3.7 VEC Selection

Based on preliminary investigations, provincial guidance, constraints analysis and the collective knowledge and expertise of the Project team, the following list of potential VECs will be used for analysis of potential impacts and mitigation:

- Air quality;
- Surficial geology (soil);
- Bedrock geology;
- Groundwater;
- Aquatic habitats;
- Fish and fish habitat;
- Terrestrial habitat;
- Wetlands;
- Rare plants;
- Avifauna;
- Bats;
- Acoustics;
- Visual aesthetic;
- Radar/telecommunication;
- Land use/recreation;
- Archaeological resources;
- First Nations resources;
- Local communities; and
- Human health and safety.

4. BIOPHYSICAL ENVIRONMENT AND EFFECTS MANAGEMENT

4.1 Atmospheric Environment

4.1.1 Weather and Climate

Nova Scotia's climate is quite varied and is largely governed by coastal influences and elevation (Davis and Browne, 1996). The Project Area (centered at 44°45'72.70"N, 64°19'78.0"W) lies within the Western Ecoregion of Nova Scotia, which extends from Yarmouth to Windsor (Neily et al., 2003). This region is characterized by mild winters and warm summers, although significant variations in temperature occur due to the proximity to the Bay of Fundy (Neily et al., 2003). Mean annual temperature for the region is 6.5°C, with summer and winter temperatures averaging 17.2°C and -4.3°C, respectively (Webb and Marshall, 1999). The typical growing season in the vicinity of the Project Area is 203 days (Webb and Marshall, 1999).

Local temperature data were obtained from the Windsor Martock meteorological station (44°56'00.00N, 64°10'00.00W) located approximately 18 km to the northeast of the

Project Area. For the period from 1971-2000, the mean annual temperature was 7.4°C, with a mean daily high of 12.3°C and a mean daily low of 2.4°C (Environment Canada, 2011a). January and February were the coldest months (-5.2 and -4.4°C, respectively), while the warmest months were July and August (19.8 and 19.3°C, respectively) (Environment Canada, 2011a).

Local precipitation data were obtained from the Avon meteorological station (44°53'00.00N, 64°13'00.00W) located approximately 11 km to the northeast of the Project Area. This station was used for the precipitation analysis because it is situated closer to the Project Area than the Windsor Martock station, although it did not record temperature data. From 1971-2000, mean annual snowfall was 216.1 cm and rainfall was 1,211.6 mm (Environment Canada, 2011b). Most snowfall is received in December and January (46.5 and 52.6 cm, respectively), while the rainiest months are September, October, and November (114.7, 123.6, and 138.3 mm, respectively) (Environment Canada, 2011b). Information provided from the Greenwood meteorological station which is located approximately 50 km northwest of the Project Area, indicates that on average, over the last 30 years, fog, freezing fog or ice fog can be expected for 34 days per year (The Weather Network, 2012).

An obvious consideration with regards to local climate, particularly in the context of wind power development, is wind speed and direction under typical and extreme conditions. EC measures wind conditions in Nova Scotia at those meteorological stations that are under long term observation. The closest such station to the Project Area is in Greenwood (44°59'00.00N, 64°55'00.00W), located approximately 50 km to the northwest. The Canadian Climate Normals (1971-2000) for this station indicate an annual mean wind speed of 15.3 km/h, most commonly out of the southwest (Environment Canada, 2011c). The maximum hourly wind speed for this station was 113 km/h, recorded on January 10th, 1964, with the highest single wind gust measured at 188 km/h on February 2nd, 1976 (Environment Canada, 2011c). This station has an average of 35.6 days per year with wind speeds in excess 52 km/h (Environment Canada, 2011c).

4.1.2 Air Quality

Nova Scotia monitors air quality at six stations throughout the province. Measured parameters include ground-level ozone (O_3), particulate matter (PM2.5), and nitrogen dioxide (NO_2), and these values are used to calculate a score on the Air Quality Health Index (AQHI) (Environment Canada, 2011d). The AQHI is a scale from 1-10+, in which scores represent the following health risk categories: Low (1-3), Moderate (4-6), High (7-10), and Very High (10+).

The AQHI monitoring station closest to the Project Area is located at Kentville, approximately 34 km north of the Project Area. The AQHI at this site is usually low at all times of the year (Environment Canada, 2011e).

4.1.3 Effects and Mitigation

The potential effects to the atmospheric environment include increased emissions during construction and localized effects on air temperature and soil moisture during operation.

Evidence provided by researchers at Duke and Princeton Universities suggest that localized air temperatures can be affected by the rotors of wind turbines. Turbine blades can create air turbulence that mixes the air, creating a warming and drying effect that could lead to as much as a 2° C rise in early dawn hours, when natural wind conditions are usually calm. It is anticipated however, that air temperature changes will be local, and significant impacts in a regional context will not be experienced. Additionally, rotors are thought to redirect wind to the ground, increasing evaporation of soil moisture (ScienceDaily, 2005). This is likely to increase in exposed areas subject to clearing, resulting in limited vegetative ground cover. Natural re-vegetation of previously exposed areas is likely to occur over time, and will decrease impacts related to soil moisture loss. No other potential effects have been identified in relation to the development of a wind farm and weather and climatic conditions.

Wind farms are a source of green energy production whereby the process does not involve combustion of fuels. However, albeit minimal, some emissions are expected during both the construction and operational phases of the Project from on-site vehicles. Potential effects to the atmospheric environment, during the different phases of the Project, are summarized in Table 4.1.

Table 4.1: Potential Effects on the Atmospheric Environment

Potential Effect	Source of Effect	Project Phase*		
		C	M/O	D
Soil moisture loss	Redirection of wind to the ground.		✔	
Increased airborne particulates and dust	Ground work (i.e. excavation, grading and exposed surfaces).	✔		✔
	Transportation of materials (i.e. mud on truck loads and collection of mud on wheels).	✔		✔
	Blasting activities (if required).	✔		
	Stockpiled material.	✔		✔
Increased vehicle emissions	Release of CO_2, nitrous and sulphur oxides from trucks, onsite machinery, service vehicles and maintenance equipment.	✔	✔	✔
Localized air temperature rise	Turbulence created by turbine blades.		✔	

**C – Construction phase M/O Maintenance/Operational Phase D – Decommissioning Phase*

The following mitigative measures will be implemented to minimize or eliminate impacts to the atmospheric environment:

- Development and implementation of an Environmental Protection Plan (EPP) for the Project, which will include provisions for erosion and sediment control, emission controls, and dust control. EPP to be approved by NSE prior to the start of construction.
- Contractor requirements that address all applicable air quality criteria during construction.
- Monitoring of complaints and implementation of appropriate actions, as required.
- Following construction, in areas where soil remains exposed (outside the turbine graded pads), re-vegetation with native species will occur to decrease the potential effects of soil moisture loss.

