4.0 ENVIRONMENTAL CHARACTERISTICS

The general and specific environmental characteristics of the Project and local areas are described in this section, such as the existing biophysical characteristics and socio-economic conditions.

4.1 Geophysical Environment

The following sections outline the geophysical environment of the Project area including the physiography and topography, soil quality, geology, seismicity, and hydrogeology of the area.

4.1.1 Physiography and Topography

The Project is located in the physiographic region known as the Cumberland Plain which occupies the northern three quarters of Cumberland County, Nova Scotia. The shoreline portion of the Cumberland Plain is characterized by large tracts of salt marsh, much of which has been reclaimed by means of dykes. The salt marshes and dykeland grade into larger freshwater bogs north of Amherst (Nowland and MacDougall 1973). Topographical relief in the Project area is relatively flat with elevations generally between 5 and 10 metres above sea level (Service New Brunswick 2006).

4.1.2 Surficial Geology and Soils

Surficial geology in the Project area consists of Holocene aged marine deposits consisting of greater than 2 m of 'mud' containing fine sand, silt and clay that may be locally overlain by peat and organics in salt marshes. This deposition is related to increased tidal activity commencing approximately 6,300 years before present (Stea and Finck 1988 and Stea *et al.* 1986).

Soils in the Project area are classified as Acadia Complex. The soils can generally be described as dark brown to dark reddish brown silt loam to silty clay loam over mottled reddish brown silty clay loam. These soils mainly consist of material reworked from the underlying Holocene marine deposits. Drainage is described as imperfect to poor (Nowland and MacDougall 1973).

4.1.3 Bedrock Geology

The bedrock geology in the vicinity of the Project is fairly simple, and consists of sedimentary bedrock of the Balfron Formation of the Pictou Group. The Late Carboniferous aged Balfron Formation dips to the north at approximately 10 degrees and in the Project area it is approximately 400 m to 500 m thick. The Balfron Formation is comprised of red-brown sandstone, mudrock, minor pebbly sandstone, calcareous mud-chip conglomerate, minor grey beds and rare thin discontinuous limestone beds. Many of the sandstone beds in this formation are up to 40 m thick and form sheet-like bodies with a lateral extent of up to several kilometers (Ryan *et al*. 1990).

4.1.4 Seismicity

Eastern Canada is located in a relatively tectonically stable region of the North American Plate. However, earthquakes can, and do, occasionally occur in Eastern Canada, although the causes of these earthquakes are not well understood. On average, Eastern Canada undergoes approximately

450 detectable earthquakes annually, of which approximately four will exceed a magnitude of 4 on the Richter scale. In a decade, Eastern Canada will receive approximately 3 events greater than magnitude 5. While a magnitude 3 earthquake is strong enough to be felt in the immediate area, a magnitude 5 earthquake is generally the threshold for potential damage to structures (Natural Resources Canada 2006).

The Project is located near the Nova Scotia and New Brunswick border in the North Appalachians Seismic Zone, which includes parts of southern and western Nova Scotia, most of New Brunswick and extends into New England down to Boston. Historically, this zone has experienced earthquakes with epicenters of intensities greater than magnitude 5. For example, the largest earthquake to affect the Maritime Provinces since 1929 occurred in an un-populated region of the Miramichi watershed, north of Highway 108 and about midway between New Castle and Plaster Rock, New Brunswick. That earthquake was a magnitude 5.7, with aftershocks measured at up to magnitude 5.1. This earthquake occurred in an unpopulated area, so damage was only very slight (*e.g.*, a few hairline cracks) but no structural damage in buildings up to 100 km away from the epicenter (Natural Resources Canada 2006). If this earthquake had occurred closer to a developed area, more damage would have likely occurred. Preliminary geotechnical investigations did not show any predilection towards earthquakes at the Amherst site. More detailed results on this aspect will be included within the final geotechnical report. If base acceleration is found to have a large influence on turbine structure, then specific studies will be required for earthquake design, and appropriate design mitigation will be incorporated.

4.1.5 Hydrogeology/Groundwater

Water supplies within approximately 1.5 kilometers of the Project are generally derived from individually drilled or dug wells. The Town of Amherst derive their water from the North Tyndal Well Field, which is located in the same aquifer as the Project, and is situated approximately 15 km northeast of the Town. According to the Nova Scotia Well Log Database of logs for wells constructed between 1940 and 2004, wells within approximately 1.5 kilometers of the Project are generally installed in sandstone, shale and claystone bedrock, and the majority of wells are for individual residential potable use. A summary of the pertinent well properties included in these logs is presented in Table 4-1.

Table 4-1 Summary of Water Wells Records Within Approximately 1.5 km of Project

	Well Depth (m)	Casing Length (m)	Estimated Yield (L/min)	Water Level (m)	Overburden Thickness (m)
Minimum	15.2	5.8	7.6	Flowing	2.4
Maximum	123.4	19.8	757	23.5	18.6
Average	42.4	10.1	91.1	8.5	6.7
Median	38.1	8.5	37.8	9.1	6.1
Number	32	31	32	23	32

Groundwater wells constructed in the Balfron Formation of the Pictou Group can be expected to produce good water quality with most parameters meeting the Health Canada Guidelines of Canadian Drinking Water Quality (Health Canada 2006). However, some wells may experience iron and/or manganese concentrations elevated above the Health Canada aesthetic objective guideline especially shallow dug or drilled wells constructed in the marshland areas.

Preliminary geotechnical site work suggests three different types of foundations maybe used: i) gravity base (*i.e.,* slab on grade), ii) pipe or H-piles and iii) Frankie piles. It is not currently known which type of foundation will be required for each turbine; additional site geotechnical investigations will be required to establish specific foundation designs.

As indicated in Figure 2-1, the closest home/well is approximately 0.7 km to the northwest, along the southwestern end of Fort Lawrence Road. This well is approximately 10 m topographically above the site (*i.e.,* up-gradient of Turbines 19 and 20). Along the southern edge of the site, the closest homes/businesses would be about 0.9 km and at approximately the same elevation (*i.e.,* side-gradient of Turbine 4), along Highway 6. Static water levels for wells within 1.5 km of the site were previously identified (Table 4-1) as approximately 8.5 m below grade (mbg).

The North Tyndall Well Field wells are approximately 15 km northeast of the site and not 1.5 km, as NSEnv's comments on the draft EA document suggested. These wells are at elevation approximately 30 m, about 20 above the site; originally static water levels for these wells were about 7 mbg. JW was responsible for identification, drilling and testing of the North Tyndall Well Field Wells. At a distance of 15 km and such a slight topographic elevation difference (*i.e.,* about 20 m), up- and down-gradient positions are not really relevant, nevertheless, the well field is upgradient of the site.

Road construction/modification, parking lot and culvert installation, as well as interconnection from turbine to substation, are anticipated to be within the upper 3 m of the ground surface. Site geotechnical work to-date indicates that bedrock is much deeper (*i.e.,* 10 mbg). These activities are expected to have no impact on local water supply wells within 1.5 km of the site and will have no impact on wells within the North Tyndall Well Field. The gravity base foundations are expected to be shallow (*i.e.,* 0 - 5 mbg) and are also expected to have no impact on either the local water supply wells, and will also have no impact on the Tyndall Well Field wells.

Presently, it is expected that the site foundation piles will extend 5–20 m into bedrock and be approximately 15-30 mbg. These piles will have no affect on the Town of Amherst water supply wells within the North Tyndall Well Field, given the approximate 15 km distance between the site and those wells.

It is considered very unlikely that site pile driving activities would affect the aforementioned local wells closest to the site (*i.e.,* to the northwest – southern end of Fort Lawrence Road, and to the southeast – along Victoria Road). This is based upon the following: 1) the northward dipping nature of the site geologic units; 2) the distance between the potentially closest wells and turbine(s); and 3) the nature of the pile installation process (*i.e.,* unlike blasting in rock, the affects of pipe driving provide minimal sub-surface disturbance). Northeast of the LaPlanche River (*e.g.,* along Highway 2), the River is considered to represent a local groundwater divide and no affects are considered likely from site activities, including pile driving.

Well location and construction details would be important factors in evaluating risk of potential impacts from foundation activities. Until additional site geotechnical work is completed, it is not known which turbines will require what type of foundation. Following completion of the specific site foundation designs, the need for a well survey of homes adjacent to the site will be evaluated.

4.2 Aquatic Environment

The following section describes the aquatic environment on site including the aquatic habitats, fauna, vegetation, surface hydrology, surface water quality and sediment quality.

4.2.1 Aquatic Habitats

The LaPlanche River runs through the Project site. On October 18, 2005, two Jacques Whitford biologists conducted a field survey of the LaPlanche River and its tributaries to assess their general health and categorization as potential for fish habitat. Identification and preliminary evaluations of LaPlanche River and its tributaries were based on 1:10000 mapping and air photos. Assessment of aquatic habitat consisted of identifying physical units (*i.e.,* riffles, pools, and runs), instream cover, substrate composition, stream depth and width, overhead cover, water colouration, and presence of fish. Combinations of stream flow, water depth, and substrate are major determinants of the quality of fish habitat for rearing and spawning. Three minnow traps were set to assess the fish population, if any, in the LaPlanche River. Photographs were taken along the stream to document habitat (see Appendix B).

Much of the discussion of fish habitat in Nova Scotia is focused on trout and salmon, which belong to the Salmonid family. A categorical system for rating salmonid habitat is commonly employed when assessing streams based on substrate, water flow, and stream morphology. LaPlanche River, however, has been modified over the last few hundred years to a degree that the River may be considered separate from the Bay of Fundy. An aboiteau structure has been present for a considerable amount of time. Gaspereau are known to run up the River in April and May. Eels are also known to occur (pers. comm. Craig Hominick 2007). LaPlanche River has also been modified by the activities of the nearby Town of Amherst. Sewage disposal occurred via paths that led directly into the River. In 2002, a plan to divert sewage from the River was released. Water and soil contamination is a likely event that would have altered the health of the River for fish populations. The habitat assessment therefore was performed to evaluate the biophysical characteristics of LaPlanche River for general fish habitat in lieu of the bias towards salmonid species.

The morphology of LaPlanche River was found to be uniform and fairly homogenous. Left and right bank vegetation consisted primarily of grasses, cattails, rushes, and sedges that often weaved and were difficult to pass through. Bottom substrate was difficult to determine since the water colour was brown. Bank bottom substrate was muddy with organic debris, which may imply the River bottom substrate was similar. Under the bridge, the bottom substrate was easier to determine and appeared to be a mix of mud and clay. Water movement ranged from flat to fast with intermittent slow moving areas. Channel width heading upstream (from the bridge crossing with Highway 104) varied from 7.5 m with a wet channel width of 7.5 m, to 13 m with a wet channel width of 9 m. Average bank slope ranged from 10^{o} to 50^{o} and there was little to no bank undercutting. The sod farm was on average 4 m away from the water's edge.

At 977 m from the bridge, a tributary from the east side of the River and heading north was observed with white foamy water pooling adjacent to a long old wooden culvert (Photos 3 and 4 in Appendix B). A tributary was also observed on the left side (Photo 2 in Appendix B) of the River with similar morphology. The tributaries further upstream were also noted to have similar morphology to the rest of LaPlanche River (Photos 7 and 8 in Appendix B). Heading downstream from the bridge, average channel width extends to 20 m with a wet channel width of 19 m. Several drainage ditches were

observed perpendicular to the River and draining directly into LaPlanche. LaPlanche River ended at the aboiteau (Photo 5 in Appendix B) with no evidence of groundwater mixing with the mouth towards the Bay of Fundy (Photo 6 in Appendix B). Fish were not caught in the three minnow traps set to determine the presence of any minnow populations in the River.

A new aboiteau structure is planned to be operational in May 2008. This structure has larger gates and is expected to improve fish passage in the LaPlanche River.

