aquatic Environment VEC, the following definitions apply:

Fish is defined in Section 2 of the *Fisheries Act* and includes: (a) parts of fish, (b) shellfish, crustaceans, and any parts of shellfish, or crustaceans, and (c) the eggs, sperm, spawn, larvae, spat and juvenile stages of fish, shellfish, and crustaceans.

Fish habitat as defined in Section 34(1) of the *Fisheries Act* includes spawning grounds and nursery, rearing, food supply and migration areas on which fish depend directly or indirectly in order to carry out their life processes. Fish habitat will be assumed to include the physical (*e.g.*, substrate/sediment, temperature, flow velocity and volumes, riparian vegetation), chemical (*e.g.*, water quality), and biological (*e.g.*, fish, benthic macroinvertebrates, periphyton, aquatic macrophytes) attributes of the Aquatic Environment that are required by fish to carry out life cycle processes.

Surface water quality is described as the chemical, physical (*e.g.*, temperature, clarity), and biological (*e.g.*, bacteria, algae) attributes of surface water.

Freshwater fish, fish habitat, and water quality are protected under federal and to some extent provincial legislation. Fish are protected under the federal *Fisheries Act* specifically by Section 32, which prohibits the destruction of fish by any means other than fishing. Fish habitat is protected under the *Fisheries Act* and by DFO’s *Policy for the Management of Fish Habitat* (DFO 1986). The guiding principle of this policy is to achieve no net loss of the productive capacity of fish habitats. The *Policy for the Management of Fish Habitat* is regulated by Sections 20, 21, 22, 30, 35, 36, 37, 40 and 43 of the *Fisheries Act* and applies to any project which occurs in or near water. Specifically, Sections 20, 32, 35 and 36 of the *Fisheries Act* apply to the present Project. Section 20 requires that fish passage be maintained at all times during Construction and Operation. Section 35 protects fish habitat from harmful alteration, disruption or destruction (HADD), and Section 36 prohibits the deposit of a deleterious substance in waters frequented by fish. DFO has overall responsibility for the administration of the federal *Fisheries Act*, except for Section 36 which is co-administered by Environment Canada.

6.1.1 Potential Environmental Effects, Issues and Concerns

The assessment of potential environmental effects on the aquatic environment focuses on key Project components that may interact with water quality, freshwater fish and their habitat including: clearing, grubbing and grading during construction of the access roads, turbine foundations, substation construction and required clearing and temporary watercourse crossings for the transmission line construction. The current proposed wind farm site plan includes one watercourse crossing within the Project Study Area. Five watercourses are anticipated to be crossed within the 19 km transmission line corridor.

Once operational, the Project interaction with the aquatic environment may continue through vegetation maintenance activities and associated temporary watercourse crossings along the transmission line corridor.

The environmental assessment of the Aquatic Environment is focused on two broad environmental effects:

- Change in Fish Habitat; and
- Change in Mortality Risk

As discussed in Section 5.3, the aquatic field surveys identified one watercourse (Black Pond Brook) within the Project Study Area and one drainage channel (Heath Brook). Black Pond Brook was not considered fish habitat based on lack of above ground connectivity to fish bearing waters and poor fish habitat characteristics. The second watercourse identified within the Project Study Area, Heath Brook, was characterized as a drainage channel within a wetland. This channel was determined to be intermittent with observations of subterranean sections made during the field surveys. Based on the lack of connectivity of both brooks to fish habitat, and the poor quality habitat present therein, fish habitat was not observed within the Project Study Area.

While both Black Pond Brook and Heath Brook may not support fish populations within the Project Study Area both brooks drain into waters that could support fish. The environmental assessment therefore examines effects of Project construction and operation and maintenance activities on a change in fish habitat and fish mortality risk through potential changes to surface water quality.

Within the transmission line corridor five watercourses will be crossed, field assessments were not conducted through this section and the number of watercourse crossings is based on the desktop review of 1:10,000 topographic mapping. The transmission line and corridor will be constructed by NSPI and may interact with the aquatic environment through a change in fish habitat and change in fish mortality risk through surface water quality and watercourse alteration.

Construction

The most substantive and likely interaction during construction is a change in fish habitat through erosion and sedimentation resulting from site preparation at facility locations (*e.g.,* tree harvesting, grubbing and grading) and construction of access roads adjacent to or across watercourses .

These interactions may occur at the turbine sites, at the substation construction location or along the transmission line corridor.

These Project-related construction activities could potentially degrade surface water quality (*e.g.*, oxygen levels, light penetration, water temperature, water chemistry such as pH, nutrients and metals) leading to changes in aesthetics, primary production and food availability for fish potentially present downstream (Anderson *et al.* 1996;Trow Consulting Engineers Ltd. 1996). Bacteria levels can also be affected by changes in sediment loading within a system.

A change in fish mortality from sedimentation in the watercourses may occur as a result of increased erosion from exposed topsoil and removal of ground vegetation. Sedimentation can decrease the water clarity and interrupt the foraging activities of fish. Excessive suspended sediment is abrasive to sensitive gill structures and can smother fish eggs (Bash 2001). As no fish habitat was observed within Black Pond Brook or Heath Brook, interactions of the Project on the Aquatic Environment through a change in fish mortality are limited to the sections within the proposed transmission corridor.

Operation and Maintenance

During operation of the Project, potential environmental effects are limited to erosion and sedimentation from access roads and winter road maintenance and maintenance of the transmission line corridor. The effects of erosion and subsequent sedimentation on surface water would likely be the same as explained above in Section 6.1.1.1. Transmission line maintenance is the routine clearing of vegetation from under the transmission lines and interacts with the Aquatic Environment through the crossing of watercourses by personnel and equipment. These stream crossings can lead to sedimentation of watercourses and alteration of benthic freshwater habitats.

6.1.2 Mitigation

Mitigation measures to reduce or eliminate the potential environmental interactions on the aquatic environment associated with the construction and operation phases of the Project are included in the following section by phase.

As discussed in Section 6.1.1.1 the majority of construction interactions with the aquatic environment will occur through changes in fish habitat through decreased water quality. The Proponent will limit the extent of potential interaction through the design and siting of turbines and roads to avoid watercourses to the extent possible. If watercourse alterations are required such as installation of a permanent crossing structure (*i.e.*, culvert), approvals from NSE will be sought. The Proponent will comply with the conditions of the approval and the Nova Scotia Environment *Watercourse Alteration Specifications for Pipe Culverts* (2006).

In addition to minimization and avoidance of stream crossings (as was done to the maximum extent practical in the turbine layout and transmission line route selection process). Most effects on surface water resources due to erosion and sedimentation can be mitigated during construction by proven mitigation methods for control of runoff and erosion.

These methods to minimize erosion and sediment transport during construction include:

- the control of surface runoff;
- provision of temporary erosion control measures after initial clearing is completed;
- avoidance of introduction of deleterious materials (mineral and organic) into streams or wetlands;
- isolation and stabilization of topsoil/subsoil storage piles from watercourses with drainage barriers, plastic sheeting, seeding, or other measures; and
- timely revegetation/stabilization of area after construction.

To reduce the potential for erosion and capture sediment before entering a watercourse, vegetation will remain within the 30 m buffer alongside all watercourses during construction. For stream crossings a 30 m buffer will remain during clearing and grubbing and vegetation will be removed by hand within 10 m of the stream bank just prior to the watercourse crossing to eliminate the potential for sedimentation from erosion.

Temporary erosion and sediment control measures (*e.g.*, silt fence, fibre rolls, diversion ditches) will be used and maintained until all work within or near a watercourse has been completed and stabilized. These temporary sediment control measures will be removed at the completion of the work but not until permanent erosion control measures, if required, have been established or the area has been revegetated.

Fuel storage and designated fuelling areas will be located at least 30 m from watercourses and wetlands to reduce the potential of hydrocarbon spills into the freshwater environments. Storage of all hazardous materials will comply with WHMIS requirements, and appropriate material safety data sheets will be located at the storage site. Refuelling and equipment maintenance required in the field will not be undertaken within 30 m of a watercourse or wetland. As with refueling and maintenance washing equipment will occur at distances greater than 30 m from the watercourses in order to ensure washwater is not released into the freshwater environment.

NSPI follows internal protocols designed to protect freshwater resources crossed by their power lines, including during clearing activities and stream crossings. Their freshwater protective measures include best management practices that focus on avoiding instream work, controlling sedimentation potential, and using temporary bridges for moving heavy equipment across streams (NSPI 2009). During all power line construction activities (with the exception of emergency situations), Nova Scotia Power adheres to their environmental protection procedures, which are intended to confirm that RoW practices address relevant Acts and Regulations (NSPI 2009).

During the operational phase of the Project, there will be little effect on surface water resources. Erosion from access roads and winter maintenance should be minimal after final clean-up and reclamation is completed. Erosion from the transmission corridor will be minimal once the transmission corridor is stabilized in the final stages of construction. A potential interaction with surface water during operation may be associated with vegetation maintenance along the transmission corridor.

To mitigate environmental effects from operation all Project-related vehicles will use established watercourse crossings to complete turbine maintenance. Detailed environmental protection measures will be incorporated into Project design which will help to minimize the potential environmental effects to surface water quality resulting from maintenance activities.

For any permanent sedimentation and erosion control measures developed during the construction phase, a complete visual assessment will be conducted on a quarterly basis and after severe storm events to ensure effectiveness of the control measures. These visual assessments will also include all crossing structures to ensure that normal water flows are being maintained through inspection and cleaning of debris.

Vegetation control for the transmission line will be completed by NSPI through mechanical means. All heavy machinery will cross watercourses at permanent crossings where available or with the aid of temporary bridges. The installation of temporary bridges will follow internal NSPI protocols developed in accordance with NSE regulations and local best management practices.

6.1.1 Residual Effects Analysis

Based on the field surveys and available data, lack of fish habitat in the Project Study Area, as well as assumptions and consideration of the potential environmental effects of the Project related activities during all phases of the Project, and implementation of the proposed mitigation, no significant adverse residual environmental effects are predicted for the Aquatic Environment.

Table 6.1 summarizes the Project Residual Environmental Effects on the Aquatic Environment.

Table 6.1 Summary of Project Residual Environmental Effects on the Aquatic Environment

<table>
<tr><th rowspan="2">Project Activity</th><th rowspan="2">Potential Effect</th><th rowspan="2">Mitigation</th><th colspan="5">Significance Criteria for Adverse Effect[1]</th><th rowspan="2">Residual Effect</th></tr>
<tr><th>Geographic Extent</th><th>Magnitude</th><th>Duration/ Frequency</th><th>Reversibility</th><th>Ecological Context</th></tr>
<tr><td>Site Clearing and Preparation</td><td>Change in habitat quality through decreased surface water quality and sediment loading.</td><td>• Avoid watercourses to the extent possible
• Heavy machinery use during clearing will be kept a minimum of 10 m from the watercourse banks
• Follow NSE Watercourse Alteration Specifications (2006)
• Implement site specific erosion and sediment control measures
• Limit area of clearing within 30 m of watercourses to the extent practical
• Clearing within 10 m of watercourses to be completed by hand at watercourse crossings.
• No storage of chemicals or POLs or equipment maintenance or refuelling will occur within 30 m of a watercourse or wetland</td><td>1</td><td>1</td><td>2/1</td><td>R</td><td>2</td><td>By following mitigation measures, adverse interactions with surface water quality will be minimized and no significant residual effects will result.</td></tr>
<tr><td>Road Construction</td><td>Change in habitat quality through decreased surface water quality and sediment loading.</td><td>• Avoid watercourses to the extent possible
• Follow NSE Watercourse Alteration Specifications (2006)
• Implement site specific erosion and sediment control measures
• No storage of chemicals or POLs or equipment maintenance or refuelling will occur within 30 m of a watercourse or wetland
• If needed, culverts will be installed per standard industry practice; instream work will occur between June and September 30, unless otherwise approved by NSE.</td><td>1</td><td>1</td><td>2/1</td><td>R</td><td>2</td><td>No residual effects are expected.</td></tr>
</table>

Table 6.1 Summary of Project Residual Environmental Effects on the Aquatic Environment

Project Activity	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
Transmission Line Construction	Change in habitat quality and mortality risk through decreased surface water quality and sediment loading.	• NSPI follows their own internal protocols and best management practices designed to protect freshwater resources.	2	1	2/1	R	2	By following mitigation measures, adverse interactions with surface water quality will be minimized and no significant residual effects will result.
Operation and Maintenance	Change in habitat quality through decreased surface water quality and sediment loading.	• Revegetation of disturbed soil during construction • Follow Project specific environmental protection measures for maintenance • Visual assessments will be completed in a quarterly basis and after a severe storm event to ensure effectiveness of erosion and sedimentation control. • Inspect, clean and repair crossing structures. • Temporary stream crossing installations follow NSE approvals and NSPI protocol.	1	1	5/1	R	2	No residual effects are expected.

1 Note	Geographic Extent	1 = <500 m^2, 2 = 500 m^2 – 1 km^2, 3 = 1 –10 km^2, 4 = 11 – 100 km^2, 5 = 101 – 1000 km^2, 6 = >1000 km^2
	Magnitude	1 = Low: *e.g.,* specific group or habitat, localized one generation or less, within natural variation, 2 = Medium: *e.g.,* portion of a population or habitat, one or two generations, rapid and unpredictable change, temporarily outside range of natural variability, 3 = High: *e.g,* affecting a whole stock, population or habitat outside the range of natural variation.
	Duration	1 = <1 month, 2 = 1-12 months, 3 = 13-36 months, 4 = 37-72 months, 5 = >72 months.
	Frequency	1 = <11 events/year, 2 = 11-50 events/year, 3 = 51-100 events/year, 4 = 101-200 events/year, 5 = >200 events/year, 6 = continuous.
	Reversibility	R = reversible, I = irreversible.
	Ecological Context	1 = Pristine area or area not adversely affected by human activity, 2 = evidence of adverse effects.

6.1.2 Follow-up and Monitoring

No follow-up and monitoring are proposed. If final design requires watercourse crossings, a Water Approval will be sought from NSE.

6.2 VEGETATION

Vegetation was selected as a VEC because of the potential for interactions between Project activities and vegetation, in particular, plant species that are considered as Species at Risk or Species of Conservation Concern.

6.2.1 Potential Environmental Effects, Issues and Concerns

6.2.1.1 Construction

There are several construction activities related to the Project that could affect vegetation. The most substantive and likely interactions are a change in habitat quantity or quality and possible loss of Species of Conservation Concern as a result of site preparation activities, road construction, turbine foundation, substation construction and transmission line construction.

In addition, a number of indirect effects can result from these site preparation activities. Clearing of forested areas can change the quality of the habitat along the edge of the Project Footprint as a result of increased side lighting or drying of what was previously forest interior habitat. This may enable more light-tolerant and disturbance-tolerant species to penetrate into adjacent forest habitat. Vegetation located within the Project Footprint will be removed during the construction phase of the Project. Construction activities have the potential to disturb vegetation habitat and cause direct mortality of vascular plants through off-road and activity outside of the Project Footprint. This may occur when vehicles are accessing the work site along tertiary roads, by the gradual widening of the thoroughfare, as well as through non-motorized activity in undisturbed areas adjacent to the Project Footprint. In addition, the site access roads can act as corridors allowing non-native weed species to penetrate into areas not previously accessible by these species.

6.2.1.2 Operation and Maintenance

Vegetation management initiatives have potential to adversely affect vegetation, including Species of Conservation Concern. There are a number of plant species of conservation interest that colonize heavily disturbed areas such as road RoWs. One such species, Nova Scotia agalinus, has been found very close to the boundary of the Project Study Area. Vegetation management activities can adversely affect these species if there is heavy soil disturbance; however, the absence of vegetation maintenance activity can also have adverse effects on these species since they fare poorly in competition with trees and shrubs. Periodic perturbations are necessary for these species to persist. Improper application of herbicide could result in exposure of non-target vegetation to herbicide resulting death or morbidity of these plants.

6.2.2 Mitigation

The following mitigation will be implemented to minimize effects on vegetation.

- Project infrastructure will be sited, to the extent possible, to avoid interaction with plant species of conservation concern. In particular, infrastructure will be sited at least 30 m from any wetland that provides habitat for southern twayblade.
- Only portions required to allow Project components to be transported and erected at the sites will be cleared.
- Herbicides will be used only when mechanical control measures will not succeed and will not be used within 30 of wetlands or watercourses. Herbicides will be applied by qualified personnel and using approved application techniques in accordance with NSPI's standard RoW management procedures.
- The potential for invasion of the RoW by weedy non-native species can be reduced by minimizing disturbance to the soil surface so that the roots and seed bank of native species can be maintained. This can be accomplished by hand clearing in areas with readily disturbed soils such as poorly drained areas. Similarly, adverse effects of sediment deposition in upland and wetland habitats adjacent to the transmission line RoW can be reduced by employing this mitigation.
- Where possible the use of road salt or sand containing salt will be replaced by sand free of salt. If this is not feasible for reasons of safety, road salt will be applied only as required and at the lowest efficacious application rate.
- Prior to decommissioning and reclamation of the wind farm, surveys will be conducted to determine if the wind farm infrastructure has been colonized by plant species of conservation interest that could be adversely affected by decommissioning or reclamation activities. If species of conservation concern are found, site specific mitigation will be developed in consultation with NSDNR.

6.2.3 Residual Effects Analysis

6.2.3.1 Construction

Project construction will result in direct and indirect effects on vegetation. Table 6.2 lists the areas of each of the vegetation types present in the Regional Assessment Area (53,614 ha), the Project Study Area (1012 ha) and in the footprint of the Project (35.2 ha) based on the current layout (excludes transmission line).

Table 6.2 Vegetation Types found in the Project Study Area and Surrounding Areas

Vegetation Type	Surrounding Regional Assessment Area (all habitats on Figures 5.4, 5.5		Project Study Area (Figure 5.4)		Project Footprint	
	Area (ha)	%	Area (ha)	%	Area (ha)	% of Project Study Area
Mature Hardwood Forest	964	1.80	2.97	0.29	0.22	7.4
Young Hardwood	116	0.22	3.96	0.39	0.80	20.2
Regeneration Hardwood	25.6	0.05	0	0	0	0
Mature Softwood Forest	8,255	15.4	221	22.0	5.81	2.6
Young Softwood	1,431	2.67	6.69	0.66	0.12	1.8
Regeneration Softwood	887	1.65	0	0	0	0
Mature Mixedwood Forest	4,505	8.40	39.1	3.88	2.10	5.4
Young Mixedwood	228	0.42	11.8	1.17	0.73	6.2
Immature Forest Other	7,123	13.3	262	26.0	9.55	3.6
Forestry Other	60.3	0.11	0	0	0	0
Clear-cut	999	1.86	0.65	0.06	.09	0.14
Wetlands	7,496	14.0	90.9	9.01	1.40	1.5
Agriculture	1,868	3.48	0	0	0	0
Other non-forested Areas	324	0.60	0	0	0	0
Shrub Thicket	3,755	7.00	111	11	3.07	2.8
Dead	31.0	0.06	0	0	0	0
Barrens	1,552	2.9	251	24.9	11	4.4
Cliff, Dunes and Coastal Rocks	74.6	0.14	0	0	0	0
Coastal Habitat Areas	8,157	15.2	0.02	0.01	0	0
Beach	137	0.25	0	0	0	0
Gravel Pits	231	0.43	0.27	0.03	0	0
Urban	4,110	7.67	2.65	0.26	0	0
Corridor	1,282	2.39	3.84	0.38	0.02	0.52
Total	53,614		1012		35.2	3.5

Of the 263 ha of mature forest (hardwood, softwood, mixedwood) in the Project Study Area, 15.4 ha (5.9 %) is predicted to be directly affected by the Project footprint. There are approximately 79.6 ha of interior forest habitat within the Project Study Area. The current proposed array of wind turbines and associated roads and collector lines will result in the loss of approximately 29.1 ha (37%) of interior forest. Most of the area of forest interior habitat lost to wind farm development will not be physically destroyed. The largest losses will occur as a result of penetration of edge effects into these stands from adjacent roads and turbine pads or as a result of forest interior patches being reduced to less than 10 ha in size in which case they are no longer considered as forest interior habitat.