Mitigation measures described above are considered to be standard best practices, and are expected to address potential impacts. Therefore, atmospheric environment is not assessed further.

4.2 Geophysical Environment

4.2.1 Physiography and Topography

The Project Area is located within two physiographic subdivisions: the Atlantic Uplands and the Hants-Colchester Lowlands (Goldthwait, 1924). Topography is characterized by a rolling till plain situated within the drumlin fields of the New Ross area. Elevation of the region ranges from 145 m to upwards of 250 m above sea level. Overall, the topography undulates but generally slopes downward from west to east.

4.2.2 Surficial Geology

Surficial geology in this part of the province can be characterized into three different units: organic deposits; silty till plain, drumlins, and stony till plain; and bedrock (Drawing 4.1). The majority of the site is overlain by a silty, compact till material which is derived from both local and distant sources (Stea et al., 1992). The silty till plain (ground moraine) creates a flat to rolling topography with a thicker till masking bedrock undulations. Drumlins appear sporadically ranging from 4 to 30 m in depth consisting of a siltier till with a higher percentage of distant source material, including red clay (Stea et al., 1992). The bog located south of South Canoe Lake is classified as an organic deposit composed of sphagnum moss, peat and clay. These organic deposits can range in depth from 1 metre at the edge to 5 m in the center.

A band of exposed bedrock and stony till plain overlies the eastern portion of the Project Area extending from Card Lake at the southern Property Boundary to South Canoe Lake at the northern Property Boundary. Surficial material in this area consists of a stony, sandy matrix material derived from local bedrock sources with many surface

boulders. Local topography varies from flat to strongly rolling with ridges of exposed bedrock in thin till areas. Till in this area generally ranges from 3 to 30 m in thickness.

The predominant soils are well-drained, coarse sandy loams that have developed on granite till (Neily, 2003). The majority of the soils can be characterized as shallow, stony and dry except those that have developed on drumlins, which tend to be deeper and less stony. Large areas of imperfectly drained soils occupy sections of land between drumlins. Elevated concentrations of radon soil gas have been confirmed in the nearby Millet Brook area, which are associated with highly evolved Middle-Lake Devonian leucomonzogranite on the eastern margin of the South Mountain Batholith (Goodwin et al., 2008).

4.2.3 Bedrock Geology

Bedrock geology consists of Middle to Late Devonian aged granite bedrock of the South Mountain Batholith (Keppie, 2000). Varying compositions of granite within the Project Area include muscovite-biotite monzogranite, leucomonzogranite, and muscovite leucomonzogranite, with the majority underlain by leucomonzogranite (Drawing 4.2). The batholith is typically composed of a quartz-feldspar-biotite granite which intruded the lower metamorphic rocks. Granites have low matrix permeability and fracture systems contribute the only significant permeability in these rocks. Trescott (1969) reports that permeability in granite is found almost entirely in joints except near the surface where the release of confining pressure by erosion of the overlying rock has allowed fractures to open and where weathering has increased the aperture of many fractures (Trescott, 1969).

N

North Canoe Lake

New Ross Road

Little Otter Lake

South Canoe Lake

Lake Lewis

Mud Lake

Cooney Lake

Big Otter Lake

Avon River

Hants County

Highway 14

Joe Long Lake

Long Bay

Halifax County

Bog Lake

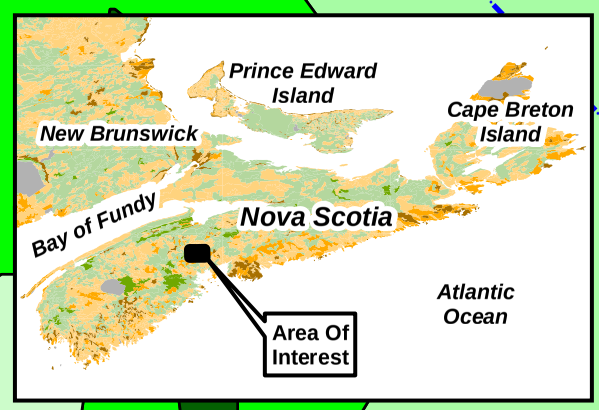
Card Lake

Dam Bay

Lunenburg County

Card Lake

0 625 1,250 2,500 3,750 5,000 Metres



Notes:

1. Reference: Nova Scotia Department of Natural Resources Map ME 1992-3, Surficial Geology Map of the Province of Nova Scotia, 1:500 000, by R. R. Stea, H. Conley and Y. Brown, 1992. Digital product compiled by R. R. Stea and B. E. Fisher.
2. Projection: NAD83(CSRS), UTM Zone 20 North.

Legend:

- Project Area
- County Boundary
- Highways

Surficial Geology By Unit

- Bedrock
- Organic Deposits
- Silty Drumlin
- Silty Till Plain (Ground Moraine)
- Stony Till Plain

Surficial Geology

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MINAS BASIN

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Strum ENVIRONMENTAL

Date:	Project #:
May 2012	12-4361
Scale: 1:40,000	**Sheet:** 4.1
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Checked By: A. Walter	

N

COMg

M-LDflmg

North Canoe Lake

M-LDflmg

M-LDlmg

M-LDflmg

New Ross Road

Highway 14

Little Otter Lake

South Canoe Lake

M-LDmlg

Lake Lewis

Mud Lake

Avon River

Hants County

M-LDflmg

Cooney Lake

Big Otter Lake

M-LDlmg

M-LDmbmg

Joe Long Lake

Long Bay

Halifax County

Bog Lake

Highway 14

M-LDlmg

Card Lake

Dam Bay

Lunenburg County

M-LDmbmg

Card Lake

Prince Edward Island

New Brunswick

Cape Breton Island

Bay of Fundy

Nova Scotia

Atlantic Ocean

Area Of Interest

0 625 1,250 2,500 3,750 5,000 Metres

Notes:

1. Reference: Nova Scotia Department of Natural Resources (NS DNR), Minerals and Energy Branch. Map ME 2000-1, Geological Map of the Province of Nova Scotia, Compiled by J. D. Keppie.
2. Projection: NAD83(CSRS), UTM Zone 20 North.

