5 ENVIRONMENTAL ASSESSMENT AND RESIDUAL EFFECTS

The following section describes the potential interactions between the proposed Digby Wind Power Project and the biophysical and socio-economic environment, and includes: an assessment of potential cumulative environmental effects; an assessment of the effects of the environment on the Project; and the potential effects of accidents and malfunctions.

The structure of this chapter follows that recommended by NRCan in their 2003 guidance document "Environmental Impact Statement Guidelines for Screenings of Inland Wind Farms Under the *Canadian Environmental Assessment Act*" (NRCan 2003). The potential effects are described for the construction, operation and decommissioning phases of the Project and suggested mitigation is presented to reduce or eliminate these potential effects. The potential interactions between the Project and the environment are summarized, as are the proposed mitigation measures to reduce or eliminate residual (or net) effects.

Table 5.1 summarizes the potential interactions between the Project and VECs.

Table 5.1 Potential Interactions Between the Project and Valued Environmental Components

Project Activities	Valued Environmental Components													Section
	Soil	Water Quality	Aquatic Environment	Terrestrial Vegetation	Wetlands	Birds & Other Wildlife	Archaeological/ Cultural Resources	Land Use	Local Community	Visual Aesthetics	Noise	Recreation and Tourism	Safety	
Construction														
Surveying and Siting	X					X								5.1.1
Land Clearing	X	X	X	X	X	X	X				X			5.1.2
Road Construction/Modification	X	X	X	X	X	X	X	X	X		X			5.1.3
Delivery of Equipment						X			X		X			5.1.4
Temporary Storage Facilities	X	X	X	X		X	X				X			5.1.5
Foundation Construction	X	X	X			X	X	X			X			5.1.6
Tower and Turbine Assembly	X					X					X			5.1.7
Electrical Cabling Installation (Interconnection from Turbines to Substation)	X	X	X			X	X	X			X			5.1.8
Substation Construction	X	X	X			X	X	X			X			5.1.9
Installation of Transmission Line (to Power Grid)	X			X		X	X	X						
Fencing/Gates														
Parking Lots														
Operation														
Operation & Maintenance						X		X	X	X	X	X	X	5.2
Decommissioning														
Turbine and Ancillary Equipment Removal	X	X	X			X		X			X			5.3.1

Table 5.1 Potential Interactions Between the Project and Valued Environmental Components

Project Activities		Valued Environmental Components												Section
	Soil	Water Quality	Aquatic Environment	Terrestrial Vegetation	Wetlands	Birds & Other Wildlife	Archaeological/ Cultural Resources	Land Use	Local Community	Visual Aesthetics	Noise	Recreation and Tourism	Safety	
Removal of Power Line	X	X	X			X		X			X			5.3.2
Site Remediation/ Reclamation	X	X	X			X		X			X			5.3.3
Accidents and Malfunctions														
Accidents and Malfunctions	X	X	X			X		X	X				X	5.4

5.1 Project Construction Activities – Environmental Effects

The following sections describe the main construction activities and the potential effects associated with each activity. All activities associated with the Project construction, including equipment maintenance and refueling, will be controlled through standard mitigation to ensure that there is a low impact associated with construction of the Project. The construction zone of impact will be localized within the Study Area, including the RoW for the distribution and transmission lines.

Overall, potential environmental impacts will be mitigated using the following standard practices:

- limit access to the turbine site via an established access road, where possible;
- keep the size of access roads to the minimum required for the safe transportation of construction equipment;
- flag/fence areas with valued environmental features (*e.g.,* wetlands), and exclude construction activities from within these identified areas to the extent practical;
- whenever practical, time clearing activities to periods when the ground surface is best able to support construction equipment (winter or dry season) to prevent rutting and to avoid clearing during sensitive ecological periods events, such as breeding seasons for resident birds (*i.e.,* May to August); and
- upon clean-up, replace topsoil stored on-site and re-vegetate areas that were temporarily cleared, where possible, with native seed mixtures or with a mix of species similar to those on adjacent lands to restore affected lands to their previous condition.

The remainder of this section focuses on the individual phases of construction and operation, and details the potential environmental effects associated with each.

5.1.1 Surveying and Siting Operations

The siting of the wind turbines was initially carried out using computer software analyzing meteorological data. This software, however, does not account for areas that are environmentally sensitive, and site visits by a biologist were conducted and combined with existing mapping data to identify environmental constraints.

Subsequent to the 2008 bird, terrestrial and aquatic field surveys, some turbine locations were changed as a result of stakeholder input and addition of Project lands. While this has resulted in some discrepancy between field data availability and Project footprint, SkyPower recognizes that additional site specific surveys may be required prior to construction activities to identify potential environmental constraints (*e.g.,* rare plants) at turbine locations not previously surveyed in order to assist with micrositing of infrastructure. Prior to construction, land surveyors will conduct a site visit to identify the exact location of each turbine on foot. Survey stakes will be used to mark each turbine site, temporary workspace, substation site and access road construction. These areas will be surveyed, as appropriate, by a qualified biologist to survey the area for rare and sensitive environmental features *(i.e.,* rare plants, wetlands) and recommendations will be made to avoid these constraints to the extent possible. Table 5.2 summarizes the potential environmental effects of surveying and siting activities.

Geotechnical testing will be undertaken at the turbine sites. This will require access by testing equipment and may require limited, localized brush removal to permit equipment operation. Geotechnical testing will be undertaken by qualified operators and supervised by an attending engineer. Existing right-of-ways (RoWs) will be used where possible and the equipment will not traverse watercourses or wetlands, and is expected to have minimal environmental effects.

Table 5.2 Potential Effects of Surveying and Siting Activities

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
Birds and Other Wildlife	Sensory disturbance	▪ Visitors will remain within relevant areas, both in-vehicle and on-foot and will aim to preserve the site's natural areas.	3	1	1/1	R	2	Sensory disturbance may cause habitat avoidance but it likely will be temporary in nature, small in magnitude and restricted to the Project footprint. The area to be subject to this disturbance has been previously disturbed by human presence (*e.g.,* forestry) and disturbance will be reversible.
Terrestrial Vegetation	Limited vegetation removal	▪ Minimize vegetation removal ▪ Avoid wetlands and watercourses ▪ Best environmental practices for geotechnical testing	1	1	1/1	R	2	Highly localized vegetation removal for equipment access will avoid sensitive ecological features and sites will be restored as part of post construction site restoration

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.

The net effects of siting and surveying activities will be spatially limited to certain areas within the Project footprint, as well as temporally limited to within the siting and surveying visits. Overall the level of impact will be **minimal** and **not significant**, especially considering that in the area birds and wildlife already experience a certain level of sensory disturbance due to ongoing forestry and quarrying activities and associated human presence. Vegetation removal will be minimal and sensitive ecological features will be avoided. It should be noted that this phase is very important in ensuring that the overall Project is carried out with the least possible disturbance to birds and wildlife by precisely identifying sensitive habitats within or near areas proposed for disturbance. Where possible, micrositing of infrastructure will also take into consideration connectivity of landscape to maintain potential corridors for wildlife migration through the area. Appropriate construction work zones will be chosen, to the extent practical, in order to limit the degree of disturbance.

5.1.2 Land Clearing

The lands within the Study Area are primarily wooded with evidence of past and current forest operations. Land clearing and vegetation removal will be required for the construction of access roads, installation of poles for interconnection cables, turbine foundation construction and the construction of the substation. However, this will require only minimal alteration for the majority of the Study Area land as existing RoWs are being used to the extent practical. Table 5.3 summarizes the potential environmental effects of land clearing activities.

Table 5.3 Potential Effects of Land Clearing Activities

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
Birds and Other Wildlife	Sensory disturbance	▪ Ensure that overall disturbance is limited to designated workspaces, and performed in compliance with the *Migratory Birds Convention Act* (MBCA).	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 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	▪ 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. ▪ Upon completion of construction and/or decommissioning, habitat will be restored	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

Table 5.3 Potential Effects of Land Clearing Activities

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
		to the extent possible. ▪ Areas of significance (*e.g.,* nesting sites) will be avoided, to the extent possible.						of habitat that will be altered due to land clearing activities for access roads, turbines and the substation will be a very small proportion of what is available therefore the impact will be minimal.
	Mortality	▪ In order to reduce the potential of bird mortality, land clearing and construction activities will be performed in compliance with the *Migratory Birds Convention Act*. ▪ Seasonal avoidance of the breeding season for most bird species is the preferred mitigation, but if this is not possible a contingency plan (*e.g.,* nest survey and avoidance of active nests), will be developed in consultation with NSDNR and CWS.	2	1	2/1	I	2	Land clearing activities mirror current forestry operations in the study area. Due to timing of activities, 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.*
Soils and Vegetation	Soil erosion and compaction	▪ Limit access to the turbine sites via established access roads, where possible. ▪ Size of access roads will be kept to the minimum required for the safe construction, operation and decommissioning of the equipment. ▪ Whenever practical, clearing activities will be conducted during periods when the ground surface is best able to support construction equipment (winter or dry season).	2	1	2/1	R	2	Implementation of mitigation measures will ensure that soil quality within the Project Area will be preserved, and no residual effects will exist.

Table 5.3 Potential Effects of Land Clearing Activities

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
		▪ Replace/re-introduce topsoil stored on-site to enable the reclamation of land to its original condition.						
	Loss of plant species of conservation concern	▪ Follow-up vegetation surveys will be conducted to assist with micrositing of turbines and access roads. ▪ Prior to construction, digital waypoint files for “Red”, “Yellow” and “Undetermined” species identified during field surveys will be provided to NSDNR. ▪ Where Plant Species of Conservation Concern are encountered, avoidance to the extent possible will be considered, especially where there may be a threat to the regional population. Where avoidance is not possible, 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 Plant Species of Conservation Concern.
Wetlands	Loss of wetland area and/or function	▪ Avoid all wetlands, where practical. ▪ If wetland impact is unavoidable, a functional analysis of the wetland will be conducted and regulatory approval of the proposed alteration will be obtained prior to construction.	1	1	2/1	R	2	Follow-up surveys will be conducted, if necessary, to confirm the presence/ absence of wetland within the Project footprint and to conduct a functional analysis of the wetland habitat were avoidance is not feasible. Any loss of wetland habitat will be compensated to ensure no net loss of wetland function.