Vegetation loss associated with construction of the access roads and turbine pads can be reduced by clearing only the portions of RoWs required to allow wind turbine components to be transported and erected at the sites. Wind turbines, access roads, transformer sites and collector/transmission lines will be sited to minimize the loss of plant species of conservation interest. Once the locations of these facilities have been finalized, vegetation surveys will be conducted within the footprints of these facilities (if not previously surveyed) to determine if any plant species of conservation interest are present. The results of the vegetation surveys conducted in the Project Study Area to date have revealed the presence of five species of conservation interest in and immediately adjacent to the Project Study Area including southern twayblade, Elliott's goldenrod, highbush blueberry, eastern skunk cabbage, and Nova Scotia agalinus. Southern twayblade is of greatest concern and wind turbine infrastructure should be sited at least 50 m from any wetland that provides habitat for this species. To date, one wetland in the southern portion of the Project Study Area is known to contain 12 southern twayblade plants. This wetland is currently avoided, however, there is potential for this species to be present in other swamps in the Project Study Area.

Elliott's goldenrod, highbush cranberry and eastern skunk cabbage are widely distributed and relatively common in the Project Study Area. Construction of the wind farm facility is not expected to result in measureable decreases in the local or regional populations of these species. No mitigation is recommended for these species. All three of these species are listed as Secure in Nova Scotia by NSDNR. Nova Scotia agalinus was found outside of the Study Area and construction of the wind farm should not affect this species. This species is typically found in poorly drained highly disturbed sites. Ditches along access roads in the wind farm could provide suitable habitat for this species resulting in a net benefit for Nova Scotia agalinus.

Based on available data and assumptions and consideration of the potential environmental effects of the activities required for construction activities, the proposed mitigation, and the residual environmental effects significance ratings criteria, the environmental effects of Project construction on vegetation are not likely to be significant.

6.2.3.2 Operation and Maintenance

Vegetation within the transmission corridor and other wind farm infrastructure such as roads will be managed periodically. Vegetation management will consist primarily of mechanical control of vegetation, although the use of herbicides may be considered where undesirable species persist. Vegetation control during operations could pose a hazard to rare plant species, either through direct disturbance or indirectly by modifying their habitat, such as through loss of an overstory canopy and increased competitive pressure from species more adapted to open, disturbed conditions. Herbicide drift as a result of improper herbicide applications could also adversely affect offsite plants. Furthermore, the release of sediment into watercourses and wetlands during maintenance activities could have a detrimental effect on the survivability of rare plants and uncommon communities in these and adjacent habitats.

Where practical, the transmission line route will be routed to avoid populations of plant species of conservation interest.

During the operational phase of the Project it may be necessary to apply sand or road salt to access roads to allow them to be safely travelled during the winter. This sand often contains salt. The use of road salts for de-icing during the winter is a concern for vegetation as salt can enter into the environment (surface water, groundwater and soil) during their storage and application. Environment Canada (2001) cites a number of studies attributing vegetation damage and changes in plant community composition to road salt application. In particular, road salt applications can damage plants located immediately adjacent to roadways and increase the salinity of soils. The effects of road salt are generally observed within 10 m of the edge of the road, although salt related injuries have been detected at distances of up to 80 m from the road. Given the low speeds of vehicles on the access roads as well as the low frequency of vehicle traffic, production of brine aerosols by vehicle passage will be low, reducing the distance over which salt damage to plants could occur. Damage to vegetation includes osmotic (*i.e.*, concentration induced dehydration) injuries as well as direct chloride ion toxicity. Salt deposited on soils can adversely affect plant growth by changing the structure of soil (development of salt crusts) or reducing soil fertility (replacement of calcium and potassium ions by sodium ions). Between five and ten percent of trees within 30 m of highways have been reported to have salt damage in some areas (Transportation Research Board 1991). Where possible the use of road salt or sand containing salt will be replaced by sand free of salt. If this is not feasible for reasons of safety, road salt will be applied only as required and at the lowest efficacious application rate.

Based on a consideration of available data and assumptions, potential environmental effects of the activities required for the operation and maintenance phase of the Project, the proposed mitigation, and the residual environmental effects significance ratings criteria, significant adverse residual environmental effects of operation and maintenance on vegetation are not predicted.

Table 6.3 summarizes the residual effects of the Project on Vegetation.

Table 6.3 Summary of Project Residual Environmental Effects on Vegetation

Project Activity	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
Construction (clearing and site preparation, road construction, foundation excavation)	Loss of plant species of conservation concern	• Follow-up vegetation surveys will be conducted to assist with micrositing of turbines and access roads. • Where Plant Species of Conservation Concern are encountered, avoidance to the extent practical will be considered, especially where there may be a threat to the regional population. • Infrastructure will be sited at least 30 m from any wetland that provides habitat for southern twayblade. • Where avoidance is not practical, additional mitigative measures will be developed in consultation with NSE and NSDNR.	**2**	1	2/1	R	2	Follow-up vegetation surveys will be conducted to assist with micrositing of turbines and access road layouts. Mitigation for species of conservation concern encountered within the Project footprint will ensure there is no significant residual environmental effect on vegetation.
Operation and Maintenance (vegetation management)	Loss of plant species of conservation concern and colonization of non-native weedy species	• Hand clearing to minimize disturbance to soils in poorly drained areas • Manual vegetation control where possible, with controlled herbicide use as necessary	1	5	1	R	2	Protection procedures for vegetation management will result in no significant adverse residual effect on vegetation.

1 Note

Geographic Extent	1 = <500 m^2, 2 = 500 m^2 – 1 km^2, 3 = 1 –10 km^2, 4 = 11 – 100 km^2, 5 = 101 – 1000 km^2, 6 = >1000 km^2
Magnitude	1 = Low: *e.g.,* specific group or habitat, localized one generation or less, within natural variation, 2 = Medium: *e.g.,* portion of a population or habitat, one or two generations, rapid and unpredictable change, temporarily outside range of natural variability, 3 = High: *e.g,* affecting a whole stock, population or habitat outside the range of natural variation.
Duration	1 = <1 month, 2 = 1-12 months, 3 = 13-36 months, 4 = 37-72 months, 5 = >72 months.
Frequency	1 = <11 events/year, 2 = 11-50 events/year, 3 = 51-100 events/year, 4 = 101-200 events/year, 5 = >200 events/year, 6 = continuous.
Reversibility	R = reversible, I = irreversible.
Ecological Context	1 = Pristine area or area not adversely affected by human activity, 2 = evidence of adverse effects.

6.2.4 Follow-up and Monitoring

Once the layout for the wind farm has been finalized, follow-up vegetation surveys will be conducted at the turbine sites, access roads and substation site (if previously unsurveyed). Permitting for the transmission line will be the responsibility of NSPI and as such, no follow-up surveys are proposed by the Proponent for the electrical transmission line. Prior to decommissioning and reclamation of the wind farm site, the wind farm infrastructure will be surveyed to determine if it has been colonized by plant species of conservation interest.

6.3 WETLANDS

The Wetlands VEC is defined as marshes, swamps, fens, bogs, and shallow water areas that are saturated with water long enough to promote wetland or aquatic processes, and includes coastal wetlands (*e.g.,* salt marshes and eelgrass beds).

Wetlands were selected as a VEC because of the potential for interactions between Project activities and wetlands, and because of their relationship with vegetation and wildlife, as well as other biological and physical environments addressed as VECs in this report. Wetlands are an important feature of the landscape, performing many biological, hydrological, social / cultural, and economic functions.

Provincially, wetlands in Nova Scotia are protected by the Nova Scotia *Environmental Act* (NS 1995), where "wetland" is defined as:

> *land commonly referred to as a marsh, swamp, fen or bog that either periodically or permanently has a water table at, near or above the land's surface or that is saturated with water, and sustains aquatic processes as indicated by the presence of poorly drained soils, hydrophytic vegetation and biological activities adapted to wet conditions.*

In October 2011, NSE released the Nova Scotia Wetland Conservation Policy. The policy provides context to legislation, regulations and operational policies designed to protect and guide management of wetlands in Nova Scotia. Most importantly, the policy establishes a specific goal of no loss of Wetlands of Special Significance and no net loss in area and function for other wetlands. The government considers the following to be Wetlands of Special Significance (NSE 2011a): all salt marshes; wetlands that are within or partially within a designated Ramsar site, Provincial Wildlife Management Area (Crown and Provincial lands only), Provincial Park, Nature Reserve, Wilderness Area or lands owned or legally protected by non-government charitable conservation land trusts; intact or restored wetlands that are project sites under the North American Waterfowl Management Plan and secured for conservation through the Nova Scotia Eastern Habitat Joint Venture; wetlands known to support at-risk species as designated under the federal Species At Risk Act or the Nova Scotia *Endangered Species Act*; and wetlands in designated protected water areas as described within Section 106 of the *Environment Act*.

Any project with the potential to alter a wetland (filling, draining, flooding or excavating), including direct and indirect effects, requires a Water Approval from NSE, pursuant to the Activities Designation Regulations, prior to starting the work. If alterations exceed two hectares of any wetland, the project is also subject to registration under the Environmental Assessment Regulations. These applications are evaluated in the context of the mitigative sequence. This is typically conducted subsequent to EA approval as part of the permitting phase.

The mitigative sequence for decision-making is the foundation for achieving wetland conservation in Nova Scotia. The sequence – avoidance, minimization, compensation – assists proponents in planning and designing project proposals that will be acceptable to NSE. Avoidance is the priority, and requires consideration of project alternatives that would have less adverse effects on the wetland. Minimization requires that the project be designed and implemented using techniques, materials and site locations that reduce or remediate the project effects on the wetland. Compensation requires that the residual effects on the wetland functions are compensated for by the enhancement, restoration or creation of wetland habitat at an area ratio commensurate with the loss. Any loss of wetland habitat, either through direct or indirect Project effects, requires compensation to replace the wetland functions lost as a result of the wetland alterations.

6.3.1 Potential Environmental Effects, Issues and Concerns

The environmental assessment of wetlands is focused on the following environmental effects:

- Change in wetland area; and
- Change in wetland function.

These environmental effects cover the range of wetland effects that may occur, including direct and indirect effects. Whereas change in wetland area is quantifiable using information on the location and extent of Project components, assessment of loss of wetland functions requires a more qualitative approach. Avoiding the loss of both wetland area and functioning align with regulatory objectives and both are commonly used in effects assessments and for determining requirements for habitat compensation. The Nova Scotia Wetland Conservation Policy (NSE 2011a) aims to achieve no net loss of wetland area and function.

6.3.1.1 Construction

There are several construction activities related to the Project that have potential to affect wetlands. The most substantive and likely interaction is a change in wetland area and function as a result of site preparation (*e.g.*, clearing, grading and excavation) for construction of access roads, turbine foundations, and the 138 kV transmission line. Clearing and grubbing during site preparation will directly remove, infill, or disturb wetland vegetation and soils. In addition, a number of indirect effects can result from these site preparation activities, particularly hydrological changes to wetlands located either down or up-gradient of construction activities.

Site preparation activities have the potential to introduce sediment or silt into wetlands and this could have an adverse effect on their vegetative character and functioning. Effects to wetland habitat as a result of erosion and sedimentation may occur during all Project phases but have potential to be most serious during site preparation activities, which include the clearing, grubbing, and infilling of upland and wetland habitat. The erosion of uplands as a result of vegetation removal and deposition of sediments in wetland habitat has potential to alter wetland habitat beyond the confines of the immediate footprint. Similarly, the construction of the access roads, turbines, substation, and transmission line may also involve disturbance to wetlands and have potential to indirectly influence adjacent wetland habitats.

Hydroseeding applications have the potential to alter the quality of wetland habitat. If applied in hydrological source areas for wetlands, hydroseeding applications have the potential to increase nutrient levels in wetlands, which could affect their biological process (*e.g.*, nutrient uptake by plants, decomposition rates, *etc.*). Although hydroseeding efforts would use an approved seed mix, these are typically comprised of non-native species and therefore have potential to influence the composition of wetland communities. Construction activities also increase the susceptibility of wetland habitats to non-native and invasive plants through increased disturbances, proximity to anthropogenic infrastructure, and by promoting their dispersal.

The Project will likely require the installation of watercourse crossing infrastructure (*i.e.*, culverts). Installation of such features can alter wetland habitat through drainage, flooding or extensive erosion. Improperly installed crossings could also result in a potential loss of wetland function - for example, by reducing their quality to support fish and other species. The environmental effects of watercourse crossing construction on fish and fish habitat are assessed in the Aquatic Environment VEC, Section 6.1.

6.3.1.2 Operation and Maintenance

Activities associated with the operation and maintenance phase of the Project have potential to interact with wetlands through vegetation disturbance as well as erosion and sedimentation. The management of vegetation during operations represents a disturbance to wetland habitats and may affect their functional characteristics – for example, by adversely influencing their ability to provide support uncommon species which are associated with more intact habitats. Vegetation management will consist primarily of mechanical control of vegetation, although the use of herbicides may be considered where undesirable species persist. The use of herbicides in source water areas for wetlands has the potential to affect the survival and composition of the botanical community and wetland fauna. Furthermore, the release of sediment into wetlands during maintenance activities could affect their character and functional attributes.

6.3.2 Mitigation

A mitigative sequence will be adopted as the approach to prevent a net loss of wetland area or function as a result of Project construction. The mitigative sequence is a step-wise approach that achieves wetland conservation through the application of a hierarchical process of alternatives as follows: 1) avoidance of impacts; 2) minimization of unavoidable impacts; and 3) compensation for residual impacts that cannot be minimized. Within this framework, the following mitigative measures will be applied during the construction phase of the Project:

- Direct disturbance to wetlands will be avoided where practical. The final location of turbines and access roads will be selected to avoid disturbance to wetlands where practical. Additionally, disturbance to wetlands during construction of the 138 kV transmission line will be minimized by selecting power pole placements in uplands and limiting the extent of disturbances.

- Wetland habitat will not be disturbed without a Wetland Alteration Approval from NSE. In accordance with the Activities Designation Regulations (NS 2010) which specifies the requisite information to support an application for Wetland Alteration Approvals, site specific plans for minimization of wetland alteration will be developed. It is understood that Wetland Alteration Approvals may be contingent on the fulfillment of compensation obligations to ensure “no net loss” of wetland habitat on the as a result of Project activities. However, NSPI holds a Blanket Water Approval issued by NSE to allow NSPI to work within wetlands without obtaining a Wetland Alteration Approval, as long as they are altering less than 25 m^2 of a wetland.

- To offset unavoidable wetland alteration, a wetland compensation plan will be developed in consultation with NSDNR and NSE prior to wetland disturbance. The objective of the compensation plan will be to ensure no net loss of wetland area or wetland function as a result of Project activities. However, due to agreements between NSE and NSPI, minor losses of wetland area or function as a result of activities within the transmission corridor will not be compensated..

- Best management practices to be adhered to by NSPI for the purpose of minimizing disturbances to wetlands are outlined in their internal document titled "Environmental Protection Procedures for Transmission and Distribution Facilities" (NSPI 2009). Adherence to this document is referenced in a condition of the aforementioned blanket approval.

- Vegetation clearing activities will be conducted outside of the breeding bird season where practical to minimize disturbance to wildlife within wetlands.

- Erosion control systems will be in place to manage runoff from the construction areas. The approach taken will be to prevent erosion rather than the capture of sediment prior to its release in watercourses and wetlands by minimizing the time, slope and area of exposed soil. Site specific erosion and sediment control measures will be identified in the EPP and also include erosion control fencing, check dams, use of mulch (possibly from shrubs and trees removed during clearing).

- If seeding applications are required to re-vegetate disturbed areas, mixtures free of noxious weeds will be used to minimize affects to wetland habitats that could result as a result of competitive interactions amongst species.

- No storage of chemicals or petroleum, oils and lubricants (POLs) or equipment maintenance or refueling will occur within 30 m of a watercourse or wetland.
- Potential environmental effects of watercourse crossing construction on wetland habitats will be minimized by following a number of mitigative measures, as identified in the Aquatic Environment VEC, Section 6.1.
- Contingency Plans will be developed and emergency resources will be available on site to react to unforeseen events (*e.g.*, spills).

Mitigative measures that will be adopted during the operation and maintenance phase of the Project include:

- Disturbance to wetland vegetation during operations will be minimized by relying on mechanical control of vegetation, with the use of herbicides being avoided where possible. If required, herbicides will not be used within 30 m of a wetland.
- The release of sediment into wetlands during operation and maintenance of the Project will be mitigated through implementation of site specific erosion and sediment control measures, as previously discussed.
- No storage of chemicals or POLs or equipment maintenance or refueling will occur within 30 m of a watercourse or wetland.
- Potential interactions between maintenance activities within the power line corridor and wetlands will be minimized by NSPI by adherence to the best management practices outlined in their internal document titled "Environmental Protection Procedures for Transmission and Distribution Facilities" (NSPI 2009). In addition to the mitigative measures outlined by this document, vegetation clearing activities along the transmission line will be conducted outside of the breeding bird season to avoid disturbance to avifauna.

6.3.3 Residual Effects Analysis

Construction activities associated with the access roads and turbines are estimated to result in the direct disturbance to 11 wetlands, accounting for approximately 1.4 ha, or less than two percent of the wetland area within the Project Study Area (Table 6.4). The majority of wetland area estimated to be disturbed is comprised of mixedwood treed swamp, at just under one hectare (4.1 % of that within the Project Area). Disturbance to coniferous treed wetland type is estimated to be approximately 0.1 ha which accounts for less than one percent of the area within the Project Study Area. Direct effects to shrub-dominated bogs account for a total of approximately 0.3 ha (less than one percent of their total estimated area within the Project Study Area). Direct disturbances to salt marsh or shallow water wetland types are not likely. Disturbance to wetlands within the Project Study Area will be met with corresponding loss to the functions which they provide. However, loss of wetland function will be compensated through the enhancement, restoration or creation of wetland habitat at an area ratio commensurate with the loss. The effects of construction, operation, and maintenance of the transmission line on wetlands are currently unknown but are likely to be minimal given implementation of previously described mitigative measures.

Table 6.4 Number and Area of Wetlands within the Project Footprint

Wetland Class	Vegetation Type	Number of Wetlands within Project Footprint		Area of Wetlands within Project Footprint	
		Number	Percent Affected by Current Project Footprint	Area (ha)	Percent Affected by Current Project Footprint
Bog	Shrub	4	8.33	0.34	1.80
	Treed	0	0	0	0
Marsh	Graminoid (Salt Marsh)	0	0	0	0
Shallow Water	Non-vegetated	0	0	0	0
Swamp	Coniferous Treed	3	17.6	0.11	0.69
	Deciduous Treed	0	0	0	0
	Low Shrub	0	0	0	0
	Mixedwood Treed	4	40	0.96	4.11
	Tall Shrub	0	0	0	0
	Tall Shrub / Coniferous Treed	0	0	0	0
	Tall Shrub / Treed	0	0	0	0
All Wetlands		11	0	1.41	1.53

In summary, both phases of the Project (construction and operation / maintenance) have potential to have an adverse effect on wetlands. Reflecting the amount of habitat likely to be directly disturbed, the magnitude of the effects of the construction, as well as operations / maintenance phases of the Project are ranked low. As a result of mitigative measures being employed to avoid indirect effects, influences of the Project on wetlands are primarily expected to be restricted to within the Project Footprint. However, because the capacity of wetlands to provide certain functions (*e.g.*, related to wildlife usage) will be altered beyond the immediate footprint of disturbance activities, effects have been ranked as extending into the Project Study Area for both phases. Whereas effects of the Project on wetlands during the construction phase will occur once, vegetation management activities during the operations and maintenance phase are likely to continue on a near-annual basis. Effects to wetlands as a result of operation and maintenance are considered reversible because successional development will re-establish much of the vegetative composition and structure following cessation of disturbance activities. Although effects during the construction phase of the Project are irreversible, compensation initiatives will act to replace loss of wetland area and function. Table 6.5 summarizes the residual effects of the Project on wetlands.