Legend:

- Project Area
- County Boundary
- Highways

Bedrock Geology By Formation:

- Goldenville Formation
- Middle - Late Devonian muscovite biotite monzogranite
- Middle - Late Devonian leucomonzogranite
- Middle - Late Devonian fine grained leucomonzogranite
- Middle - Late Devonian muscovite leucomonzogranite

Bedrock Geology

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May 2012	12-4361
Scale: 1:40,000	**Sheet:** 4.2
Drawn By: H. Serhan	
Checked By: A. Walter	

Sulfides occur in trace amounts throughout all granitic rock units, but concentrate locally near the contact with the sulphide-rich Meguma Group (Poulson et al., 1991; Samson, 2005). Geological mapping indicates the Goldenville Formation of the Meguma Group lies approximately 1.9 km north of the Project Area. Metallic and non-metallic mineral occurrences have been noted within this transition zone including flurorite, pyrite, chalcopyrite and molybdenite. A large hydrothermal deposit (uranium-silver) occurs approximately 6 km north of the Project Area at Millet Brook (Chatterjee and Strong, 1984).

Granitic regions in general are prone to higher levels of uranium in the subsurface that, when broken down naturally, form the radioactive gas, radon. When released to outdoor air, radon is diluted and is not a concern; however, in enclosed spaces the gas can sometimes accumulate to high levels (NSE, 2009c). The current Canadian guideline for radon in indoor air is 200 Becquerels (Bq) per m^3. Radon soil gas emissions were monitored in 2007 – 2008, at known uranium occurrences, in Millet Brook. The radon gas concentrations were shown to dissipate very rapidly to negligible concentrations in ambient air at 10 cm aboveground directly over the mineralized source (Goodwin, 2008).

4.2.4 Hydrogeology and Groundwater

A hydrogeological assessment was carried out by Strum in January 2012 to assess local groundwater supply and quality within the Property Boundaries and surrounding region. Detailed findings are provided in Appendix B.

Groundwater Quantity

Water supplies near the Project Area are generally derived from individually drilled wells. According to the Nova Scotia Well Log Database (NSE, 2010) of logs for wells constructed between 1940 and 2010, wells near the Project Area are generally installed in granite bedrock with the exception of those located north of the Project Area, which encounter the metamorphic rocks of the Goldenville formation. A summary of the pertinent well properties included in these logs for wells within 500 m of the Project Area, are presented in Table 4.2.

Table 4.2: Summary of Drilled Well Records

	Drilled Date (yr)	Well Depth (m)	Casing Length (m)	Estimated Yield (Lpm)	Water Level (m)	Overburden Thickness (m)	Water Bearing Fractures (m)
Minimum	1980	23.8	4.6	0.9	3.4	1.5	6.1
Maximum	2001	152.3	12.2	68.1	7.6	5.8	152.3
Average	1995	75.4	7.5	20.8	5.0	3.3	43.5
Geomean	1995	63.8	7.1	11.5	4.7	3.0	32.0
Number of well records	12	12	12	9	5	12	10

Source: NSE, 2010

Based on short term driller's estimates for the 12 drilled wells identified in the NSE Well Log Database, the average yield for wells within 500 m of the Project Area is approximately 20.8 Lpm (5.5 gpm) and average well depth is approximately 75.4 m (247.3 ft). These yields represent very short term yields estimated by the driller at the completion of well construction. Groundwater flow in granite bedrock is highly fracture dependant with the majority of drilled wells containing one to two water bearing fractures. Fracture depths ranged from 6.1 m (20.0 ft) to 152.3 m (499.5 ft). The closest drilled well is located along the northern boundary of the Project Area.

The NSE Pump Test Database (NSE, 2009c) provides longer term yields for select wells throughout the province. Two regional wells drilled through granite bedrock, and located within a 10 km radius, of the Project Area indicate long term safe yields (Q_{20}) of 5.9 Lpm (1.3 gpm) and 50 Lpm (11 gpm), and apparent transmissivity (T) values of 0.8 and 3.7 m^2/d. Storativity values were not available from the two pump tests.

An observation well (No. 079) is situated at the Jerry Lawrence Provincial Park, approximately 37 km southeast of the Project Area. This well forms part of the NSE Nova Scotia Groundwater Observation Well Network (NSE, 2011a). A 3 hour pump test was completed on the well in 2008 and results indicated a T value of 1.53 m^2/d and a safe yield rate of 39.8 Lpm (8.8 gpm).

Groundwater Quality

Water quality from dug wells in the vicinity of the Project Area is very limited. Analytical data from one dug well within 10 km of the Project Area was available for review, in addition to several dug wells within Lunenburg County, from the DNR Groundwater Mapping database (NSDNR, 2009a). Some median or average values and ranges from various literature sources were also reviewed. Water quality from dug wells is normally acceptable when in compliance with the Guidelines for Canadian Drinking Water Quality (GCDWQ) (Health Canada, 2010). Hardness, iron, manganese, colour, turbidity, and low pH are the most common chemical parameters noted in the area that may pose aesthetic issues to the user and may require point-of-entry treatment.

Groundwater in contact with granite bedrock will tend to have higher alkalinity, hardness, and total dissolved solids (TDS). Potential health-related concerns associated with groundwater supplies in granite bedrock aquifers include elevated concentrations of arsenic (related to sulphide and base metal mineralization), as well as radionuclides such as radium, uranium, fluoride, radon, and lead-210 (Fracflow, 2004). Mineralized zones near the contacts of granite bedrock and the Meguma Group (Goldenville Formation) bedrock (approximately 1.9 km north) can result in elevated concentrations of arsenic, iron and manganese. Water quality data from four wells drilled in granite bedrock located within 10 km of the Project Area indicated exceedences of iron, fluoride, arsenic and uranium guideline values. All other parameters were found to typically meet the "Guidelines for Canadian Drinking Water

Quality" (GCDWQ) (Health Canada, 2010).

4.2.5 Effects and Mitigation

Potential geophysical effects from Project activities include localized disturbances of surface soil and shallow bedrock from ground stripping, excavation and heavy machinery during construction. Mobilization of soils by wind or water may be transported to nearby surface water bodies. If sulphide bearing minerals are present on site, acid rock drainage (ARD) may occur once bedrock is disturbed.

Proposed turbine locations are greater than 1.2 km from any likely domestic well location; however, Project Area boundaries are near several identified wells. While large scale blasting is not anticipated to occur, the potential for short term, localized blasting may arise during construction throughout the site.