A meeting was held with DFO and NSEnv in December 2007 to discuss existing conditions at the site, the planned aboiteau changes and the proposed installation of a culvert as part of the Project. DFO indicated that due to very site specific circumstances, the culvert is not likely to trigger a Harmful Alteration, Destruction, or Distribution" (HADD) authorization as defined by the federal *Fisheries Act*. Additional culvert design and installation details are provided in Appendix B. This includes installation of the culvert in the dry between mid-July and September when there is the least potential to encounter a fish run.

Flow monitoring was attempted in the river, however due to unsafe conditions in the river for field personnel (*i.e.,* very soft unconsolidated bottom sediments), attempts to access the river were abandoned. Flow modelling is being undertaken to confirm assumptions regarding the river and watershed characteristics utilized in the design of the culvert. Should the model determine that larger flows than assumed are possible; the culvert size will be modified to ensure it can handle maximum predicted flows in the river.

It is understood that culvert installation requires an authorization under the *Navigable Waters Protection Act*. The Proponent is presently in the process of completing necessary requirements to obtain the authorization and associated sign-off on a *CEAA* screening dealing specifically with the culvert installation.

Review of the DFO policy and conservation management guidelines for the protection of fish habitat (DFO 1998) indicates that the remaining structures and components proposed for the Project are not considered to have the potential to trigger a HADD authorization as defined by the federal *Fisheries Act*. Nevertheless, during the Project's construction phase, mitigation measures to reduce soil erosion and downstream sediment transport are proposed to ensure the general protection of LaPlanche River, its tributaries and the drainage systems in the vicinity of the proposed Project.

4.3 Terrestrial Environment

The terrestrial environment section details the flora and fauna, including any species of special conservation concern, which may be present within the Project area.

4.3.1 Flora

4.3.1.1 Rare Plants and Species Richness

Rare plants and floral species richness in the Project area was described using a combination of desk-top and field surveys. Prior to conducting field surveys, aerial photography of the site was reviewed to determine the types and distribution of various habitats within the Project area. The air photo interpretation exercise was used to assist in a rare plant modeling exercise.

The rare plant modeling exercise was performed to determine the likelihood of presence of rare or sensitive plants within the Project area. As part of the modelling exercise, all records of vascular plant species listed by the Nova Scotia Department of Natural Resources (NSDNR) as at risk (Red listed) or sensitive to human activities or natural events (Yellow listed) (NSDNR 2007) within a radius of 100 km were compiled by means of an Atlantic Canada Conservation Data Center (ACCDC) data search. The habitat requirements of these species were compared to the habitat descriptions compiled for the Project area to determine if suitable habitat was present for these species. In instances where appropriate habitat was present for a particular species, that species was considered to be potentially present and the suitable habitat in the Project area was identified as a target for field surveys. The phenology and ease of identification of each of the species potentially present in the Project area was also incorporated into the model in order to determine the best times to conduct the field surveys.

A total of 158 Red or Yellow-listed vascular plant species have been recorded within 100 km of the Project area. Based on the results of the habitat model, only four Red or Yellow-listed species could potentially be present in the Project area. Table 4-2 lists these species and the habitats present in the Project area where they could potentially be found.

A vegetation survey was conducted by an experienced Jacques Whitford botanist on October 18, 2005. All species of vascular plants encountered during the surveys were identified and their population status in Nova Scotia was determined through a review of the species status reports prepared by NSDNR, ACCDC, and COSEWIC. A list of the 83 vascular plant species found on the site is presented in Appendix C.

Two species, Common Yarrow (Achillea millefolium) and Spotted Water-Hemlock (Cicuta maculata) found during the field survey are considered to be of Special Concern by COSEWIC. However, these vascular plant species noted during the survey are not considered rare in Nova Scotia (*i.e.,* listed as S5 or secure by ACCDC and Green or not at risk by NSDNR), nor would any rare species likely be present in this area, especially in areas likely to be affected by wind farm development.

The Project area is largely sod farm, displaying a recently disturbed, weedy fallow field, and frequently cleared drainage ditches. Any habitat with any possibility of some of the rare plant species remotely possible for this site would occur in the salt marsh habitat beyond the dykes that fringe the LaPlanche River, in a deep aboiteau ditch slough along the north east sector of the Project area, and in the moist, old field habitat east of the access road off the south end of the sod farm area outside the turbine array.

Table 4-2 Rare and Sensitive Vascular Plant Species Potentially Present in the Project Area

Scientific Name	Common Name	Habitat	Season	Likely on Site?	ACCDC Rank	NSDNR Rank	COSEWIC RANK
Suaeda rolandii	Roland's Sea-Blite	Salt marshes and saline shores.	September	Possible	S1?	Red	Not Listed
Alopecurus aequalis	Short-Awn Foxtail	Muddy margins of rivers and shallow ponds, and gravel margins where competitor species are few.	Summer	Possible	S2S3	Yellow	Not Listed

Table 4-2 Rare and Sensitive Vascular Plant Species Potentially Present in the Project Area

Scientific Name	Common Name	Habitat	Season	Likely on Site?	ACCDC Rank	NSDNR Rank	COSEWIC RANK
Bidens connata	Purple-Stem Swamp Beggar-Ticks	Boggy swales, and the borders of ponds, thickets and in ditches behind brackish shores.	August and September, can be identified when not in flower.	Possible	S3?	Yellow	Not Listed
Eleocharis ovata	Ovate Spikerush	Muddy shores and ditches.	Flowers/Fruit May to October	Possible	S2?	Yellow	Not Listed

Likely on Site Key:
No= No suitable habitat, likelihood of occurrence negligible

Unlikely= Unlikely to occur on site and if present would be in areas peripheral to turbine sites not likely to be affected by their emplacement with suitable erosion control measures during installation

Possible= These species could have some potential to be present but were not noted and would only be expected from the salt marshes beyond the dykes or in a small deep slough along the east side of the Project area or in the peripheral oldfield and moist meadow areas to the south of the Project area.

Key to species rankings:
ACCDC Ranking
S1: Extremely rare. S2: Rare. S3: Uncommon. S4: fairly common. S5: Secure. S#S#: A range between two consecutive numeric ranks. Denotes range of uncertainty about the exact rarity of the element (e.g., S1S2). B: Breeding. SH: Historical and suspected to be still extant. SU: Unrankable: Possibly in peril throughout its range in the province, but status uncertain; need more information. SX: Extinct/Extirpated: Element is believed to be extirpated within the province. S?:Unranked: Element is not yet ranked. SZ: Zero occurrences: Not of practical conservation concern in the province, because there are no definable occurrences, although the species is native and appears regularly. NZ: Long distance migrants whose occurrences during their migrations are too irregular (in terms of repeated visitation to the same locations) or transitory.

NSDNR Ranking
Red: Known to be or thought to be at risk. Yellow: Sensitive to human activities or natural events. Green: Not believed to be sensitive, or at risk. Not Assessed: Known or believed to be present in Nova Scotia but yet unassessed. Undetermined: Insufficient data exists to determine status. Exotic: Introduced as a result of human activity.

COSEWIC Ranking
Endangered: Species facing imminent extirpation or extinction. Threatened: Species likely to become endangered if limiting factors are not reversed. Special Concern: Species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats. Data Deficient: A category that applies when the available information is insufficient to resolve a wildlife species' eligibility for assessment or to permit an assessment of the wildlife species' risk of extinction. Not at Risk: Species that has been evaluated and found to be not at risk of extinction given the current circumstances.

Atlantic Canada Conservation Data Centre Species Rank Definitions	
S1	Extremely rare throughout its range in the province (typically 5 or fewer occurrences or very few remaining individuals). May be especially vulnerable to extirpation.
S2	Rare throughout its range in the province (6 to 20 occurrences or few remaining individuals). May be vulnerable to extirpation due to rarity or other factors.
S3	Uncommon throughout its range in the province, or found only in a restricted range, even if abundant at some locations. (21 to 100 occurrences).
S#S#	Numeric range rank: A range between two consecutive numeric ranks. Denotes uncertainty about the exact rarity of the species (*e.g.*, S1S2)
S#?	Inexact or uncertain ranking.
Nova Scotia Department of Natural Resources General Status Ranks	
Red	Known to be or thought to be at risk.
Yellow	Sensitive to human activities or natural events.

Source: ACCDC 2007; NSDNR 2007

4.3.1.2 Habitats

The Project area is largely sod farm, displaying a recently disturbed, weedy fallow field, and frequently cleared drainage ditches. Sites on the dyke lands both west and east of Highway 104 south of the LaPlanche River, and east of John Lusby Marsh were examined on October 18, 2005 by an experienced Jacques Whitford botanist. These sites were based on preliminary mapping for proposed wind turbine, access roads and substation positions. The sites were assessed for potential to host any rare vascular plant species or for natural or modified wetland conditions.

Once part of a lowland salt marsh complex associated with the LaPlanche River, the area has long been converted via a dyke and drainage ditch system that restricts the tidal influence of the river and drains the fields, to agricultural land, presently dominated by sod farms. The area is primarily sod farm with some patches of hay or forage crop, and relatively few areas of recent very weedy fallow areas and older old field vegetation dominated fallow areas. Of the approximately 83 species of vascular species noted from the area, cultivated and otherwise exotic species predominate in both coverage and make up near half of the species (Table C-1 in Appendix C). This is especially true inside the dykes away from the saltmarsh habitat. Native plant species within the dykelands outside the salt marsh habitat occur primarily in and along drainage ditches and larger sloughs, along less mowed portions of the dykes and along areas off access road/track and in older fallow field situations. Tree class vegetation is not present in the study site and small trees and shrub class vegetation, including young tree species are uncommon.

As noted above, none of the vascular plant species noted during the survey are considered rare in Nova Scotia nor would any rare species likely be present in this area, especially in areas likely to be affected by wind farm development.

Natural wetland habitats are restricted to the areas along the river beyond the dyke and are primarily estuarine salt marsh. This salt marsh is generally thickly vegetated by herbaceous species, with some pools and open muddy patches. The marsh vegetation is dominated by characteristic flora such as freshwater cordgrass (*Spartina pectinata*), seaside goldenrod (*Solidago siempervirens*) and American alkali grass (*Puccinelia maritima*) in the higher areas influenced by tide and by species like salt-meadow cordgrass (*Spartina patens*) and sea lavender (*Limonium carolinianum*). Saltwater cordgrass (*Spartina alterniflora*) dominates the area lower down, before the mud of the deeper intertidal zone.

Within the dyke land agricultural area, natural wetlands are mostly absent although areas of upland drainage along the margin of the upland slope where it abuts the flat of the dyke land may have some moist meadow patches in the fallow old field like habitats present along the interface.

Wetland-like habitats are present in some of the numerous drainage ditches that lace the sod farm area. While some of these host wetland associated species such as (*S. pectinata*), broad leaf cattail (*Typha latifolia*) and even turtlehead (*Chelone glabra*) and watercress (*Rorippa nasturtium-aquaticm*), these ditches are both anthropogenic in nature and there is evidence that they are periodically grubbed out to maintain their drainage capability. This ongoing disturbance regime both lessens the likelihood of many rare species being present and at the same time suggests any that could be, would be able to persist with such levels of disturbance. Larger drainage ditches become more slough like and host a greater diversity of wetland species. A basin like depression, only somewhat tidally influenced, below a one way valve ditch culvert, constitutes the largest true wetland within the Project site, albeit either created or modified by man. This large slough basin is near some proposed wind turbine locations.

Since the turbines will be located outside of the wetland, and erosion control practices would be followed during their construction, no impacts to this wetland are predicted.

4.3.2 Fauna

The Project site supports animals that are typical of agricultural areas in Nova Scotia. Further details on the fauna of the Project area, including information on the birds, mammals, reptiles and amphibians, are presented below.