Table 6.5 Summary of Project Residual Environmental Effects on Wetlands

Project Activity	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
Construction (clearing, road construction, turbine foundation construction and turbine installation, substation construction and installation of collector lines, transmission line construction)	Loss of wetland area and/or function	• Final layout of access roads and turbine locations will avoid direct disturbance to wetlands within Project Area, where practical. • Avoid placing power poles within wetlands along transmission line, where possible. • Adherence to "Environmental Protection Procedures for Transmission and Distribution Facilities" (NSPI 2009) during construction of the transmission line. • Vegetation clearing to be performed outside the breeding bird season. • Implement site specific erosion and sediment control measures. • Use of seed mixtures free of noxious weeds and use of native species (where available) during re-vegetation. • Compensation for loss of wetland habitat (a wetland compensation plan will be developed in consultation with NSDNR and NSE) • No storage of chemicals or POLs or equipment maintenance or refueling will occur within 30 m of a watercourse or wetland • Follow watercourse crossing mitigation, as outlined in Section # (Aquatics)	2	1	2-1	I	2	By following mitigation measures (including wetland compensation to ensure no net loss of wetland function), adverse interactions with wetlands will be minimized and no significant residual effects are predicted.
Operation and Maintenance	Loss of wetland function	• Herbicide use for vegetation management will not be used within 30 m of wetlands. • Implement site specific erosion and sediment control measures. • No storage of chemicals or POLs or equipment maintenance or refuelling will occur within 30 m of a watercourse or wetland	2	1	2-6	R	2	By following mitigation measures, adverse interactions with wetlands will be minimized and no significant residual effects are predicted.

Table 6.5 Summary of Project Residual Environmental Effects on Wetlands

Project Activity	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
		• Adherence to "Environmental Protection Procedures for Transmission and Distribution Facilities" (NSPI 2009) during maintenance of the transmission line.						

1 Note

Geographic Extent	1 = <500 m^2, 2 = 500 m^2 – 1 km^2, 3 = 1 –10 km^2, 4 = 11 – 100 km^2, 5 = 101 – 1000 km^2, 6 = >1000 km^2
Magnitude	1: <5% of wetland area within the Project Area disturbed or indirectly influenced; 2: 5 - 20% of wetland area within the Project Area disturbed or indirectly influenced; 3: >20% of wetland area within the Project Area disturbed or indirectly influenced
Duration	1: <1 month, 2: 1-12 months, 3: 13-36 months, 4: 37-72 months, 5: >72 months.
Frequency	1: <11 events/year, 2: 11-50 events / year, 3: 51-100 events/year, 4: 101-200 events/year, 5: >200 events / year, 6: continuous.
Reversibility	R Reversible: effects will cease during or after the Project is complete; I Irreversible: effects will persist after the life of the Project
Ecological Context	1: effect takes place within a pristine area or area not adversely affected by human activity; 2: effect takes place within an area that has been substantially influenced by human developments and disturbances

Based on the field surveys and available data, as well as assumptions and consideration of the potential environmental effects of the Project related activities during all phases of the Project, the proposed mitigation, and the residual environmental effects significance ratings criteria, it is anticipated that adverse effects to wetlands will be not significant.

6.3.4 Follow-up and Monitoring

Additional wetland assessments will be required once the final Project location is finalized and will include field surveys for more detailed/accurate delineations of wetland boundaries within the extent of Project components. Although wetlands will be avoided to the extent practical, site-specific wetland functional analyses of potentially affected wetlands will also be conducted by a qualified wetland ecologist prior to any wetland disturbance. These analyses would be used to support Application for Water Approvals for wetland alteration as these would be required from NSE before wetlands can be altered. As such, site works that may affect wetlands will not proceed until the requisite approvals are acquired.

A wetland compensation plan will be developed in consultation with NSDNR and NSE prior to wetland disturbance. Compensation requires that residual effects on wetlands as a result of the Project be compensated by the enhancement, restoration, or creation of wetland habitat at an area ratio commensurate with the loss. As such, the objective of the compensation plan will be to ensure no net loss of wetland area or wetland function as a result of Project activities.

Monitoring will be conducted to confirm the extent of wetland alteration during the construction phase of the Project, the effectiveness of mitigative measures, and the successful completion of compensatory wetland restoration and creation. Site specific monitoring plans will be developed through consultations with NSDNR and NSE.

6.4 BIRDS AND OTHER WILDLIFE

Birds and Other Wildlife (*i.e.,* bats, mammals, reptiles and amphibians) was selected as a VEC because of the potential for interactions between Project activities and birds and other wildlife, in particular, birds protected under the *Migratory Birds Convention Act* (MBCA) and all wildlife that are considered as Species at Risk or Species of Conservation Concern.

The purpose of the MBCA is to protect and conserve migratory bird populations and individuals and their nests. The possession of, purchasing, selling, exchanging or giving a migratory bird or nest are prohibited without authorization, as stated in Section 5 of the MBCA. In 2005, the MBCA was amended to expand the purpose of the Act to include conserving migratory birds; specifically that birds are to be protected and conserved as populations and as individual birds. In the *Migratory Birds Regulations, 1994*, Section 6 states that without the authorization of a permit, the disturbance, destruction, taking a nest, egg, nest shelter, eider duck shelter or duck box of a migratory bird; possessing a migratory bird, carcass, skin, nest or egg of a migratory bird are prohibited.

As Environment Canada cannot provide authorizations or permits to allow for construction and operations-related incidental take of migratory birds and their nests and eggs (Environment Canada 2011), best management practices should be followed to prevent contravention of the MBCA.

There are both federal (*SARA*) and provincial (NS *Endangered Species Act*) legislation for the protection of Species at Risk and Species of Conservation Concern, and there are different levels of protection afforded a species within these acts pending the species rarity ranking. For example, only those species currently listed in Schedule 1 of *SARA* are protected by that Act. *SARA*-listed species designated as “Special Concern” are not protected by the prohibitions of Sections 32-36 of SARA, but do require that provincial or regional management plans are developed to protect the species. Also, although Species of Conservation Concern, as identified by NSDNR and/or ACCDC population rankings are not protected by legislation, they do require special consideration for the purpose of environmental assessments.

As mentioned in Sections 5.6.3 and 5.6.4 there are no terrestrial or reptile and Amphibian species of conservation concern in the Project Study Area. As such, the effects analysis will focus on birds and bats, and loss of habitat.

6.4.1 Potential Environmental Effects, Issues and Concerns

Construction

There are several construction activities related to the Project that could affect birds and other wildlife. The most substantive and likely direct interactions are habitat alteration and loss, mortality of birds and other wildlife and sensory disturbances as a result of site preparation activities (clearing and grubbing).

Operation and Maintenance

Mortality of birds and bats is the key issue of concern during Project operations. Wildlife sensory disturbance may occur as a result of on-going human activity on-site as well as visual and auditory disturbance related to the operation of the turbines. Sensitivity of wildlife to disturbance varies by species and life-stage.Human presence (noise, sight and smell) and vehicles may disturb wildlife. During operation of the wind-farm, Project-related vehicles and personnel will be in the vicinity of wind turbines on a regular basis for ongoing maintenance. It is likely that some disturbance of diurnal wildlife will occur during operation and maintenance of the Project.

6.4.2 Mitigation

- Construction on-site will occur outside of the breeding season to the extent practical to avoid contravention of the MBCA. If clearing activities cannot be scheduled to avoid the breeding season for most birds (May to August), then a birder on-site will use non-intrusive searching methods to identify the potential for nests within or immediately adjacent to work areas, and flag them for avoidance during construction. In cases when nests are known to be easy to locate, active nest searches may be performed

- Habitat loss may be mitigated by only clearing the land necessary for construction activities and by limiting the overall land disturbance to within designated workspaces.

- Measures to reduce construction noise will be implemented as per mitigation discussed in Section 6.5.2.

- Mitigation recommended by the Avian Power Line Interaction Committee (2006) will be considered to minimize effects of overhead distribution lines.

- Lighting will be the minimum allowed by Transport Canada for aeronautical safety, and white or red flashing or continuous lights (CL-865) may be used with the minimum intensity and flashes per minute allowable. The turbines for this Project will be built using tubular steel towers, as some data indicate that lattice towers encourage perching by raptors during hunting and, as a result, may put these birds at risk of collisions.

- Upon completion of construction and/or decommissioning, habitat will be restored to the extent practical.

- A bird and bat monitoring program will be developed in consultation with NSDNR and CWS. Based on the results of the program, necessary modifications to mitigation plans and/or wind farm operations will be undertaken.

6.4.3 Residual Effects Analysis

6.4.3.1 Construction

Project construction will result in direct and indirect effects on birds and other wildlife. A recent study undertaken by Pearce-Higgins *et al.* (2012) suggests that there may be greater impacts of wind farms on bird populations during construction than operation. Analysis of density data for 10 species (excluding raptors) at five or more wind farms with reference sites demonstrated a significant difference between pre-construction and construction densities on wind farms, with no such significant differences observed at the reference sites. Red grouse, snipe and curlew demonstrated the greatest differences although densities of red grouse had recovered by the first year post-construction (Pearce-Higgins *et al.* 2012). The authors found little evidence of differences between operational wind farms and reference sites, implying that any increase in mortality through collision with operating turbines (or other effects associated with wind farm operation) has little effect on local populations. Based on these findings, Pearce-Higgins *et al.* (2012) recommended that mitigation to minimize the spatial extent of disturbance and scheduling construction outside breeding season should be implemented to prevent adverse effects of construction disturbance on bird populations.

For the Wedgeport Wind Farm, clearing activities are planned to occur outside the main breeding season for birds (May to August), so the potential for direct mortality to nesting birds is low. The more predominant effect is predicted to be habitat loss. Table 6.2 of the Vegetation VEC provides the areas of habitat within the Project footprint, compared to the Project Study Area and surrounding Regional Assessment Area. Of the 35 ha in estimated habitat loss, most is immature forest (9.55 ha), mature softwood forest (5.81 ha) and Shrub thicket (3.07 ha). Only 1.40 ha of wetland is estimated to be lost. The predicted habitat loss is distributed throughout the Study Area and is mostly associated with linear corridors and small 1.5 ha areas for the turbines.

There are approximately 79.6 ha of interior forest habitat within the Project Study Area. The current array of wind turbines and associated roads and collector lines will result in the loss of approximately 29.1 ha (37%). Most of the area of forest interior habitat lost to wind farm development will not be physically destroyed. The largest losses will occur as a result of penetration of edge effects into these stands from adjacent roads and turbine pads or as a result of forest interior patches being reduced to less than 10 ha in size in which case they are no longer considered as forest interior habitat. Most bird species recorded during breeding surveys in one or more of these interior forest stands were also recorded in smaller patches of mature forest or in other habitats. The exceptions were Ruby-throated Hummingbird and Eastern Wood-Pewee, each recorded in one of two interior mature mixedwood stands surveyed. Interior forest is not the typical habitat of Ruby-throated Hummingbird, a common and Secure species likely found elsewhere in other habitats within and beyond the Study Area. Eastern Wood-Pewee recorded once in Point Count 12, is considered Sensitive and is relatively uncommon in the region (MBBA 2012). There is potential habitat within and near the Project Study Area for this species, away from planned turbine locations.

In addition to direct habitat loss, a number of indirect effects can result from site preparation activities, as well as subsequent construction activities including road construction, turbine foundation, substation construction and collector line installation, and transmission line construction. Clearing of forested areas can change the quality of the habitat along the edge of the Project Footprint as a result of increased side lighting or drying of what was previously forest interior habitat. It also can provide increased access by predators, thereby potentially affecting breeding success of wildlife in edge habitats. Sensory disturbance can occur in remaining wildlife habitats adjacent the directly disturbed areas, where construction activities will occur, though not continuous throughout the PDA. This potential effect could extend several hundred metres from the Project footprint.

Sensory disturbance may cause habitat avoidance but it likely will be temporary in nature, small in magnitude and restricted to within several hundred metres of the Project footprint. The area to be subject to this disturbance is forested land and effects associated with sensory disturbance will be reversible. Sensory disturbance of birds during the construction phase will be temporary and given the planned mitigation measures the effects are not considered significant.

6.4.3.2 Operation and Maintenance

The residual effects analysis of operation and maintenance of the Project focuses on birds and bats separately.

Birds

The operation of the wind turbines will likely result in visual and auditory disturbance of wildlife, including birds. Breeding birds may avoid habitat within a zone surrounding the immediate Project footprint, although sensitivity is species-specific (Kingsley and Whittam 2005). Many species will not avoid habitat near rotating wind turbines, as has been noted by James (2003) and James and Coady (2003), but other species show a reduction in breeding densities near turbines (Johnson *et al.* 2000). While habitat avoidance will most likely occur during periods of construction, avoidance may be more intermittent during periods of operation, when human presence on-site is less frequent and typically of short duration. Given the limited amount of interior forest within the Study Area, and the fact that most of the turbines are located in open habitats, the potential for increased fragmentation is reduced.

The flight behaviour of birds may be influenced by Project development. Operation of the turbines may affect bird movements through the partial obstruction of regular flight paths. Certain species (*e.g.*, waterfowl) appear to exhibit avoidance behaviour when flying close to an operating wind farm, while others do not appear to be influenced by the presence of a wind farm (James 2003; Kingsley and Whittam 2005). Breeding birds at Pickering, Ontario, do not appear to be disrupted by the 1.8 MW operating turbine, and birds continue to nest and move within the area as before (James 2003). Most diurnal migrants fly at low altitude, within 40 m of the ground, and are unlikely to be significantly disturbed by the wind turbines or associated facilities. At night, migrants fly well above the height of the wind turbines, typically greater than 150 m above the ground, and are thus also unlikely to be disturbed by the Project. However, visual or auditory features that cause bird avoidance may have a constructive effect in that birds will be less likely to accidentally collide with turbines.

Mortality

Mortality of birds due to collisions with operating wind turbines could occur. There is a perception that wind turbines cause many bird deaths, and it has been highlighted by regulatory agencies and non-governmental agencies as an issue that needs to be addressed. General information about bird-turbine collisions is presented below.

Kingsley and Whittam (2005) provide a detailed review of available information regarding turbine-related bird fatalities in North America and elsewhere. Numerous studies during the last 20+ years have been conducted to estimate bird mortality at wind farms, from a single turbine or small wind farms such as the present proposal, to larger wind farms with thousands of wind turbines (Gill *et al.* 1996; Erickson *et al.* 2001; Percival 2001). This level of study effort is principally due to the circumstances at one large site in California, Altamont Pass, which alerted industry, government and the public to potential bird mortality at wind-farms. Thousands of wind turbines installed in the early 1980s at Altamont Pass were shown to cause high raptor (hawks, eagles and falcons) mortality. Collisions with the turbine structures were the primary cause of death, although electrocution and wire collisions also played a part (Orloff and Flannery 1992). These raptor fatalities triggered an increase in scrutiny of potential wind farm developments, which has led to the development of monitoring protocols and a substantial amount of data on bird use and mortality at proposed and existing wind farms.

Despite these early studies in California, very few raptors have been found killed at other North American wind farms (Erickson *et al.* 2001; Kingsley and Whittam 2005). Songbirds are the most frequent casualties of wind farms in North America, and tend to collide with wind turbines more frequently during migration. Breeding birds appear to adapt to the presence of wind turbines near their nesting and/or foraging areas and avoid collision (Erickson *et al.* 2002; James 2003; James and Coady 2003; Kingsley and Whittam 2005). Songbirds can make up anywhere from 10% to 90% of the overall bird fatalities, depending on the location of the wind turbine site (Erickson *et al.* 2001). Excluding California, 78% of bird casualties at wind farms in the United States tend to be of migratory species (Kingsley and Whittam 2005). Many of these collisions occur at night, when individuals may be attracted to lit structures and collide with transmission wires, turbine towers or other structures in a wind farm. Findings at a West Virginia wind farm, where 27 birds were killed by colliding with a substation and the three wind turbines closest to the substation on a foggy night during May 2003, are probably attributable to the sodium vapour lights of the substation, which, combined with the very low visibility and the presence of the wind farm on a rise in elevation, may have caused this rare mortality event (Kerlinger 2003). No fatalities were found at any of the other 41 wind turbines of the wind farm, located further away from the substation and its sodium vapour lights (Kerlinger 2003). In Spring 2011, a similar event occurred in Nova Scotia during a persistent fog event. Bird mortality was observed at various wind farms in the province during this fog event. Excepting this event, however, bird mortality at wind farms in Nova Scotia has been reportedly low.

Although fatalities occur at wind energy facilities, the number of fatalities is generally small. This is especially noticeable when compared to bird fatalities caused by other sources, such as communication towers, roads and buildings. Erickson *et al.* (2001) compared estimates of bird mortality caused by different human sources in the United States, and estimated that an average of 2.19 birds per turbine, or between 10,000 and 40,000 birds, are killed each year. Compared to other sources, such as buildings (98-980 million birds killed each year), communication towers (40-50 million birds killed each year) and vehicles (60-80 million birds killed each year), the mortality caused by wind turbines is significantly less (Erickson *et al.* 2001). Each house in North America kills on average between 1 and 10 birds each year, and tall buildings kill many more (Dunn 1993, Kingsley and Whittam 2005). Additionally, Kingsley and Whittam (2005) indicate that the effects are small compared to the millions of birds that travel through existing wind power developments in the U.S. each year. This has been noted for two sites in Washington and one site in Minnesota, where conservative estimates of mortality, using surveillance radar and carcass surveys to determine passage rates and fatality rates, respectively, are less than 0.01% of birds passing through each wind farm (Erickson 2003). In Canada, existing wind farms in Alberta were included in a research study examining the movement of nocturnal migrant birds (and bats) using radar and sound recording technology. This research, conducted during the fall of 2004, compared the behaviour and abundance of birds and bats between operating wind farms and comparable sites without wind turbines. Millikin (2005) estimated that approximately 0.02% of the individuals (birds and bats combined) observed on radar may have resulted in a collision with a turbine. Furthermore, this research identified that these nocturnally migrating birds exhibited avoidance behaviour, with individuals reducing their speed and increasing their flight height to avoid the turbines (Millikin 2005). Nocturnal bird studies were not conducted as a part of the Project.

The National Wind Coordinating Collaborative (Strickland *et al.* 2011) summarized the bird mortality rates from 63 studies of wind power facilities across North America and Canada. The NWCC reports that bird mortality rates range from 0-14.0 birds per MW per year, with two-thirds reporting less than or equal to three fatalities per MW per year Anecdotal evidence of bird and bat mortality monitoring from the 17-turbine West Pubnico Wind Farm suggests that mortality incidents have been very infrequent, with two bird mortalities reported since the commissioning of the project in 2005 (D'Entremont 2012) in spite of the high volumes of migrating birds in the area.

Overall, the findings of the studies discussed above indicate that bird fatalities caused by wind turbines are very low in the majority of cases (Erickson *et al.* 2001; Percival 2001; Erickson *et al.* 2002; Kingsley and Whittam 2005). Stopover (Transect) counts suggest that the Project Study Area is not an important stop for nocturnal migrating songbirds. The largest flocks of land birds included between 30 and 100 American Robins, as well as several large flocks of Red-winged Blackbirds and Common Grackles in mid- to late-fall. A single flock of an estimated 100 Canada Goose was noted flying over the site at H height. A flock of 30 unidentified shorebirds was also recorded once in the fall, flying at H height.

It is important to understand what factors may increase the collision risk of birds at a wind farm. A number of factors may influence the potential for bird-turbine interactions that lead to bird kills, including weather and lighting, landscape features, turbine design, facility design and bird abundance and behaviour. These are described further in the following discussion.