Potential effects to the geophysical environment during the different phases of the Project are summarized in Table 4.3.

Table 4.3: Potential Effects on the Geophysical Environment

Potential Effect	Source of Effect	Project Phase*		
		C	M/O	D
Soil mobilization	Ground stripping, excavation and heavy machinery use.	✔		✔
	Blasting (if required)	✔		
ARD	Excavation activities.	✔		✔
Interference with domestic wells	Blasting (if required).	✔		

**C – Construction phase M/O Maintenance/Operational Phase D – Decommissioning Phase*

The following mitigative measures will be implemented to minimize or eliminate impacts to the geophysical environment:

- Development and implementation of an EPP for all phases of construction that will include specific sediment and erosion controls as well as provisions for the inspection and monitoring of erosion and sedimentation controls, handling of petroleum products and environmental protection measures. EPP will be approved by NSE prior to the start of construction.
- In the event mapped areas of the Meguma Group contact are closer than indicated, the potential for environmental issues relating to ARD will be assessed if future disturbance or exposure of bedrock is anticipated (i.e. as part of construction). Any issues related to ARD will be completed in accordance with the NSE Sulphide Bearing Material Disposal Regulations (NSE, 2011b).
- Upon confirmation of the final turbine layout, the location of any required blasting will be confirmed, and an inventory of wells in the vicinity of the blasting will be

completed. The need to complete a pre-blast survey and monitor during blasting will also be evaluated.

- Upon confirmation of the final turbine layout, the location of any watercourses and waterbodies will be confirmed, blasting activities will be in accordance with the setback distances and practices outlined in the Department of Fisheries and Oceans (DFO) Guidelines for the Use of Explosives Near Canadian Fisheries Waters, 1998.
- Minimize the extent of blasting activities, to the extent possible.
- Areas of exposed bedrock or previously undisturbed soils will be minimized during construction.
- Following any blasting or disturbance of soils or bedrock, exposed soils or bedrock will be recovered with soil and re-vegetated as required to minimize any exposure.
- Workers will be required to conform to appropriate attire during work at the site.

Mitigation measures described above are considered to be standard best practices, and are expected to address potential impacts. Therefore, the geophysical environment is not further assessed.

4.3 Freshwater Environment

4.3.1 Freshwater Habitats

The majority of the Project Area lies within the Lahave Drumlins Ecodistrict that borders the South Mountain Ecodistrict (Neily et al., 2003). The New Ross area is characterized as a drumlin field where a reddish, moderately fine-textured till overlies the granite bedrock. Drainage is poor, and sluggish, and rivers and streams meander from one shallow lake to another, or among wetlands (Webb and Marshall, 1999).

The Project Area lies within two primary watersheds, referred to as the Avon River (1DE) and Gold River (1EG) Watersheds. The eastern portion of the Project Area lies within the Avon River Watershed. The Avon River flows northerly rising on the South Mountain, southwest of the town of Windsor. Near the rural community of Martock, the river enters a broad glacial river valley and becomes tidal, creating an estuary for the rest of the remaining route to the Minas Basin located several kilometers downriver from the Town of Hantsport. Prominent water bodies in the Avon River Watershed include Card Lake, Panuke Lake, Falls Lake, Big St. Margaret's Bay Lake and Mockingee Lake.

The Gold River Watershed occupies the eastern portion of Lunenburg County, including the western portion of the Project Area. Gold Brook, which forms the east branch of the Gold River is located in the northwestern corner of the Project Area and drains water into Lewis Lake located off site to the north. The river flows into Nova Scotia Lake, Long Lake, Grassy Lake, Wallaback Lake, and Camp Lake. Below Camp Lake, and before reaching Harris Lake, the river joins the north branch of the Gold River. Past Harris Lake, the Gold River enters De Adder Lake, followed by Lake Lawson near New

Ross, and then discharges into Mahone Bay.

The Project Area contains two surface water bodies including Cooney Lake and Mud Lake. Several additional water bodies are located adjacent to the Project Area and include: South Canoe Lake; North Canoe Lake; Lewis Lake; Big Otter Lake; Little Otter Lake; Joe Long Lake; Long Bay; Card Lake; Dam Bay; and Bog Lake. Multiple mapped watercourses also exist throughout the Project Area (Drawing 4.3).

Water quality data was obtained for lakes located within and surrounding the Project Area from the Lake Inventory Program (NSE, 2012).

Data from 12 lakes were reviewed, from sampling events completed between 1977 and 2006. Summary data of each lake including proximity to the Project Area is provided in Table 4.4. Corresponding water chemistry results are provided in Table 4.5.

N

North Canoe Lake

New Ross Road

WC3

WC2

Lake Lewis

South Canoe Lake

Little Otter Lake

Mud Lake

WC6

WC4

Cooney Lake

WC1

WC5

Big Otter Lake

Avon River

Highway 14

Hants County

Long Bay

Joe Long Lake

Bog Lake

Card Lake

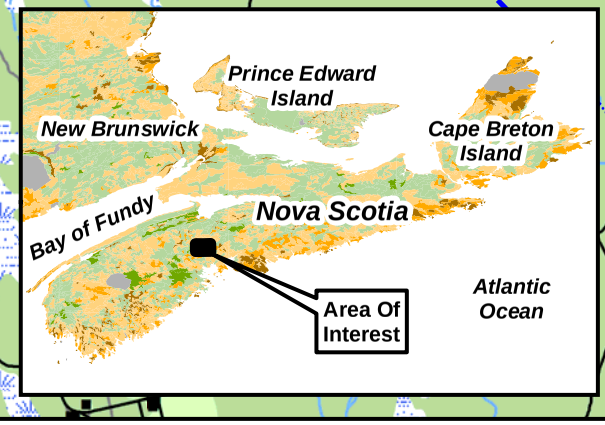
Dam Bay

Card Lake

Halifax County

Lunenburg County

0 625 1,250 2,500 3,750 5,000 Metres



Notes:

1. Reference: Nova Scotia Property Records. 1:10,000 digital topo mapping by Nova Scotia Geomatics Centre.
2. Projection: NAD83(CSRS), UTM Zone 20 North.