Table 5.3 Potential Effects of Land Clearing Activities

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
Water Quality/ Aquatic Environment	Surface water contamination	▪ Watercourses will be avoided to the extent possible. ▪ If alteration of watercourses is required, regulatory approval of the proposed alteration will be obtained prior to construction. ▪ All activities, including equipment maintenance and refuelling, will be controlled or done off-site to prevent entry of petroleum products or other deleterious substances, including any debris, waste, rubble or concrete material, into a watercourse. ▪ Construction material, excess material, construction debris, and empty containers will be stored away from watercourses and watercourse banks. ▪ A contingency plan for accidental spills will be developed for the Project.	2	1	2/1	R	2	By following mitigation measures, adverse interactions with surface water quality and fish habitat will be minimized and no significant residual effects will result.
	Sediment loading	▪ Watercourses will be avoided to the extent possible. ▪ Land clearing and construction near watercourses should occur between June and September 30 where practical. ▪ Temporary erosion and sediment control measures, silt fence, straw bales (etc.) will be	2	1	2-3/1	R	2	By following mitigation measures, negative interactions with surface water quality and fish habitat in the Project Area will be minimized and no significant residual effects are predicted.

Table 5.3 Potential Effects of Land Clearing Activities

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
		used and maintained until 100% of all work within or near a watercourse has been completed and stabilized. ▪ 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.						
Noise	Increases to sound levels due to the transportation and operation of clearing 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 will only be operated 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.	3	2	2/1	R	2	Increased sound levels caused by land clearing will be temporary in nature and will be caused by activities conducted during working, daylight hours. Due to the short nature of this disturbance and its limited geographic range, the level of impact will be minimal and residual effect is considered not significant.
Archaeological and Cultural Resources	Disturbance	▪ Areas of significance will be avoided, to the extent possible. ▪ If ground disturbance is necessary in areas of medium or high archaeological potential, these activities will be monitored by a licensed	2	1	2/1	R	2	Local areas of high archaeological potential identified near the Study Area are not anticipated to be impacted by the Project. Follow-up surveys will be conducted if necessary and a contingency plan will be

Table 5.3 Potential Effects of Land Clearing Activities

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
		archaeologist. ▪ 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.						implemented. 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.,* 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.

The amount of clearing for the Project is minimal due to the use of existing access roads to the extent possible and placement of turbine locations in existing harvested areas. Considering the footprint of the turbine locations and substation, along with access roads, it is estimated that approximately 4.5% of the total Project Area will be affected by Project infrastructure, although as stated above, much of this 4.5% has already been disturbed so this is a conservative estimate of vegetation to be cleared. Eleven out of 18 habitat types (refer to Table 4.5) will be affected by the development. Three of these habitat types comprise 93% of the habitat that will be affected including clear-cut (26 ha, 50%), softwood forest (13 ha, 25%) and mixedwood forest (10 ha, 18%). This reflects the relative abundance of these habitats on the local landscape except that clear-cuts are represented more frequently due to the fact that turbines and access roads will be preferentially placed in clear-cuts.

The effective mapping and avoidance of natural habitat hosting vascular plant species of conservation concern during facility layout design, including site-specific vegetation and wetland surveys (if required), micrositing of turbines and ancillary structures and infrastructure, use of existing access roads and cleared areas to a large extent, and successful restoration measures during the Project's construction, operation and decommissioning stages, will not likely result in significant environmental effects to native habitat from the Project. If wetland or watercourse alterations cannot be avoided, all necessary regulatory approvals will be obtained prior to the disturbance.

The preliminary background research indicates that the areas around Gulliver's Cove and Rossway have a high potential for containing both First Nations and historic period archaeological resources. Archaeological follow-up work will be considered based on final design and layout of Project infrastructure and proximity to areas deemed to have high potential for First Nation and Historical archaeological resources. The MEKS results may also provide guidance on follow-up work. Such work could include more in-depth background research, a pedestrian survey of the high potential areas, possibly, sub-surface testing and/or monitoring of high potential areas subject to excavation. Mitigation strategies for all identified heritage resources will be designed by the archaeologist in consultation with appropriate regulatory agencies.

The net effects of clearing activities will be spatially limited to certain small areas within the Project footprint. Overall the level of impact will be **minimal** and **not significant**, especially considering that the area's birds and wildlife already experience a certain level of sensory disturbance due to ongoing forestry activities and associated human activities. Standard mitigation measures to protect terrestrial resources, aquatic resources, archaeological resources and humans from increased sound levels and direct disturbance (including habitat compensation, if required) will be adequate to effectively reduce or eliminate residual effects.

5.1.3 Road Construction/Modification

To the extent possible, existing access roads will be used, and upgraded where required. Access roads will be surveyed and staked/flagged. The roads are based on a proposed layout at this time and may require alterations as the Project proceeds. Roads on the wind farm site will be approximately 11 m wide to accommodate maintenance vehicles and equipment for repairs/replacements. In special cases if difficult turns are required, roads may be wider than 11 m. Construction roads will be designed to accommodate the crane types that will be required to erect the wind turbine generators and towers. Roads will be constructed by placing a layer of geogrid on the native soil, followed by layers of compacted shale or sandstone with a screened stone topping. Once Project construction is complete, the construction roads will be removed and the topsoil replaced across approximately three-quarters the width, leaving single lane tracks to allow access to the turbines for maintenance purposes.

Temporary improvements in roads may be necessary in some areas to enable access to the site by articulated (multi-axle) trucks carrying the turbine components, the largest component of which is the nacelle. These improvements may include widening the turning radius of the corners by adding fill to the ditches. None of these modifications are expected to be permanent and the corners will be remediated.

Watercourses and wetlands will be avoided to the extent possible. In the event that a watercourse crossing is required, culverts will be designed and installed in consultation with NSE and DFO and in accordance with applicable regulations and conditions of approval. Wetland alteration, if required, will be in accordance with applicable regulations and conditions of approval including compensation planning.

The potential environmental effects associated with road construction (including culvert installation, if required) includes impacts to birds and other wildlife, water quality/aquatic environment, noise levels, archaeological/cultural resources, land use and traffic. Table 5.4 summarizes the potential environmental effects of road construction/modification activities.

Table 5.4 Potential Effects of Road Construction/Modification

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1] Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	Residual Effect
Birds and Other Wildlife	Sensory disturbance	▪ Ensure that overall disturbance is limited to designated workspaces, and performed in compliance with the *Migratory Birds Convention Act*.	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 the Project footprint..
	Habitat loss/alteration	▪ 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. ▪ Upon completion of construction and/or decommissioning, habitat will be restored to the extent possible.	2	1	2/1	I	2	Habitat loss will be considered to be irreversible (*i.e.*, 20 years) but the area of habitat that will be altered due to access road construction will be a very small proportion of what is available, and therefore the impact will be minimal.
	Mortality	▪ In order to reduce the potential of bird mortality, land clearing and construction activities will be performed in compliance with the *Migratory Birds Convention Act (e.g.,* outside of critical time periods for breeding birds). If this is not possible, a contingency plan will be implemented in consultation with NSDR and CWS (see Section 5.1.2).	2	1	2/1	I	2	It is predicted that there will be no residual effect on bird mortality.
Soils and Vegetation	Soil erosion and compaction	▪ Access to the turbine sites will be limited to established access roads, where possible. ▪ The size of access roads will be kept to the minimum required for the safe construction, operation and	2	1	2/1	R	2	Implementation of mitigation measures will ensure that soil quality within the Project area will be preserved, and no residual effects will exist.

Table 5.4 Potential Effects of Road Construction/Modification

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
		decommissioning of the equipment. ▪ Whenever possible, clearing activities will be timed for periods when the ground surface is best able to support construction equipment (winter or dry season). ▪ Compacted soil will be reclaimed as required.						
	Loss of plant species of conservation concern	▪ Follow-up vegetation surveys will be conducted, if necessary. ▪ Prior to construction, digital waypoint files for “Red”, “Yellow” and “Undetermined” species identified during field surveys will be provided to NSDNR. ▪ Where Plant Species of Conservation Concern are encountered, avoidance to the extent possible will be considered, especially where there may be a threat to the regional population. Where this is not possible, additional mitigation will be developed in consultation with NSE and NSDNR.	2	1	2/1	R	2	Follow-up vegetation surveys will be conducted to confirm vegetation and habitats in the Project footprint, if necessary. Mitigation for species of conservation concern encountered within the Project footprint will ensure there is no significant residual environmental effect on Plant Species of Conservation Concern.
Wetlands	Loss of wetland area and/or function	▪ Avoid all wetlands, where possible. ▪ If alteration of wetlands is required, functional analyses of the potentially affected wetlands will be conducted and regulatory approval of the proposed alteration will	1	1	2/1	R	2	Follow-up wetlands surveys will be conducted if necessary to confirm the absence of wetland within the Project footprint. Any loss of wetland habitat will be compensated to ensure no net loss of wetland function.

Table 5.4 Potential Effects of Road Construction/Modification

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
		be obtained prior to construction.						
Water Quality/ Aquatic Environment	Surface water contamination	▪ Watercourses will be avoided to the extent possible. ▪ All activities, including equipment maintenance and refuelling, will be controlled, or will be done off-site, to prevent entry of petroleum products or other deleterious substances, including any debris, waste, rubble or concrete material, into a watercourse. ▪ Construction material, excess material, construction debris, and empty containers will be stored away from watercourses and watercourse banks. ▪ A contingency plan for accidental spills will be developed for the Project.	2	1	2/1	R	2	No residual effects are expected.
	Sediment loading	▪ Watercourses will be avoided to the extent possible. ▪ If watercourse alterations are required, they will be done in consultation with NSE/DFO and in accordance with regulatory requirements. ▪ Instream work will occur between June and September 30 where possible, unless otherwise approved by NSE. ▪ Temporary erosion and sediment control	2	1	2/1	R	2	No residual effects are predicted.