Weather and Lighting

When conditions are clear, there is low likelihood that birds will collide with wind turbines (Crockford 1992; Kingsley and Whittam 2005). However, low visibility (<200 m) may cause nocturnal migrants to fly at lower altitudes, and lights may attract individuals (Jones and Francis 2003; Kingsley and Whittam 2005).

Birds may be attracted to red visibility beacons or other lighting associated with turbine structures. Lighting that attracts birds can increase the probability of bird-turbine collisions and result in kills. CWS recommends that the minimum amount of pilot warning and obstruction avoidance lighting should be used on tall structures. Only strobe lights will be used at night, at the minimum intensity and minimum number of flashes per minute (longest duration between flashes) allowable by Transport Canada. The use of solid-burning or slow pulsing warning lights at night will be avoided. Transport Canada typically specifies red flashing lights for wind farms in Canada (Canadian Aviation Regulations Standard 621.19). Spotlights or other exterior or decorative lights will not be used to illuminate turbines. Lighting elsewhere within the Project will be the minimum necessary for safety. Lighting for the safety of the employees will be shielded to shine down and only to where it is needed, without compromising safety, and turned off when not in use. Final lighting selection will be determined in consultation with Transport Canada. A recent study of communications towers found that fewer avian fatalities are recorded at flashing versus steady-burning lights, regardless of the colour (Gehring *et al.* 2009).

Turbine Design

Turbine height is believed to be a strong influence on the likelihood of collision with taller structures having an increased risk of collision, while structures below 150 m cause minimal mortality (Kerlinger 2000; Crawford and Engstrom 2001; Kingsley and Whittam 2005). Migratory birds typically fly at altitudes greater than 150 m such that structures lower than 150 m in height do not usually obstruct migratory bird movements or result in bird mortality (Kingsley and Whittam 2005). The turbines of the Project will be as high as 100 m hub height with a rotor diameter of 97 m. As a result, the greatest height of the turbines will be 148.5 m above the foundation, or just below 150 m. At this height, the turbines are not likely to obstruct the movements of most migratory birds that frequent the region or to increase risk of material collision. Furthermore, results from a research project in Alberta indicate that migrating birds will modify their flight paths to increase in flight height when approaching an operating wind farm (Millikin 2005).

Facility Design

The scale of the wind farm has a direct influence on the potential for bird-turbine collisions. Facilities of 100 turbines or more are thought to more likely have a greater effect in terms of bird mortality due to the increased number of vertical obstacles (potential collision hazards) in the landscape (Environment Canada 2007a). The Project will consist of a maximum of 25 turbines and would therefore be considered to be a medium-sized facility. The site sensitivity is considered very high, making the facility a Category 4 level of concern (Environment Canada 2007a).

Bird Abundance and Behaviour

When considering the results of the avian pre-construction monitoring program, the majority of birds observed flying within the Project Study Area were flying within 40 m of the ground, which roughly corresponds to the air space below the turbine blade sphere (*i.e.*, below where the turbine blades would be turning). Flock sizes were typically low, on average from 1.2 birds per flock in fall, to 2.2 birds per flock in spring, to 3.7 birds per flock in winter, during watch counts. However there were some relatively large flocks observed in fall (15 flocks between 25 and 100 birds during watch counts), but only one in the spring (40 Cedar Waxwings) and one on winter (25 Canada Geese). These large flocks were all observed above or below the blade sweep of a turbine. During the 2-hour raptor watch mid-day on September 22, 2011, a flock of an estimated 300 Herring Gulls was observed flying West, between 40 and 70 m height. Excluding this one observation, flock size ranged from 1 – 6, and were dominated by Great Black-backed Gulls and Herring Gulls flying at AT and WAT heights.

There are local and regional factors having an influence on local bird movement in the area, possibly by resident or overwintering species. Local fishing wharves and fish processing plants likely attract birds, especially gulls, and are located in nearby Little River Harbour, and Lower Wedgeport (both in Goose Bay and Tusket River Harbour). The estuaries and mud flats surrounding the Project Study Area are used as feeding areas for overwintering Canada Geese. Turkey Vultures overwinter in the area, and roost in a gravel pit northeast of the Project Study Area. Southeast of the Project Study Area are islands of varying size, many of which host breeding colonies of waterbirds such as terns, gulls, and herons as well as Osprey. Of these species, only gulls and Turkey Vultures have been regularly observed flying through the Study Area.

In general, the Project Study Area does not seem to be a major staging or stopover area for migrating birds, however overwintering birds fly over the peninsula the position of the site between coastal estuaries and feeding areas.

Although species of conservation concern were recorded in or near the Project Study Area, it is unlikely that any are at risk of collision, due to the very low use of the site by these species, the general low habitat suitability within the Project footprint for their breeding or staging, and the expected low number of fatalities overall, based apparent low collision rates at West Pubnico Point Wind Farm and elsewhere in North America. As a result, no specific mitigation measures or monitoring programs have been identified to address potential effects to species of conservation concern.

Evidence from wind farms in North America and elsewhere, as noted above, suggests that bird collisions are likely to occur but are in very low numbers, and the potential for significant bird kills is low. The results of the pre-construction bird survey program and collection of existing data indicate that the bird use of the Project Study Area does not cause concern with regards to increasing risk of collision, disturbance or habitat alteration. However, there are further monitoring measures that will help verify these potential effects to bird populations.

Bats

Bats are unlikely to be affected by human presence as they are nocturnal and the majority of human presence will occur in the Project Study Area during the day. Although there is the potential for limited human presence induced disturbance to wildlife, significant adverse effects are not predicted for several reasons. Disturbance will be intermittent and generated noise will be of low levels (*i.e.*, human speech and vehicle noise). The effects analysis on bats therefore focuses on bat-turbine collisions.

Bat-Turbine Collisions

Despite having the ability to navigate cluttered environments in the darkness, bats are known to collide with large man-made structures, occasionally with fatal consequences. Bat collision mortality has been identified to occur with various kinds of tall structures including lighthouses, buildings, power lines, communication towers and wind turbines. Bat collision with human structures appears to be an infrequent occurrence, but it has the potential to be of concern. A recent study by Long, Blade and Lepper (2010) found that echoes returned from moving turbine blades that could render them attractive or difficult for approaching bats to detect and locate in time for avoidance which might explain the sometimes inordinant rates of mortality at some wind farms.

The first report of bat fatalities at a wind farm was by Hall and Richards (1972). Over four years, 22 White-striped Mastiff-Bats (*Tadarida australis*) were found at the base of turbines at an Australian wind farm. Since then, bat fatalities have been reported at several wind farms in North America (Arnett *et al.* 2008). A report by Arnett *et al.* (2008) synthesized available information from 21 post-construction fatality studies across the United States and Alberta . This summary shows a consistent trend in fatalities occurring in late summer and fall among primarily lasiurine migratory species. Hoary bats, red bats, and silver-haired bats had the constituted most of the mortality at wind farms. At one wind development where the tri-colored bat is the most common resident bat, mortaility approached 25%. However, fatalities among resident bat species such as *Myotis* spp. and big brown bats were low with the exception of two sites located in Alberta and Iowa where little brown bats comprised 25% of mortality. There were no reports of fatalities of threatened or endangered species. Overall estimated mean fatality rates per MW varied between 0.2 and 53.3 (0.1 and 69.6 deaths/turbine/year) with the highest rates occurring in the eastern US. The average rate across all sites was 11.6 fatalities/MW/year. The study also found that fatalities were not generally concentrated around particular turbines and strobe lights did not influence rates of fatality.

Based on the timing of spring migration (Koehler and Barclay 2000), spring migrations of Hoary, Eastern Red and Silver-haired bats are most likely to occur in May. Despite these movements, Arnett *et al.* (2008) found that far fewer collision fatalities occurred in the spring at wind farms in the United States and Alberta. Erickson *et al.* (2002) found that of 536 recorded bat collision fatalities at wind farms across the United States, only two were killed in May (Erickson *et al.* 2002). Collision data collected from other types of structures also support these findings. For example, of 50 dead Eastern Red Bats collected at a building in Chicago, 48 were found in the fall and two in the spring (Timm 1989). It is not clear why spring migrants collide with wind turbines far less frequently than fall migrants. Behavioral differences between migrating hoary bats in the spring and fall may influence collision risk, as suggested by Johnson *et al.* (2002). These differences have been reported in Florida, where autumn migration occurred in waves, whereas the spatial distribution of bats during spring migration appears to be far more scattered (Zinn and Baker 1979).

The principal factors adversely affecting bat populations are predation and habitat alteration/destruction, not collision with wind turbines or any other human structure (Bat Conservation International 2001). Despite this, bats are being killed at wind farms, or at least some wind farms, though the factors putting them at risk of colliding with wind turbines are still poorly understood. Without a clear understanding of what would place bats at risk of collision, it is difficult to predict the frequency of bat-turbine collisions. For example, Erickson *et al.* (2002) report several instances where bats were observed foraging very close to turbines without being struck by the turbine blades. This is further complicated by a lack of understanding of bat ecology, especially on migration, and the paucity of data on abundance and movement of bats at multiple spatial scales (continent-wide, provincial, regional) that could provide context for pre-construction surveys.

Barotrauma

It is now understood that barotrauma is the cause of death in a high proportion of bats found at wind energy facilities (Baerwald *et al.* 2008). Barotrauma involves tissue damage to air containing structures (*i.e.,* lungs) caused by rapid or excessive air pressure change. In this case, it is believed that air pressure change at turbine blades (in movement) causes expansion of air in the lungs not accommodated by exhalation, therefore resulting in lung damage and internal hemorrhaging. However, a more recent study by Grodsky *et al.* (2011) used radiology to investigate causes of mortality and found that a majority of the bats (74%; 29 of 39) examined had bone fractures that are likely to have occurred during direct collision with turbines. Approximately one-half (52%; 12 of 23) of bats whose ears were examined had mild to severe hemorrhaging in the middle or inner ears (or both). The true nature of mortality resulting from turbine collision remains poorly understood.

Fatalities in the Northeast

While pre-construction bat surveys have demonstrated little correlation with actual fatalities post-construction, competed wind farms in the area have demonstrated that bat fatalities are low. The operational Kent Hills Wind Farm located near Prosser Brook along the Bay of Fundy could be considered a high potential site for bat interaction based on its location near a known hibernaculum, and proximity to the Bay of Fundy Coast. Despite these factors, mortality at this site has been low over the last two years of carcass monitoring (32 turbines) with only one bat carcass found in 2009 and four in 2010. The estimated casualties corrected for searcher efficiency over the entire period is 0.10 casualties per turbine (Stantec 2010, 2011).

Likewise, a post construction monitoring study at the Mars Hill Wind Development along the New Brunswick/Maine border found no unreasonable adverse impact to these species, recording only 0.17 fatalities per turbine per year in 2008, and 0.43 in 2007 (Stantec 2009). These numbers represent only a fraction of the mortality experienced at many other wind developments in the eastern US. These low numbers could be considered noteworthy given that the Mars Hill wind development follows a highly pronounced north-south running ridge, surrounded by agricultural plateau that could present an obvious migratory marker for any bats that might be moving through the area.

While nearby wind developments have demonstrated low rates of mortality, migration pathways can be localized and our ability to predict the locations of migration corridors is limited. There are also other post construction monitoring programs underway in the Maritimes that may help to shed additional light on the general hazard of fatalities to bats in the region.

Predicting Risk of Bat Mortality

To further assess potential for bat mortality, landscape and site level conditions were examined and interpreted in consideration of existing knowledge of bat demographics and movement in Nova Scotia.

The local landscape features and habitat conditions at the site were investigated using available digital data sources for forest cover, buildings, wet areas mapping, water bodies and watercourses, topography, aerial imagery, and abandoned mines records, all of which were available from GeoNova online digital data gateway (2012).

Currently in Nova Scotia there is no official guidance for assessing the potential for interaction with bats for wind development. In adjacent New Brunswick, Pre-Construction Bat Survey Guidelines for Wind Farm Development in NB, released by New Brunswick Department of Natural Resources (NBDNR) in June 2009 identify certain landscape and site level features as indicators for increased likelihood of presence of bats. These features as outlined by NBDNR (2009) include:

- Known hibernacula or potential caves or mines within 5 km of the site;

- Coastline, or major water bodies within 500 m; or
- Forested ridge habitat on or near the site.

In addition to assessing these features, a forest stand level review of the Project Study Area was conducted to assess potential for summer maternity colonies for local bats species, and potentially heavy foraging areas.

Known or Potential Winter Hibernacula

With the recent spread of WNS into the Maritimes, and the potential for catastrophic consequences on local bat populations, increased attention and concern has become focused on the winter hibernacula where the associated fungus (*Geomyces destructans*) is thought to spread and propagate (Blehert *et al.* 2009). Hibernacula can house large concentrations of bats and may be the sites of swarming activity where large numbers of bats congregate near cave or mine openings in late summer or fall where they engage in social behaviours that include courtship and copulation (Rivers *et al.* 2005). In Nova Scotia, researchers at Dalhousie and Saint Mary's Universities have recently undertaken studies of bat movements among hibernacula in Nova Scotia and New Brunswick in an attempt to better understand the structure and movement of bat populations in the region which may shed light on how this disease spreads.

In the Wedgeport area, there are no known bat hibernacula. To assess the potential for unknown hibernacula to occur locally, the provincial database for abandoned mine openings was investigated. NSDNR has documented more than 600 mining areas, containing approximately 7,000 mining features which are or were at one time, open to the surface (NSDNR 1995). Some of these abandoned shafts are known to be used by hibernating bats. There may be additional mines that are not included within this database. Many of the mines that are recorded are of unknown status (in terms of depth, condition opening *etc.*) but most that are known are flooded, in-filled, or too shallow for the thermal conditions required by hibernating bats. Where known, the database records information on the abandoned mine opening that includes: depth, flooding, condition of opening, physical form (shaft/slope/adit), *etc.* One recent study by Randall (2011) considered known caves and abandoned mines in mainland Nova Scotia, and identified 30 of these as having potential importance to bats, 21 of which were previously unstudied. The predictive model developed in this study suggested that caves must have a depth of at least 50 m to have greater than 10% chance to be used as a swarming site for bats. In the course of these surveys, no abandoned mines around the wind development area were identified as having high potential for swarming bats. The nearest mine opening is more than 6 km to the north of the Project Study Area and has a depth of 11 m.

Major Water Bodies

There are no major lakes or rivers within 500m of the Project Study area, but it is located on a coastal peninsula at the southwestern end of Nova Scotia. Coastal landforms could potentially be used as flyways or navigational aids for migrating bats, particularly when in a north-south configuration. The use of this area as a migration corridor would indicate a potential for mortality associated with wind development near the coast, but evidence to date indicates that there are not large numbers of bats that migrate across the gulf of Maine to Nova Scotia.

In 2001, Broders, Quinn, and Forbes (2003) recorded more than 30,000 echolocation sequences during migration periods in Kejimkujik National Park and Brier Island, of which less than 0.001% were attributable to migratory species. During the course of this study the first breeding record for red bat was incidentally recorded in Yarmouth, NS. During this study, opportunistic surveys were also conducted at Bon Portage Island (a known migration gateway for birds) and no migratory bats were recorded. However, during more recent work by Stantec (2011), a variety of species were recorded at off-shore locations (islands, buoys, lighthouses) along the coast of Maine. The activity levels were higher during migration periods, suggesting that migrating bats follow the Gulf of Maine to more northerly summer habitat. Despite this, there are few records of migratory species in Nova Scotia and it is not anticipated that large numbers migrate through the Wedgeport area between Nova Scotia and the Northeast coast of the US, although the potential for bat mortality cannot be ruled out.

Goose Lake is located approximately 600m to the north of the Project Study Area, and while beyond the 500m limit in the Guidelines, it may be used as a foraging area by bats. However, due to the apparent low potential for maternity colonies in the project area to the south, and the more coastal position of the site, it is unlikely that the Project Study Area is an important commuting area for local bats.

Wetlands are also identified in the New Brunswick Guidelines as representing potentially important foraging sites. There are coastal and freshwater wetlands in the area that may also be used by foraging bats but these will be avoided to the extent possible and they are largely located outside the Project Study Area. The abundance of wetlands within the Project Study Area is much lower than in the surrounding landscape.

Forested Ridge Habitat

Most wind developments on eastern North America are located along forested ridgelines due to the geography of the region, and the wind speeds that can be found along these features. Wind developments along these features may experience elevated mortality levels when migrating bats exploit favorable air currents associated with the features, or use them as navigational markers. The landscape in the Project Study Area is generally low and flat, and does not have elevated potential for bat mortality in this context.

Roosting and Foraging Habitat

Assuming that little brown and northern long-eared myotis are present, it is possible that maternity colonies may occur near the site which may be sensitive to construction activities, operational disturbance, or direct mortality from collisions with turbines. While male northern long eared and little brown myotis have less specific or limiting roosting requirements, maternity colonies of the local *Myotis* species are typically found in hollow, tolerant hardwood trees, or in the case of reproductive little brown myotis, in man-made structure where available (Broders *et al.* 2004). There are no buildings located within 500 m of the Study Area, and the forest cover of the surrounding area is spruce dominated coniferous habitat and is all under 13 m in height. It is unlikely that the area contains trees that are typically preferred as maternity colonies by these species (Broders *et. al*. 2004).

While the potential for direct interaction with breeding and Myotis species is anticipated to be low, their recently updated COSEWIC status warrants precautions to avoid direct interaction with breeding Myotis bats. Clearing and other construction activities that produce high noise levels such as jack-hammering will be conducted outside the active season for bats.

This assessment of risk based on landscape level and site specific features attributed to elevated risk levels for bat mortality found that there are no important risk factors evident within or around the proposed Project Study Area with the potential exception of its position near the coastline. Many features considered to have potential for elevated risk to bats such as known hibernacula or potential caves or mines; major water bodies; or forested ridge habitat are either absent, or do not likely pose an important risk to bats. The Project Study Area is at, or beyond the northern range limits for migratory species and while it cannot be ruled out, high rates of mortality of the locally common *Myotis* species is not anticipated.

To better understand the potential use of the Project Study Area by bats, the Proponent has also committed to participating in a regional study being undertaken by Hugh Broders of St. Mary's University, pending PPA award. This study is intended to characterize bat movement patterns and populations at a regional scale to help better inform which factors best predict bat mortality risks of wind farms.

Post-construction fatality monitoring will be conducted at the site for likely two seasons, including the fall migration period from mid-August to late September. The duration of the monitoring could depend on levels of mortality found in the first season. In the event that mortality is high at the site, operational mitigation can be employed to reduce mortality which may include changes to cut-in wind speeds, feathering of blade under certain wind speeds, or shut-downs during high activity periods. The Ontario Ministry of Natural Resources (OMNR) (2010) recommends a threshold of 10 bat deaths/turbine/year after-which mitigation should be implemented to reduce mortality through operational mitigation. There are currently no guidelines in Nova Scotia for monitoring bat populations, in part due to the lack of good baseline data. In the absence of these guidelines, post-construction monitoring protocols and mitigation measures, should monitoring in the first year of operations deem them necessary, will be developed in consultation with NSDNR. Monitoring will include fall bat mortality surveys to be conducted at a frequency to be determined though consultation with regulators.

As discussed above, the Proponent is committed to monitoring the Project during its first year of operation to identify if bats are being killed, and will be prepared to adopt post-construction mitigation measures should there be a need. These surveys are discussed further in Section 7.0. At this stage, the level of impact on bats is considered low and not significant,

6.4.3.3 Summary

Overall, residual adverse environmental effects on birds and other wildlife are not predicted to be significant for construction or operation and maintenance. Table 6.6 summarizes residual effects.