Legend:

- Proposed Turbine Locations
- Buildings
- Preliminary Watercourse Crossing
- Proposed Roads
- Project Area
- County Boundary
- Major Roads
- Roads
- Access Roads / Trails
- Mapped Stream
- Mapped Indefinite Stream
- Mapped Wet Area
- Water Bodies

Preliminary Watercourse Crossings

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Date:	Project #:
May 2012	12-4361
Scale: 1:40,000	**Sheet:** 4.3
Drawn By: H. Serhan	
Checked By: A. Walter	

Table 4.4: Summary of Lake Characteristics

Lake	Mean Depth (m)	Lake Volume (m^3)	Surface Area (ha)	Headwater Lake (y/n)	Approximate Distance from Project Area (km)
Armstrong	6.8	3,512,000	52	N	8 km northeast of the Project Area
Lewis	2.9	2,198,890	74.9	Y	Borders the western boundary of the Project Area
Little Island	2.5	467,470	19	N	1 km north of the Project Area
Mockingee	5.7	6,182,400	109.3	N	5 km northeast of the Project Area
North Canoe	2.4	2,216,869	87.5	N	Borders the northern boundary of the Project Area
Zwicker	4.9	2,805,100	56.9	N	4 km northeast of the Project Area
Card	2.9	770,000	270	N	1 km southeast of the Project Area
Little Joe Long	2.2	150,220	6.7	Y	2 km east of the Project Area
Long	2	3,841,802	197	N	3 km north of the Project Area
Nine Mile	1.2	579524	49.2	N	5 km south of the Project Area
South Canoe	4	9444280	237.1	N	Borders the south boundary of the Project Area
Wallaback	3.1	9009600	287.7	N	6 km northwest of the Project Area

Source: NSE, 2012

Table 4.5: Water Chemistry Results

Lake	Sample Date	Temperature(°C)		Dissolved Oxygen (mg/L)		Sechhi Disk (m)	Conductivity (umho/cm)	pH
		Surface	Bottom	Surface	Bottom			
Armstrong	21-Jul-77	26	24	8	4	1.9	40	
Lewis	9-Jul-80	19	10.5	8.4	5	1.7	22.5	5.0
Little Island	23-Aug-77	21.1	12.2	8	2	4.15	25	6.0
Mockingee	6-Aug-06	21.9	11.9	7.3	0.3	1.7	31	5.9
North Canoe	23-Aug-77	21	14.4	9	2	1.96	25	6.0
Zwicker	19-Aug-77	21	5.2	7	1	3.1	26	6.5
Card	16-Aug-06	22	7.5	7.9	3.2	1.75	29.5	5.1

Little Joe Long	3-Nov-80	4.2	4.2	11	11	3		6.2
Long	22-Aug-83	21	20.5	8	7	4.3	24.9	5.5
Nine Mile	19-Jul-89	23	22	6.8	5.6	1.5	39	5.1
South Canoe	24-Jun-80	21.9	15.5	8	5.6	1.2	17.9	6.4
Wallaback	18-Jun-80	19.9	14.8	8.8	7.4	2.1	18.7	7.0

Source: NSE, 2012

The majority of water quality data was collected prior to 1990 with the exception of Card Lake and Mockingee Lake, which were both sampled in 2006. Results were relatively consistent among all lakes with few apparent observations. Dissolved oxygen (DO) levels higher than 2 mg/L are considered optimal and were observed for all lakes with the exception of bottom readings from Mockingee and Zwicker Lakes. Conductivity levels reflected dilute waters ranging from 17.9 to 40 umho/cm. Populated areas may contribute to slightly higher conductivity readings as illustrated with South Canoe (17.9 umho/cm) and Armstrong Lake (40 umho/cm). Armstrong Lake is surrounded by a residential community where the potential for pollution is greater in comparison to South Canoe Lake which is fairly isolated. All lakes surveyed reported acceptable pH levels (guideline 5.0 – 9.0), secchi disk (<1.2 m), and surface DO levels (>5.0) mg/L) based on water quality guidelines for the protection of aquatic life (CCME 2009) and recreational use guidelines (Health Canada, 2009).

4.3.2 Fish and Fish Habitat

For the purposes of the EA, all watercourses and lakes existing within the Project Area have been assumed to be 'fish bearing' and shall be treated as such throughout site development plans and construction., unless otherwise determined.

Since tributaries to the Avon River exist within the eastern portion of the Project Area, a review of the Avon River fish community was completed. Table 4.6 lists the fish species identified.

Table 4.6: Fish Species Historically and Recently Identified (1995-2005) in the Avon River and Estuary

Scientific Name	Common Name	Type
Alosa pseudoharengus	Alewife (gaspereau)	Anadromous
Alosa sapidissima	American shad	Anadromous
Ameiurus nebulosus	Brown bullhead	Freshwater
Anguilla rostrata	American eel	Catadromous
Apeltes quadracus	Four-spined stickleback	Estuarine/freshwater
Catostomus commersoni	White sucker	Freshwater
Couesius plumbeus	Lake chub	Freshwater

Scientific Name	Common Name	Type
Esox niger	Chain pickerel	Freshwater
Fundulus heteroclitus	Banded killifish	Freshwater
Gadus morhua	Atlantic cod	Marine
Gasterosteus aculeatus	Three-spined stickleback	Estuarine/freshwater/ Anadromous
Liposetta putnami	Smooth flounder	Marine
Luxilus cornutus	Common shiner	Freshwater
Menidia menidia	Atlantic silversides	Marine
Microgadus tomcod	Tomcod	Estuarine/Anadromous
Micropterus dolomieu	Smallmouth bass	Freshwater, introduced
Morone americana	White perch	Anadromous
Morone saxatilis	Striped bass	Anadromous
Notemigonus crysoleucas	Golden shiner	Freshwater
Notropis heterolepis	Blacknose shiner	Freshwater
Oncorhynchus mykiss	Rainbow trout[1]	Freshwater introduced
Osmerus mordax	Rainbow smelt	Anadromous
Perca flavescens	Yellow perch	Freshwater
Petromyzon marinus	Sea lamprey	Anadromous
Phoxinus eos	Northern redbelly dace	Freshwater
Pseudopleuronectes americana	Winter flounder	Marine
Pungitius pungitius Y	Nine-spined stickleback	Estuarine/anadromous
Salmo salar	Atlantic salmon	Anadromous
Salmo trutta[3]	Brown trout	Anadromous, introduced
Salvelinus fontinalis Y	Brook trout	Freshwater/anadromous
Semotilus atromaculatus	Creek chub	Freshwater
Squalus acanthias	Spiny dogfish	Marine

[1] Confirmed only in Meadow Pond
[2] Avon River population may be extirpated; but may still be in other tributaries; from local KI observations
[3] Presence not confirmed; only evidence are accounts by two local KIs and an unofficial, unpublished NS Department of Lands and Forests (NSDLF) survey of fishery officers
Source: Isaacman and Beazley, 2005

In addition to above listed fish species, a review of the Atlantic Canada Conservation Data Center (ACCDC) database for fish species recorded within a 100 km radius of the Property Boundary was completed. All species including status rankings are provided in Table 4.7.