4.3.2.1 Birds

Overview

Nova Scotia provides habitat for a species rich array of avian fauna. Influenced by distribution and habitat requirements, seasonality, and geography, the assemblage of avian species in Nova Scotia includes a variety of migratory, resident and vagrant species. Resident species and many migratory birds breed in the province. Nova Scotia's two main life zones of warmer deciduous forests and cooler coniferous forests offer a good variety of stand habitat that complements the province's other groupings of habitat including agricultural lands, freshwater wetlands, coastlines, and marine areas. This complex of habitat types results in an number of forest and edge-habitat birds, birds of prey, waterfowl, open-habitat birds, and freshwater wetland birds being found in the province (Davis and Browne 1996).

The Project area is characterized by several habitat types which are used by birds. These habitats include intensively managed agricultural lands, small patches of non-agricultural grass and shrubs, as well as tidal and non-tidal reaches of the LaPlanche River and associated salt marsh and riparian zones. The habitat of the Project area has been dramatically influenced by human activities. Most notably, the agricultural lands of the Project area are dyked and drained salt marsh. Other infrastructure in the Project area includes the Trans Canada Highway, CN railroad and a major powerline. This historic and ongoing human disturbance continues to affect the habitat types available in the Project area and thus the spectra of species associated.

Information on the distribution and abundance of birds in the Project area was derived from field surveys, publicly available documents and other sources. The methodologies and results of desktop and field studies conducted in support of the Project are described in the following sections.

Desktop Studies

Desktop studies were conducted to evaluate bird species richness and the relative importance of the Project area as bird habitat, particularly for breeding and at-risk species. An important source of information is the Maritimes Breeding Bird Atlas (MBBA) database (Erskine 1992), which contains a summary of bird distribution and abundance across the Maritime Provinces of Canada. However, the breeding bird atlas data is of limited use because that data is recorded in 10 km X 10 km census squares, making it impossible to establish whether a particular species has been observed in close proximity to the Project area. Nevertheless, the MBBA data was used to provide a general inventory of breeding birds in the vicinity of the Project area. The MBBA also provides a list of bird species of special conservation concern which may be present in the Project area, which helps to focus field surveys. The Project area falls within one breeding bird square.

A total of 127 bird species have been recorded in the MBBA square that overlaps the Project area. Table D-1 in Appendix D contains a list of these species, their NSDNR Rankings, breeding status and whether they were also recorded during field surveys. Breeding status is designated as possible, probable or confirmed. According to MBBA data, species observed or heard singing in suitable nesting habitat are classified as possible breeders. Species exhibiting the following behaviours are classed as probable breeders:

- courtship behaviour between a male and female;
- birds visiting a probable nest site;
- birds displaying agitated behaviour; and
- male and female observed together in suitable nesting habitat.

Species are confirmed as breeding if any of the following items or activities were observed:

- nest building or adults carrying nesting material;
- distraction display or injury feigning;
- recently fledged young;
- occupied nest located; and
- adult observed carrying food or fecal sac for young.

A review of the ACCDC database was conducted to obtain a list of provincially rare or sensitive bird species found within a 100 km radius of the Project area. ACCDC provides information on species and ecological communities that require consideration for their conservation (ACCDC 2007). The ACCDC listing and ranking system is useful since it provides a georeferenced outlook on rare or sensitive species and habitats. The ACCDC list, however, is generated on a radius that is considered to be in excess of the ecological footprint of the Project. A model was therefore employed by Jacques Whitford to determine the likelihood of the presence of the ACCDC ranked bird species within the Project area. Likelihood of presence was determined by crosschecking the habitat requirements of the ACCDC listed species with the habitat description within the footprint of the Project. Table 4-3 presents the results of the ACCDC search and related modelling exercise.

Table 4-3 Birds of Conservation Concern Potentially Breeding in the Project Area

Common Name	Scientific Name	Habitat	Likely on site?	ACCDC Ranking	NSDNR Ranking	COSEWIC
Asio flammeus	Short-eared Owl	Nests on the ground in open country. An open hayfield is often chosen as a nest site.	Possible	S1S2B	Yellow	Special Concern
Asio otus	Long-eared Owl	Various woodland habitats as well as open habitats.	Possible	S1S2	Yellow	-
Dolichonyx oryzivorus	Bobolink	Fields with dense grass cover, particularly hay fields.	Possible	S3B	Yellow	-
Progne subis	Purple Martin	Open woodlands, residential areas, and agricultural land.	Unlikely-Possible	S1S2B	Red	-
Bucephala islandica	Barrow's Goldeneye (Eastern population)	Mountain streams, large rivers.	No	S1N	Yellow	Special Concern

Table 4-3 Birds of Conservation Concern Potentially Breeding in the Project Area

Common Name	Scientific Name	Habitat	Likely on site?	ACCDC Ranking	NSDNR Ranking	COSEWIC
Charadrius melodus	Piping Plover	Coastal sand and gravel beaches.	No-Unlikely	S1B	Red	Endangered
Falco peregrinus anatum	American Peregrine Falcon	Almost any habitat type that provides hunting opportunities. For nesting, prefer habitats with cliffs.	Unlikely	S1B	Red	-
Accipiter gentilis	Northern Goshawk	Mature coniferous and mixedwood forest generally remote from human habitation.	Unlikely	S3B	Yellow	Not at Risk
Euphagus carolinus	Rusty Blackbird	Breeds in wet forests, including areas with fens, bogs, muskeg, and beaver ponds.	Unlikely	S3S4B	Yellow	Special Concern
Pooecetes gramineus	Vesper Sparrow	Areas of low grass or shrubs such as pastures, blueberry fields and clearings. Most frequently found in blueberry fields in Nova Scotia.	Unlikely	S2S3B	Yellow	-
Sialia sialis	Eastern Bluebird	Open woodlands, clearings, farmlands, parks, orchards, gardens, fields, along roadsides on utility wires and fences.	Unlikely	S2S3B	Yellow	-
Sterna hirundo	Common Tern	Coastal and freshwater islands, coastal beaches and salt marshes.	Unlikely	S3B	Yellow	Not at Risk

Key to Likely on site column:
NO= No habitat or breeding habitat on site. If ever found it would be a human translocation.

P= Possible.

NO-U= No good habitat and highly unlikely to pass through the area except as vagrant or in passage.

U= Unlikely, no breeding habitat or even especially good foraging or living habitat on site. In the case of bird or bat species almost any species might at some point fly through the area even if this was not on a characteristic flyway. Some like Perigrine Falcons could appear in the area and forage however briefly.

U-P= Unlikely but possible.

Key to species rankings:
ACCDC Ranking
S1: Extremely rare. S2: Rare. S3: Uncommon. S4: fairly common. S5: Secure. S#S#: A range between two consecutive numeric ranks. Denotes range of uncertainty about the exact rarity of the element (e.g., S1S2). B: Breeding. SH: Historical and suspected to be still extant. SU: Unrankable: Possibly in peril throughout its range in the province, but status uncertain; need more information. SX: Extinct/Extirpated: Element is believed to be extirpated within the province. S?:Unranked: Element is not yet ranked. SZ: Zero occurrences: Not of practical conservation concern in the province, because there are no definable occurrences, although the species is native and appears regularly. NZ: Long distance migrants whose occurrences during their migrations are too irregular (in terms of repeated visitation to the same locations) or transitory.

NSDNR Ranking
Red: Known to be or thought to be at risk. Yellow: Sensitive to human activities or natural events. Green: Not believed to be sensitive, or at risk. Not Assessed: Known or believed to be present in Nova Scotia but yet unassessed. Undetermined: Insufficient data exists to determine status. Exotic: Introduced as a result of human activity.

COSEWIC Ranking
Endangered: Species facing imminent extirpation or extinction. Threatened: Species likely to become endangered if limiting factors are not reversed. Special Concern: Species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats. Data Deficient: A category that applies when the available information is insufficient to resolve a wildlife species' eligibility for assessment or to permit an assessment of the wildlife species' risk of extinction. Not at Risk: Species that has been evaluated and found to be not at risk of extinction given the current circumstances.

The model identifies four species of conservation concern that could be present within the Project area, namely: Short-eared Owl (*Asio flammeus*), Long-eared Owl (*Asio otus*), Bobolink (*Dolichonyx oryzivorus*) and Purple Martin (*Progne subis*). In the case of the Short-eared and Long-eared Owls, some possibility of dispersed individuals foraging in the area exists and there could be breeding habitat potential in the general area. For Bobolinks, some suitable nesting habitat occurs near the south end of the Project area (though not within the turbine array and the areas are generally extensions of suitable habitat from nearby areas). Although Purple Martins have nested historically near the area in manmade multi-chambered nest boxes, unless there was an active colony nearby the site the risk to them from active wind turbines would be expected to be no more than for any general bird species that might move through the area.

Field Studies

Overview

The site was monitored by a qualified ornithologist, Mr. John Wile, from January 21, 2005 to January 18, 2006. The surveys generally followed a protocol (see Appendix D) developed in consultation with Mr. Dan Busby of the Canadian Wildlife Service (CWS), with input from Ducks Unlimited Canada. The purpose of the surveys was to obtain pre-construction data on bird activity within the proposed Project area.

A variety of field techniques were used to catalogue the bird species present and/or breeding in the Project area and assess relative abundance. Data collection methods followed during the field surveys are stipulated by the guiding document, Baseline Information Requirements for Evaluation and Effects of Wind Power Facilities on Migratory Birds in Atlantic Canada (CWS undated). In early January 2005, the Proponent and Environment Canada (CWS) met to discuss the Project and develop a bird monitoring protocol for the site. The current Environment Canada guidelines for wind energy projects as they relate to birds were not available at this time. However, consultation was recently made with 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), and the guideline applied to this situation. A stand-alone report that delineates bird survey methodology, results and interpretations is included in Appendix D. The following text summarizes this report for the purposes of the assessment.

The original protocol called for three hour ground surveys each week during winter and more intense six hour per week surveys during migration peaks. Originally, the plan was to conduct the three hour surveys in short blocks of time during the morning, mid and late day period. However, for practical reasons, the surveys were done, for the most part, in a continuous three hour time frame. Although some surveys were conducted both during the early morning and late evening, late morning or early afternoon surveys were just as productive. The tide cycle seemed to be an important factor affecting birds of the Project area, with an incoming tide or a high tide resulting in more bird activity.

Due to the seasonal difficulty in traveling through the area, transects or fixed observation stations were not used. While the survey route and observation points varied throughout the seasons, each survey did cover the majority of the Project area. The three hour survey time was sufficient to cover the entire Project area and because of the open nature of the area, flying birds could be seen and identified from great distances. It was felt that the six hour per week survey was not necessary once spring migration

was over and breeding birds occupied the study area. This protocol change was discussed with CWS and considered appropriate. This period was roughly from mid-June until late July.

Efforts were made to understand peak migration periods on the Isthmus of Chignecto to ensure that surveys were conducted during this period. In addition to field guides and the Maritime Breeding Bird Atlas, reference was made to a recent publication by Erskine and McMannus (2005) to help understand the timing and historical use of the area by birds.

It was hypothesized that an overland aerial travel route may be used by birds to avoid following a large meander in the river. Therefore, particular attention was given to a 100 m wide corridor, running west from the LaPlanche River Bridge on the Trans Canada Highway, located above the tidal barrier, to reconnect with the tidal river within the John Lusby National Wildlife Area. Observations were noted at other major points within the study area, because they were either obvious habitat changes or they were separate sections divided by highways or other linear features. These included: the southern upland edge, central sod farm area, over or close to the tidal river, east of the Trans Canada highway and bird “hot spots” such as the sewer outfall or tidal gate area or large areas of unused cover containing tall grasses or shrubs.