Table 6.6 Summary of Project Residual Environmental Effects on Birds and Other Wildlife

Project Activity	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
Construction	Sensory Disturbance	• Ensure that overall disturbance is limited to designated workspaces, and performed in compliance with the *Migratory Birds Convention Act* (MBCA). • Conduct clearing outside the breeding period of most migratory birds. • Clear only the land necessary for construction activities and limit the overall land disturbance to within designated workspaces. • Upon completion of construction and/or decommissioning, habitat will be restored to the extent possible. • Implement noise reduction mitigation as per Section 6.5.2. • Mitigation recommended by the Avian Power Line Interaction Committee (2006) will be considered to minimize effects of overhead distribution lines.	2	1	2/1	R	2	Sensory disturbance may cause habitat avoidance but it likely will be temporary in nature, small in magnitude and restricted to within several hundred metres of the Project footprint. The area to be subject to this disturbance is forested land and effects associated with sensory disturbance will be reversible.
	Habitat alteration and loss		2	1	2/1	I	2	Although some habitat loss will be considered irreversible (*i.e.*, 20 years), this “irreversible” habitat loss will be limited in geographic extent and magnitude and will ultimately be restored after Project decommissioning. Project design has attempted where feasible to make use of existing roads and cleared areas. The area of habitat that will be altered due to land clearing activities for access roads and turbines will be a very small proportion of what is available due to the fact that the majority of the Project has been sited to use existing access roads, and therefore the impact will be minimal.

Table 6.6 Summary of Project Residual Environmental Effects on Birds and Other Wildlife

Project Activity	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1] Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	Residual Effect
	Mortality		2	1	2/1	I	2	Due to timing of land clearing activities outside the breeding period for most migratory birds, it is predicted that there will be no residual effect on bird mortality. If clearing must be conducted during the breeding season for most birds, a contingency plan will be implemented to ensure compliance with *MBCA.*
Operation and Maintenance	Sensory disturbance	• Lighting will be the minimum allowed by Transport Canada for aeronautical safety, and white or red flashing or continuous lights (CL-865) may be used with the minimum intensity and flashes per minute allowable. • A bird and bat monitoring program will be developed in consultation with NSDNR and CWS. Based on the results of the program, necessary modifications to mitigation plans and/or wind farm operations will be undertaken.	3	2	5/6	R	2	It is anticipated that sensory disturbance during Project operations may cause birds to change their flight patterns in order to avoid the towers and rotating blades. This will serve to reduce the number of bird collisions. There is potential for avoidance of habitat within the vicinity of the turbines; this will be evaluated during post-construction monitoring.
	Mortality		3	2	5/6	I	2	Given existing information from operating wind energy facilities elsewhere in North America, including the West Pubnico Wind Farm (less than 20 km to the east), it is anticipated that fatalities due to avian collision with wind turbines will not cause significant bird fatalities, either of sensitive species or large numbers of birds. Post-construction monitoring will be implemented to confirm that the effect of the Project on bird populations is not significant. Likewise, based on existing information from monitoring programs elsewhere in North America, it is anticipated that the impact of wind farm operations on bat mortality will not be significant. However,

Table 6.6 Summary of Project Residual Environmental Effects on Birds and Other Wildlife

Project Activity	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
								post-construction monitoring will be implemented to confirm this expectation.

1 Note

Geographic Extent	1 = <500 m^2, 2 = 500 m^2 – 1 km^2, 3 = 1 –10 km^2, 4 = 11 – 100 km^2, 5 = 101 – 1000 km^2, 6 = >1000 km^2
Magnitude	1 = Low: *e.g.,* specific group or habitat, localized one generation or less, within natural variation, 2 = Medium: *e.g.,* portion of a population or habitat, one or two generations, rapid and unpredictable change, temporarily outside range of natural variability, 3 = High: *e.g,* affecting a whole stock, population or habitat outside the range of natural variation.
Duration	1 = <1 month, 2 = 1-12 months, 3 = 13-36 months, 4 = 37-72 months, 5 = >72 months.
Frequency	1 = <11 events/year, 2 = 11-50 events/year, 3 = 51-100 events/year, 4 = 101-200 events/year, 5 = >200 events/year, 6 = continuous.
Reversibility	R = reversible, I = irreversible.
Ecological Context	1 = Pristine area or area not adversely affected by human activity, 2 = evidence of adverse effects.

6.4.4 Follow-up and Monitoring

It is expected that monitoring of bird mortality will be conducted during the two years year following wind farm commissioning, with emphasis placed on surveying during peak spring and fall migration of birds and fall migration of bats. It is understood that the Province of Nova Scotia is currently working with CWS to develop post-construction monitoring protocols. The monitoring program design will be confirmed with CWS and NSDNR and results submitted annually.

6.5 LAND USE AND COMMUNITIES

Land Use was selected as a VEC in consideration of potential Project-related interactions with land use in the vicinity of the Project Area. The potential environmental effects of the Project are assessed for the immediate vicinity of the proposed Project and the surrounding areas, including the Little River Harbour, Comeaus Hill, Upper Wedgeport, Wedgeport and Lower Wedgeport. The focus of this VEC is on effects which may potentially affect the use and enjoyment of residential properties (*e.g.*, as a result of noise and visual effects of the Project).

The discussion of land use will also consider current use of lands and resources by Mi’kmaq persons which is defined as the known use of lands, and resources within those lands, which are within the Project Area or on adjacent lands where those uses and resources are potentially affected by the Project. This “use” refers to contemporary hunting, fishing, and gathering activities for subsistence purposes as well as the use of lands and resources for social and ceremonial activities.

6.5.1 Potential Environmental Effects, Issues and Concerns

The potential environmental effects on residential land use adjacent to the proposed Project include a potential loss of enjoyment of residential property as a result of noise and air emissions (*i.e.*, dust), a change in the visual landscape, change to access to property and potential electromagnetic interference. Another issue of concern that is frequently raised by stakeholders is a potential reduction of property values. The Project is predicted to have a positive economic effect on the community through job creation, tax revenues and landowner income.

6.5.1.1 Construction

During the construction there is potential to interact with informal recreational land use within the area by limiting access where construction activities are occurring. Although there are no formal trails in the Project Area, there are informal hiking and ATV trails. Construction may cause potential hazards and/or inconveniences to informal recreational activity (*e.g.,* ATV operations, hunting).

The effect on land use will be primarily temporary access loss/disruption during the delivery and installation of the turbines. These deliveries may slow or interrupt traffic on the local roads; however, at no time will landowners be unreasonably prevented from gaining access to their land.

During the construction of the wind turbine generators and associated infrastructure, it is anticipated that there will be periodic increases in ambient noise levels at the site. Construction activities, including clearing and grubbing, the installation of wind turbine generators, roadways, collection lines, pad transformers and transmission lines; these activities will use heavy equipment, trucks and smaller equipment. This equipment can generate both temporary steady and episodic noise that may extend beyond the Project Area. There is the possibility for impacts to local sound levels and traffic due to the transportation of materials. **Appendix E** contains a Sound Assessment Study for the Wedgeport Wind Farm Project and assesses potential construction noise. Given the proposed setback of Project components from residences, and temporary nature of construction activities, potential effects of construction noise are expected to be minimal.

6.5.1.2 Operation and Maintenance

The key potential effects of the Project on Land Use and Community during the operations phase are associated with sound levels and visual effects. During operation of the proposed Project, an increase in sound levels from the wind turbines is a potential issue of concern for residential properties in the vicinity of the Project Area and adjacent residential communities.

The large turbine structures will visually alter the viewscapes from some of the nearby residential properties potentially resulting in a change to visual amenity of an otherwise natural landscape. Shadow flicker, a phenomenon characterized by alternating changes in light intensity due to the moving blade shadows cast on the ground and objects (including through windows of residences), will also occur to varying extents. Shadow flicker can be an annoyance to residents and has been cited as a potential concern for photosensitive epilepsy sufferers. It is generally considered that 900 m is the limit beyond which shadow flicker becomes insignificant or non-existent.

Turbines have the potential to interfere with radio electromagnetic signals and degrade the performance of transmitter/receiver systems under certain conditions.

During operation there is also potential the proposed Project could affect informal recreational use in the Project Area. Access to the area may be restricted for safety and security reasons, limiting informal recreational use (*i.e.,* hiking, ATV use, and hunting) within the Project Area.

It may also be perceived that the proposed Project may negatively affect property values in the area.

6.5.2 Mitigation

The following mitigation will be implemented to minimize potential adverse effects on Land Use and Communities.

- Development and Building Permits will be obtained from the Municipality prior to construction in accordance with the Land Use By-law.
- The Proponent has consulted with DND, NavCanada and Transport Canada with respect to radar and electromagnetic interference, and land use interference and taken steps necessary to address concerns (*e.g.*, adjusted turbine layout to avoid interference with flight path to Yarmouth airport).
- Dust from work areas will be controlled through suppressants (*e.g.*, water).
- Construction noise will be reduced through standard operations practices and equipment (*e.g.*, use of mufflers and routine maintenance of equipment).
- Nearby residents will be advised of significant sound generating activities and these will be scheduled to create the least disruption to receptors.
- Heavy equipment (including delivery of Project components) will only be operated between 7:00 a.m. and 10:00 p.m., avoiding Sundays and holidays unless absolutely necessary.
- Turbines will be all of the same type and model, and will be painted light grey to reduce reflection.
- Screening opportunities for adjacent residences through tree planting or other measures may be considered where post-construction evaluation indicates a legitimate concern regarding visual effects.

- To reduce visual effects at night, lighting will be the minimum allowed by Transport Canada to ensure the appropriate level of aeronautical safety.
- For any turbines that contribute to shadow flicker above 30 hrs/yr, the Proponent has agreed to further analysis and mitigation as required (*e.g.*, shutting down these turbines a few hours to a day per year for the times when shadow flicker may peak).
- A registry will be established to receive stakeholder questions and concerns, including, but not limited to, issues associated with noise and visual effects of the wind turbines.
- Landowners hosting turbines will be compensated for the use of their lands and access to private lands is not anticipated to change.

6.5.3 Residual Effects Analysis

6.5.3.1 Construction

Land use within the Project Study Area consists of informal recreation such as hiking, ATV use and hunting; and minimal forestry use. During construction, land clearing, installation and development activities have potential to adversely affect these land use activities within the Project Study Area. These construction activities are expected to occur on relatively small footprints considering the surrounding lands available for these uses. These land uses are not concentrated in the Project Study Area and any effects associated with construction activities will be temporary. In general, Project construction will not impair current land uses or change land use patterns aside from temporary roadway restrictions during equipment delivery. The residual impact to existing land use is considered to be minimal and not significant.

A total of four residential properties are located within the proposed Project Study Area, with the nearest property (seasonal cottage on Goose Lake) located 659 m to the nearest turbine, which meets the municipal requirements of a minimum 297 m setback. Nearby residents may occasionally be subject to Project noise and dust emissions during construction. Increased sound levels and dust emissions caused during construction activities (including equipment delivery) will be temporary and generally limited to daylight hours. Sound resulting from construction activities was modeled and is included in **Appendix E**. Due to the short nature of this disturbance and its limited geographic range, the level of effect will be minimal and residual effect is considered not significant.

In summary, given the implementation of appropriate mitigation, effects of Project construction on land use are expected to be minor and temporary in nature.

This Project will create jobs for local contractors. It is estimated that the Project will provide up to 100 jobs during the construction phase and five to ten full time positions during the operation and maintenance phase. In addition, the Project will provide significant tax revenues and income for landowners. At the municipal level $250,000 to $350,000 per year will be generated in tax revenue from the Project and at the provincial level, the Project has the potential to generate $10 to $20 million from locally sourced materials. These increases in employment and economy will have a positive effect on economic development in the region.

6.5.3.2 Operation and Maintenance

Sound Level Effects

The Province of Nova Scotia does not currently have set sound level limits specific to wind turbine operations. This assessment therefore used the Ontario guidance document "Interpretation for applying MOE Technical Publications to Wind Turbine Generators" (2004) as the basis for the noise impact assessment for the Wedgeport Wind Power Project, completed by Stantec (see **Appendix E**).

Wind turbine generators produce sound through a number of different mechanisms which can be categorized into mechanical and aerodynamic sound sources. The major mechanical components including the gearbox, generator and yaw motors each produce their own characteristic sounds, including sound with tonal components. Other mechanical systems such as fans and hydraulic motors can also contribute to the overall sound emissions. Mechanical sound is radiated at the surfaces of the turbine, and by openings in the nacelle casing. Mechanical issues involving yaw motor supports or power train design can result in anomalous sounds such as periodic booming or tonal sounds.

The interaction of air and the turbine blades produces aerodynamic sound through a variety of processes as air passes over and passed the blades. The sound produced by air interacting with the turbine blades tends to be broadband sound, but is amplitude modulated as the blades pass the tower, resulting in a characteristic ‘swoosh’. Generally, wind turbines radiate more sound as the wind speed increases.

The manufacturer’s predicted operational sound levels were combined with background sound data obtained from receptor locations surrounding the Project site to obtain a more accurate representation of the potential sound levels at the selected receptor locations. Sound modelling was conducted using CadadA version 3.7, which includes the calculation methodology of the International Organization for Standardization (ISO) *Standard 9613 – Attenuation of Sound during Propagation Outdoors* (ISO 9613). Local terrain was considered in modelling Sound power level data provided by the manufacturer were used to model operational sound at the selected receptors. Predicted sound levels at receptors increased with increasing wind speed due the fact that the sound power level of the wind turbine generators also increased with increasing wind speed.

The study results presented in **Appendix E** show that sound levels at the receptor locations will be less than the accepted guideline of 40 dBA. The nearest receptor is more than 600 m from any turbine. In addition, routine maintenance of the wind turbines and associated equipment will be conducted as recommended by the manufacturer to ensure the turbines operate efficiently and do not produce additional noise. Modelling of predicted sound levels caused by the operation of wind turbines indicated that all the receptors within the Project Study Area are expected to receive sound exposures from the proposed wind farm within acceptable sound limits (*i.e.*, less than 40 dBA).

Visual Effects

Due to the importance of assessing the potential impact to the area's visual aesthetics, a visual impact assessment was completed. Stantec used the photo montage module from the EMD WindPro 2.4 to render all photo montages for the assessment. A photo montage is a photograph taken in the field from a specific location with the proposed wind farm turbines superimposed to scale. Prior to taking baseline photographs, a viewshed analysis was conducted to predict which locations would have visibility of Project components. **Appendix I** includes the viewshed analysis results and graphical representations of what the constructed wind farm could potentially look like upon completion from specific vantage points.

The turbines are designed to rotate and be oriented in rows facing the prevailing wind direction at any given time. The towers will be light grey and made out of rolled steel. The housing at the top of the tower, which contains the generator, is fiberglass and will also be light grey. The height of the turbine towers will be approximately 100 m (hub height), with rotor blades that are approximately 48.5 m long.

Given the relatively flat terrain and height of the turbines, the Project infrastructure is expected to be visible from various vantage points in surrounding communities..

Lighting

The wind turbine generators will be lit to meet the requirements of Transport Canada's Canadian Aviation Regulations (CAR) 621.19. Lighting will be the minimum required to ensure the appropriate level of aeronautic safety; white strobe lights (CL-865) may be used with the minimum intensity and flashes per minute allowable.

Shadow Flicker

Shadow flicker caused by wind turbines is defined as alternating changes in light intensity due to the moving blade shadows cast on the ground and objects (including through windows of residences). The distance between a wind turbine and a potential shadow flicker receptor affects the intensity of the shadows cast by the blades, and therefore the intensity of flickering. Shadows cast close to a turbine will be more intense and distinct because a greater proportion of the sun's disc is intermittently blocked. Similarly, flickering is more intense if created by the area of a blade closer to the hub and further from the tip. At 500 m and more, shadow flicker occurs only at sunrise and sunset. At 900 m and more, shadow flicker is considered to be insignificant. At distance, the blades do not cover the sun but only partly mask it, substantially weakening the shadow. This effect occurs first with the shadow from the blade tip, the tips being thinner in section than the rest of the blade. The shadows from the tips extend the furthest and so only a very weak effect is observed at distance from the turbines (Northern Ireland Department of Environment 2007).Buildings to the north and south of the wind farm are less likely to be affected by shadow flicker than those to the east and west.

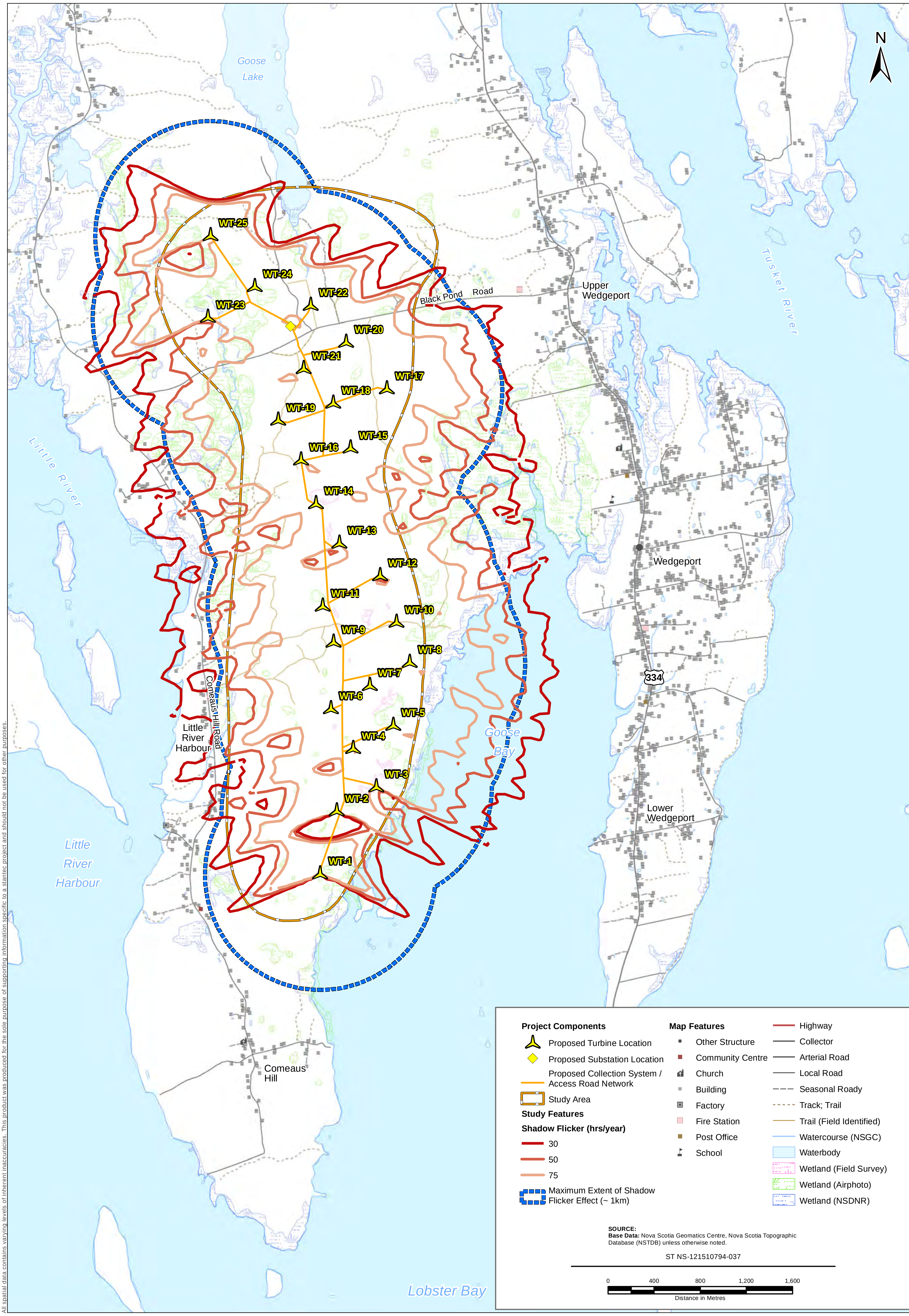
The modeling software WindPro 2.4 by EMD (Denmark) was used to model potential shadow flicker within the area. The model calculated the duration of shadow flicker various receptors receive within a year, given a number of assumptions. The model assumes a worst-case scenario, with the following conditions:

- the sun is fully shining all year (no clouds or fog);
- the absence of natural obstacles (no trees or terrain to block exposure);
- the rotor plane is perpendicular to the sun (biggest shadows); and
- the rotor is always turning (causing shadow movements).