Table 5.4 Potential Effects of Road Construction/Modification

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
		measures, silt fence, straw bales (etc.) will be used and maintained until 100% of all work within or near a watercourse has been completed and stabilized. ▪ 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. ▪ Visual assessments will be completed in a quarterly basis and after a severe storm event to ensure effectiveness of erosion and sedimentation control.						
	Surface water flow	▪ Watercourses will be avoided to the extent possible. ▪ Access roads constructed across existing watercourse that require a culvert will follow standard industry practice, installing culverts of sufficient size to accommodate expected maximum flows within the watercourse. ▪ A Water Approval will be obtained for all required watercourse crossings and the conditions of approvals will be followed.	2	1	2/1	R	2	No residual effects are expected.
	Fish mortality	▪ Watercourses will be avoided to the extent	2	1	2/1	I	2	No residual effects are expected given these

Table 5.4 Potential Effects of Road Construction/Modification

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
		possible. ▪ Watercourse crossings, where required, will occur between the period of June 1 to September 30 unless otherwise approved by NSE ▪ Where possible, culverts will be installed during low flow periods. If water is present, watercourses will be dammed and flow will be preserved through water pumps. In this case, a biologist would be on site to facilitate fish rescue within the dammed area. ▪ Where fish bearing streams must be crossed (*e.g.,* culvert installation) DFO will be consulted regarding possible requirements for authorization under the *Fisheries Act.*						mitigation measures.
Noise	Increases to sound levels due to the transportation and operation of clearing equipment	▪ Heavy equipment will only be operated 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.	3	2	2/1	R	2	Residual effects are expected to be minimal, as discussed in Table 5.2.
Archaeological and Cultural Resources	Disturbance	▪ Areas of significance will be avoided to the extent possible.	3	1-2	2/1	R	2	No residual effects are expected.

Table 5.4 Potential Effects of Road Construction/Modification

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
		▪ Additional follow-up work may be required depending on final design and layout.						
Land Use	Reduction of forested land	▪ Existing forest roads will be used as access roads to the extent possible. ▪ New access roads will be constructed to minimize the Project footprint.	3	2	2/1	R	2	The area of forested land that will be lost due to access road construction will be a very small proportion of what is available and therefore the impact should be minimal.
Local Community	Hazards and/or inconveniences to forestry operations, and informal recreational activity (e.g,. ATV operations, hunting)	▪ Road construction schedule will consider planned forestry operations in the area to ensure required access is maintained	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 5.2.1.7.

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.

The construction of access roads on individual landowner's private property will comprise a relatively small portion of the Study Area, and thereby should not jeopardize species habitat. The Proponent will take advantage of existing access roads and upgrade those as necessary. Sensory disturbance and habitat loss/alteration for birds and other wildlife will be temporary in nature and not significant. Culverts will be installed according to all regulatory requirements and wetland alteration will require regulatory approvals including, compensation to ensure no net loss of function. Upon completion of construction, and after consulting with the appropriate landowners, SkyPower intends to reclaim property access roads, if the landowner is in agreement, thereby limiting any long-term impacts. Overall it is anticipated that with implementation of the above-stated mitigation measures, the environmental impact associated with access road construction and modification activities will be **minimal** and **not significant**.

5.1.4 Delivery of Equipment

Currently, traffic patterns in and around the Project Area, are largely related to forestry operations. With the exception of its boundary roads, the Project Area receives very little traffic other than movements of local residents and occasional visits by tourists and other outdoor enthusiasts.

The trucks used for the heavy loads have multiple axles, with the potential to add more, and have steering capability at the back end, allowing them to turn corners much tighter than trucks without such rear steering capability. A large mobile crane will also be required, approximately the size of a standard semi-trailer.

A detailed transport study will be undertaken to determine the appropriate routes and means for the equipment to be delivered to the site. It is anticipated that the current road network (outside of onsite turbine access roads) will not require upgrades to accommodate construction traffic.

Approvals for transporting these materials will be sought from the provincial transportation departments. As the turbine components are oversized, a Special Move Permit and any associated approvals will be obtained through the Nova Scotia Department of Transportation and Infrastructure Renewal (NSTIR) for heavy load transport.

The tower sections, the nacelles, and rotor parts will be moved to each turbine site within the Project Area by flatbed truck and placed into an exact position for picking using cranes. One flatbed truck will be used for each of the three tower sections. In addition, a flatbed truck will be used for the nacelle, and one flatbed truck will be required to transport each of the three rotor blades. An additional three truckloads will be required for the rotor hub, small parts and the erection equipment for each turbine. This site preparation will require approximately ten people for five days for each turbine. All the equipment at the site will be cleaned using a pressure washer and biodegradable truck wash.

There is the possibility for impacts to local sound levels and traffic due to the transportation of materials. In addition, the potential increase in sound levels may cause sensory disturbance to birds and other wildlife. Table 5.5 summarizes the potential environmental effects of activities associated with the delivery of equipment to the site.

Table 5.5 Potential Effects of Delivery of Equipment

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
Birds and Other Wildlife	Sensory disturbance	▪ Delivery vehicles will remain on designated roads.	3	1	1/1	R	2	Sensory disturbance may cause habitat avoidance but it likely will be temporary in nature, small in magnitude and restricted to the Project footprint. The area to be subject to this disturbance is forested land however disturbance will be reversible.
Noise	Increase in sound levels	▪ Equipment will be delivered between 7:00	3	2	1/1	R	2	Increased sound levels caused by delivery of equipment will be

Table 5.5 Potential Effects of Delivery of Equipment

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
		a.m. and 10:00 p.m., avoiding Sundays and holidays unless absolutely necessary.						temporary in nature and will be conducted during working, daylight hours. Due to the short nature of this disturbance and its limited geographic range, the level of impact will be minimal and residual effect is considered not significant.
Local Community	Hazards and/or inconveniences to traffic	▪ A detailed transport study will be undertaken to determine the appropriate routes and means for the equipment to be delivered to the site; however no modifications to existing roads are expected at this time. ▪ A Special Move Permit and any associated approvals will be obtained through the Department of Transportation and Infrastructure Renewal for heavy load transport.	2	1	1/1	R	2	No significant impact on road use is expected.

Note 1 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.

It is anticipated that with implementation of the above-mentioned mitigation measures, the residual effects of the delivery of equipment will be **minimal** and **not significant**. Traffic is relatively low along the potential access routes and therefore it is unlikely that there will be a significant inconvenience to local motorists or emergency services.

5.1.5 Temporary Storage Facilities

Temporary storage facilities/equipment lay-down will comprise a small portion of the Project Area, and should not jeopardize species habitat. Sensory disturbance and habitat loss/alteration for birds and other wildlife will be temporary in nature and not significant. The area's birds and wildlife already experience a certain level of sensory disturbance due to ongoing forestry activities and associated human activities. Upon completion of construction, the temporary storage facilities will be removed and the ground will be remediated to its previous use. The environmental effects of temporary storage facilities are principally due to land clearing and delivery of equipment, and are discussed in Sections 5.1.2 and 5.1.4. Overall it is anticipated that with the implementation of the above-stated mitigation measures, the environmental impact associated with the temporary storage facilities will be **minimal** and **not significant**.

5.1.6 Foundation Construction

Foundations of turbines and substations will leave a small footprint on the landscape that will last the extent of the Project's life. Excavation of soils and installation of the engineered foundations have the potential to interact with several environmental components. Environmental components that potentially could be impacted as a result of foundation construction include birds and other wildlife, soils, water quality/aquatic environment, land use, noise and archaeological/cultural resources. Table 5.6 summarizes the potential environmental effects of activities associated with foundation construction.

Table 5.6 Potential Effects of Foundation Construction

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
Birds and Other Wildlife	Sensory disturbance	▪ Overall disturbance will be limited to designated workspaces, and performed in compliance with the *Migratory Birds Convention Act*	3	1	1/2	R	2	Sensory disturbance may cause habitat avoidance but it is likely to be temporary in nature, small in magnitude and restricted to the Project footprint. The area to be disturbed is primarily forested land however disturbance will be reversible.
	Habitat loss	▪ The footprint for excavation will be restricted to the minimum required for the safe and proper installation of the turbine/substation foundation.	2	1	1/2	R	2	The area of habitat that will be lost due to foundation construction will be a very small proportion of what is available. Therefore the impact will be minimal.
	Mortality	▪ Construction activities will be performed in compliance with the *Migratory Birds Convention Act*.	2	1	1/2	I	2	It is predicted that there will be no residual effect on bird mortality.
Soils	Soil disturbance and erosion	▪ Topsoil and subsurface soils will be separated and stored on-site to be replaced appropriately after the pouring of the concrete foundation. When the soils are stored they will be covered with a tarp or otherwise protected from erosion and runoff.	2	1	1/2	R	2	By implementing these standard mitigation measures, the residual effect on soils will not be significant and will have a minimal level of impact.
Water Quality/ Aquatic Environment	Surface water contamination	▪ Watercourses will be avoided to the extent possible. ▪ All activities, including equipment maintenance and refuelling, will be controlled, or will be done off-site, to prevent	2	1	1/1	R	2	No residual effects are predicted.

Table 5.6 Potential Effects of Foundation Construction

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
		entry of petroleum products or other deleterious substances, including any debris, waste, rubble or concrete material, into a watercourse. ▪ Construction material, excess material, construction debris, and empty containers will be stored away from watercourses and watercourse banks. ▪ A contingency plan for accidental spills will be developed for the Project.						
	Sediment loading	▪ Land clearing and construction will not take place in the immediate vicinity of a watercourse. Temporary erosion and sediment control measures, silt fence, straw bales (etc.) will be used and maintained until 100% of all work within or near a watercourse has been completed and stabilized. ▪ 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.	2	1	1/1	R	2	No residual effects are predicted.
Land Use	Reduction of forested land	▪ Turbines and substations, with their relatively small footprint on the land, have been sited with consideration	2	2	1/2	R	2	The area of forested land that will be lost due to foundation construction will be a very small proportion of what is

Table 5.6 Potential Effects of Foundation Construction

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
		for the potential impact to existing land uses.						available and will be situated to minimize disturbance to existing forestry operations. Due to the limited footprint, its reversibility after decommissioning and small proportion of land to be directly impacted by foundation construction, the residual effect is expected to be minimal.
Noise	Increases to sound levels due to operation of equipment	▪ All internal combustion engines will be fitted with appropriate muffler systems. ▪ Noise abatement equipment, in good working order, will be used on all heavy machinery used on the Project.	3	2	1/2	R	2	Increased sound levels caused by foundation construction will be temporary in nature and will be conducted during working, daylight hours. Due to the short nature of this disturbance and its limited geographic range, the level of impact will be minimal and residual effect is considered not significant.
Archaeological and Cultural Resources	Disturbance	▪ Areas of significance will be avoided to the extent possible.	3	1	1/2	R	2	No residual effects are predicted.