The original study area was restricted to land on both the east and west sides of the Trans Canada Highway owned by Maritime Sod Ltd. However, occasional visits were made to surrounding or adjacent habitats outside of the original study area to help determine what species of birds may be there or to look for early migrating arrivals. As mentioned above, the flat open, treeless landscape enabled birds to be seen at great distances and most of these observations were recorded. In particular, bird use of the salt marsh and estuary habitat was recorded. Habitats to the north and west of the original study area were visited on occasion and general bird use of air space over these pasture and hay fields was noted. From November 2005 until January 18, 2006, survey time was devoted to these areas, in anticipation that they too may become sites for wind turbines.

Additional bird surveys were completed on the site during the period of July 18, 2006 to November 7, 2006 to survey the part of the study area located on the north side of the LaPlanche River which was not formally surveyed until November of 2005, and to gain a better understanding on the use by Peregrine Falcons and Short Eared Owls over the entire Project area. The surveys generally followed a protocol (see Appendix D) developed in consultation with the Canadian Wildlife Service (CWS), with input from Ducks Unlimited Canada. Eighteen separate surveys were conducted over a total of 28.5 observation hours. Surveys ranged from 1 to 2 hours in length, taking place during a variety of times and tide cycles, twice per week during the peak of shorebird staging period and reduced to once per week thereafter.

Results and Discussion

In total, 68 individual surveys were conducted, providing 203 hours of observation, over a full year. A total of 59 bird species were observed during the survey period and are listed in Table 2 (see Appendix D). The 68 surveys resulted in 827 individual sightings (single birds and flocks) involving 20,677 birds (Table 3 in Appendix D). While effort was made to avoid counting the same birds twice during each daily survey, it was impossible to know how many times the same birds may have been counted during the entire seasonal or yearly survey period.

The largest number of total sightings (292) and bird numbers (11,096) as well as the largest percent of the total sightings (35.3%) and percent of total birds (53.6%) were seen during the fall survey period. This is heavily influenced by the presence of shorebirds and waterfowl that use the region as a staging or migration stop during the long fall period. Spring had the fewest number of sightings and birds of all the seasons, although this is partly explained by the fewer surveys undertaken for this time period.

In general, the area does not seem to be a major flight path for migrating birds or for birds traveling over the study area to get to some other location. Nearly 80% percent of the observations and individual birds were seen on the ground or at a height of less than 30 m, with only 5% observed at over 100 m. Most of the waterfowl were seen resting or foraging in the tidal river. The shorebirds used the tidal river for foraging and the central area for roosting during high tide, both of which place the birds on the ground. Obviously, the birds seen on the ground had to have occupied air space to get there. Most of the birds seen on the ground flew when disturbed, but stayed close to the ground (< 30 m) and usually flew to another similar habitat close by to land and resume feeding or resting.

It is important to note that the tidal section of the LaPlanche River and the salt marsh adjacent to it (including the John Lusby Salt Marsh) received 36% of the total bird sightings and 53% of the total bird numbers. Nearly 30% of the bird sightings and total number were seen in the large central area, but this is mainly due to the fact that the central area represents a very large percentage of the total surface area being studied. Only 2.5% of the sightings and 0.5% of the total bird numbers were seen using the 100 m wide travel corridor connecting the non tidal section of the LaPlanche River to the John Lusby Salt Marsh. Therefore, this area is not as important to birds as anticipated.

The data were sorted into five major bird groups for further discussion: Waterfowl, Waterbirds, Raptors, Shorebirds and Landbirds. The following text provides a synopsis of survey results as they relate to these five major bird groups, including peak numbers, how they used the study and surrounding areas, both on the ground and in the air and how the observations relate to the long term (1930 – 2000) data presented by Erskine and McMannus (2005).

Waterfowl

A total of 282 observations resulted in 6,718 individual birds, representing 11 waterfowl species. Individual numbers of Green-winged Teal were the most abundant followed by Canada Goose, American Black Duck, Mallard, Blue-winged Teal, Gadwall, American Wigeon, Northern Pintail, Northern Shoveler, Brant and Common Merganser. Peak numbers of Green-winged Teal were recorded in April (125 – many appeared to be breeding pairs) and in late September (200-250). The other large dabbler ducks were present in lesser numbers, often in mixed groups. A late spring / early summer migrating flock of Brant was seen on June 6, flying east, several hundred metres above the study area near the upland edge. The only waterfowl species seen during the winter survey period were Common Merganser, American Black Duck and Green-winged Teal. American Black Duck and Green-winged Teal were first observed in late March, with the other species showing up in April.

Summer and fall accounted for over 60% of the observations of birds in the waterfowl group, but fall itself accounted for nearly 60% of the individual birds, due mainly to the long fall period and staging use by Green-winged Teal.

Preferring wetland areas, 70%-80% of waterfowl observations and individual birds were in the river (tidal and non tidal) and the salt marsh. During spring, breeding pairs were seen scattered in small

numbers in small ditches or ponds. Geese used the fields in spring and fall for foraging, but ducks were seldom seen on land. A group (up to 120) of goslings and adult geese were seen either in the study area or in the tidal section of the river during June and July. Broods of Mallard, Green-winged Teal, Blue-winged Teal and Canada Goose were observed, indicating that the area was used as breeding or brood rearing habitat for these species. The section of river immediately below the tide gate was a concentration area for waterfowl due, in part, to the sewer outfall as a food source. While waterfowl occasionally used the monitored flight corridor, this was not a common flight path.

Between 80% and 90% of the waterfowl observed were resting or foraging in the river. Those that were seen in flight preferred to follow the twists and turns of the river near the western and northern edges of the study area. Most waterfowl that were seen flying near, over or in the study area were below an estimated 100 m, more often in the 30 to 100 m range. Flocks of Canada Geese were observed gaining altitude to well above 100 m when traveling east from the salt marshes, presumably in response to the power line and Trans Canada Highway.

The salt marsh and estuary habitat adjacent to the study area to the west was used by waterfowl, especially during the late summer and early fall. Flocks were often seen circling and landing in the salt marsh ponds and creeks. Waterfowl were not seen routinely traveling from the salt marsh over the study area to the large freshwater wetlands to the east, as predicted, but more often seemed to leave the salt marsh in a southerly direction, perhaps going to a freshwater pond nearby or the freshwater marshes of the Amherst Point Migratory Bird Sanctuary. Migrating sea ducks were seen crossing the Isthmus of Chignecto, but not over the study site. Adjacent dyked pasture and hay land to the north west of the study area did not seem to be a routine flight path either; however, waterfowl were often seen using salt marsh habitat close to or crossing over the western tip of the pasture, adjacent to the open tidal waters of the upper Bay of Fundy.

No listed species were observed and only the migrating flock of Brant would be considered unusual, since there have been no recent records of Brant in the area and none in June.

There have been some long term changes in waterfowl numbers in the region. In particular, there has been a decline in the spring staging numbers of Canada Geese, which historically had much larger spring staging populations (10,000 peak numbers in 1968) in the area and was one reason behind the establishment of the John Lusby National Wildlife Area. Increased numbers of spring staging geese in Prince Edward Island may account for the decline in spring staging numbers in the West Amherst area. There has been increased breeding activity of Canada Geese, probably as a result of introductions.

Over the past few decades there has been an increase in the species diversity of large dabbling ducks in the area, such as Mallard, Northern Pintail, American Wigeon and Gadwall. This has come about possibly due to Mallard releases, a natural eastward expansion of these species from the west and/or in response to the large managed freshwater wetlands built in the area that simulate western marshes.

Waterbirds

The surveys resulted in 211 observations of waterbirds or 3,217 individuals, representing nine species: Pied-billed Grebe, Double-crested Cormorant, American Bittern, Great Blue Heron and five gull species (Ring-billed, Herring, Iceland, Glaucous and Great Black-backed). The five gull species accounted for most of the waterbird observations, but two large flocks (800 to 1,000 birds in total) of cormorants (presumably Double-crested) were seen flying high (several hundred metres) over the study area in a

westerly direction on October 22. These two cormorant sightings alone accounted for 30% of the total individual waterbirds.

Approximately 70%-80% of all waterbird observations and individuals were seen during the summer and fall survey period. The gull species composition changed with the seasons, and was the only waterbird seen during winter. The Pied-billed Grebe was a single summer sighting; Double-crested Cormorants were seen only occasionally except for the large fall migrating flock mentioned above; American Bitterns were not common and seen only in summer; Great Blue Herons were seen on a regular basis from June until the end of November (peak count in August of 15 birds); Herring and Great Black-backed Gulls were seen in all seasons, while Ring-billed Gulls were present from the end of July to the time of writing (peak September to October 125+); Iceland Gulls were present during fall and winter and Glaucous Gulls were seen in winter.

As with waterfowl, the LaPlanche River was an attraction for waterbirds. During spring, summer and fall, the tidal and non-tidal sections of the river are where 50% of the waterbird sightings took place, while the large central area of sod land accounted for approximately 25%, as it provided a resting area for gulls. In the winter, gulls were the only waterbird seen, spending much of their time flying low (<30 m) as they foraged over the tidal section of the river.

The Town of Amherst's sewer outfall was a hot spot as was the area immediately downstream of the tidal gate. Gulls, especially Ring-billed Gulls, used the study area both for feeding and resting. Large groups were seen resting together in mixed flocks during high tides or windy conditions. The adaptable Ring-billed Gulls were seen feeding both on flying insects at or above 100 m and on invertebrates on the ground. They also followed sod harvesters, similar to what is often seen on upland fields that are being ploughed.

Overall, about 50% of the waterbird observations were of non-flying birds, either resting or foraging. Approximately 20% were seen flying at less than 30 m, 20% between 30 and 100 m and about 10% were above 100 m. Gulls were the most commonly seen waterbird in the air space above the study area, although they, like waterfowl, usually followed the river at a height below 100 m. When in the air over the sod farm fields, gulls were usually above 100 m and were traveling to other destinations. Morning and evening flights of gulls during winter indicated that the birds moved inland towards town for the day and back to the tidal marsh area in the evening. Great Blue Heron were seen flying below 100 m coming or leaving the study area, but gaining altitude if heading east over the highway.

Gulls and Great Blue Heron used the salt marsh and tidal habitats regularly and were seen traveling over or into the study area, either coming from or going to the salt marsh or river estuary. As mentioned, gulls were seen traveling towards the Town's urban areas, likely in a search for food.

No listed or uncommon species of waterbirds were seen. Black-crowned Night-Heron, Yellow-crowned Night-Heron, Cattle Egret and Snowy Egret have been seen in the past in the general surrounding area, but not during this survey.

The large migrating flocks of Double-crested Cormorants seem a bit unusual, as these numbers were higher than previously recorded. As for the other species of waterbirds identified in this study, the numbers and timing seem to be consistent with previous records.

Raptors

A total of 74 raptor individuals were seen during 67 observations, indicating that they were mostly single bird sightings. The 7 raptor species seen were the Bald Eagle, Northern Harrier, Rough-legged Hawk, Sharp-shinned Hawk, American Kestrel, Merlin and Peregrine Falcon.

Approximately 45% of the raptor observations and individuals were seen during the summer survey period. The Bald Eagle was seen during all four seasons. Northern Harriers were quite common except in winter, while Rough-legged Hawk was seen mainly in winter (never more than one at a time), but were also seen both during spring and fall surveys. Sharp-shinned Hawk was present only during fall migration and American Kestrel used the area in spring and summer. Merlin and Peregrine Falcons first appeared with the arrival of the shorebirds in late July and were seen occasionally into the fall.

Rough-legged Hawk, American Kestrel and Northern Harrier were most commonly seen in the central grassland area, while Peregrine Falcon and Merlin used the tidal river area, mainly as they hunted shorebirds. The Bald Eagles were seen in all areas, but in winter focused over the tidal river.