These assumptions therefore result in a substantial overestimation of actual impacts. As a demonstration of the level of overestimation, the modeling software assumes approximately 4,000 hours of sun, while Canadian Climate Normals data (1961-1980) for the nearest weather station recording bright sunshine (Yarmouth) reports approximately 1,800 hours of sunshine per year.

Nova Scotia has no set regulatory limits for exposure to shadow flicker; however, the industry commonly uses 30 hours per year as a limit to reduce nuisance complaints and NSE has verbally communicated this standard. Calculations of shadow flicker for all nearby residences, given a worst-case scenario as described above, determined that, when distance is taken into account (*i.e.*, residences within 1 km of a turbine), only one residence is predicted to result in more than 30 hours per year (refer to Figure 6.1). In this case, the receptor is a seasonal cottage and the modeling does not take into account obstacles such as terrain and vegetation which are located between the wind turbine and a potential shadow-flicker receptor; hence shadow-flicker will be either significantly reduced or eliminated.

A registry will be created to document complaints of shadow flicker. When a complaint or complaints of shadow flicker are received from a receptor located within 900 m of the turbine, shadow flicker will be monitored from that receptor. Information collected from the shadow flicker monitoring will be used will be used to develop further mitigation, if warranted.



All spatial data contains varying levels of inherent inaccuracies. This product was produced for the sole purpose of supporting information specific to a stantec project and should not be used for other purposes.

PREPARED BY: M. Huskins-Shupe	WEDGEPORT WIND PROJECT	FIGURE NO.: 6.1
REVIEWED BY: C. Shupe		DATE: Jun 14, 2012
AnaiaGlobal RENEWABLE ENERGIES www.anaiaenergy.com	**Estimated Shadow Flicker**	Stantec

Path: V:\1215\active\121510xxx\121510794_Wedgeport\geomatics\mapping\mxd\EA_final\ST_NS-121510794-037_Estimated_flicker_hr_per_year_100mHub.mxd

Stantec Consulting Ltd. © 2012

Land Use

Although there is minimal tourism or recreational activities located in the Project Area, local informal recreational use such as hiking, ATV use and hunting could be affected if access to the area is restricted. For safety and security reasons, these informal recreational activities will be restricted in close proximity to Project infrastructure. Safety issues must be considered as they pertain to the operational phase and the potential interaction with the local population and public access issues. In accordance with landowner agreements, access will be controlled so as to discourage trespass on private lands. Therefore the Project is not expected to increase recreational use in the area and trespass on private lands.

It is possible that tourists may be drawn to the area to view the wind farm facilities. There are examples of other wind farm facilities in Atlantic Canada which have attracted tourism activity to a region (*e.g.*, North Cape Wind Farm in Prince Edward Island). In the case of the Wedgeport Wind Farm, where the Project is located on privately owned lands and viewing will be limited from adjacent public roads, a significant amount of tourism activity is not predicted.

The effect of wind turbines on undeveloped lands within the Project Study Area is negligible with only a minor portion of land use required to house turbines and their ancillary equipment. Land use impacts associated with operation of the Project will not impair current land uses, change land use patterns, or be incompatible with existing uses. The proposed Wedgeport Wind Power Project is located in a largely undeveloped setting; the Project has the potential to add value to the current use of the lands.

Property Values

Several studies have been conducted to understand the effects of wind farms on property values. A recent study conducted in January 2012 examined residential property values near a 24 MW wind project owned by Iberdrola Renewables Inc. located in the Town of Lempster in Sullivan County, New Hampshire which became operational in 2008 (Magnusson *et al.* 2012). The study compared the sales of similar homes within the general area of the wind project with sales of similar homes in different nearby communities. Although isolated cases of property impacts are plausible, the study found no evidence that the project has had a consistent statistically-significant impact on property values within the region (Magnusson *et al.* 2012Magnusson *et al.* (2012) reviewed six previous studies representing research in the area of residential property values in relation to wind project. As observed through actual market transactions, the review identified all but one of the studies found no statistically-significant difference in housing prices after wind projects were constructed. One report concluded a statistically-significant decline in property values ranging from 8% to 18% due to wind turbines in one geographic location in New York from the immediate time period preceding construction completion to immediately after project construction (Magnusson *et al.* 2012).

Hinman (2010,cited in Magnusson *et al.* 2012) identified that there was a temporary decline during the period between when a project is announced up until when the project is completed, rebounding during the operational stage. The temporary decline could be anticipation or that some homeowners expected (or were at least uncertain about) negative impacts from the wind farm resulting in property sales transacted at lower values than would otherwise be expected (Magnusson *et al.* 2012).

Sterzinger *et al.* (2003) also took a comparative study, statistically testing whether the perception that property values are negatively affected by wind farms is true or false. For their study, Sterzinger *et al.* (2003) compiled data on every U.S. wind energy development commissioned between 1998 and 2001 that was of a capacity of 10 MW or greater. Property sales records for the area within 5 miles (8 km) of the wind farm were collected for the three years prior to commissioning and the three years following commissioning, to determine if there was a difference between pre-construction and post-construction property sales. For comparison, sales records were also collected for the same time period from communities comparable to that included for each wind farm. A total of 10 wind power projects were analyzed, including two projects from New York, two projects in Pennsylvania and one project in Vermont (Sterzinger *et al.* 2003).

Overall, property values increased with the same rate in wind farm communities within 8 km of a wind farm compared to similar communities without wind farms (Sterzinger *et al.* 2003). Nine of the ten projects showed a greater increase in property values after commissioning compared to the period prior to commissioning, and when looking at the rate of increase in property values after commissioning of the wind farm, communities near a wind farm actually had greater increases to property values than those without a nearby wind farm (Sterzinger *et al.* 2003). These findings indicate that there is no support for the notion that the development of wind farms decreases property values.

General discussions with municipal staff at the District of Argyle regarding community acceptance of the West Pubnico Wind Farm appear to substantiate study findings of a negligible effect on property values. The proposed Wedgeport Wind Power Project is located in a rural setting, and is surrounded by a mix of forested and residential properties. The Project has the potential to represent a long-term land use, which may have the effect of promoting some stability in land values. It is predicted that impacts on property values as a result of the Project are likely to be negligible.

Communication Signals and Electromagnetic Interference

Wind turbines have the potential to interfere with radio frequencies and electromagnetic radiation by blocking the line of sight from the transmitter to the receiver (*e.g.*, shadowing), reflecting transmitter signals, and/or scattering signals (*e.g.*, signal passes through the turbine and is scattered as a result of blade rotation). During preliminary design and layout, Anaia contacted Industry Canada, DND, Royal Canadian Mounted Police and Nav Canada to determine if there could be potential interference with government communication systems. Following a revision of the layout which included moving three turbines north of Black Pond Road to the southwest of Goose Lake, there are no reported outstanding communication issues to be resolved with these parties. A complaint system will be in place to investigate and resolve potential electromagnetic/communication signal issues.

6.5.3.3 Summary

In summary, there are no predicted significant residual adverse environmental effects on Land Use and Communities as a result of Project activities. Table 6.7 summarizes residual effects of the Project on Land Use and Communities.

Table 6.7 Summarizes the Project Residual Environmental Effects on Land Use

Project Activity	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
Construction	Hazards and/or inconvenience to traffic	• Road construction schedule will consider planned forestry operations in the area to maintain required access.	3	1	2/1	R	2	No significant impact on road use is expected.
	Hazards and/or inconveniences informal recreational activity (*e.g.*, ATV operations, hunting)	• None required.	3	1	2/1	R	2	There may be minor delays to unscheduled land use activities; however these will be of short duration. The impact is therefore predicted to be minimal. Safety issues are addressed in Section 6.8.
	Increases in sound levels due to the transportation and operation of construction equipment	• Nearby residents will be advised of significant sound generating activities and these will be scheduled to create the least disruption to receptors. • Heavy equipment operation and equipment delivery will occur between 7:00 a.m. and 10:00 p.m., avoiding Sundays and holidays unless absolutely necessary. • Construction equipment will have mufflers. • Noise abatement equipment, in good working order, will be used on all heavy machinery used on the Project. • A Special Move Permit and any associated approvals	3	2	2/1	R	2	Increased sound levels caused by land clearing and equipment delivery and installation will be temporary and limited to daylight hours. Due to the temporary nature of disturbance and its limited geographic range, the level of impact will be minimal and residual effect is considered not significant.

Table 6.7 Summarizes the Project Residual Environmental Effects on Land Use

Project Activity	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
		will be obtained through the Department of Transportation and Infrastructure Renewal for heavy load transport.						
Operation and Maintenance	Effect on property values	• None required.	4	1	5/6	R	2	Existing research indicates that property values are generally not adversely affected by the construction and operation of wind farms.
	Effect to tourism and recreation	• None required.	4	2	5/6	R	2	Informal recreational activities may be limited at the site due to restricted access for safety and security. reasons. The Project could have a minor positive effect on tourism in the Project Area.
	Increase sound levels	• None required.	3	2	5/6	R	2	Modelling of predicted sound levels from operation of the proposed wind turbines indicates that sound exposures for all residential receptors within the Project Study Area will be within acceptable levels (*i.e.*, 40 dB). .
	Change to visual landscape	• Turbines will be all of the same type and model, and will be painted light grey to reduce reflection. • Screening opportunities for adjacent residences through tree planting or other measures may be considered where post-construction evaluation indicates a fair concern.	4	2	5/6	R	2	Given the relatively flat terrain, several turbines are expected to be visible from various viewing locations.
	Lighting	• Lighting will be the minimum allowed by Transport Canada to ensure the appropriate level of aeronautical safety.	4	2	5/6	R	2	Given the viewing distance of approximately greater than 600 m and design of lighting, the presence of these lights will create a substantial concern.

Table 6.7 Summarizes the Project Residual Environmental Effects on Land Use

Project Activity	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
	Shadow flicker	• For any turbines that contribute to shadow flicker above 30 hrs/yr, the Proponent has agreed to additional mitigation as required.	3	2	5/1	R	2	Modeling of shadow flicker using very conservative assumptions indicates there are minimal potential visual impacts for residential receptors from shadow flicker within the Project Study Area. A registry will be created to document complaints of shadow flicker and shadow flicker will be investigated from that receptor. Information collected from the shadow flicker monitoring will be used will be used to develop further mitigation, if warranted.

1 Note

Geographic Extent	1 = <500 m2, 2 = 500 m2 – 1 km2, 3 = 1 –10 km2, 4 = 11 – 100 km2, 5 = 101 – 1000 km2, 6 = >1000 km2
Magnitude	1 = Low: *e.g.*, specific group or habitat, localized one generation or less, within natural variation, 2 = Medium: *e.g.*, portion of a population or habitat, one or two generations, rapid and unpredictable change, temporarily outside range of natural variability, 3 = High: *e.g.*, affecting a whole stock, population or habitat outside the range of natural variation.
Duration	1 = <1 month, 2 = 1-12 months, 3 = 13-36 months, 4 = 37-72 months, 5 = >72 months.
Frequency	1 = <11 events/year, 2 = 11-50 events/year, 3 = 51-100 events/year, 4 = 101-200 events/year, 5 = >200 events/year, 6 = continuous.
Reversibility	R = reversible, I = irreversible. Ecological Context 1 = Pristine area or area not adversely affected by human activity, 2 = evidence of adverse effects.

6.5.4 Follow-up and Monitoring

Throughout the life of the Project, the Proponent will maintain a communication line (*e.g.*, 1-800 phone number and/or email) such that landowners and affected stakeholders can ask questions and/or register concerns for investigation. Regardless of any specific complaints, it is anticipated that a noise monitoring study will be conducted during operations as a condition of approval to proceed with this Project. Concerns raised regarding shadow flicker will also be investigated as applicable. If ambient sound levels and/or shadow flicker are shown to exceed acceptable limits (40 dBA and 30 hours/year, respectively), the Proponent will report these concerns to NSE and develop a follow-up program to address these concerns.

6.6 ARCHAEOLOGICAL AND HERITAGE RESOURCES

For the purposes of this assessment, archaeological and heritage resources are defined as any physical remnants found on top of and/or below the surface of the ground that inform us of past human use of and interaction with the physical environment. These resources may be from the earliest times of human occupation within the proposed Project Study Area, up to the relatively recent past and include both built and depositional resources.

Archaeological and Heritage Resources is a VEC in recognition of the potential interest of First Nations, the general public, and provincial and federal regulatory agencies in ensuring the effective management of these resources. For the purposes of this assessment, archaeological and heritage resources are defined as any physical remnants found on top of and/or below the surface of the ground that inform us of past human use of and interaction with the physical environment. These resources may be from the earliest time of human occupation in the Project Area up to the relatively recent past and include both built and depositional resources. Heritage resources are generally considered to include historic period sites such as cemeteries, heritage buildings and sites, monuments, and areas of significance to First Nations or other groups.

6.6.1 Potential Environmental Effects, Issues and Concerns

6.6.1.1 Construction

Certain activities associated with Project construction (*i.e.*, clearing, grubbing, turbine construction) will cause surface or subsurface disturbance that could affect archaeological and heritage resource sites. These disturbances, if left unmitigated, could result in the loss of the resource and the potential knowledge to be gained from its interpretation. As noted in Section 5.7.6, the Project Study Area has a low potential for First Nations and historic archaeological resources

6.6.1.2 Operation and Maintenance

There are no predicted interactions between the Project archaeological and heritage resources during operation and maintenance.

6.6.2 Mitigation

Although potential for encountering archaeological and heritage resources during Project construction is considered to be low, an Archaeological Contingency Plan will be developed and implemented during construction to address any previously unknown resources discovered during ground disturbance. If any features, artifacts, or other cultural material is found during ground disturbance, work will be halted in the immediate area and the find will be reported to the Nova Scotia Museum and other agencies as applicable (*e.g*,. KMKNO) to determine appropriate action.

6.6.3 Residual Effects Analysis

Potential interactions with archaeological and heritage resources is considered low. However, should a suspected feature, artifact or other cultural material be encountered during Project activities, work will be suspended in the immediate area until an appropriate action plan is implemented to protect the resource. In summary, adverse residual environmental effects on Archaeology and Heritage Resources are not predicted to be significant. Table 6.8 summarizes residual effects.

Table 6.8 Summary of Residual Effects on Archaeological and Heritage Resources

Project Activity	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
Construction Activities involving ground disturbance	Disturbance to archaeological and/or heritage resource	• An Archaeological Contingency Plan will be developed. • In the event that an archeological heritage resource is discovered, work in the immediate area will stop and the appropriate authorities will be contacted.	2	1	2/1	R	2	No significant residual effects to archaeological and cultural resources are anticipated.

1 Note	Geographic Extent	1 = <500 m^2, 2 = 500 m^2 – 1 km^2, 3 = 1 –10 km^2, 4 = 11 – 100 km^2, 5 = 101 – 1000 km^2, 6 = >1000 km^2
	Magnitude	1= Low: *e.g.,* minor impairments to cultural resources appreciation or effects to non-significant historic period heritage feature, *e.g.,* loss of individual artifact. 2 = Medium: *e.g.,* loss of historic or cultural resources not of major importance, or pre-disturbed heritage site/artifacts present, however, no or little chance of intact features. 3 = High: *e.g.,* intact "significant" heritage site, pre-contact and/or contact period, features present, portion or all of site will be destroyed or lost.
	Duration	1 = <1 month, 2 = 1-12 months, 3 = 13-36 months, 4 = 37-72 months, 5 = >72 months.
	Frequency	1 = <11 events/year, 2 = 11-50 events/year, 3 = 51-100 events/year, 4 = 101-200 events/year, 5 = >200 events/year, 6 = continuous.
	Reversibility	R = reversible, I = irreversible.
	Ecological Context	1 = Pristine area or area not adversely affected by human activity, 2 = evidence of adverse effects.

6.6.4 Follow up and monitoring

No follow-up or monitoring are proposed at this time. Should an unsuspected resource be encountered during Project construction, monitoring and follow-up may be required at that time. An archaeological study should be commissioned by NSPI prior to construction of the transmission line.

6.7 PUBLIC HEALTH AND SAFETY

This VEC focuses on public health and safety and does not address occupational health and safety of wind farm workers. Occupational health and safety is generally considered to be outside the scope of environmental assessment as it is regulated through other mechanisms under the *Occupational Health and Safety Act*.

6.7.1 Potential Environmental Effects, Issues and Concerns

Public health and safety issues associated with wind energy operations have received considerable scientific and public attention in recent years. Knopper and Ollson (2011) reviewed peer-reviewed and popular publications and found that both agree that wind turbines can be a source of annoyance for some people although the reasons differed. In general, peer-reviewed literature finds that reported health effects are attributable to a number of environmental stressors that result in an annoyed/stressed state, but popular literature attributes reported health effects directly to turbine-specific variables like audible noise, infrasound or EMF (Knopper and Ollson 2011). Wind farm operations have unique structural components that may be perceived to present health and safety concerns (*i.e.,* moving blades) to the public. In addition, the construction of ancillary facilities present public health and safety concerns not specific to wind energy development.

6.7.1.1 Construction

Potential effects to public health and safety include increased construction related traffic, the delivery of large oversized wind turbine equipment and unauthorized access of the public to work sites. Construction activities associated with the wind farm may present some safety challenges with respect to these hazards and routine hazards associated with construction activities. In the operational phase, safety issues such as potential for ice throw must be considered in the context of local populace and public access issues. All safety issues will be addressed with the appropriate design and mitigation measures (*e.g.,* setbacks, restricted access, public notification).

6.7.1.2 Operation and Maintenance

In recent years there has been considerable interest in potential health effects associated with the operation of wind farms. Public interest groups, government stakeholders, and industry have commissioned various studies to explore potential health effects associated with a variety of issues, of which the most commonly discussed include turbine noise, shadow flicker, and electromagnetic fields (EMFs). Additional safety concerns include potential turbine blade and structural failure, icing issues and unauthorized site access. Predicted sound levels and shadow flicker effects are addressed in Section 6.6 (Land Use and Communities) because they are primarily related to annoyance and can affect enjoyment of land use. However, they are also discussed in this VEC to the extent that the public perceives these effects as health-related effects.

6.7.2 Mitigation

Several design features and mitigation measures will be implemented to protect public health and safety.

6.7.2.1 Construction

- Implementing good transportation planning and safety measures during construction will minimize the potential for traffic related safety concerns.
- A detailed transportation study will be undertaken to determine the appropriate routes and means for the equipment to be delivered to the site. It is currently anticipated that the existing road network (outside of onsite turbine access roads) will not require upgrades to accommodate construction traffic, although this will be confirmed through the transportation study.
- Approvals for transporting oversized wind farm materials will be sought from NSTIR.
- During construction, access to the wind turbine facility will be restricted to authorized personnel wearing proper personal protective equipment and who have had appropriate safety training. The Contractor will be required to have a safety manual in place prior to construction activities.

6.7.2.2 Operation and Maintenance

- During operation activities, access to the wind turbine facilities will be restricted to authorized personnel wearing proper personal protective equipment and who have had appropriate safety training.
- The wind turbine facilities will be monitored and maintained as necessary to ensure proper working function and will be shut down for maintenance as required to minimize risk of equipment failures that could potentially result in safety issues and/or excessive noise and vibration.
- Meteorological conditions will be monitored regularly and turbines may be shut down in inclement weather including potential icing conditions where ice throw could occur. During these certain conditions (*e.g.*, icing), access may also be restricted to qualified personnel and warnings regarding potential unsafe conditions will be communicated (*e.g.*, site access restricted during potential icing event to avoid potential injury associated with ice shedding off the blades).