Table 4.7: Fish Species Recorded within a 100 km radius of the Property Boundary

Common Name	Scientific Name	NSDNR Status[1]	COSEWIC Status[2]	SARA Status[3]	NSESA Status[4]
Atlantic salmon	*Salmo salar*	Red	Special Concern	No Status	Not Listed
Atlantic salmon Inner Bay of Fundy pop.	*Salmo salar pop.1*	Red	Endangered	Endangered	Not Listed
Atlantic sturgeon	*Acipenser oxyrhynchus*	Red	Threatened	Not Listed	Not Listed
Atlantic whitefish	*Coregonus huntsmani*	Red	Endangered	Not Listed	Endangered
Striped bass	*Morone saxatilis*	Red	Threatened	No Status	Not Listed

[1] NSDNR, 2009b; [2] COSEWIC, 2009; [3] SARA, 2011; [4] NSESA, 2007; [5] ACCDC, 2011

Atlantic Salmon

Atlantic salmon are native to the North Atlantic Ocean and coastal rivers (NSFA, 2007), and, as an anadromous species, spend long migration periods in the ocean, returning to freshwater streams to reproduce. The species prefers rivers that are clear, cool and well oxygenated and that contain shallow riffles with gravel, rubble, rock or boulder bottoms (COSEWIC, 2011a). In the western portion of the Project Area, Gold Brook forms the eastern branch of the Gold River. This river once had a healthy population of Atlantic salmon but in recent years, the population has diminished to the point of the river being completely closed to salmon angling (Bluenose Coastal Action Foundation, 2011). This species is unlikely to occur in the Project Area.

Atlantic Salmon (Inner Bay of Fundy (iBoF))

Although the iBoF population of Atlantic salmon have been known to exist in the Avon River, the only anadromous species confirmed to still regularly ascend to the upper Avon River are blueback herring and alewife (gaspereau), although sea trout are occasionally observed (Isaacman and Beazley, 2005). Furthermore, the salmon population in the Avon River is either thought to have extremely low abundance or to have been extirpated. Therefore, this species is unlikely to occur in the Project Area.

Atlantic Sturgeon

Occurring in rivers and estuaries near North Atlantic shore environments, the Atlantic sturgeon requires a river with access to the sea, preferably with deep channels. The species spawns in freshwater over rocky-gravel substrates at depths of 1-3m in areas of strong currents, under waterfalls, and in deep pools (COSEWIC, 2011b). The Atlantic sturgeon has also been reported in the Minas Basin and the Avon River (as cited in Colligan et al., 1998). The depth of water observed in portions of the Avon River

channel closest to the Project Area (approximately 3.6 km to the east), as well as other channels across the Project Area, do not appear deep enough to provide suitable Atlantic sturgeon habitat. This species is unlikely to occur within the Project Area.

Atlantic Whitefish

The Atlantic whitefish is typically anadromous and spawns in the deeper cool waters of Hebb, Milipsigate and Minamkeak Lakes in the Petite Riviere Watershed (MTRI 2008). Although recovery strategies are ongoing in southwest Nova Scotia (Bluenose Coastal Action Foundation, 2011), it is very unlikely that the species would occur in the Project Area.

Striped Bass

Striped bass are typically associated with estuaries and coastal waters. The species spawns in freshwater and occasionally brackish water. In Nova Scotia, the following rivers are known or believed to sustain spawning populations: the Annapolis River in the outer Bay of Fundy; and the Shubenacadie–Stewiacke River system in the inner Bay of Fundy (Rulifson and Dadswell, 1995).These river systems are not part of the watershed associated with the Project, so it is very unlikely that the species would occur in the Project Area.

4.3.3 Watercourse Crossings

Watercourse locations were identified along the majority of existing access road locations within the Project Area during the 2011 wetland field surveys. These watercourses are listed in Table 4.8. Additional field surveys will be completed in 2012 to confirm the presence/absence of watercourses in relation to the final site layout. Four watercourse locations (WC1-4) were identified on existing roads, as well as two additional mapped watercourses (WC5-6).

Table 4.8: Location of Watercourse Crossings along Existing Access Roads

Watercourse ID	Location	Width (m)	Water Depth (cm)	Substrate	Flow
Watercourse 1[1]	N: 4958633m, E: 394330m	1-1.5	10	Gravel	slow
Watercourse 2[2]	N: 4961250m, E: 392292m	1.5-2	10	Sand/gravel	moderate
Watercourse 3[2]	N: 4961287, E: 392274m	0.5-1	10	Sand/gravel	moderate
Watercourse 4[2]	N: 4959245m, E: 392917m	1-1.5	7	Sand/gravel	slow
Watercourse 5[3]	N: 4956984m, E: 394093m.	N/A	N/A	N/A	N/A
Watercourse 6[3]	N: 4960453m, E: 395678m.	N/A	N/A	N/A	N/A

[1] Watercourse characterization completed in October 26- 28, 2011

[2] Watercourse characterization completed on December 6, 2011
[3] Mapped Watercourse; no characterization completed

Based on the proposed road layout, it is estimated that turbine access roads will require six watercourse crossings within the Project Area (Drawing 4.3). No watercourse alteration impacts are expected in association with turbine pads, as all pads will be located a minimum of 30m from watercourses.

4.3.4 Effects and Mitigation

The potential effects on the aquatic environment are mostly related to the construction and decommissioning phases of the Project. Site activities may result in erosion and sedimentation leading to the introduction of silt and sediments to aquatic habitats thereby affecting both surface water quality, and fish and fish habitat at local and downstream areas. Direct and indirect effects creating alterations to flow and fish habitat are also possible during both construction and decommissioning phases as large equipment is utilized to complete activities associated with these phases. Improper disposal of wastes throughout all Project phases can also impact surface water quality, and fish and fish habitat. Potential effects to the freshwater environment are summarized in Table 4.9.