The study area contains few natural perching areas for raptors, with only the power line towers, the wind test tower and a couple of gate posts serving the purpose. In spite of this, 30% of the sightings and individual raptors were seen not flying – either on the ground or perched. Rough-legged Hawks used the area for hunting during the winter and early spring and could often be seen sitting on the artificial perches (including the wind test tower) or circling overhead at various heights. They sometimes settled on the ground as well. Overall, 86% of the raptors were seen below 100 m either perched or hunting over the open grass land or along the river. Bald Eagles were sometimes seen overhead, soaring at great heights or sometimes low over the tidal river, but seldom seen low over the sod farm area. In winter, eagles were seen hunting over the Trans Canada Highway, perhaps searching for road killed birds or mammals. The study area contains few nesting areas for eagles, with only the power transmission line serving the purpose. No eagle nests were observed on the transmission line or elsewhere during the surveys. American Kestrels were seen in late spring and summer, often chasing Savannah Sparrows or insects, at heights between 30 m and 100 m. Northern Harriers were abundant, usually seen hunting just above ground level or sitting on any slight elevations such as the dikes. Occasionally, Harriers would be seen circling above 100 m, usually near the Trans Canada Highway. Peregrine Falcons were seen chasing shorebirds and these encounters are described in detail in the shorebirds section below. Merlin were seen chasing Semipalmated Sandpipers, the pursuit flights usually taking place low (<30 m) over the tidal river, but sometimes taking them over the sod farmed area, after smaller flocks of sandpipers. A Merlin was also seen chasing a Tree Swallow in a pursuit that lasted (unsuccessfully for the Merlin) several minutes at about a height at or above 100 m. A Merlin was also seen in the late fall on the pasture land on the north side of the LaPlanche River, where it chased Snow Buntings.

Raptors used the air space over the study area and surrounding habitats interchangeably. Northern Harriers seemed to focus on a hay field to the north west of the study area, during late June and early July. The tidal river seemed to be the main attraction for the falcons, as they hunted shorebirds.

Consideration must be given to the Peregrine Falcon. It is known to be present in the Upper Bay of Fundy during shorebird migration and its presence on this study area cannot be deemed accidental. Peregrine Falcons were seen in the study area on three occasions (July 25, Sept. 20, and Oct. 19). The

July sighting was most interesting in that the falcon was seen flying into the study area from the west carrying prey and was attacked by a Short-eared Owl during a brief aerial battle. The Peregrine landed in a cultivated field, ate its prey and then flew back towards the salt marsh. On Sept. 20, a Peregrine was observed chasing and attacking a Sharp-shinned Hawk within the study area and below 100 m. The final Peregrine sighting was on October 19, when a single bird was seen perched on a driftwood log, near the tidal river.

Species conspicuous by their absence are Red-tailed Hawk and Osprey. While it is difficult to quantify Northern Harrier numbers, they seemed abundant, both in the study area and in surrounding habitats. Harriers have been studied extensively in the area and are known to nest on the dyked marsh land.

Shorebirds

A total of 64 observations of shorebirds resulted in 8 species and 6,494 individual birds being sighted. Semipalmated Sandpiper and Semipalmated Plover accounted for most of the shorebirds during the survey period. Other species seen in very low numbers were: Greater Yellowlegs, Least Sandpiper, Killdeer, Black-bellied Plover, Lesser Yellowlegs and Short-billed Dowitcher.

Greater Yellowlegs, Least Sandpiper and Killdeer were observed during the spring survey period. Starting in July, populations of Semipalmated Sandpiper (peak of 2,000 on August 19) and Semipalmated Plover (peak of 1,200-1,500 on Sept. 9) began to build in the area. Most Sandpipers left in early September, while Plovers were seen as late as October 19. Black-bellied Plover, Lesser Yellowlegs and Short-billed Dowitcher were present in small numbers (< 5) during late summer and fall.

Killdeer pairs were seen near the Trans Canada Overpass and likely nested on or near that area. Black-bellied Plovers used the sod flats close to the river (north and west sections of study area) or salt marsh as resting areas and flew low to the ground when in the air. Greater Yellowlegs (three birds) were seen only once and that was in the freshwater section of the river near the old town dump site, during a spring survey. Lesser Yellowlegs (three birds) and Short-billed Dowitchers (two birds) were seen feeding at low tide in the mud flats immediately below the tidal gate. Least Sandpipers used the same area for feeding during the spring and also were observed with the larger flocks of Semipalmated Sandpipers and Semipalmated Plovers. The Semipalmated Sandpipers stayed almost exclusively along the exposed mud flats on the banks of the tidal river.

The Semipalmated Plovers, on the other hand, were often seen resting on the newly cultivated sod fields, especially during high tide. They preferred the brown earth, possibly for camouflage or because of the warmth generated from the dark earth. On September 9, 1,200 to 1,500 plovers were observed in one large roosting flock that assembled as smaller groups flew in from the tidal marsh to the west. They were also seen on newly cultivated fields on the east side of the Trans Canada Highway, a kilometre or two from the tidal area, so it appears they will travel to find these newly cultivated fields and not roost only on those found close to the tidal marshes or mud flats. Interestingly enough, the falcons did not seem to find these large roosting flocks of Semipalmated Plovers.

Semipalmated Sandpipers and Semipalmated Plovers accounted for most of the shorebird sightings and individuals. Their behaviour of foraging in the mud flats at low tide or roosting in the fields at high tide greatly influenced the statistic that 87% of the individual shorebirds seen on the study area were non-flying birds. When in flight, the Semipalmated Sandpipers traveled low over the water and followed the river. Occasionally, they were seen flying overland when being pursued by Falcons, at which time

they stayed < 30 m from the ground. When in flight, the Plovers usually stayed below 30 m, but some were seen above that height, while heading towards the eastern side of the Trans Canada Highway.

The shorebirds obviously used the tidal river and salt marsh to a great extent as a feeding area and some species moved to the sod flats for a roosting area. It was speculated that Black-bellied Plovers may be present on surrounding upland pastures, but none were seen during occasional visits. The pasture to the northwest of the study area is a very likely habitat for these birds, but the area was not surveyed extensively.

During one survey of the surrounding area, an unconfirmed sighting of Whimbrel in flight took place. These birds were seen only briefly and at a great distance and therefore were not recorded. However, Whimbrels were reported in the Cape Jourimain area at about the same time. Other than this, no uncommon or listed shorebird species were present during the survey times.

Owls

Only one species of owl was observed during surveys: Short-eared Owl. A total of five sightings were made over the study period. All observations of Short-eared Owl were made during July and August. On three occasions Short-eared owls were seen roosting on the ground within the sod farm land. All other observations were of birds flying low over the river or over the John Lusby Salt marsh.

Short-eared Owls were seen both in the study area and on the salt marsh or flying from one to the other and have been seen in abundance during the Christmas Bird Count on the Minudie Marsh located a few kilometres to the west of this study area.

Short-eared Owl is a species of Special Concern. Single birds were sighted on July 15, July 20, July 25, July 30 and August 19. On July 25, a Short-eared Owl was seen attacking a Peregrine Falcon, as discussed above, but on the same day and just previous to this, three Short-eared Owls were seen flying low over the salt marsh, possibly pushed off of a roosting site by a very high tide. Except for the attack on the Peregrine Falcon, all sightings of the Short-eared Owl were of birds sitting on or flying just barely above the ground.

Landbirds

All other bird species observed during the survey period were grouped as landbirds. A total of 178 observations of 4,169 birds, represents 23 species, that are listed in Table 2 in Appendix D.

While species in the landbird group were present during all four seasons, the number of observations and numbers of individual birds were more abundant in fall and winter. This is due mainly to the abundance of Snow Buntings and Horned Larks in the area during late fall and winter. Roosting flights of over 100 American Crow were observed in winter, although these species used the study area on a regular basis in smaller groups during all seasons. Most of the other landbird species did not occur in large numbers, except for the occasional migrating flock. One-time peak counts of staging or migrating flocks of Tree Swallows (200+ on July 25) and Red-winged Blackbirds (500+ on Oct. 14) occurred in the air space adjacent to the study area, specifically, the salt marsh (Swallows) and pasture land to the northwest (Red-winged Blackbirds). Sparrows (Song, Savannah, and Sharp-tailed) were seen during spring, summer, and fall and were believed to be nesting in the area. Other species such as the American Goldfinch were seen only once, as a large flock was feeding on a patch of thistle on August 3rd.

The landbird group, expectedly, used the non-wetland areas to a great extent. Eighty-seven percent of the sightings and 70% of the individuals were seen on the terrestrial habitats. However, the river and salt marsh still attracted some of the landbird species (Common Raven, American Crow and Snow Bunting) as they were often seen searching for food here. Ground nesting birds that quite possibly use the study area for nesting purposes are: Savannah Sparrow (nest with young found (intact) in mowed sod field and many newly fledged birds), Song Sparrow, Sharp-tailed Sparrow (more likely in adjacent salt marsh than on sod flats), Bobolink (hayfield), Ring-necked Pheasant and Red-winged Blackbird (ditches and wetlands). Landbird species seen using the area as a feeding or resting area were Snow Bunting, Horned Lark, American Crow, Common Raven, Barn and Tree Swallow. All other landbird species were seen only occasionally, either flying over the site at various heights or on the ground or perched in the few trees found in the area.

Approximately 95% of the landbirds were observed to be <100 m. Of these, 45% were seen on the ground, 32% were <30 m from the ground and the remaining 18% or so were flying between 30 and 100 m. Most of the flights were short and low, as the birds searched for food, often flying only a few metres or so before landing again. Except for the two large migrating flocks mentioned above (Swallows - 200 and Red-winged Blackbirds – 500), the area does not seem to be a migration path for species in the landbird group.

Sharp-tailed Sparrows were heard and seen in the salt marsh adjacent to the dykes and Bobolinks were observed in the hayfields across the LaPlanche River to the northwest of the study area. Crows and Ravens were often seen flying along the Trans Canada Highway corridor in winter, searching for food. The same species used the study area and adjacent habitats interchangeably during the other seasons, often flying over one only to land in another.

The Sharp-tailed Sparrow and Bobolink are considered to be species in decline and both were seen here.

The numbers and timing for most landbirds sightings during the survey period appear to be consistent with historic sightings. Many woodland species of landbirds known to be in the Isthmus of Chignecto were not seen here, because of a lack of forest or tree cover in the Project area.

Supplemental Bird Surveys

The survey period July 18 to November 7, 2006 provided a more detailed look at bird use of the habitat and air space found on the north side of the LaPlanche River, as well as another look at bird use over the entire proposed area, prior to construction activities. Special effort was made to survey for two listed species found during the previous year's survey - Peregrine Falcon and Short Eared Owl.

There did not appear to be any dramatic difference in bird use of the air space above the proposed area between the two survey periods. No Short Eared Owls were seen, even during the early morning and evening surveys during high tide cycles. Three Peregrine Falcon sightings occurred, all of a single and possibly the same immature bird.

Spring use of the air space was picked up during the previous year's survey and this area was intensively surveyed for winter birds. The July 18, 2006 start date for this survey is believed to be early enough to capture the species of birds that might be using this area as breeding habitat. Those species are mentioned in the discussion above and include: Savannah Sparrow, Bobolink, Northern Harrier and waterfowl such as the American Widgeon.

4.3.2.2 Mammals

Overview

Nova Scotia is home to 57 species of terrestrial mammal (Davis and Brown 1996). The mammal fauna of Nova Scotia has been altered dramatically since the arrival of Europeans. A number of species have been extirpated, such as the caribou (*Rangifer tarandus*) and the wolf (*Canis lupus*), due to habitat destruction, human encroachment and hunting (Davis and Brown 1996; Banfield 1974). Others species, such as the whitetail deer *(Odolcoileus virginianus)* and coyote *(Canis latrans)*, appear to have benefited from human disturbance, and are relatively recent arrivals to the province (Davis and Brown 1996). The abundant mammal species are generally mobile and widespread in Nova Scotia, and the mammal fauna of the province has not been delineated into distinct communities (Davis and Brown 1996). However, a number of mammal species native to Nova Scotia currently have restricted ranges and exist in disjunct populations.