6.7.3 Residual Effects Analysis

Several studies have been undertaken to explore the possible relationship between proximity to wind turbines and health effects. A review of peer-reviewed literature indicates that some people living near wind turbines experience annoyance and that some people are also disturbed in their sleep by wind turbines. Scientific literature does not dispute that health effects may occur due to stress associated with annoyance and sleep deprivation and suggests that most anecdotal reports of health effects attributed to wind turbines are likely associated with these stressors. The following discussion addresses potential safety and perceived health effects associated with Project activities.

In general, effects on safety as a result of wind farm construction, operations and decommissioning will be minimal with proper planning and the implementation of standard safe work practices. During operations, there are more likely to be public concerns related to potential health issues associated with noise and visual effects.

Noise (Audible, Low Frequency, and Infrasound)

Section 6.6.3 and **Appendix E** (Sound Level Assessment) discusses the predicted sound levels from the operation of the Wedgeport Wind Farm Project.

The World Health Organization (WHO) Europe recommends a night-time noise guideline (not specifically for wind) of 40 dBA for the protection of public health from community noise (WHO 2009). According to WHO, this guideline is below the level at which effects on sleep and health occurs. This value of 40 dBA is considered to be the lowest observed adverse effect level for night noise based on expert evaluation of scientific evidence in Europe. This guideline is intended to protect the public including the most vulnerable groups such as children, the chronically ill and the elderly (WHO 2009). The United States Environmental Protection Agency (EPA) document titled Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety (1974) recommends that indoor-day-night-level (DNL) not exceed 45 dBADNL is a 24-hour average that gives 10 dB extra weight to sounds occurring between 10 pm and 7 am, assuming that during these sleep hours, levels above 35 dBA indoors may be disruptive. Based on the proposed setbacks and predicted noise modeling, there are no receptors who will be exposed to sound levels greater than 40 dBA (outdoor noise level). Indoor sound levels are about 10 to 20 dBA lower than those outdoor, depending on the structure of the home.

Various studies have explored the relationship among annoyance and wind turbine noise (Pederson and Persson Waye 2004, 2007, 2008; Pederson 2010; Keith 2008). Knopper and Ollsen (2011) synopsize these studies into three key conclusions:

1. People tend to notice sound from wind turbines almost linearly with increasing sound pressure level.

2. A proportion of people that notice sound from wind turbine find it annoying.

3. Annoyance is not only related to wind turbine noise but also to subjective factors like attitude to visual impact, attitude to wind turbines and sensitivity to noise (refer to citations above for details on individual studies).

Recognizing that annoyance can result in a heightened sense of anxiety and potentially affect the physical, mental and social well-being of individuals, the mitigation to reduce potential effects is to establish appropriate setback distances and sound level limits. Based on peer-reviewed literature, the limits proposed for this Project are considered appropriate mitigation.

Low frequency sound is generally defined as sound at a frequency of less than 200 Hz. Infrasound is considered to be sound frequencies below human's audible range (less than 20 Hz) and is usually measured in terms of dB or dBG instead of A-weighted decibels (dBA). The A-weighting network is commonly used to adjust sound levels to approximate the sensitivity of human hearing whereas the G-weighting network was defined specifically by the International Standards Organization to deal with infrasound (HGC Engineering 2006). In the 1980s, low frequency sound was considered an associated problem with wind turbines. However, this has been attributed to earlier designs of turbines where turbine blades were placed downwind of the tower resulting in a sound output that generated high levels of energy in the infrasound range. Since then, turbine design has progressed, resulting in modern turbines with blades placed upwind of the tower, generally negating the problem (National Research Council 2007; Leventhall 2004). Research on low frequency sound and modern turbines confirms that levels of low frequency sound have been below accepted thresholds and should not be considered a problem (BWEA 2005; Leventhall 2004).

Infrasound is produced by physiological processes like respiration, heartbeat and coughing, as well as anthropogenic sources like air conditioning systems, vehicles, some industrial process and wind turbines (Knopper and Ollsen 2011). Although infrasound cannot be "heard", there is some degree of auditory perception below frequencies of 20 Hz (*e.g.*, stimulation of outer hair cells of the cochlea) and there are non-auditory mechanisms such as the vestibular balance system by which humans can sense infrasound (HGC Engineering 2006; Salt and Hullar 2010).

Infrasonic levels created by wind turbines are often similar to the ambient levels prevalent in the natural environment due to wind. Under many conditions, low frequency sound below 40 Hz from wind turbines cannot be distinguished from environmental background noise from the wind itself (Leventhall 2006; Colby *et al* 2009, cited in CMOH 2010). There is no evidence of adverse health effects caused by infrasound below the sound pressure level of 90 dB (Leventhall 2003).

International standards have been established to define acceptable thresholds for infrasound exposure based on human sensitivity at 85 dBG. O'Neal *et al.* (2011; cited in Knopper and Ollson 2011) conducted a study to measure wind turbine noise outside and within nearby residences of turbines (nearest turbines 305 m and 467 m from residences) at a wind farm in Texas and measured low frequency sound and infrasound at both distances. The turbine models included in the study were the GE 1.5sle (1.5 MW) and Siemens SWT-2.3-93 (2.3 MW) wind turbines. The authors concluded that the results of their study suggest there should be no adverse public health effects from infrasound or low frequency noise at distances greater than 305 m from the two wind turbine types measured (O'Neal *et al.* 2011). There is no evidence for direct physiological effects from either infrasound or low frequency sound at the levels generated from wind turbines (indoors or outside) (Colby *et al.* 2009).

Shadow Flicker

Shadow flicker is caused by the rotating blades of the turbines interrupting sunlight causing flicker. Individuals diagnosed with photosensitive epilepsy (approximately 0.03% of the population) are at risk for seizures caused by flickering light at certain frequencies. Photosensitive epileptic patients are most sensitive to flickering light at 5-30 Hz, although some report sensitivity as low as 3 Hz or as high as 60 Hz (Epilepsy Action 2007). At 3 Hz or below, the cumulative risk of inducing a seizure is about 1.7 per 100,000 of the photosensitive population (Harding *et al.* 2008). At maximum rotational speeds, most turbines flicker at a frequency below 3 Hz. It is therefore concluded that shadow flicker effects would represent, at worst, a visual annoyance, rather than a health impact (refer to Section 6.6.3 for a discussion of shadow flicker visual effects).

Electromagnetic Fields

An electromagnetic field (EMF) is a physical field containing electric and magnetic aspects which is caused due to the movement of an electrical charge. All electronic devices, powerlines and generating stations produce EMFs (Sierra Club Canada 2011).

Wind turbines are not considered a significant course of EMF exposure since emission levels around wind farms are low (CMOH 2010). Previous studies have shown that magnetic field levels as a result of the cable distribution system are a fraction of those found in the vicinity of household appliances such as hairdryers, blenders or televisions (National Institute of Environmental Health Sciences 2002). At present, there are no Canadian government guidelines for exposure to EMFs. Health Canada does not consider guidelines for the Canadian public necessary because the scientific evidence is not strong enough to conclude that exposures cause health problems for the public (Health Canada 2010).

EMFs created by the operating wind farm will be localized and become weaker with distance. The strength of the EMF from equipment within the substation, such as transformers, decreases rapidly with increasing distance. Beyond the substation, the EMF produced by this equipment is typically indistinguishable from background levels. Similarly, the EMF produced by the equipment within the turbines will be very weak, reduced not just by distance, but also by objects such as trees and other objects that conduct electricity. As a result, there is no evidence that the proposed Project will present any human health effects related to EMFs.

Additional Safety Concerns

Turbine Blade and Structural Failure

Wind turbine safety standards have improved considerably since they were first introduced on a commercial scale, with wind turbine safety standards meeting wind strengths equivalent to hurricane forces (Chatham-Kent 2008).The probability of a tower collapse and/or blade detachment from the turbine structure is highly improbable. However, should either of these events occur there is potential that the collapse zone and/or landing area would be damaged by the impact. The structural integrity of the turbines is designed to withstand wind speeds of about 200 km/hour (equivalent to a Level 2 tornado). However, during high wind events (>25 m/s or 90 km/h) the turbines will cease operations. The blade of a turbine weighs several tonnes, therefore in the unlikely event of blade detachment, it would drop to the ground rather than be flung a large distance. Given the built-in safety features as well as ongoing maintenance of equipment, the likelihood of tower collapse and/or blade detachment is extremely remote and is not predicted to result in a significant adverse residual effect on public health and safety.

Icing Issues

Under certain weather conditions (*e.g.*, based on the right combination of air temperature, wind speed and moisture in the air), ice can form on the turbine blades. Falling ice and the throwing of ice therefore present a hazard to on-site personnel during maintenance and operation of the wind turbines.

Falling ice from an immobile turbine does not differ from other tall structures. Ice throw distance depends on a variety of factors including turbine specifications, wind speed and geometry and mass of the ice fragment. Several studies conducted under the Wind Energy in Cold Climates (WECO) project in Europe have analyzed the risk to public health associated with turbine icing. Morgan *et al.* (1998) report results of a survey of turbine operators on the occurrence of icing including mass and location of any observed ice debris flung off the rotor. Results showed most fragments on the ground were estimated to be in the range of 0.1 to 1 kg in mass and were found approximately 15 to 100 m from the turbines. Simulations and risk assessments have been developed to project ice throw trajectories and predict probability of events and risk to public safety. Initial work on risk assessment methodology demonstrates that the risk of being struck by ice thrown from a turbine is diminishingly small at distances greater than approximately 250 m from the turbine in a climate where moderate icing occurs (Morgan *et al.* 1998).

Monitoring at an existing Tacke TW600 wind turbine near Kincardine, Ontario between its installation in December 1995 until March 2011 revealed ice build-up on the wind turbine on 13 occasions out of 1000 inspections conducted during this time. In most cases, only a few pieces of ice were found on the ground. During one monitoring event in February 1996, about 1 tonne of ice in approximately 1000 pieces was estimated on the ground, with the largest pieces 5 inches long, 2 inches thick and 2 inches wide (12.5x5x5 cm). The pieces were scattered up to 100 m from the base of the turbine in the same direction as the blade arms were pointing. Most pieces were found within 50 m of the tower base. There was no event recorded by the operator in which the ice that was thrown from the turbine stuck any property or person (LeBlanc 2007).

A computer modeling study used to estimate the number of potential residential, vehicle and person ice strikes within a typical wind farm in Southern Ontario calculated that, assuming a building setback of 300 m, the potential number of ice strikes to buildings would be one in every 500,000 years. Predicted number of ice strikes to vehicles, with a setback of 200 m would be one in every 260,000 years and number of ice strikes to individuals on the ground (assuming a setback of 300 m) would be one in every 137,500,000 years (LeBlanc 2007). Given the setbacks used for this Project, the risk to the public from ice drop or ice throw is very small in comparison with average risk levels. The impact of turbine icing would be greatest for construction or maintenance workers when the blade is at rest and not rotating.

Due to the distance to the nearest residence, a minimum of approximately 600 m, it is extremely unlikely that ice throw would present a risk to landowners. Furthermore, there are only a few days a year where ice could potentially form on turbines based on the right combination of air temperature, wind speed and moisture in the air.

Summary

In summary, given proper design, maintenance and monitoring and most importantly, an established setback from residences that is greater than 650 m (and in most cases more than 1 km), the Project is not expected to have adverse residual effects on Public Health and Safety, Table 6.9 summarizes residual effects of the Project on Public Health and Safety.

Table 6.9 Summary of Residual Effects of the Project on Public Health and Safety

Project Activity	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
Construction								
Road Construction	Increased Traffic	Implement good transportation planning and safety measures Conduct detailed transport study	2	1	2/1	R	2	Minor delays to increased traffic however these will be of short duration and will not pose a risk to public health and safety.
Turbine Foundation and Turbine Installation	Delivery of oversized equipment Authorized access to the public	Obtain a Special Move Permit Control site access with signage and restrict to authorized personnel only. Construction Manager will employ good site safety practices during the construction phase.	2	1	2/1	R	2	No significant impact public health and safety is expected

Table 6.9 Summary of Residual Effects of the Project on Public Health and Safety

Project Activity	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]: Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	Residual Effect
Operation and Maintenance								
Operation and Maintenance	Shadow Flicker	None required	2	2	5/1	R	2	Modeling of shadow flicker indicates there are minimal potential visual impacts at the locations throughout the Project. A registry will be created to document complaints of shadow flicker.. Information collected from the shadow flicker monitoring will be used will be used to develop further mitigation, if warranted.
	Electromagnetic fields (EMF)	None required	2	2	5/1	R	2	The strength of the EMF from equipment within the substation, such as transformers, decreases rapidly with increasing distance. Beyond the substation, the EMF produced by this equipment is typically indistinguishable from background levels. Similarly, the EMF produced by the equipment within the turbines will be very weak, reduced by distance and objects such as trees and other objects that conduct electricity. Overall the EMF is not anticipated to have any negative results on human health and safety.
	Infrasound energy	None required	1	1	5/1	R	2	There is no evidence that the wind turbine technology proposed for this Project presents any potential problems related to the generation of infrasound energy.
	Ice throw	Monitor ice conditions and restrict access to authorized personnel as required.	2	1	5/1	R	2	Due to the distance to the nearest residence, more than 650 m, it is extremely unlikely that ice throw would present a risk to landowners. Furthermore, there are only a few days a year where ice could potentially form on turbines based on the right combination of air temperature, wind speed and moisture in the air.

Table 6.9 Summary of Residual Effects of the Project on Public Health and Safety

Project Activity	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	

1 Note	Geographic Extent	1 = <500 m^2, 2 = 500 m^2 – 1 km^2, 3 = 1 –10 km^2, 4 = 11 – 100 km^2, 5 = 101 – 1000 km^2, 6 = >1000 km^2
	Magnitude	1 = Low: *e.g.*, potential to result in mild or perceived symptoms by a few individuals; standards not exceeded 2 = Medium: *e.g.*, potential to result in health or safety effects on a portion of the community; standards not exceeded; 3 = High: e.g, potential to result in significant injury or chronic illness; standards may be exceeded
	Duration	1 = <1 month, 2 = 1-12 months, 3 = 13-36 months, 4 = 37-72 months, 5 = >72 months.
	Frequency	1 = <11 events/year, 2 = 11-50 events/year, 3 = 51-100 events/year, 4 = 101-200 events/year, 5 = >200 events/year, 6 = continuous.
	Reversibility	R = reversible, I = irreversible.
	Ecological Context	1 = Pristine area or area not adversely affected by human activity, 2 = evidence of adverse effects.

6.7.4 Follow up and Monitoring

The Proponent will maintain open communications with local public and stakeholders. A registry will be created to document complaints of shadow flicker and noise. Information collected from the investigation will be used to develop further mitigation, if warranted.

7.0 Cumulative Effects Assessment

The “Proponent’s Guide to Wind Power Projects” (NSE 2007, updated 2012) requires consideration of other undertakings in the area which may have effects that could overlap spatially and temporally with effects of the Project.

Guidance is taken from the Canadian Environmental Assessment Agency to provide context for the cumulative effects assessment and identification of other undertakings. In particular, it is helpful to consider the clarification provided by the Joint Review Panel for the Express Pipeline Project in Alberta. Following an analysis of subsection 16(1)(a) of *CEAA*, the Joint Review Panel determined that certain requirements must be met for the Panel to consider cumulative environmental effects:

- there must be a measurable environmental effect of the project being proposed;
- that environmental effect must be demonstrated to interact cumulatively with the environmental effects from other projects or activities; and
- it must be known that the other projects or activities have been, or will be, carried out and are not hypothetical (NEB and CEA Agency 1996).

Furthermore, the Joint Review Panel indicated that it is an additional requirement that the cumulative environmental effect is *likely* to occur, that is, there must be some *probability*, rather than a mere possibility, that the cumulative environmental effect will occur. These criteria were used to guide the assessment of cumulative environmental effects of the proposed Project.

Environmental effects resulting from Project-related activities were identified and assessed in Sections 6.1 to 6.7 The evaluation of cumulative environmental effects is warranted for several environmental components discussed in these sections, namely birds and other wildlife, visual impact, noise and economic development. This section outlines cumulative environmental effects that may result from the Project in combination with other projects or activities that have been or will be carried out, within the regional area. For the purposes of this cumulative effects assessment, the regional area is defined as Yarmouth County.

The cumulative effects assessment focuses only on adverse effects of the Project remaining after the application of mitigation measures (*i.e.*, only residual effects on an environmental component identified within the scope of the assessment). Residual effects are identified Section 6.

7.1 OTHER UNDERTAKINGS IN THE AREA

There is currently limited industrial development within or surrounding the Project Study Area. A discussion with the District of Argyle Director of Property Inspection and Public Works indicated that there are no new substantial future developments proposed in the municipality at this time (L. Doucette, District of Argyle, pers. comm. 2012).

In consideration of the larger regional study area, there is one operating wind farm on West Pubnico Point, approximately 20 km from the proposed Wedgeport Wind Farm. The West Pubnico Wind Farm was established in 2005 and consists of 17 Vestas V-80 turbines producing 30.6 megawatts. These turbines are approximately 78 m tall from the ground to the hub of the turbine. This wind farm employs approximately five locally-based workers and, as the first commercial wind farm development in Nova Scotia, has been a specific destination for tourists as well as other developers and stakeholders wanting to learn more about wind farm developments in the province. Local residents have been fairly accepting of the wind farm, with new construction occurring in close proximity to the existing wind farm (D'Entremont 2012).

In February 2010 Scotian WindFields Inc. was awarded a 1.99 megawatt large wind project by the Department of Energy under the Community Feed-in Tariff (COMFIT) program for renewable energy. The proposed project is located just south of Black Pond Road and within the proposed Project Study Area for the Proponent's Wedgeport Wind Farm. Scotian WindFields' project is expected to be in operation 2013. As reported in the provincial Chronicle Herald (2012), survey and environmental work has been completed for the project and development permits have been applied for from the Municipality of the District of Argyle (The Chronicle Herald 2012).

7.2 POTENTIAL CUMULATIVE INTERACTIONS

Identifying potential cumulative effects is considered through a comparison of the temporal and spatial scope of the additional projects identified in the regional area. A qualitative assessment of these interactions is undertaken in the following section, using experience and professional opinion of the Study Team.

In consideration of predicted residual effects from the Wedgeport Project, there may potentially be cumulative effects on Birds and Other Wildlife, Vegetation, Wetlands, Land Use and Communities, and Public Health and Safety. Potential adverse effects on Wetlands and the Aquatic Environment would be mitigated through habitat compensation as applicable, resulting in no net effect and are therefore not considered in this assessment. Considering the other undertakings are developments very similar in nature to the proposed Wedgeport Wind Farm Project, effects from those undertakings would be very similar (albeit on a different scale of proportion), as would mitigation.

7.2.1 Birds and Other Wildlife

Wildlife mortality, specifically bird and bat mortality, is a residual environmental effect associated with the proposed Project. Bird and bat mortality may also occur as a result of collisions with overhead power lines, vehicles and buildings resulting in a cumulative effect. Historical evidence (see Section 6.4) has shown that wind turbines typically do not kill large numbers of birds and bats compared with other structures. Anecdotal evidence of bird and bat mortality monitoring from the West Pubnico Wind Farm suggests that mortality incidents have been very infrequent, with two bird mortalities reported since the commissioning of the project in 2005 (D'Entremont 2012) in spite of the high volumes of migrating birds in the area. It is therefore unlikely that the incremental contribution of the Wedgeport Wind Farm and proposed COMFIT 1.99 MW project to bird and bat mortality will affect bird and bat species on a population basis causing adverse cumulative effects. A post-construction bird and bat monitoring program at Wedgeport Wind Farm will confirm these predictions.

Looking beyond the other undertakings in the area and considering cumulative effects on birds and other wildlife in general however, cumulative habitat loss and degradation (*e.g.*, fragmentation) has a greater influence on mortality of wildlife. The Wedgeport Wind Farm Project is being designed to minimize Project footprint (and habitat disturbance) so the overall contribution to cumulative habitat loss and degradation is low.