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.

The foundations will comprise a relatively small portion of the Project Area land, and thereby their presence, while permanent, should not jeopardize species habitat. Sensory disturbance for birds and other wildlife will be temporary in nature. Upon completion of construction, the ground surrounding the foundations will be restored. Overall, it is anticipated that with the implementation of the above-stated mitigation measures, the residual effects associated with foundation construction will be **minimal** and **not significant**.

5.1.7 Tower and Turbine Assembly and Installation

The tower comes in three sections that will be assembled on site. The rotor blade system, consisting of three blades and a hub, will also be assembled on site, attached to the generator and lifted into place at the top of the tower by a large hydraulic crane. This will require approximately ten people for three days per turbine. An additional 1-2 days will be required to install the remainder of the turbine assembly. Control and switching equipment will be placed on each turbine pad by a crane. A large crawler crane with a hydraulic crane will be used to install each tower section. Each tower section will be lifted and secured with bolts to the section below, followed by the nacelle secured to the top tower section. Finally, the assembled rotor will be lifted and attached to the nacelle.

This phase of construction could potentially have impacts on birds and other wildlife, soils and vegetation, and sound levels. Table 5.7 summarizes the potential environmental effects of activities associated with tower and turbine assembly and installation.

Table 5.7 Potential Effects of Tower and Turbine Assembly and Installation

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
Birds and Other Wildlife	Sensory disturbance	▪ Overall disturbance will be limited to designated workspaces, and performed in compliance with the *Migratory Birds Convention Act*.	3	1	2/1	R	2	Sensory disturbance likely will be temporary in nature, small in magnitude and restricted to the Project area. The residual effect is considered minimal.
Soils	Soil compaction and contamination	▪ Trucks and equipment will remain in designated workspaces. ▪ Whenever possible, delivery will be timed for periods when the ground surface is best able to support construction equipment (winter or dry season). ▪ Compacted soil will be reclaimed as required.	3	1	2/1	R	2	No residual effects are expected.
Noise	Increases to sound levels due to the transportation and operation of equipment	▪ Heavy equipment will only be operated between 7:00 a.m. and 10:00 p.m., avoiding Sundays and holidays unless absolutely necessary. ▪ All internal combustion engines will be fitted with appropriate muffler systems. ▪ Noise abatement	3	2	2/1	R	2	Increased sound levels caused by equipment assembly and installation will be temporary in nature and will be conducted during working, daylight hours. Due to the short nature of this disturbance and its limited geographic range, the level of impact will be minimal and residual effect

Table 5.7 Potential Effects of Tower and Turbine Assembly and Installation

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
		equipment, in good working order, will be used on all heavy machinery used on the Project.						is considered not significant.

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.

Sensory disturbance for birds and other wildlife will be temporary in nature, and not significant. The area's birds and wildlife already experience a certain level of sensory disturbance due to ongoing forestry activities and associated human activities. Compacted soil will be remediated and reclaimed as appropriate, and measures will be in place to decrease the likelihood of this occurring. Overall it is anticipated that with the implementation of the above-stated mitigation measures, the residual effects associated with the tower and turbine assembly and installation will be **minimal** and **not significant**.

5.1.8 Interconnection from Turbine to Substation

Above-ground 34.5 kV electrical cables will be installed running from each turbine to the on-site substation, largely following existing linear disturbances (*i.e.,* access road system).

Potentially affected environmental components include birds and other wildlife, soils, water quality/aquatic environment, noise, land use and archaeological/cultural resources. Table 5.8 summarizes the potential environmental effects of activities associated with interconnection of the turbine and substation.

Table 5.8 Potential Effects of the Interconnection from Turbines to Substation

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
Birds and Other Wildlife	Sensory disturbance	▪ Overall disturbance will be limited to designated workspaces, and be performed in compliance with the *Migratory Birds Convention Act*. ▪ Mitigation recommended by the Avian Power Line Intervention Committee (1994, 1996) will be considered to minimize effects of overhead distribution lines.	3	1	2/1	R	2	Sensory disturbance likely will be temporary in nature, small in magnitude and restricted to the Project area. The residual effect is considered minimal.
Soils	Compaction and contamination – via heavy equipment	▪ Topsoil will be stored on-site for future use in restoring the land to its original condition. ▪ Standard erosion and sediment control measures will be implemented as required.	3	1	2/1	R	2	No residual effects are expected.
Water Quality/ Aquatic Environment	Surface water contamination	▪ Watercourses will be avoided to the extent possible; overhead lines preclude the need for in-stream work. ▪ All activities, including equipment maintenance and refuelling, will be controlled, or will be done off-site, to prevent entry of petroleum products or other deleterious substances, including any debris, waste, rubble or concrete material, into a watercourse.	2	1	2/1	R	2	No residual effects are expected.
	Sediment loading	▪ Watercourses will be avoided to the extent possible. ▪ Temporary erosion and sediment control measures, silt fence, straw bales (*etc.*) will be used and maintained until 100% of all work within or near a watercourse has been completed and stabilized.	2	1	2/1	R	2	No residual effects are expected.

Table 5.8 Potential Effects of the Interconnection from Turbines to Substation

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]: Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	Residual Effect
		▪ 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.						
Noise	Increases to sound levels due to the transportation and operation of equipment	▪ Heavy equipment will only be operated between 7:00 a.m. and 10:00 p.m., avoiding Sundays and holidays unless absolutely necessary. ▪ All internal combustion engines will be fitted with appropriate muffler systems. ▪ Noise abatement equipment, in good working order, will be used on all heavy machinery used on the Project.	3	2	2/1	R	2	Increased sound levels will be temporary in nature and will be conducted during working, daylight hours. Due to the short nature of this disturbance and its limited geographic range, the level of impact will be minimal and residual effect is considered not significant.
Land Use	Reduction of forested land	▪ Existing forest and access roads built earlier in the construction schedule will be used to install the collection system.	3	1	2/1	R	2	Provided these mitigation measures, and considering the temporary and reversible nature of this effect over a small spatial scale, no residual effects are expected.
Archaeological and Cultural Resources	Disturbance	▪ Areas of significance will be avoided to the extent possible.	3	1	2/1	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.

Overall it is anticipated that, with the implementation of the above-mentioned mitigation measures, the residual effects of the collection system installation will be **minimal** and **not significant**.

5.1.9 Substation Construction

The substation will contain transformers to convert the voltage from 34.5 kV to 69 kV, which is required for connection to the proposed transmission lines. Topsoil excavated from the substation site will be re-distributed to adjacent lands. Substation equipment will be installed within the 0.25 ha fenced yard that will be surfaced with gravel. Since this will be a high voltage area, similar to all transformer substations, it will be surrounded by a high locked fence to prevent accidental access to the high voltage equipment.

The effects associated with substation construction are principally due to the construction of the foundation, as discussed in Section 5.1.6. Potentially affected environmental components as a result of the construction of the substation for this Project include birds and other wildlife, soils, water quality/aquatic environment, noise, land use and archaeological/cultural resources. Proposed mitigation measures and discussion regarding residual effects of substation construction are discussed in Section 5.1.6.

The substation will have a footprint that is relatively small compared to the Project Area. Given appropriate mitigation measures, the small spatial scale and footprint of the substation, and the temporary nature and reversible nature of many of the interactions with the environment, the residual effects associated with substation construction will be **minimal** and **not significant**.

5.1.10 Transmission Line to Power Grid

A 69 kV transmission line will link the Project from the onsite substation to the NSPI substation in Conway. Approximately 10.6 km of aboveground pole-mounted 69 kV distribution line will be installed along the RoW of Route 217 to link the project to the Conway substation and the provincial power grid.

Potentially affected environmental components include soil, vegetation, birds and other wildlife, archaeological/cultural resources, land use and noise. Table 5.9 summarizes the potential environmental effects of activities associated with the installation of the transmission line to the power grid.

Table 5.9 Potential Effects of the Installation of Transmission Line to the Power Grid

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
Birds and Other Wildlife	Sensory disturbance	▪ Overall disturbance will be limited to designated workspaces, and be performed in compliance with the *Migratory Birds Convention Act*.	3	1	2/1	R	2	Sensory disturbance likely will be temporary in nature, small in magnitude and restricted to the Project area. The residual effect is considered minimal.
Soils/Vegetation	Compaction and contamination – via heavy equipment	▪ Topsoil will be stored on-site for future use in restoring the land to its original condition. ▪ Standard erosion and sediment control measures will be implemented as required.	3	1	2/1	R	2	No residual effects are expected.
Noise	Increases to sound levels due to the transportation and operation of equipment	▪ Heavy equipment will only be operated between 7:00 a.m. and 10:00 p.m., avoiding Sundays and holidays unless absolutely necessary. ▪ All internal combustion engines will be fitted with appropriate muffler systems. ▪ Noise abatement equipment, in good working order, will be used on all heavy machinery used on the Project.	3	2	2/1	R	2	Increased sound levels will be temporary in nature and will be conducted during working, daylight hours. Due to the short nature of this disturbance and its limited geographic range, the level of impact will be minimal and residual effect is considered not significant.
Land Use	Reduction of forested land	▪ Existing RoWs will be used to the extent possible.	3	1	2/1	R	2	This activity will be localized and have reversible effects; no residual effects are expected.
Archaeological and Cultural Resources	Disturbance	▪ Areas of significance will be avoided to the extent possible.	3	1	2/1	R	2	No residual effects are expected.