Information regarding the presence of mammals, including rare species, and sensitive mammal habitat within the Project area was derived from existing data sources, a review of data for the area obtained from ACCDC and field surveys which were conducted in 2006.

The majority of the Project area is agricultural land and thus a low diversity of mammal species is expected. Indeed, the only sign of mammals recorded during field surveys were coyote tracks. However, a variety of small mammals and other species which are tolerant of human disturbance may be found in the area on occasion. Table 4-4 lists the mammal species that are likely in the Project area, at least on an occasional basis.

Table 4-4 Mammal Species that Likely Occur in the Project Area

Common Name	Binomial	Habitat	NSDNR Ranking	ACCDC Ranking
Star-nosed Mole	*Condylura cristata*	Lowlying woods, meadows, marshes, lake and stream banks.	Green	S5
Shrew, short tail	*Blarina brevicauda*	Hardwood forest, high humidity and loose humus.	N/A	S5
Whitetail Deer	*Odolcoileus virginianus*	Edges of hardwood forest, glades, swamp edges, stream banks, cedar swamps.	Green	S5
River Otter	*Lutra canadensis*	Rivers, lakes and coastal marine habitats.	Green	S5
American Mink	*Mustela vison*	Near waterbodies.	Green	S5
Coyote	*Canis latrans*	Hilly country with poplar bluffs, willow-lined stream banks, boreal forest, aspen parklands, short-grass steppes.	Green	S5
Red Fox	*Vulpes vulpes*	Agricultural areas, lakeshores, river valleys, natural clearings.	Green	S5
American Black Bear	*Ursus americanus*	Coniferous or deciduous regions, swamps, berry patches.	Green	S5
Racoon	*Procyon lotor*	Forested areas near watercourses, river valleys, trees in grasslands.	Green	S5
Meadow Vole	*Microtus pennsylvanicus*	Wet meadows, grasslands, salt marshes, abandoned fields, prairies, vacant lots, edges and openings of forest.	Green	S5

Table 4-4 Mammal Species that Likely Occur in the Project Area

Common Name	Binomial	Habitat	NSDNR Ranking	ACCDC Ranking
Southern Bog Lemming	*Synaptomys cooperi*	Bogs, grassy marshes, damp mixed forests.	Green	S3/S4
Meadow Jumping Mouse	*Zapus hudsonius*	Moist grassland, grassy stream banks, marsh borders, alder-willow borders, low fields, edges of forests, and fence rows.	Green	S5
Muskrat	*Ondatra zibethicus*	Lakes, rivers, ponds, sloughs, marshes.	Green	S5
Beaver	*Castor canadensis*	Slow-flowing streams, lakes, rivers, and marshes.	Green	S5
Porcupine	*Erethizon dorsatum*	Deciduous and coniferous regions, farmland.	Green	S5
Eastern Chipmunk	*Tamias striatus*	Dry hardwood forest, hedgerows, fences, stone piles, gardens.	Green	S5
Red Squirrel	*Tamiasciurus hudsonicus*	Boreal coniferous forest, eastern hardwood deciduous forest, mixed forests.	Green	S5
Varying Hare	*Lepus americanus*	Forests, swamps, riverside thickets.	Green	S5

Rare, Sensitive and at Risk Mammals

According to ACCDC, the long-tailed shrew (*Sorex dispar*), eastern pipistrelle (*Pipistrellus subflavus)* and Southern Flying Squirrel (*Glaucomys volans*) have been reported within a 100 km radius of both ends of the proposed RoW. ACCDC ranks the southern flying squirrel as an S2 species, and the long-tailed shrew and eastern pipistrelle as an S1 species. All three of these mammals are Yellow-listed by NSDNR. In addition a number of other bat species which are Yellow-listed by NSDNR may occur in the Project area; these include hoary bat (*Lasionycteris noctivagans)*, red bat (*Lasiurus borealis*), little brown bat (*Myotis lucifugus*), big brown bat (*Eptesicus fuscus)* and northern long-eared bat (*Myotis septentrionalis*).

The long-tailed shrew is Yellow-listed by NSDNR and ACCDC ranks it as an S1 species. The long-tailed shrew was discovered in Nova Scotia in 1984, and the distribution and abundance of this species is poorly known (NSDNR 2007, Davis and Brown 1996). This species in known only from a handful of specimens collected at two localities in the Cobequid Hills region of the Province. The long-tailed shrew prefers hilly or upland areas with steep slopes, rocky outcrop and talus. No long-tailed shrews have been recorded in the Project area and it is unlikely that the long-tailed shrew occurs in the vicinity due to a lack of suitable habitat.

All bat species native to Nova Scotia are considered to be sensitive to anthropogenic disturbance. However, as indicated in a review of bat literature conducted for a non-related wind development project (AMEC 2006), the risk of bat collision with wind turbines is generally greater for migrating bats than for resident breeding, commuting or foraging bats, which generally forage between 1-10 m above ground level and seldom above 25 m, thus avoiding turbine blades. Only two bat species are likely found throughout Nova Scotia (Broders et al. 2003). Little brown bats (*Myotis lucifugus*) are found in both forests and human-dominated landscapes (Jung et al. 1999, Broders and Forbes 2004). The northern long-eared bat (*Myotis septentrionalis*) is found in forest habitats (Broders et al. 2003, Broders and Forbes 2004). Neither of these species is migratory, thus they are unlikely candidates for high mortality due to wind turbines based on their low flight paths. Yet, non-migratory bats may have increased sensitivity during the winter months when regional populations congregate into a few hibernation locations. Disturbance at these sites can potentially result in the deaths of large numbers of

bats. There are no known hibernation sites such as caves or mines near the Project area so these species are unlikely to be present during the period from November to May when they are hibernating. The closest abandoned cave locations (potential hibernacula) are located approximately 25 km from the Project site in Springhill, NS (Hugh Broders, pers. comm. 2008). Another non-migratory species found in Nova Scotia is the eastern pipistrelle (*Pipistrellus subflavus*), but this species appears to be at the edge of its range in southwest Nova Scotia. Small numbers of this species occur in southern coastal New Brunswick as well (Broders et al. 2003).

Migratory bat species such as the red bat and hoary bat may be present in the Project area. These migratory bats are found across North America, but there have been few accounts of these species in the province. One study conducted in Kejimkujik National Park indicated that less than 0.05% of echolocation sequences recorded during a May to September window belonged to migratory species (Broders et al. 2003). Thus, it seems unlikely that higher flying migratory species will be common occurrences in the Project area. Nonetheless, 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.

The southern flying squirrel is Yellow-listed by NSDNR and ACCDC ranks it as an S2 species. The southern flying squirrel is not known to occur in the Project area. The population of this species in Nova Scotia is thought to be restricted to the south-western portion of the province (NSDNR 2007) and no suitable habitat (*i.e.,* thick stands of deciduous trees) is found in the Project area.

4.3.2.3 Reptiles and Amphibians

Overview

Amphibians and reptiles are normally treated together as herpetiles. There are 22 terrestrial and freshwater herpetile species recorded from Nova Scotia. The herpetofauna of Nova Scotia is relatively depauperate when compared to adjacent mainland areas of the continent, mostly because of the difficulty of post-glacial colonization of this peninsula and a relatively harsh climate.

Information regarding the herpetofauna in the Project area was obtained from existing information sources (*e.g.,* ACCDC 2007, Gilhen 1984, Gilhen and Scott 1981, and Scott 1994) and field surveys. The diversity of herpetiles within the Project area is likely reduced due to the paucity of natural habitats and the predominance of agricultural lands. In addition, tidal reaches of the LaPlanche River are unsuitable as breeding grounds for amphibians. No herpetiles were recorded during field surveys, although a number of species are likely present. Table 4-5 lists the herpetile species that are likely in the Project area, at least on an occasional basis.

Table 4-5 Herpetile Species that Likely Occur in the Project Area

Common Name	Binomial	Habitat	NSDNR Ranking	ACCDC Ranking
Maritime garter snake	*Thamnophis sirtalis pallidual*	Woods, meadows, marshes, lakes, farmlands, edges of developed areas and stream banks; wide ranging.	Green	S5
Eastern smooth green snake	*Liochlorophis vernalis borealis*	Grassy and shrubby areas along the shores of watercourses, fields, and lawns in suburban areas.	Green	S5
Leopard frog	*Rana pipiens*	Forages in terrestrial habitats such as fields, woodlands and roadside ditches; breeds in the shallows of lakes and ponds.	Green	S5
Green frog	*Rana clamitans melanota*	Common in a wide range of aquatic habitats, including lakes, ponds, streams, and ephemeral pools.	Green	S5
Mink Frog	*Rana septentrionalis*	Ponds, lakes and quiet steams with lily pads and pickerel weed.	Green	S5
Wood frog	*Rana sylvatica*	Damp woodlands, particularly in deciduous and mixed woods; breeds in roadside ditches and ephemeral pools.	Green	S5
Pickerel frog	*Rana palustris*	Agricultural areas, lakeshores, river valleys, natural clearings; breeds in ponds and small streams.	Green	S5
American toad	*Bufo a. americanus*	Flexible habitat requirements; breeds in shallows of lakes, ephemeral pools, small streams.	Green	S5
Spring peeper	*Psendacris c. crucifer*	Forested areas near watercourses; breeds in standing water, often where there is dense submerged plant debris.	Green	S5
Red-spotted Newt	*Notophthalmus v. viridesceus*	Red eft larval stage lives in damp decidnous, coniferous or mixed woodlands for approximately two years. Adults and aquatic larval stage live in ponds, vegetated coves of lakes and sluggish streams.	Green	S5
Yellow-spotted salamander	*Ambystoma maculatum*	Inhabits coniferous, deciduous and mixed woodlands adjacent to aquatic breeding sites; breeds in ponds and vegetated coves, in lakes and vegetated sluggish streams.	Green	S5
Blue-spotted Salamander	*Ambystoma laterale*	Inhabits coniferous, deciduous and mixed woodlands adjacent to aquatic breeding sites in areas of red sandstone, conglomerate, limestone and gypsum	Green	S5
Red-backed salamander	*Plethodon cinereus*	Woodland areas; breeds under rocks or in decaying tree stumps. The larval stage occurs within the egg and the young hatch as juveniles.	Green	S5

The wood turtle is known from the general area. Wood turtles are a species of concern; they are ranked as S3 by the ACCDC (2007). Provincially, they are listed as a Yellow species, as well as being listed as vulnerable under the Nova Scotia *Endangered Species Act*. The wood turtle is also listed under the federal *SARA* as a species of special concern.

No wood turtles were encountered during field surveys. Wood turtles are almost invariably associated with streams, creeks, and rivers and the associated rich intervale forest, shrub communities, as well as with the meadows and farmland terrestrial habitat associated with these watercourses. Streams with sand and/or gravel bottoms are preferred, but rocky streams are used occasionally. Wood turtles may

wander some distance from watercourses during summer foraging, but characteristically remain within linear home ranges. These home ranges are 1 to 6 ha in size and are centred on a suitable river or stream where non-vegetated or sparsely vegetated sandy beaches and banks serve as nesting sites. Natural nesting sites consist of sandy river beaches, but may also include select disturbed sites, such as railway grades and roadsides. Some turtles may travel considerable distances up small tributaries that lack suitable nesting sites and hibernacula during the summer months that offer good foraging opportunities. These smaller streams may serve as dispersal corridors between populations on different river systems.

The Project area does not represent typical habitat for the wood turtles. The LaPlanche River is deep and tidal along a portion of its reach and does not have appropriate bank substrates (*i.e.,* gravel and sand) for nesting. In addition, adjacent terrestrial habitat consists mainly of intensive agriculture and thus provides little foraging opportunities. As such, it is unlikely that the LaPlanche River provides hibernaculae or nesting habitat for wood turtles.