In summary, the cumulative effects of this Project with other activities on Birds and other Wildlife is rated to be not significant.

7.2.2 Vegetation

The Wedgeport Wind Farm Project will result in loss of vegetation as will the proposed COMFIT project. Although detailed site plans are not known for the COMFIT project, given the small scale of the project, it is anticipated that vegetation loss would be minimal. It is also expected that environmental surveys will have been conducted prior to clearing to allow micrositing of the facilities to avoid or minimize interaction with rare vegetative species and uncommon plant communities (including interior forest habitat) as will be done for Wedgeport Wind Farm. Cumulative effects on Vegetation are therefore considered to be not significant.

7.2.3 Land Use and Communities

There are predicted residual effects with respect to visual and noise effects for the Wedgeport Wind Farm Project. As shown in the Project-specific visual assessment, there will be several locations in and around the Project Study Area which will have a vantage point for viewing the proposed turbines. Some of these locations already have a line of sight to the West Pubnico Wind Farm and others will also likely view the proposed COMFIT turbine. Therefore there is predicted to be a cumulative effect with respect to visual landscape. However, in terms of visual effects such as shadow flicker, given the distance of the West Pubnico Wind Farm and predicted dissipation of shadow effects beyond 900 m, there is no predicted cumulative effect of shadow flicker with the West Pubnico Wind Farm. It is possible, however, there could be a potential cumulative effect of shadow flicker for some receptors with respect to the proposed COMFIT turbine. Given the COMFIT project will consist of one turbine, it is expected that this cumulative effect would not be noticeable to nearby receptors. If complaints of shadow flicker are registered during operations, it is expected that the offending turbine would be easily identifiable and appropriate mitigation would be undertaken by the applicable operator (*e.g.*, the Proponent or Scotian Windfields). In recognition of ongoing monitoring of public concerns and mitigation of complaints as required, the cumulative effect of this Project with the other existing structures in the landscape is deemed to be not significant.

Acceptable sound levels are expected to be produced by the Wedgeport Wind Farm Project. Given the distance from the West Pubnico Wind Farm, there is no predicted overlap of sound emissions and therefore no cumulative effect. The proposed COMFIT turbine may potentially result in a cumulative effect for nearby receptors. Sound level monitoring during operations and investigation of complaints will identify legitimate concerns regarding cumulative sound level effects and mitigation will be implemented as appropriate. Cumulative increase in sound is therefore considered to be not significant.

This Project will continue to contribute to the community through job creation for local contractors. It is estimated that the Project will provide up to 100 jobs during the construction phase, five to ten new jobs during the operation and maintenance phase, and two to ten new or existing jobs during the decommissioning phase. In addition, the Project will provide significant tax revenues and income for landowners. These increases in employment and economy will have a cumulative benefit for economic development in the region. The Municipality of the District of Argyle is already receiving tax revenues from the West Pubnico Wind Farm and will realize a cumulative positive effect as the Wedgeport Wind Farm and Scotian Windfield’s COMFIT project are developed.

In summary, cumulative adverse effects on Land Use and Communities are predicted to be not significant.

7.2.4 Public Health and Safety

As with the Wedgeport Wind Farm, safety concerns are expected to be paramount for the West Pubnico Wind Farm and Scotian Windfields’ COMFIT project. Regular monitoring and maintenance of equipment will safeguard against potential safety issues. For all wind farm developments, the key to minimizing potential health and safety concerns lies in proper setback from residences. The nearest residence to the Wedgeport Wind Farm is a seasonal cottage located approximately 659 m from the closest turbine. The majority of receptors are located more than 1 km away from the closest turbine. In recognition of the due diligence on the part of wind farm operators and established setbacks cumulative adverse effects on Public Health and Safety are predicted to be not significant.

7.3 SUMMARY OF SIGNIFICANCE OF CUMULATIVE EFFECTS

With the adherence to mitigation presented in this report, in addition to compliance with regulatory requirements (including terms and conditions of approval), the residual environmental effects of the Project, including cumulative effects, are predicted to be not significant.

8.0 Accidents and Malfunctions

Accidents and malfunctions that could potentially occur and result in environmental effects include hydrocarbon spills, traffic accidents (during delivery of Project components), and turbine malfunctions which could result in unsafe conditions.

Hydrocarbon spills, although unlikely, could occur during equipment refueling or use (*e.g.*, broken hydraulic line). Spilled hydrocarbons could potentially contaminant surface water and groundwater, wetlands, and terrestrial habitat, depending on the location and quantity of the spill. Fuel will be stored onsite during Project construction to fuel construction machinery. Onsite storage of fuel will be as per applicable regulations, will include secondary containment, and will not occur within 30 m of a wetland or watercourse. Refueling procedures will be followed to minimize risk of spillage. An EPP will be developed for the Project prior to construction, which will outline environmental protection procedures to prevent spills from occurring and minimize environmental effects from spills that could occur through emergency response and remediation. The EPP will be written in construction specification format and will include the recommended mitigation measures in this EA report, as well as industry-accepted construction practices. The EPP will be used by the construction contractor and by all operations and maintenance workers during the life-of-the-Project.

Traffic accidents involving large machinery during delivery of equipment could potentially affect public safety and could also potentially result in a hydrocarbon spill with effects as outlined above. The Transportation Study to be conducted prior to construction will recommend specific mitigation and design measures that will be required to address potential hazards associated with Project transportation. In addition, compliance with applicable NSTIR approvals and standards will minimize this risk.

Blade or structural failures of the turbines could result in effects on public health and safety and cause environmental damage. The probability of a tower collapse or blade detachment is highly improbable. However, should either of these events occur, there is potential that the collapse zone would be damaged from the impact. Given the structural integrity of the towers, and ongoing equipment maintenance and monitoring, an accident or malfunction of this type is considered to be highly improbable.

The Proponent will develop an environmental health and safety plan to manage Project activities in a safe manner and facilitate hazard assessment and mitigation to address potential accidents and malfunctions. Accident and incident Investigations, as required, will involve a documented process to investigate, document and report all accidents and incidents, to be carried out by suitably trained personnel, and where corrective or preventative action is required, such action will be fully documented and completed.

The Proponent will develop an emergency response plan for the unlikely event of a site emergency during any phase of the Project. The emergency response plan will include a report form and a map of the Project site, showing the most direct route from the site to an emergency resource such as a hospital. All on-site personnel and contractors will be required to complete a site safety and emergency response orientation prior to the start of pre-construction and construction activities. The Proponent will also coordinate emergency response procedures with local emergency providers. The Wedgeport Volunter Fire Department has facilities on Black Pond Road, in close proximity to the Project Study Area.

In consideration of design, planning and mitigation measures, residual environmental effects as a result of accidents and malfunctions are predicted to be not significant.

9.0 Effects of the Environment on the Project

The following section outlines the effects of the environment on the Project, which includes climatic fluctuations and extreme events that are likely to occur in the Project area.

Several aspects of the potentially changing climate have been considered, and must continue to be monitored during the lifetime of the Project. The potential rise of sea level is one such concern. The Municipality of the District of Argyle has not yet undertaken flood risk mapping for the region, although flood risk planning will likely occur over the next two to three years (L. Doucette, Municipality of the District of Argyle, pers. comm. 2012). Given the Project Study Area's proximity to coastal waters sea level rise and climate change adaptation are particularly relevant and should be taken into account during detailed design. However, it should be noted that proposed changes in layout design will have turbines sited even further back from the coastline as is currently shown, therefore effects of sea level rise and storm surges on the Project are expected to be negligible.

The turbines are designed to have a safe upper working limit for windspeeds. As the frequency of storms increases, particularly the strong late summer hurricanes that are anticipated to retain strong windspeeds as tropical depressions as they move up the coast, there would be an associated increase in the frequency of conditions exceeding the safe operating envelope for the turbines. During such conditions, the turbines are halted and generation suspended until safe working conditions occur again. The lost generation due to the marginal increase in storm frequency is a relatively small quantity of generation time; that is, it is not anticipated to significantly negatively affect the economic viability of the Project. Similarly, any change in the frequency of freezing rain, or blade-icing conditions, is not anticipated to significantly affect operating times, and the monitoring instruments in place will allow the physical risk to the turbines to be managed effectively.

Weather events that put wind turbines at risk include icing conditions, particularly freezing rain, lightning, and extreme winds. Although Nova Scotia has fewer lightning storms than, for example, central Canada, the lightning protection must, and will, be designed to cope with accepted industry standards. Freezing rain is an operations issue. Blade specifications are sufficient to cope with foreseeable icing loads, but it is possible that an event that exceeds this level could be encountered. In such an event, the turbine would have been halted, and the damage would be confined to the immediate vicinity of the turbine base, should ice falling, or structural damage occur.

The wind turbines will be the highest features in the surrounding landscape, and therefore it is necessary that a lightning protection system be incorporated into each turbine. For the Project, each turbine blade material is fibreglass-reinforced epoxy resin with integral lightning protection supply. Each blade and each turbine tower are grounded to prevent adverse effects from lightning strikes. Additional grounding rods can be installed at each turbine site. Most effects from a lightning strike would be dissipated. If lightning struck the generator at the top of the tower, serious damage could occur and the generator may be damaged. However, it is highly unlikely that lightning would hit a wind turbine generator accurately enough to severely damage it.

The generator is designed to automatically shutdown at wind speeds that exceed 25 m/s. The turbine tower is designed to withstand excessive wind speeds. Comprehensive geotechnical work at each site prior to construction will enable for proper design of wind turbine foundation. Extreme wind conditions are used as a parameter in this design.

Taking into consideration the design features that will be used in the Project, a significant environmental effect is unlikely to occur as a result of extreme weather events.

10.0 Follow-up and Monitoring

The Proponent is committed to conducting monitoring activities to address residual environmental effects with a high level of concern or uncertainty. While it is anticipated that the residual environmental effects of the Wedgeport Wind Farm will not be significant, an EPP and corresponding monitoring and contingency plans will be developed to address potential issues and concerns. In addition, the Proponent has committed to pre-construction micrositing of turbine and access road locations, to refine mitigation as required, and support environmental regulatory approvals as required (*e.g.*, Water Approvals)..

10.1 PRE-CONSTRUCTION SURVEYS AND APPROVALS

As part of the detailed surveying and siting process, a follow-up vegetation survey may be required to confirm appropriate siting of Project. It is anticipated that in the event that a species of conservation concern is identified, the specific footprint of the infrastructure (*e.g.,* turbine foundation) can be adjusted to avoid this constraint and/or additional site specific mitigation plans can be developed. When the layout design has been finalized, a gap analysis will be conducted to determine if there are any turbine locations which had not previously been surveyed for rare species or wetlands.

Watercourses and wetlands will be avoided to the greatest extent practical. Where these features are unavoidable, approval will be sought from NSE and DFO as appropriate for alteration. Follow-up watercourse and/or wetland functional analyses will be conducted as required to complete applications for approval. Habitat compensation planning, if required, will be done in consultation with NSE and/or DFO to ensure no net loss of function/habitat.

10.2 FOLLOW-UP AND MONITORING PROGRAMS

The following section provides a brief overview of the Project follow-up and monitoring measures to be implemented to support construction and operations activities.

An EPP will be developed to cover construction and operation phases of the Project. The EPP for the construction period aims to reduce adverse environmental effects during construction activities and consists of: environmental protection measures for routine construction activities; contingency procedures in the event of an erosion control failure, fuel and hazardous material spill, fire and/or encounter of archaeological and heritage resources; environmental monitoring, inspection and reporting requirements; a list of applicable permits, approvals and authorizations; and a key contact list. The EPP for the operating period aims to reduce adverse environmental effects of the operation activities and consists of: guidelines for equipment maintenance activities; the safe storage, handling, and disposal of petroleum, oils and lubricants (POL); and the safe storage, handling and disposal of hazardous materials.

The EPP will also contain details on monitoring programs. Table 10.1 outlines the Environmental Monitoring Programs that will be in place for the Wedgeport Wind Farm.

Table 10.1 Environmental Monitoring Programs (Operations)

Component	Method	Timing	Response-Action Plan
Sound	In response to noise complaints, if any occur, the Proponent would measure ambient sound levels and wind speed at selected residential receptors. The sound and wind data will then be combined to produce a plot of background ambient sound pressure levels versus wind speed.	In response to noise complaints, if any occur. Will also likely be a condition of EA approval from NSE.	If the ambient sound levels at any residential receptors are higher than existing allowable limits, a report shall be filed with the NSE with the particulars of the concern, the suspected source, and any remedial actions taken or to be taken to resolve the concern. If the noise exceedance is related to equipment malfunction, maintenance/repair will be undertaken as necessary to minimize the potential for a reoccurrence.
Bird and Bat Mortality	Bird and bat carcass monitoring will be performed within a 40 m radius of each selected turbine. The fatality rate will require correction for scavenger removal of carcasses and field observation abilities of surveyors. The monitoring program will be confirmed with Environment Canada (CWS) and NSDNR.	It is expected that monitoring of bird mortality will be conducted during the two years year following wind farm commissioning, with emphasis placed on surveying during peak spring and fall migration of birds and fall migration of bats.	It is likely that two years of monitoring will be conducted for bats and birds, to be determined in consultation with NSDNR and CWS
Aesthetics and Visual Impacts	A registry will be established to record both negative and positive comments on the aesthetics and visual impact of the wind turbines. Media comment on the wind turbines will also be collected and documented. If required, photographs will be taken of the turbine locations from a minimum of two vantage points.	Photographs will be taken at least once after the turbines become operational. The comment registry will be maintained and media comment will be collected throughout the operation of the Project.	Information collected from the aesthetics and visual impact monitoring will be used to develop further mitigation, if required.
Electromagnetic Interference	A complaint resolution system will be in place to record and investigate complaints regarding telecommunications interference.	In response to interference complaints, if any occur.	Mitigation will be conducted on a case by case basis pending results of the investigation.

A Contingency Response Plan, which may be contained within the EPP, will include a detailed response system in the event of the accidental release of hazardous materials and/or discovery of archaeological and heritage resources. Aspects of the plan include environmental concerns; personnel training; prevention measures; response-action plan, and a spill clean-up resource list.

11.0 Summary and Conclusions

AnaiaGlobal Renewable Energies, a joint venture between Membertou Corporate Division and GrupoGuascor - Dresser Rand from the Basque region of Spain, is proposing to construct and operate a wind energy facility to be located in the district of Argyle, Yarmouth County, Nova Scotia (the Wedgeport Wind Farm Project; the Project). The Wedgeport Wind Farm Project will include up to 25 turbines with a nameplate capacity of approximately 50 MW and will include an approximate 16 km long 138 kV transmission line to connect to the Tusket River Generating Station in Tusket, Nova Scotia.

As a standard practice in the renewable energy industry an SPC was created to be the sole proponent and owner of this Project. The SPC in this case is named 3250777 Nova Scotia Limited. All permits, agreements and approvals will therefore be given to the SPC.

This EA Report is intended to meet the requirements for an EA Registration in accordance with the Nova Scotia *Environment Act* and has been structured to address requirements in The Proponent's Guide to Wind Power Projects: Guide to Preparing an Environmental Assessment Registration Document" (NSEL 2007, updated 2012).

VECs selected for analysis based on regulatory guidance, literature and data review, field study results, consultation and engagement, and professional judgement of the study team included:

- Aquatic Environment;
- Vegetation
- Wetlands
- Birds and Other Wildlife;
- Land Use and Communities;
- Archaeological and Heritage Resources; and
- Public Health and Safety.

Potential adverse environmental effects that cannot be avoided by design and siting can be effectively mitigated using standard and proven mitigation methods and technologies. Table 11.1 summarizes potential effects, key mitigation, residual effects determination and follow-up and monitoring for each VEC.

Table 11.1 Summary of VEC Assessment

VEC	Potential Effect	Key Mitigation	Residual Effect	Follow-up/Monitoring
Aquatic Environment	Potential interaction with watercourse/drainage channels through site preparation and access road construction.	Avoidance where possible through site design. Implementation of erosion and sediment controls. Water Approval for watercourse alteration if applicable.	No significant adverse residual effects.	Follow-up surveys if turbine layout changes and new watercourse interaction is identified.
Wetlands	Potential direct and/or indirect effects to wetland habitat quality and/or quantity. Predicted loss of 1.41 ha of wetland given current layout.	Avoidance where possible through micrositing. Implementation of erosion and sediment controls. Water Approval for wetland alteration if applicable (including habitat compensation).	No significant adverse residual effects.	Follow-up surveys if turbine layout changes and wetlands cannot be avoided.
Vegetation	Loss of habitat and loss of species of conservation concern through site preparation. Project footprint is estimated to include 35.2 ha of land, with barren habitat most affected with current layout (11.3 ha).	Minimization of Project footprint and avoidance of plant species of conservation concern where possible during micrositing.	No significant adverse residual effects.	Follow-up surveys if turbine layout changes and areas not previously surveyed are identified.
Birds and Other Wildlife	Loss of habitat and changes in mortality risk.	Minimization of Project footprint, clearing outside breeding season, and ongoing monitoring during operations to determine if additional mitigation is required.	No significant adverse residual effects.	Post-construction bird and bat surveys
Land Use and Communities	All receptors are predicted to experience less than 40 dBA sound levels. All receptors (except for one seasonal camp) within 1 km of the nearest turbine predicted to experience greater than 30 hours/day of shadow flicker based on worst case, conservative modeling.	Maintain setback >600m and maintain ongoing communication with landowners. If complaints are registered regarding noise or shadow flicker these incidents will be investigated and mitigation implemented as required.	No significant adverse residual effects.	Proponent will maintain complaint registry and follow-up as appropriate.
Archaeological and Heritage Resources	Although low potential, there is some risk of	Archaeological Contingency Plan as	No significant adverse residual	No follow-up or monitoring unless

Table 11.1 Summary of VEC Assessment

VEC	Potential Effect	Key Mitigation	Residual Effect	Follow-up/Monitoring
	encountering unidentified resources during earthmoving activities.	part of EPP to halt work in event of archaeological discovery and consult with Nova Scotia Museum regarding appropriate mitigation.	effects.	resource is encountered during construction.
Public Health and Safety	Safety risks associated with large equipment transportation to and use on site. Perceived health concerns by public regarding EMF, shadow flicker, and noise.	Transportation study to document transport routes and identify safe transportation, appropriate setbacks from residences, complaint registry, and monitoring of extreme weather conditions (*e.g.*, icing) and need for site restriction.	No significant adverse residual effects.	Proponent will maintain complaint registry and follow-up as appropriate.

In consideration of implementation of the proposed mitigation measures, significant adverse residual environmental effects (including cumulative effects) from Project activities are not likely. If the Proponent is awarded a Power Purchase Agreement, the construction and operation of the Wedgeport Wind Farm Project will generate approximately 50 MW of clean renewable energy, producing energy sufficient to power approximately 20,000 homes annually and displacing energy on the provincial grid that is produced through non-renewable fuel sources.

This Project will contribute to the community through job creation for local contractors. It is estimated that the Project will provide up to 100 jobs during the construction phase and five to ten jobs during the operation and maintenance phase. In addition, the Project will provide significant tax revenues and income for landowners.

12.0 Signature

This report presents details on the EA of the proposed Wedgeport Wind Farm Project, conducted in accordance with the "Proponent's Guide to Wind Power Projects: Guide to Preparing an Environmental Assessment Registration Document" (NSE 2007, updated 2012). Overall, the residual effects of the Project are not significant and are acceptable, based on a balanced assessment against all of the screening criteria and the results and conclusions of the EA.

This EA was completed for Anaia and SPC 3250777 Nova Scotia Limited by Stantec Consulting Ltd. The names and credentials (CVs) of all primary and secondary investigators are presented in Appendix A. Specifically, and on behalf of the Proponent, this report was reviewed and accepted by the undersigned.

Terrance J. Paul

Chief Terry Paul
President
3250777 Nova Scotia Limited

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