Table 5.9 Potential Effects of the Installation of Transmission Line to the Power Grid

Potential Interaction	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.,* 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.

Overall it is anticipated that, with the implementation of the above-mentioned mitigation measures, the residual effects of the transmission line installation will be **minimal** and **not significant**.

5.1.11 Fencing/Gates

With the exception of the substation, the need for fencing or gates is not anticipated for the Digby Wind Power Project, therefore environmental effects and mitigation are not discussed.

5.1.12 Parking Lots

The need for a parking lot is not anticipated for the Digby Wind Power Project therefore environmental effects and mitigation are not discussed.

5.2 Operational Activities – Environmental Effects

The environmental components that may be adversely affected by the operation of the Digby Wind Power Project include land use, local community, recreation, visual aesthetics, ambient sound levels, birds and other wildlife and health and safety. In addition, its operation may raise certain health and safety issues, both for Project personnel and landowners. Table 5.10 provides a general overview of these components and associated impacts. The remainder of Section 5.2 describes these interactions and potential effects in greater detail.

Table 5.10 Summary of Potential Effects of Operational Activities

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
Birds	Sensory disturbance	▪ None required.	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.
	Mortality	▪ Lighting will be the minimum allowed by Transport Canada for aeronautical safety, and white strobe 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. ▪ 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	I	2	Given existing information from operating wind energy facilities elsewhere in North America, 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.
Other Wildlife	Sensory disturbance	▪ None required.	3	2	5/1	R	2	Studies of game animals in western North America (*e.g.,* Anderson *et al.* 1999) have shown that species are either unaffected by wind energy facilities, given their small footprint and the preservation of existing

Table 5.10 Summary of Potential Effects of Operational Activities

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
								land use, or that they can readily adapt to the presence of wind turbines. At this site, habitat avoidance will most likely occur during periods of construction, and may be more intermittent during periods of operation, when on-site human activities are less frequent and would occur on a short-term basis.
	Mortality	▪ Post-construction monitoring (*e.g.,* bat monitoring) will direct the need and form of further post-construction mitigation measures. ▪ 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	5/1	I	2	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, post-construction monitoring will be implemented to confirm this expectation. The risk of bat collisions is greater for migrating bats than for resident breeding, commuting or foraging bats. Therefore, post-construction monitoring will be conducted in the fall in order to correspond to migration activities by migratory species and the movement of resident species to hibernacula.
Land Use	Disruption to undeveloped woodlands or infrastructure	▪ The Project has been designed to minimize impacts to the local land use. No mitigation, therefore, is required as no significant impacts are predicted.	2	2	5/1	R	2	The effect of wind turbines on undeveloped woodlands is negligible with only a small portion of the available land required for wind turbines, ancillary equipment and access roads.
Local Community	Effect on local economy	▪ Local residents will be employed to the extent possible during the	4	1	5/6	R	2	A positive residual effect would be realised by the operation of the Project,

Table 5.10 Summary of Potential Effects of Operational Activities

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
		construction, operation and decommissioning of the Project.						through increases in employment opportunities, increases in private spending due to an influx of Project personnel, and an increase in the municipal tax base.
	Effect on property values	▪ None required	4	1	5/6	R	2	Existing information indicates that property values are not adversely affected by the construction and operation of wind farms.
Recreation and Tourism	Effect to tourism and recreation	▪ None required.	4	2	5/6	R	2	The Project is expected to have a minor positive effect on tourism and recreation in the Study Area.
Visual	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 legitimate concern.	4	2	5/6	R	2	Given the viewing distances and sparse population, the visual impact will not be significant. Some landowners within the Study Area will have views of the wind turbines from the residences, but many views will be obstructed by terrain, existing vegetation and distance.
	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 500 m, the presence of these lights will not place excessive nighttime visual pollution within several kilometers of the Study Area.
	Shadow flicker	▪ None required.	3	2	5/1	R	2	Modeling of shadow flicker indicates there are minimal potential visual impacts at the locations throughout the Project area caused by shadow flicker due to the limited duration and distance of visibility under "ideal" viewing conditions as well as the presence of existing

Table 5.10 Summary of Potential Effects of Operational Activities

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
								vegetation which would effectively mitigate potential negative impacts. 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 1,000 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.
Noise	Increases to sound levels	▪ None required.	3	2	5/6	R	2	Modelling of predicted sound levels caused by the operation wind turbines indicated that all the receptors within the Project area are expected to receive sound exposures from the proposed wind farm within acceptable sound limits. As a result, any increase in sound levels due to the operation of the Project will be not significant.
Health & Safety	Electromagnetic fields (EMFs)	▪ 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 not just

Table 5.10 Summary of Potential Effects of Operational Activities

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
								by distance, but also by 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.	2	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	▪ During construction and operation activities, access to the wind turbine facility will be restricted to authorized personnel wearing proper personal protective equipment and who have had appropriate safety training. ▪ During site visits, vehicles will be parked up-wind of the turbines. ▪ During operation, access to the wind turbine sites will be restricted to authorized personnel only.	3	1	5/1	R	2	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. For maintenance personnel, the potential of ice throw presents a greater risk to health and safety. With the implementation of the mitigation measures proposed herein, the risk of injury and property damage will be reduced.

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

5.2.1 Wind Turbine Operation

The following sections discuss the potential effects of the operation of the Project on the biophysical and socio-economic environment.

5.2.1.1 Effects on Birds

Environment Canada's "Wind Turbines and Birds – A Guidance Document for Environmental Assessment" and "Recommended Protocols for Monitoring Impacts of Wind Turbines on Birds" (Environment Canada 2007a and 2007b) were applied during the pre-construction surveys and environmental assessment of Project impacts on birds.

In particular, Tables 1 to 3 of Environment Canada (2007a) were consulted to identify the sensitivity, facility size, and level of concern. According to the criteria identified in the aforementioned tables, the facility would be considered Medium, but is considered to have an overall very high sensitivity due to the presence of landform structures in the Study Area (shoreline, ridge) and presence of a SARA-listed species (*i.e.*, Peregrine Falcon) . As a result, the level of concern for this Project would be Very High. Table 5.11 identifies the information that Environment Canada would expect to be considered for projects with a High or Very High level of concern.

Table 5.11 Questions for Consideration as per Environment Canada (2007a)

Question	Answer
Identify the species that breed and winter at the site and in the surrounding area, and indicate their relative abundance.	See Section 4.4.1 and Appendix E.
Identify any species at risk, including species listed under the *Species at Risk Act (SARA),* provincially or territorially designated species, species designated by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), or species designated as priority species by the ACCDC, Partners in Flight (PIF) or the CWS.	See Section 4.4.1 and Appendix E. The *SARA*-listed Peregrine Falcon was observed in the Project Area during one field visit.
Identify bird colonies (note species, size, location).	No bird colonies have been identified during pre-construction surveys. According to Lock *et al.* (1994), the nearest seabird colony to the site is a Double-crested Cormorant colony (69 breeding pairs identified in 1987) on Bear Island, approximately 18 km away.
Identify raptors, shorebird concentrations.	See Section 4.4.1 and Appendix E.
Identify species that give aerial flight displays.	Aerial flight displays are predicated on breeding. With the exception of the Turkey Vulture which are known to roam along Digby Neck, no raptors were recorded consistently during breeding season and were not confirmed breeding in the Study Area (refer to Section 4.4.1 and Appendix E). It is expected that the raptors recorded during the surveys use the Project Area only infrequently and are therefore not likely to be demonstrating aerial flight displays in this area. Raptors and other species that give aerial flight displays are indicated in Table E3 in Appendix E.
Identify the species that congregate at significant migration staging areas at or near the site.	The Project Area does not appear to be a major staging or stopover site for migration (see Section 4.4.1 and Appendix E).
Identify the species that frequently migrate through or near the area.	See Section 4.4.1 and Appendix E.

Table 5.11 Questions for Consideration as per Environment Canada (2007a)

Question	Answer
Identify the species that commute (*i.e.,* between breeding and foraging habitats) through or near the area, as compared to other locations within the region.	See Section 4.4.1 and Appendix E.
What habitat types occur on the site and in the surrounding area?	See Section 4.4.1 and Figure 4.2.
Do these habitats typically support habitat-sensitive or habitat specialist species, *e.g.,* forest-interior species, grassland species, or shrubland species?	The Project Area does not provide valuable habitat for bird species compared to other areas in the region (*e.g.,* lowland areas at the head of St. Mary's Bay). Due to the fragmentation that has already occurred in the Study Area, much of the forested habitat is considered edge habitat.
What is the relative density of breeding birds in these habitats?	See Section 4.4.1 and Appendix E.
What breeding or migrating birds do these habitats typically support?	See Section 4.4.1 and Appendix E.
How much of each habitat type or function will be lost or altered as a result of this development?	The Project footprint will be primarily on recently logged lands and only a very small proportion of the area within the Study Area will be altered (less than 4.5%). The area is heavily logged and Project infrastructure locations (including access roads) will maximize use of cleared lands. Three habitat types comprise 93% of the habitat that will be affected including clear-cut (26 ha, 50%), softwood forest (13 ha, 25%) and mixedwood forest (10 ha, 18%). This reflects the relative abundance of these habitats on the local landscape except that clear-cuts are represented more frequently due to the fact that turbines and access roads will be preferentially placed in clear-cuts.
What topographical features, such as islands, peninsulas, and ridges, are located on or near the site that may influence bird activity and movement?	Project site is situated on Digby Neck spanning the full width of the peninsula from the Bay of Fundy to St. Marys Bay.
What is the expected amount and type of human presence (vehicles, pedestrians, tourism, etc.) at the site at different times of the year, during and following construction?	See Section 2 for information on Project traffic. The area is already subjected to human disturbance as a result of forestry, agriculture and quarry operations.
What are the relevant meteorological data, such as wind speed, wind direction and visibility (*e.g.,* number of days during migration period with visibility <200 m or cloud bases <200 m) for the site?	See Appendix E.
If a bird colony is located within 5 km of the Project area, or if a nationally recognized site occurs within 1 km, do individual birds pass through the proposed turbine locations as part of their daily movements? What proportion of the colony does this represent?	No bird colonies are known to occur within 5 km of the Project area, nor is there a nationally recognized site within 1 km. According to Lock *et al.* (1994), the nearest seabird colony to the site is a Double-crested Cormorant colony on Bear Island, approximately 18 km away.
Do raptors breed at the site or within 1 km of the site? If so, what species are present and how close do they nest to the proposed facility?	No raptors were confirmed breeding at the site, nor were any raptor nests observed. However, a few species were considered possible breeders based on observations made during breeding bird surveys, including Red-tailed Hawk, Broad-winged Hawk, and Sharp-shinned Hawk. The Peregrine Falcon may be considered a probable breeder in the Study Area (refer to Section 4.4.1 and Appendix E).