According to ACCDC data, four-toed salamanders have been recorded within a 100 km of the Project area. The four-toed salamander is now listed as a Green species by NSDNR (2007). Local herpetologists generally believe that the four-toed salamander is more abundant and widespread than existing records indicate. The paucity of records is likely attributable to the cryptic nature of this species. Four-toed salamanders are rarely found away from cover. During the breeding season, females nest in sphagnum moss hummocks; during the rest of the year, this species is present under stones, logs and other cover in forest habitats. They emerge from cover only at night to forage.

A recent study of the distribution of the four-toed salamander in Nova Scotia supports the contention that this species is not as rare as previously thought and is widely distributed (JWEL 1999). The study found four-toed salamanders in more than half of the sites searched and increased the number of recorded nesting sites in Nova Scotia from 20 to 45. The study also found that four-toed salamanders use a variety of sites as nesting habitat including anthropogenically created or modified sites, such as roadside ditches and ponds, wheel ruts and quarry ponds. Critical habitat requirements for this species are sphagnum moss in which to lay eggs and a semi-permanent or permanent, soft bottomed pond or slow flowing stream adjacent to the sphagnum moss in which the hatched larvae can develop. There are no areas of sphagnum moss within the Project area and thus it is unlikely that this species is found in or near the Project footprint.

4.4 Atmospheric Environment

The following section describes the climate and air quality of the site.

4.4.1 Climate

Weather data were acquired from the Sackville, New Brunswick meteorological station, which is located approximately 5 km northwest of the Project site and the Moncton meteorological station, located within 30 km northwest of the site. With the exception of the town of Amherst and the presence of Highway 104, the vicinity of the proposed Project site is primarily agricultural and is relatively flat in nature, mostly consisting of low-lying vegetated ground with some intermittent treed areas and roadways. The facility will be in operation throughout the year; therefore, a variety of ground conditions will occur. At

the Moncton meteorological station, where wind speed and direction data is available, the average annual wind speed is about 17 km/h, based on Environment Canada climate normals for the period of 1971-2000. In the summer months (June – August), average wind speeds drop to 13.7 km/h; however wind speeds increase to over 19 km/h in the winter months. Prevailing winds are consistently from the southwest throughout every month of the year.

According to the Sackville weather station climate normals from 1971-2000, the average annual temperature in the region is 5.5^{o}C, with the average daily maximum and minimum being 9.8^{o}C and 1.1^{o}C, respectively. The warmest period during the year is typically from June to August (daily mean of 16.4^{o}C), while the coldest period is between December and February (daily mean of -6.1^{o}C). The site's close proximity to the coast allows for the ocean to have a temperature moderating effect, which also allows for New Brunswick's coastal regions to have a significantly longer frost-free season in comparison to inland localities.

According to 1971-2000 precipitation data at the Sackville station, precipitation occurs approximately 281 days per year and averages approximately 1,164 mm of precipitation throughout the year, where 80% is rain and the remainder is snow. Overall, fall is the foggiest time of year in New Brunswick and northern Nova Scotia, with Moncton having an average of 60 foggy days throughout the year. No specific data are available for the Project area, but the above numbers are expected to be reasonable estimates.

4.4.2 Air Quality

To-date, laboratory testing has not been conducted to determine air quality within the Project area. Based on the land use and industry in the Amherst and surrounding areas, it is expected that the Project area's air quality is typical of agricultural areas across much of northern Nova Scotia and southeastern New Brunswick.

The closest air quality monitoring station is in Moncton, New Brunswick, located approximately 30 km northwest from Amherst. The Province of New Brunswick, through the New Brunswick Department of Environment (NBENV), operates the Moncton station, to measure the ground-level concentrations of air contaminants. The monitoring station considered in the analysis to establish existing conditions for ambient air quality is located at the Highfield Street water pumping station in Moncton. The Moncton monitoring station was operated in 2004, which is the most recent recorded data, and the air contaminants measured in Moncton are Particulate Matter less than 2.5 microns ($PM_{2.5}$), Carbon Monoxide (CO), Nitrogen Dioxide (NO_2) and Ozone (O_3). Given the rural location of the Project, air quality would be expected to be better than that described below.

Particulate Matter Less than 2.5 microns ($PM_{2.5}$)

Monitoring results for the Moncton station in 2004 showed few hourly values exceeding 40 µg/m^3. The annual average concentration of $PM_{2.5}$ measured at the Moncton station was 4.1 µg/m^3. No provincial or national guideline or standard exists for $PM_{2.5}$; however there is a Canada-Wide Standard of 30 µg/m^3 by 2010 (24-hour averaging time) where achievement is based on the annual 98th percentile ambient measurement, averaged over three consecutive years. The 98th percentile value measured at this station in 2004 was 15.1 µg/m^3 and there were no days recorded with a 24-hour average or hours with a running 24-hour average exceeding 30 µg/m^3.

Carbon Monoxide (CO)

In 2004, there were no exceedances of the 8-hour (13 ppm) CO standard recorded in at the Moncton station. In fact, no exceedances of CO objectives have been recorded since monitoring at this station began in 1998.

Nitrogen Dioxides (NO_2)

In 2004, there were no exceedances of the 24-hour (200 µg/m^3) NO_2 standard recorded in at the Moncton station, although there were missing data between the months of June and October. Maximum hourly values were less than 25% of the objective. No exceedances of NO_2 have been recorded since monitoring at this station began in 1998.

Ozone (O_3)

In 2004, there were two exceedances of the hourly objective for O_3 in May, and 13 exceedances of the Canada-Wide Standard occurring in April, May, and July. The Canada-Wide Standard for O_3 is 65 ppb, over an 8-hour averaging time, by 2010, where attainment is based on the 4th highest measurement annually, averaged over 3 consecutive years. In 2004, the annual Canada-Wide Standard statistic was 59.9 ppb.

4.5 Socioeconomic Conditions

4.5.1 Population

The Project is located in Cumberland County, Nova Scotia, near the town of Amherst. In the mid-to-late 1700's, New England settlers were encouraged to settle in the numerous communities that dotted the Bay of Fundy coast. One of these settlements grew to become the Town of Amherst, established in 1764, two miles west of its present location. However, a grist mill and tannery were built a mile east of the settlement, and the community gradually migrated closer to them so that by 1850, Amherst was located where it is today.

Population statistics for the Town of Amherst and Cumberland County are summarized in Table 4-6 below.

Table 4-6 Population statistics for the Town of Amherst and Cumberland County

Population and Dwelling Counts	Town of Amherst	Cumberland County
Population in 2006	9,505	32,046
Population in 2001	9,470	32,605
2001 to 2006 population change (%)	0.4	-1.7
Total private dwellings	4,410	18,153
Population density per square kilometre	790.7	7.5
Land area (square km)	12.02	4,271.14

Source: Statistics Canada 2006

The Town of Amherst had very slight population growth from 2001 to 2006; however, despite this slight increase, the 2006 population numbers are almost 2% less than 1996 figures. The 2001 population of Amherst was distributed fairly evenly across various age groups; however, the age ranges 5-14 and 25-

44 are related anomalies (representing parental and subsequent child cohorts), and are significantly higher than other age ranges. The median age of the population was 40.9, which is slightly older than the provincial median of 38.8. Approximately 19.3% of the population was over the age of 65, which is somewhat higher than the province's 13.5%. Less than 1% of the population identified as Aboriginal, while only 2% identified as foreign-born.

From 2001 to 2006, Cumberland County experienced a population decrease of approximately 1.7%. However, from 1996 to 2006, the population decrease was a more pronounced 5%. Similar to the Town of Amherst, Cumberland's population distribution is fairly even across various age groups, with the same anomalies for the age ranges 5 to 14 and 25 to 44, although the variance for age range 5-14 is not as pronounced in Cumberland. The median age of individuals residing in Cumberland was 42.3. Less than 1% of the population identified as Aboriginal, and 2.5% identified as foreign-born.

4.5.2 Health, Industry, and Employment

Traditionally, Cumberland County's economy was principally resource based, with lumbering, fishing, farming, and mining the vocations of the majority of county residents. To a large extent, resource-based activities continue to play a significant role in the area. In recent years, the manufacturing and construction industries, as well as occupations in health and education, have been leading economic development.

The primary industry in the immediate Project footprint is sod farming. In Amherst, approximately 25% of the labour force is concentrated in manufacturing and construction industries, roughly 34% in the service industry, and less than 4% in agriculture. In Cumberland County, 27% of the labour force is concentrated in manufacturing and construction industries, while roughly 11% is concentrated in agriculture. Ultimately, more than half of the labour force in Cumberland County is involved in manufacturing, construction, and service industries.

Table 4-7 illustrates the participation in local industry for the Town of Amherst and Cumberland County.

Table 4-7 Local industry for the Town of Amherst and Cumberland County

Industry	Amherst			Cumberland County		
	Total	Male	Female	Total	Male	Female
Agriculture and other resource-based industries	145	130	15	1,620	1,285	330
Manufacturing and construction industries	1,155	825	335	3,960	2,735	1,225
Wholesale and retail trade	785	390	395	2,205	1,080	1,120
Finance and real estate	160	45	120	380	95	285
Health and education	795	150	650	2,380	490	1,885
Business services	520	360	160	1,440	965	475
Other services	1,025	415	610	2,775	1,275	1,505
Total – Experienced labour force	4,590	2,310	2,285	14,760	7,930	6,835

Source: Statistics Canada 2001

A limited number of people also work in the finance and real estate industry. In Cumberland County, approximately 16% of the labour force is located in the health and education sector. Amherst and Cumberland are under the jurisdiction of the Cumberland Health Authority, and located on the outskirts of Amherst is the Cumberland Regional Health Care Centre, a state-of-the-art acute care facility that

opened in 2002. Services offered include Level 3 Emergency, ICU, surgery, maternal/child and medical units supported by laboratory, diagnostic imaging, pharmacy, respiratory therapy, physiotherapy and occupational therapy departments.

According to the 2001 census, 15,670 individuals in Cumberland County earned an income (from either full time or part time jobs). The average earning for all persons working was $21,449, which is below the average earnings for Nova Scotia $26,632. However, for those in Cumberland who had full-time work all year-round, the average earnings were approximately $30,601, which is still well below the provincial average of $37,872. Those in the Town of Amherst who worked full-time all year earned slightly less than $31,000, well below the provincial average.

The unemployment rates for Cumberland and Amherst are 13.4% and 10.8% respectively, similar to the provincial unemployment rate of 10.9%. Overall, Amherst labour force indicators have improved significantly since 1991, when the unemployment rate stood at 16.7% (Statistics Canada 2001).

4.5.3 Recreation and Tourism

The immediate Project footprint is located northeast of Amherst, and encompasses areas utilized for commercial sod farming. Tourism is not an important industry in this area compared to other industries; however, it does play a minor role.

Amherst is located off Nova Scotia Highway 104, a portion of the TransCanada Highway system. The Town serves as the trail-head for two major scenic driving trails in Nova Scotia: the Sunrise and Glooscap Trails. Numerous beaches and public parks dot the area, including Amherst Shore Provincial Park, Cape Chignecto Provincial Park, and Joggins Fossil Cliff. In addition, Amherst boasts the Cumberland County Museum, which is located in the heritage home (c. 1838) of Robert Barry Dickey, Father of Confederation, and focuses on the industrial and social history of Cumberland County, including exhibits outlining the history of the County from Native American times through to the early twentieth century. Guided walking tours through the Town are offered at various times of the year.

The Amherst area boasts a wide array of recreational opportunities. In addition to the numerous beaches and parks, there are several golf courses in the area, including the Amherst Golf Club, Northumberland Links, Fox Harb'r Golf Resort and Spa, Sunrise Beach Golf Club, and Springhill Centennial Golf Club. The area boasts a variety of walking/hiking trails, including the Amherst Point Bird Sanctuary and the Henry G. Ketchum Recreational Trail.