Table 4.9: Potential Effects on the Freshwater Environment

Potential Effect	Source of the Effect	Project Phase*		
		C	M/O	D
Sediment and erosion	Excavation, installation of water crossing infrastructure, grubbing, vegetation clearing, blasting (if required), etc.	✔		✔
	Increased surface run-off due to impervious surfaces (i.e. access roads).	✔	✔	✔
Flow alteration	Culvert and ditch blockages and use of large machinery.		✔	
Disturbance/alteration to fish habitat	Use of large machinery, and installation of watercourse crossings.	✔		✔
Improper disposal of wastes	Leaks and accidental spills.	✔	✔	✔

**C – Construction phase M/O Maintenance/Operational Phase D – Decommissioning Phase*

As previously noted, the Proponent will be treating all watercourses as salmonid bearing. Fish habitat assessments will be completed where needed (i.e. watercourse crossings) during the permitting stage of the Project. Avoidance of watercourse crossings (related to access roads) will be practiced, to the extent possible, and where unavoidable, completed in accordance with the NSE Watercourse Alterations Specifications (i.e. protective of fish habitat).

To minimize other potential impacts to the freshwater environment, the following mitigation measures will be employed:

- Development and implementation of an EPP for the Project, which will include provisions for an erosion and sediment control plan, as well as a spill contingency plan. EPP will be approved by NSE prior to commencing construction.
- Field confirmation of all watercourse locations in relation to road and pad locations (once the road and turbine layout is finalized).
- Placement of turbine pads at a minimum of 30m from any watercourse, where possible.
- Maintenance of equipment in good working order to reduce the risk of spill/leaks and avoid surface water contamination.
- Completion of any blasting (if required) in accordance with the setback distances and practices outlined in the DFO "Guidelines for the Use of Explosives in or Near Canadian Fisheries Waters" (1998).

Mitigation measures described above are considered to be standard best practices, and are expected to address potential impacts. Therefore, the freshwater environment is not further assessed.

4.4 Terrestrial Habitats

4.4.1 General Habitats

Vegetation composition within the Property Boundary is mixed wood forest, made up of intermediate to tall stands of red spruce (*Picea rubens*), eastern hemlock (*Tsuga canadensis*), and white pine *(Picea strobus)*. American beech *(Fagus grandifolia),* sugar maple *(Acer saccharum)*, and red oak *(Quercus rubra)* are found on exposed slopes and hilltops, particularly around lakes. Fire stands of red oak *(Quercus rubra)*, red maple (*Acer rubrum*), and white birch (*Betula papyrifera)*, often mixed with white pine and black spruce *(Picea mariana)*, are abundant. Balsam fir *(Abies balsamea)* and black spruce occupy the poorly drained sites (Webb and Marshall, 1999).

Ground vegetation typical of this type of mixed wood forest includes bracken fern (*Pteridium aquilinium Kuhn*), bunchberry *(Cornus Canadensis)*, sheep-laurel (*Kalmia angustifolia*) and blueberry (*Vaccinium angustifolium).*

Habitat types present within the Project Area are presented in Drawing 4.4. Relative percent cover of habitats is listed in Table 4.10.

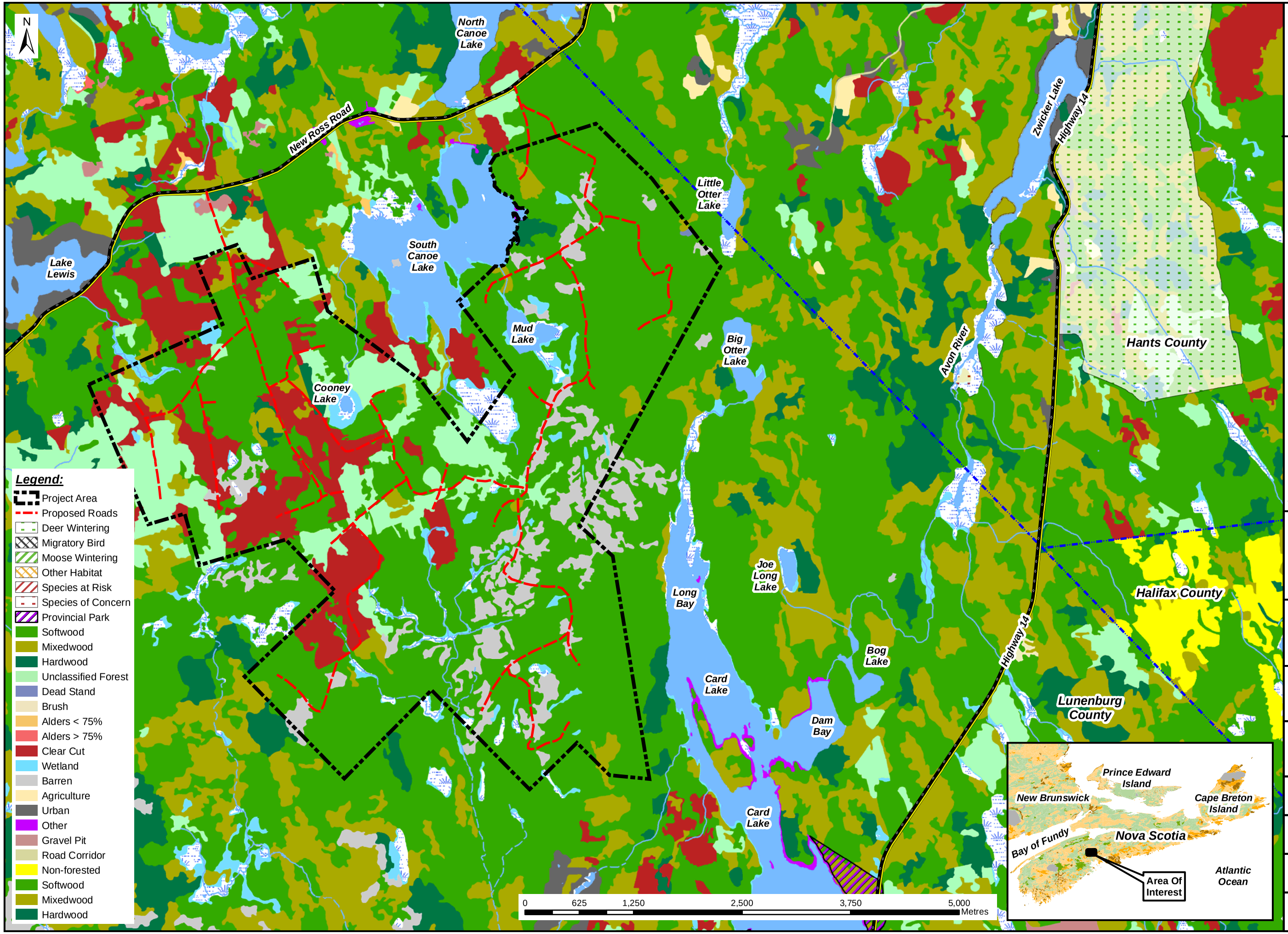
Table 4.10: Habitat Types - Cover

Habitat Type	Percent Cover
Softwood	62.4%
Clear Cut	10.9%
Unclassified Forest	10.26%
Barren	7.9%
Wetland	3.55%
Mixed Wood	3.4%
Hardwood	<1%
Water Body	<1%
Dead Stand	<1%
Brush	0%
Alders <75%	0%
Alders >75%	0%
Agriculture	0%
Other	0%
Gravel Pit	0%
Road Corridor	0%
Urban	0%