Table 5.11 Questions for Consideration as per Environment Canada (2007a)

Question	Answer
If the site is recognized by local experts as having bird habitat that is locally important, how much of this habitat would be lost or altered by the proposed Project?	The Project Area is not considered to have bird habitat that is locally important. The majority of Project lands have already been impacted by forestry, agriculture or quarry operations.
If the site contains land features (islands, ridges, shorelines, peninsulas, areas of open water in winter, etc) that may concentrate birds on migration, while staging, or in winter: Do birds concentrate at this site during any of the seasons mentioned above?	The Project Area includes steep cliffs and ridges and is adjacent to the shoreline for the Bay of Fundy and St. Mary's Bay. As indicated in Section 4.4.1 and Appendix E, the survey data generally shows no evidence of large concentrations of birds in the Project Area.
If the site is recognized by CWS or local experts as regionally or locally important to birds, how does the number and diversity of birds that use the site in the season of interest compare to other locations in the region or province? How much habitat would be lost or altered by the proposed Project?	Although Digby Neck itself is considered to be an important bird migration corridor, no such importance has been identified for the Project area itself (refer to Appendix E). The habitat included in the Project Area is not regionally or locally important to birds. The Project Area is characterized primarily by fragmented forest habitat of little value compared to other locations in the region or province. Less than 4.5% of the habitat in the Project Area is expected to be directly impacted by Project construction.
If large numbers of birds may commute through or near the area during the day, what is the height and direction of this movement, and how does this relate to the proposed Project design and turbine locations?	Refer to Section 4.4.1 and Appendix E.
If large numbers of birds stage in or near (within 1 km of) the area, are there any activities taking place nearby that could potentially disturb birds (for example by causing large numbers of birds to take off and fly directly overhead), thereby resulting in collisions with wind facility structures?	There is no evidence of large numbers of birds staging within 1 km of the Project Area.
What is the frequency of dense fog (visibility <200m) and low cloud bases (<200m) at the site during the spring and fall bird migration periods?	See Appendix E.
If aerial flight display species occur at the site: ▪ How many individuals might be affected by the proposed wind farm? ▪ How significant is the site for these species (*i.e.,* is it one of the few sites in the region or province with this species)? ▪ What proportion of these species' local habitat would be close to the facility, and what is the likelihood that birds will be displaying in close proximity to turbine blades?	Refer to Section 4.4.1 and Appendix E. Aerial flight displays are predicated on breeding. With the exception of the Turkey Vulture which are known to roam along Digby Neck, no raptors were recorded consistently during breeding season and were not confirmed breeding in the Study Area (refer to Section 4.4.1 and Appendix E). It is expected that the raptors recorded during the surveys use the Project Area only infrequently and are therefore not likely to be demonstrating aerial flight displays in this area.

The potential environmental effects resulting from Project-related activities on birds include sensory disturbance and mortality. Section 4.4.1 provides detailed information on the breeding, wintering and migrating birds of the Project Area and the broader regional area.

Sensory Disturbance

Sensory disturbance of birds may occur during all phases of the Project as a result of on-site human activities such as surveying, clearing, trenching, turbine assembly, equipment operation, site inspections and site decommissioning. A certain level of sensory disturbance to birds in the area has already resulted from ongoing agricultural and forestry activities and associated human presence. The operation of the wind turbines may also 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). Habitat avoidance will most likely occur during periods of construction, and may be more intermittent during periods of operation, when human presence on-site is less frequent and typically of short duration.

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

A possible effect of this Project on birds is mortality due to collisions with the operating wind turbines. Indeed, there is a perception that wind turbines cause a great 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 2004). 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 2004). 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.

The recent 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). Indeed, single night fatality events of this magnitude are not known to have occurred at any other North American wind farm.

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 (4-50 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.

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). However, it is important to reduce or eliminate fatalities to the extent possible, and 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. Environment Canada recommends that white strobe lights be used on towers at night and that their number and light intensity be minimized. It is also recommended that the number of flashes per minute be minimized within allowable parameters. Lighting for this Project will be based on the standards and requirements of Transport Canada, with the intent to install the minimum amount of lighting required. Medium Intensity White Flashing Omnidirectional Obstruction Lighting will be utilized at the top of turbines (CL-865), with short flash durations and the ability to emit no light during the “off phase” of the flash (*e.g.* as allowed by strobes and modern LED lights). These lights will operate at the minimum intensity (day: 7,500 candela, night: 750 candela), minimum flash duration (0.1 – 0.25 second/flash), and the longest duration between flashes (40 flashes/minute) allowable by Transport Canada’s CAR Standard 621.19.

Lighting elsewhere within the Project will be the minimum necessary for safety. Final lighting selection will be determined in consultation with Transport Canada.

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 80 m in height and the blade length will be approximately 38.5 m. As a result, the greatest height of the turbines will be below 150 m. At this height, the turbines are not predicted 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).

The nature of the support structure on which the rotor blades are mounted may also influence bird-turbine collisions. Wind turbines can be mounted on either a lattice structure or tubular steel towers. Limited information is available to identify the preferred support structure although some data indicate that lattice towers encourage perching by raptors during hunting and, as a result, may put these birds at risk of collisions. As such, the turbines for this Project will be built using tubular steel towers.

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 2005). The Project will consist of a maximum of 20 turbines and will not be of a size that should cause concern for elevated collision risk.

Bird Abundance and Behaviour

When considering the results of the avian pre-construction monitoring program, the vast majority of birds observed during the study were flying less than 50 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).

In general, the area does not seem to be a major staging or stopover area for migrating birds or for birds traveling over the Study Area to get to some other location. The spring and fall migration counts generally show no evidence of major peaks of arrival or departure like that observed in other parts of the region (*i.e.,* Brier Island).

Although species of conservation concern were recorded in the 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 absence of habitat suitable within the Project footprint for their breeding or staging, and the expected low number of fatalities overall, based on previous studies undertaken 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.

Potential Impact and Mitigation

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 Area does not cause any concern with regards to increasing risk of collision, disturbance or habitat alteration. However, there are further mitigation and monitoring measures that will help reduce effects to bird populations.

Breeding bird surveys will be conducted in the Project Area in June 2009 to confirm breeding status, particularly that of the Peregrine Falcon, and will include the transmission line corridor which was not included in the 2007-2008 surveys.

Construction on-site will occur outside of the breeding season to the extent possible to avoid contravention of the *Migratory Birds Convention Act*. If clearing activities cannot be scheduled to avoid the breeding season for most birds (May to August), then a biologist on-site will identify nests within or immediately adjacent to work areas, and flag them for avoidance during construction.

Mitigation for distribution lines will consider techniques recommended by the Avian Power Line Intervention Committee (1994, 1996). This mitigation may include:

- Line visibility should be increased by bird flappers or other bird-flight diverters, and, where possible/feasible, increasing the size of the wire (to larger than 230 kV).
- Lines should not be built over water or other areas of high bird concentrations.
- Small lightning shield wires should be eliminated where lines cross wetlands.
- Lines should be placed as close to trees as is practical and below the level of tree tops wherever possible.
- To prevent the electrocution of large birds such as raptors and cranes, lines should be designed with adequate space between conductors to prevent a bird from simultaneously touching two phases.

To determine the accuracy of the predicted environmental effects and ensure all mitigation measures are successful, post-construction monitoring will be conducted and will be developed in consultation with CWS and NSDNR. Monitoring will include bird use and mortality surveys, to be conducted at a frequency to be determined though consultation with CWS. With respect to mortality surveys, typically searches include a 40 m radius around each turbine and will be developed as per the “Recommended Protocols for Monitoring Impacts of Wind Turbines on Birds” (Environment Canada 2007b). Additionally, as a part of the monitoring protocol, searcher efficiency trials will be conducted and may include spring scavenger impact trials if required by Environment Canada, to correct for these potential influences on the carcass monitoring. The length of the post-construction bird monitoring program will be determined in consultation with CWS and NSDNR although it is expected that two years of monitoring may be required. The detailed protocol and subsequent results of the post-construction monitoring will be used to assess the success of the mitigation measures in consultation with Environment Canada and NSDNR. In turn, this may lead to other mitigation being suggested using the available options at the time.

Taking into account the mitigation measures, there likely will be residual effects of the Project on the area’s birds. In general, sensory disturbance will be infrequent, temporary in nature, reversible, small in magnitude and restricted to the Project Area given the mitigation measures proposed. Residual effects of sensory disturbance are not predicted to be significant. Fatalities as a result of colliding with structures within the Project will be irreversible, but they are expected to be infrequent and minor in magnitude and in geographic extent. It is unlikely that mortality will affect birds at a population level. As a result, the residual effect of this mortality is not considered to be significant.

5.2.1.2 Other Wildlife

Other wildlife species of the Project area include mammals, reptiles and amphibians. Most species are year-round residents of the Project area and adjacent lands, although certain local or long-distance migrations of some species occur. Potential environmental effects of the Project on wildlife include habitat alteration, mortality and sensory disturbance.