In comments received from the NS Department of Tourism, Culture and Heritage on the draft EA document, it was acknowledged that not only is the proposed development site not one identified as an area with the potential to develop tourism products in any key areas (*e.g.,* birding, hiking/walking, etc.), but also that the proposed turbines will not be constructed in an area adjacent to tourism businesses, nor will the Project affect any pristine landscape views.

4.5.4 Land Use

The immediate Project area is located on privately-owned cultivated fields used for sod farming. In addition, some turbines are located north of the existing sod farm's cultivated fields on land that lies on the northwest side of the LaPlanche River. This land is primarily used for haying.

The Project site was initially zoned as Rural Resource Zone, which did not allow for the development of electricity generating facilities. As a result, a zoning amendment was required for each turbine location. Acciona commenced this process with the Municipality of the County of Cumberland, and on March 16, 2005, specific Project area lands were re-zoned as Utility Zone to permit the construction of a wind farm. This zoning permit also serves as the building permit. Since that time, the land use by-law has been revised. The updated Strategy By-Law provides that wind farms may be constructed in rural areas as of right, subject to certain requirements including that turbines be set back 500 m from buildings.

To the southwest of the Project footprint, on the opposite bank of the LaPlanche River which the Project area borders, is the John Lusby Salt Marsh, a 600 ha portion of the Chignecto National Wildlife Area (see Figure 2-1). The Project area does not encroach into the marsh or wildlife area. The Amherst Point Migratory Bird Sanctuary is also part of the Chignecto National Wildlife Area (see Figure 2-1). The John Lusby section is dominated by salt marsh, with small saline ponds interspersed throughout the marsh. Amherst Point Sanctuary section is a mosaic of freshwater wetlands of several natural types, including sink-hole ponds, small lakes, bogs and marshes. However, shallow controlled water level impoundments (with depths from 30-60 cm) comprise nearly half of the wetland area. Wetlands at the site are the most productive in the province, and derive this fertility from the gypsum- limestone bedrock and from marine silt deposits.

4.5.5 Property Values

In 2001, there were 4,020 total dwellings in the Town of Amherst: 2,390 owned and 1,630 rented (Statistics Canada 2001), with relatively few (roughly seven percent) constructed after 1991. The average value of a home in Amherst was $78,865, which is roughly $22,650 less than the provincial average. According to the Multiple Listing Service (MLS), the average price of a home in Amherst and its surrounding areas is approximately $147,000; however, this average is slightly skewed by the higher priced homes in the Town of Amherst, and is not reflective of more moderately priced homes in the rural countryside.

4.5.6 Existing Sound Level

The Project is located in a predominantly rural area, with the primary sources of background sound levels from traffic on Highway 104. Other contributors include the operation of farm machinery, and the consistent blowing of the wind. No other industrial facilities that generate noise are located near the proposed Project.

On average, sound in a typical rural environment can be expected to be in the vicinity of 35 - 45 dBA; however, ambient sound levels in rural and urban areas are typically greater during the daytime as a result of increased activity. For example, in the Project area, noise is currently emitted from typical agricultural operations, such as plowing, harvesting and transportation of farm equipment, conducted within and near the Project area. Wind and residential activities also contribute to background sound levels. For homes that are near these activities on a day with low winds, sound levels may range from 45 dBA to 60 dBA over a ten minute period (*i.e.,* over the sound level limits for rural areas). To quantify the potential sound impacts resulting from this Project, Jacques Whitford conducted a sound impact assessment.

Environment Canada provides guidelines on acceptable on-site construction sound levels (Environment Canada 1989). The maximum construction-related sound levels recommended for residential areas near construction sites are as follows:

- day (07:00 – 19:00) – 65 dBA L_{eq};
- evening (19:00 – 23:00) – 60 dBA L_{eq}; and
- night (23:00 – 07:00) – 55 dBA L_{eq}.

There is not a specific noise bylaw in place for Cumberland County. Colchester County, which is immediately adjacent to Cumberland County, has a noise bylaw that states that no person shall generate a sound that is measureable at a point of reception in excess of 70 dBA between the hours of 22:00 – 07:00 and in excess of 90 dBA at other times.

The Ontario Ministry of Environment (MOE) guideline NPC-205 *Sound Level Limits for Stationary Sources in Class 1&2 Areas (Urban)* was consulted in terms of general assessment guidelines for industrial sound impacting land use that has qualities of both urban and rural areas (Class 2), such as the area considered in the current study. In addition, the MOE's guidance document *Interpretation for Applying MOE NPC Technical Publications to Wind Turbine Generators* was used to determine wind turbine sound criteria according to wind speed.

The noise study report, including background noise levels at selected receptors, is presented in Appendix E and further details are in Section 5.1.2.4.

4.5.7 Heritage Sites, Archaeological Sites and Other Cultural Resources

The assessment of archaeological potential for the site considered both prehistoric and historic period resources. Archaeological potential modeling for prehistoric era sites is based largely on the identification of landscape features which are either known to have attracted past habitation or land use, or which appear to have potential for attracting human use. These features include the availability of potable water, suitability for habitation (*e.g.*, ground conditions), proximity to desirable resources (such as workable stone), and proximity to water transportation routes, coastal areas, portage routes and food supplies. The complete archaeological assessment report, conducted by Archaeologist Mr. Laird Niven, is provided in Appendix F. A summary of the report is provided below.

4.5.7.1 Historical Background

The Amherst region is one that boasts a rich Mi'kmaq prehistory mainly due to the abundant resources of the surrounding marshlands and the canoe routes that connected the Cumberland Basin with the Northumberland Strait. While many of the historic references refer to Mi'kmaq occupation around Amherst, there is usually very little specific geographic detail supplied.

The historic occupation of the area began in earnest with the Acadian settlement in the seventeenth century. The closest former Acadian village to the study area is Beaubassin, located on Fort Lawrence Ridge, approximately 1.5 km to the northwest. Jacques Bourgeois founded the village of Beaubassin in 1671 or 1672 and by 1686 there were 22 houses on the ridge, and it was boasted that the area could sustain 100,000 cattle (Lavoie 2003). The village thrived as the hub of a trading network with the Mi'kmaq, Louisbourg, and New England and by 1720 it was reported that there were 70 or 80 families there (Lavoie 2003). The Abbé Le Loutre evacuated Beaubassin on April 21 and 22, 1750, and burned

the village to the ground. By September of that year the British had built Fort Lawrence just north of the former village in a bid to gain military control of the area. The French retaliated by building Fort Beasusejour on present-day Aulac Ridge, 1.8 km west of Fort Lawrence.

Figure 2 in Appendix F shows the area around 1750. Figure 3 (Appendix F) shows the two forts at some time between 1750 and 1755, but there is no indication of Beaubassin. This map does, however, show the portage route along the Missiquash that led to the Baie Verte. Figure 3 (Appendix F) shows the area in more detail with the two forts and their associated settlements. Of particular interest are the dykes along the LaPlanche River, which border the north end of the Project area. Ironically, there is a small hill that is labeled “Wind-mill Hill”. Finally, the prominent ridge to the south of the Project area is also shown.

The two forts faced each other for several years but, in 1755, a combined British and New England force attacked Beausejour from Fort Lawrence and, after a short siege, they captured the fort, which they renamed Fort Cumberland. Figure 4 (Appendix F) dates after 1755 and shows the new Fort Cumberland and includes insets of the soon-to-be demolished Fort Lawrence. Beaubassin is shown to be more widespread on this map, presumably to illustrate its destruction. The well-documented exportation of the Acadians began that year and, as the British moved their operations to the more substantial Fort Cumberland, Fort Lawrence was abandoned and burned in 1756 (Dawson 1988).

There was very little development close to the study area, apart from the establishment of Amherst in the second half of the eighteenth century, until 1888, with the start of construction on the Chignecto Ship Railway. This mega project, which was the brainchild of engineer Henry Ketchum, was designed to carry ships the 27 km overland from Baie Verte to the Cumberland Basin. Unfortunately, the project had financial difficulties and came to an end, three quarters completed, with the withdrawal of government support in 1891 (Historical Atlas of Canada 1987). Figure 5 (Appendix F) shows the proposed Chignecto Ship railway and the Cumberland Basin lifting dock. It also shows a proposed “Keefer’s Canal” just north of the Project area.

While the project was not completed, one can still see evidence of the work on the shores of the Cumberland Basin. Figure 6 (Appendix F) shows the remains of the lifting dock and the filled-in line of the railway. The Project area is located just at the right-hand side of the photograph and Fort Lawrence Ridge can be seen to the left.

4.5.7.2 Previous Archaeology

There has been archaeological work done on the sites of Beaubassin Fort Beausejour and Fort Lawrence, but there are no reported archaeological sites located within the Project area.

4.5.7.3 Archaeological Potential

First Nations

There is documentation indicating the presence of Mi’kmaq people in the region surrounding the Project area. They would have used the Missiquash River as a canoe route between the Cumberland Basin and the Northumberland Strait. The Mi’kmaq would have also exploited the natural resources located within the marshlands and in the higher inland regions. It is very unlikely the Project area was a place where the Mi’kmaq would have settled, as it was too low and wet. It is more likely they were to be found

on the high ridge where the town of Amherst is now located. Therefore, the potential for the Project area containing First Nations archaeological resources should be considered low.

Historic

While there is a great deal of historic potential to the north and south of the Project area, concentrated on the high ground, it is unlikely that any settlement was attempted within the Project area itself. It is too low and wet for any type of habitation. However, there is little doubt that the Acadians had used the area beginning in the seventeenth century, and this is reflected in the dyke system constructed along the banks of the LaPlanche River (Figure 3 in Appendix F). The remains of these dykes can be seen today and they should be considered as significant. It is also possible that aboiteau were incorporated into the dyke construction as well. The historic potential for the study area should then be considered as moderate.

4.5.7.4 Summary

The background research shows that the region around the Project area has a rich prehistory and history, but there is no evidence of any settlement within the Project area itself. The area is salt marsh and would simply have been too wet and all settlement in the area is concentrated on any patch of high ground ('islands') or along the ridges of land. However, there are remnants of an Acadian-period dyking system within the Project area and this is considered as moderately significant. It is unclear if the dykes have been modified or destroyed by past development and difficult to evaluate what remains. The proponent intends to establish a 30 m buffer zone around the river, except in the case of culvert construction and upgrades to the roadway over the old aboiteau structure, thereby protecting the areas with the most potential to contact archaeological resources. The Chignecto Ship Railway was constructed very close to the study area but no impacts are predicted as a result of Project activities.

4.5.8 Transportation

Currently, traffic patterns in and around the Project area, are largely related to agricultural 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 site is immediately adjacent to Highway 104 and trucking the equipment to the site should be accommodated relatively easily.

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. Acciona does not anticipate the requirement for upgrades or modifications to existing roads for the purposes of transporting facility components to the site, with the exception of the main access road to the site, near the Wandlyn Inn and the road over the old aboiteau for construction equipment and as a secondary access route. The proponent may request the Nova Scotia Department of Transportation and Infrastructure Renewal to conduct road grading and widening of this road.

4.5.9 Safety Issues

Lands within the Project area do not present any safety issues, such as steep cliffs, deep or steep ravines and waterways. There currently exists clear, safe access to the Project area. Safety issues are typically associated with construction and decommissioning activities associated with the wind farm. However, safety issues must also be considered as they pertain to the operational phase and the potential interaction with the local populace and public access issues.

4.5.10 Visual Landscape

The viewshed was photographed in the field and assessed to determine what turbines could potentially be seen from specific locations. The view of the wind turbines varies according to factors related to distance, topography, existing vegetation cover and human-made structures including transmission lines. The Project area is located primarily on a sod farm.

The visual characteristics of the wind farm and the adjacent rural landscape type are considered to exhibit minimal scenic attributes with respect to landscape distinction. In analyzing views from several locations near the Project, it is anticipated that the wind farm infrastructure, particularly the turbines, will be visible from some distance.

Further information and viewshed photographs on the area's visual landscape are presented in Section 5.2.1.3).