Sensory Disturbance

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. Bats are unlikely to be affected by human presence as they are nocturnal and the majority of human presence will occur in the Project 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. First, the Project Area has a high degree of existing human disturbance (*i.e.,* forestry activities) and thus wildlife species have either become acclimatized to some degree of human disturbance or have already left the area. Second, disturbance will be intermittent and generated noise will be of low levels (*i.e.,* human speech and vehicle noise). Third, no rare or at-risk wildlife species were reported as breeding in the Project area. In order to further reduce the severity effects of human disturbance on wildlife, worker presence on-site should be minimized and limited to designated work areas. In addition, all Project-related vehicles will be maintained to minimize noise and no idling will be permitted. In consideration of existing conditions and suggested mitigation no significant adverse effects are predicted on wildlife due to human presence during operation and maintenance.

The operation of the wind turbines may also result in visual and auditory disturbance of wildlife. However, studies in the western United States have shown that there has been no significant effect of the construction and operation of wind farms on big game (Strickland and Erickson 2003), indicating that species are either unaffected by these developments, given their small footprint and the preservation of existing land use, or that they can readily adapt to the presence of wind turbines. At this site, habitat avoidance will most likely occur during periods of construction, and may be more intermittent during periods of operation, when human presence on-site is less frequent and would occur on a short-term basis.

Mortality

Mortality of wildlife has the potential to occur during all phases of Project development. During construction and decommissioning, there is a small chance that small mammals may be harmed as a result of limited site clearing and through the use of heavy equipment for moving materials on and off the Project site. However, additional potential for mortality relates to interactions between operating wind turbines and bats. Bats have been identified as animals with the potential to be affected by wind energy facilities, as measured by numbers of carcasses found during surveys at wind farms in the United States and Canada. The remainder of this section describes the issue of bat mortality at wind farms in more detail, places the issue in the Nova Scotia context and provides background to the assessment.

Bat Turbine Collisions

Given the ability of bats to navigate in darkness, to avoid large obstacles and detect small insects in the air using echolocation, it is interesting that bats would be found to collide with wind turbines and other tall structures. However, this is indeed the case. Bat collision mortality has been identified to occur with a number 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, as discussed below.

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 the United States and at one wind farm in Alberta (Brown and Hamilton 2002, Erickson *et al.* 2002, Johnson *et al.* 2002). Reports prepared by Erickson *et al.* (2002) and Johnson *et al.* (2002) provide excellent summaries of data available from a number of studies in the United States. These summaries show that the majority of bat fatalities at wind farms in the United States occur in late summer and early fall, presumably during southward migration. Of the 536 bat collision fatalities included by Erickson *et al.* (2002), nearly 90% of all the fatalities occurred from mid-July through mid-September, with over 50% in August (Erickson *et al.* 2002), peaking during the first two weeks. Most fatalities were of migratory tree bats with Hoary Bats being by far the most numerous, comprising approximately 61.7% of all fatalities. Additionally, 17.2% of the fatalities were of Eastern Red Bats and 7.1% were Silver-haired Bats. Small numbers of dead Big Brown Bat, Little Brown Bat, and Eastern Pipistrelle were also found during these studies.

Studies appear to support the belief that most fatalities are of bats during fall migration. For example, relatively large populations of bats were documented breeding in close proximity to wind farms at Buffalo Ridge, Minnesota and Foote Creek Rim, Wyoming, yet very few fatalities were recorded during the summer (Erickson *et al.* 2002). The four-year study at Foote Creek Rim determined that the majority of bats were killed in August, with the remaining carcasses found between June and September. Hoary Bats made up approximately 80% of the casualties at this site, with other species consisting of Little Brown Bats, Silver-haired Bats and Big Brown Bats (Johnson *et al.* 2002). Collisions have been reported from turbines located in crop fields, pastures and prairie, away from habitat typically used by foraging bats. Instead, the timing of documented mortality coincides well with the seasonal migration of bats, and most collisions involve these migratory species rather than resident species.

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, very few collision fatalities have been found in the spring at wind farms in the United States. 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).

With the exception of Buffalo Mountain and Mountaineer, studies from wind farms are reporting relatively small numbers of casualties in line with the Klondike study, even taking into consideration carcass removal and searcher efficiency. Table 5.12 summarizes bat fatality data at a number of wind farms in the U.S. Many facilities reported few bat fatalities. As an example, and including factors correcting for carcass removal and searcher efficiency, only 19 bat collisions were recorded at the Klondike Wind Project in Oregon, consisting of 16 turbines, during a one-year study (Johnson *et al.* 2003). The 16 turbines at this open field site are 1.5 MW turbines with a blade sweep approximately 30-100 m above the ground. The six bats actually found at the wind farm were three Hoary Bats that had collided during September, a Silver-haired Bat found in May and two decomposed *Myotis* bats found in June. Based on the estimate of 19 bat collisions at the facility during the year, the average rate of collision is 1.2 bat fatalities per turbine per year (Johnson *et al.* 2003). With the possible exception of Mountaineer (see below), there is no current evidence that suggests populations are affected by wind farm mortality, despite the low population growth rates exhibited by most bats (excluding the Hoary Bat; see Bat Conservation International 2001). 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).

Table 5.12 Estimated Bat Collision Fatality Rates at United States Wind Farms

Wind Resource Area	Bat Mortalities per Turbine per Year	Correction	Reference
Klondike, Oregon (16 - 1.5 MW turbines)	1.2	Adjusted for search biases	Johnson *et al.* 2003
Buffalo Ridge, Minnesota (Phases II & III)	2	Adjusted for search biases	Johnson *et al.* 2003

Table 5.12 Estimated Bat Collision Fatality Rates at United States Wind Farms

Wind Resource Area	Bat Mortalities per Turbine per Year	Correction	Reference
(281 – 750 kW turbines)			
Northeastern Wisconsin (31 – 660 kW turbines)	4.3	-	Howe *et al.* 2002
Foote Creek Rim, Wyoming (72 – 600 kW and 33 – 700 kW turbines)	1.3	Adjusted for search biases	Johnson *et al.* 2000, Young *et al.* 2001, Gruver 2002
Buffalo Mountain, Tennessee (3 – 660 kW turbines)	28.5	-	Nicholson 2003
Vansycle, Oregon (38 – 660 kW turbines)	0.7	Adjusted for search biases	Erickson *et al.* 2000
Lake Benton, Minnesota (354 - 660 kW turbines)	0.1 - 2.0	Adjusted for search biases	Johnson *et al.* 2003
Mountaineer Wind Energy Centre, West Virginia (44 - 1.5 MW turbines)	9.1	-	Lindsay and Kearns 2003
Nine Canyon, Washington (37 - 1.3 MW turbines)	3.2	Adjusted for search biases	Erickson *et al.* 2003

A more recent study proves to be an exception, in that large numbers of bats have been found to collide with wind turbines. At the Mountaineer Wind Energy Centre on Backbone Mountain, West Virginia, approximately 400 bats were found killed by 44 turbines during the first year of its operation (Lindsay and Kearns 2003). Of the 232 that were identified to the species level, most of the bats killed were Eastern Red Bats and Hoary Bats (Lindsay and Kearns 2003). Taking into consideration observer effort and carcass removal by scavengers, researchers have estimated that more than 1000 bats were killed at the site during a six week period (Bat Conservation International 2001). This is the greatest number of bats reported killed at any wind farm. The reasons why so many bats have been killed at the Mountaineer site are poorly understood but may include its siting at a high elevation within the Appalachian Mountains.

Bats are being killed at wind farms, or at least some wind farms, but the factors putting them at risk of colliding with wind turbines are unknown. 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 on 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

Recent research indicates that turbine collisions account for only about half of bat fatalities. A recent study by the University of Calgary reports that barotrauma is the cause of death in a high proportion of bats found at wind energy facilities. 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 causes expansion of air in the lungs not accommodated by exhalation, therefore resulting in lung damage and internal hemorrhaging (Baerwald *et al.* 2008).

Impact Assessment and Mitigation

Pre-construction bat surveys at the proposed Digby Wind Power Project were not undertaken due to the inability to be able to evaluate the significance of the site for bat migration, due to a lack of knowledge of what numbers of bats exist in and migrate through or within Nova Scotia, and the inability to be able to predict impact if site-specific data existed. As indicated in Section 4.4.2.2, there are no known bat hibernaculae in the Project Area. A possible hibernaculum site (abandoned mine shaft) is located approximately 7 km from the Project Area.

SkyPower 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. 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. Typically searches include a 40 m radius around each turbine. Additionally, as a part of the monitoring, searcher efficiency trails will be conducted and may include spring scavenger impact trials if required, to correct for these potential influences on the carcass monitoring. Bat mortality surveys will be conducted in conjunction with bird mortality surveys as required. The results of the post-construction monitoring will be used to assess the success of the mitigation measures in consultation with NSDNR and other biologists, which may lead to other mitigation being suggested using the options available at the time. At this stage, the level of impact is considered **low** and **not significant**. These surveys are discussed further in Section 6.

5.2.1.3 Land Use

As indicated in Section 4.5.4 of this report, the majority of the land required for Project development is forested land which has historically been subjected to forestry activities. The effect of wind turbines on undeveloped lands within the Project area is negligible with only a minor portion of land use required to house turbines and their ancillary equipment. There is also agricultural land (primarily pasture) within the Study Area, although Project infrastructure is not proposed to be sited on these lands. Cattle grazing, which occurs in the southwestern part of the Study Area is not predicted to be affected by Project activities. Experience has shown wind farms to be a compatible land use with agriculture (CanWEA 2001). The U.S. Department of Energy has indicated that wind turbines have minimal effects on farming and ranching operations. They indicate that turbines have a small footprint so crops can grow and livestock can graze right up to the base of the turbine (U.S. Department of Energy 2004). Land use impacts associated with construction and operation of the Project will be negligible since it will not impair or impact current land uses, change land use patterns, or be incompatible with existing uses. The residual impact to existing land use is considered to be **minimal** and **not significant**.

5.2.1.4 Property Values

Prior to 2003, there was a general lack of empirical data assessing the impact of wind energy facilities on the economic value of properties whether within a wind farm or within site of a wind farm. However, Sterzinger *et al.* (2003) undertook such a 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 analysed, 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.

Further assessment of the potential impact of wind farms on property values was conducted by ECONorthwest (2002). For this assessment, interviews were conducted with tax assessors from 13 counties in the United States for which wind farms had been developed during the previous 10 years. Based on these interviews with unbiased and trained assessors of property values, ECONorthwest (2002) concluded that there is no loss of value for those residential properties with views of wind turbines (*i.e.,* views of wind turbines do not negatively impact property values).

A report conducted by the Renewable Energy Policy Project (REPP 2003) concluded that, based on a study of nine different communities from across the United States, property values of homes within a wind farm's viewshed were not harmed by the construction and operation of the wind energy facility. To the contrary, for the majority of the projects analyzed, property values actually rose more quickly in the viewsheds than in comparable communities outside of the viewsheds (REPP 2003). Furthermore, statistical evidence does not support the idea that property values within the viewshed of wind farms suffer or perform poorer than in comparable regions (REPP 2003). This statistical analysis is supported by a literature review conducted as part of the REPP (2003) study.

The Environmental Review Report for the Wolfe Island Wind Project near Kingston, Ontario (CREC 2007) also includes a comprehensive review of literature on property value studies conducted in Australia, Denmark, United Kingdom, the United States, and Canada. These studies consistently reported a neutral or positive effect on property values (CREC 2007).

The proposed Digby Wind Power Project is located in a rural setting, and is surrounded by a mix of forested and agricultural lands 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 conceivable that the value of specific properties could even rise as a result of an increase in the potential for tourist related commercial activities in this area. It is predicted that impacts on property values as a result of the wind farm are likely to be negligible.

5.2.1.5 Visual Impacts

Due to the importance of assessing the potential impact to the area's visual aesthetics, a visual impact assessment was completed. The following section summarizes the visual assessment with respect to the photo montage analysis and shadow flicker analysis that were conducted.

Viewsheds

Jacques Whitford Stantec Limited 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. It is a graphical representation of what the constructed wind farm could potentially look like upon completion from a particular vantage point. Figure 5.1 shows the viewing locations selected for the assessment (*i.e.,* location from which photographs were taken) and Figures 5.2-5.9 show the simulated results.

The turbines are designed to rotate and be oriented in rows facing the prevailing wind direction at any given time. The towers themselves 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 base of the tower is approximately 4.6 m across, while the height of the turbine towers will be approximately 80 m, with rotor blades that are approximately 38.5 m long.

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Figure 5.1

DIGBY WIND POWER PROJECT

Photo Montage Viewpoint Locations

Photo Montage
- Viewpoint Location
- View Direction

Project Components
- Proposed Turbine Location
- Proposed 69 kV Substation
- Proposed Turbine Access Road
- Proposed Transmission Route Nov. 28-08
- Proposed Site Development Area

Map Features
- Building
- Road
- Unpaved Road
- Railroad
- Contour (5m)
- Watercourse
- Wetland (NSTD)
- Waterbody
- Property Boundary

0 300 600 900 1,200

Meters

Data Sources:
Planimetric Data - NSGC; Nova Scotia Topographic Database (NSTDB), 1997, 1:10 000 (GeoNOVA)
Project Components - Skypower, Nov. 2008
Wetlands - NSTDB & NSDNR; Wetland Inventory Mapping, 2007, 1:10 000

Map Parameters
Projection: UTM/NAD83/Z20
Scale 1:22,000
Date: April 2009
Project No.: 1030972.01

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Figure 5.2

View from Viewpoint 1 Looking West

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Figure 5.3

View from Viewpoint 2 Looking North

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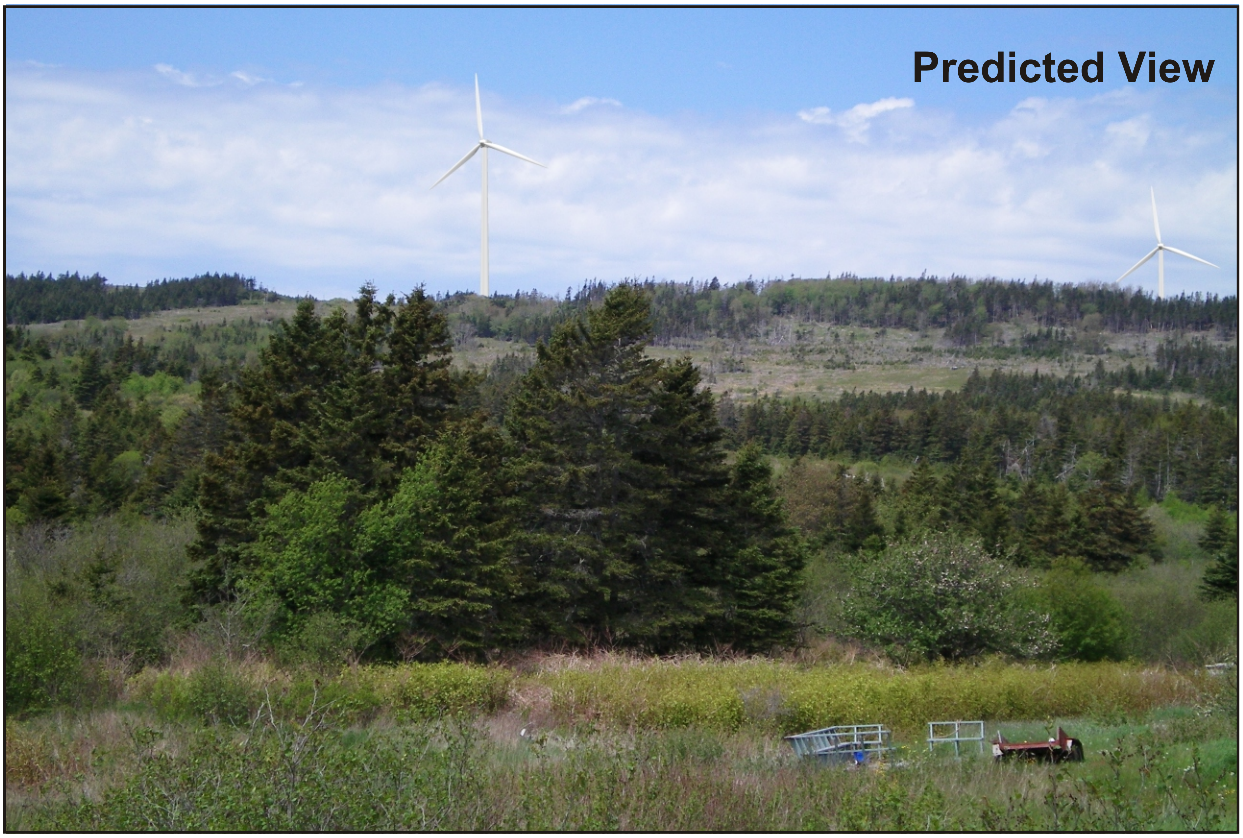

Figure 5.4

View from Viewpoint 3 Looking North West

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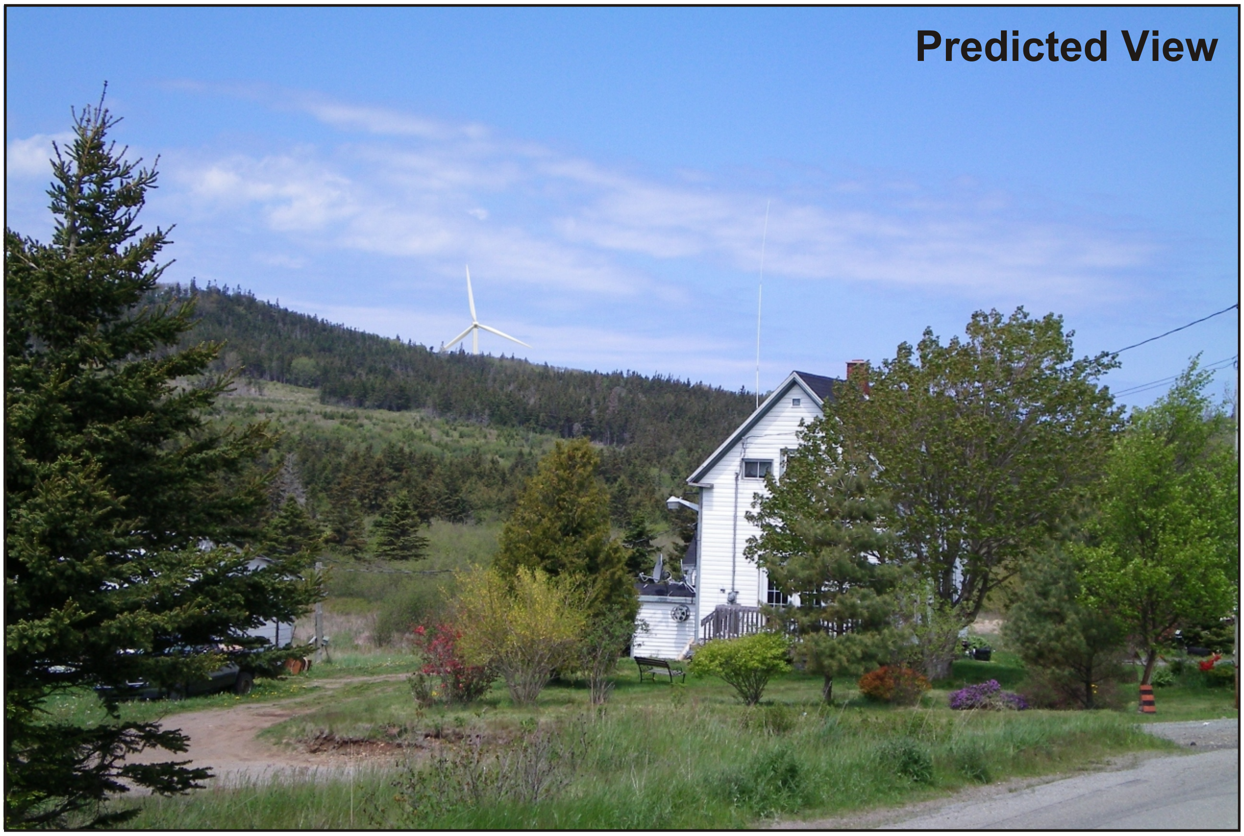

Figure 5.5

View from Viewpoint 4 Looking North West

Digby Wind Power Project

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