Source: NSDNR, 2011a

The Project Area is mostly forested but also supports other habitats including shrubby barren, clear cut, and wetland habitats. Softwood stands dominate the landscape (62.4%) and consist mainly of balsam fir, black spruce, red spruce and eastern hemlock species. Unclassified forest accounts for 10.26% and mixed wood stands account for 3.4% of the cover type within the Project Area. In addition to the softwoods already mentioned, these stands consist of mainly red maple, yellow birch *(Betula alleghaniensis)* and paper birch species.

Areas of significant logging (clear cut) occur throughout the Project Area accounting for 10.9% of the cover type, evident by the presence of an extensive complex of older logging roads. Western portions of the site have undergone significant logging, likely within the last five years. Vegetation in harvested areas is predominantly coniferous. Regeneration of the forest canopy is slow due to thin soils and poor soil quality, which has also resulted in the absence of agricultural operations in the area (Daborn, 2006). Secondary growth hardwood forests exist elsewhere within the Property Boundaries, indicating historical tree harvesting activities.



Notes:

1. Reference: Nova Scotia Property Records. 1:10,000 digital topo mapping by Nova Scotia Geomatics Centre. Nova Scotia Department of Natural Resrouces (NS DNR) Forest Inventory.
2. Projection: NAD83(CSRS), UTM Zone 20 North.

Habitat Cover Type

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Checked By: A. Walter	

Barren habitat is relatively limited to areas of high land located in southeastern portions of the Project Area. Vegetation is dominated by shallow rooting shrub species such as sheep laurel, rhodora *(Rhododendron canadense)*, blueberry, and stunted black spruce and larch *(Larix laricina)*.

Wetland habitat is most abundant across lands associated with lake margins and watercourses; however, some areas of swamp habitat exist on flatter land at the top of watershed boundaries. Treed and shrub swamps are the more common wetland type within the Project Area, and typically consist of mixed wood communities, dominated by black spruce, balsam fir, red maple and yellow birch trees and shrubs. Additional information related to wetlands is provided in Section 4.4.2.

4.4.2 Wetlands

Wetland Surveys – 2011

Prior to the development of a finalized site layout, a wetland assessment was completed in October – December 2011 to identify locations of wetland habitat in relation to the preliminary site layout.

A desktop identification of the location and extent of potential wetlands across the area encompassing the preliminary site layout was completed by reviewing the following information sources:

- Aerial photography;
- Nova Scotia Wet Areas Mapping database (WAM);
- NS Significant Species and Habitats database; and
- Topographical maps.

This information was analyzed to produce a site plan showing areas with a high potential for wetland habitat. A conservative approach was used, by applying the following general strategies to identify areas considered to be high potential for wetland habitat:

- All wetlands identified on topographical maps and the NS Significant Species and Habitats Database.
- All areas identified by WAM to have a depth to groundwater of less than 0.5 m.
- All areas identified by WAM to have a depth to groundwater of between 0.5 m-2.0 m and located adjacent to “mapped” wetlands.
- All areas of relatively flat land existing between areas identified by the WAM to have a depth to groundwater of less than 0.5m, or between NSDNR mapped wetlands.

Results of the desktop review and identification of high potential areas for wetland

habitat is discussed in Appendix C.

Based on the results of the desktop review and the preliminary site layout, a field assessment strategy was developed and subsequently completed, in October - December 2011. This assessment was strategically planned to focus on land associated with the preliminary turbine and access road layout design. Strategic transects, designed to intercept preliminary access roads and turbine pads, were completed by experienced wetland delineators within 22 field assessment areas across the preliminary site layout. Using field identified wetland boundaries, in combination with field observations and desktop information, conservative wetland boundaries were identified. In addition, where preliminary roads were routed along existing roads, a 30 m wide easement was assessed and wetland boundaries defined.

Wetlands identified within the field assessment areas consisted predominantly of treed and shrub swamps (and former treed swamps in clear cuts). Most of the swamps function as outflow or seepage, basin type swamps that drain water from higher land and seep into lower lying watercourse systems and lakes, via drainage channels or seepage wetlands. Few areas of bog, fen and marsh habitat were observed within the 22 field assessment areas (less 10% of wetland identified). Wetland conditions are typically dominated by saturated surfaces and groundwater existing within 20 cm of the surface, although due to seasonality, areas of standing water and flowing water also existed. Table 4.11 summarizes the dominant types of wetland vegetation observed during the field assessments. Complete wetland assessment methodologies, results, and mapping are provided in Appendix C.

Table 4.11: Dominant Wetland Habitat Vegetation within the Preliminary Site Layout Area

Wetland Type	Herbaceous Plants	Shrub and Saplings	Trees
Treed and shrub swamps	Cinnamon fern	Balsam Fir	Balsam Fir
	Sheep Laurel	Black Spruce	Black Spruce
	Rattlesnake Grass	Red Maple	Red Maple
	Bunchberry	Yellow Birch	Yellow Birch
	Snowberry		
Swamps in areas of clear cut	Wool Grass	Black Spruce	N/A
	Sedge *spp*	Balsam Fir	N/A
Bogs	Sedge and grass *spp*	Black spruce	N/A
Fen	Sedge and grass *spp*	Black spruce	Black spruce
	Sheep laurel		

Wetland Impacts

The optimized site layout (Drawing 4.5) has been designed to avoid as much wetland habitat as possible utilizing the following information sources:

- Wetlands identified during the 2011 wetland survey;
- Aerial photography;
- Nova Scotia Wet Areas Mapping database (WAM);
- NS Significant Species and Habitats database; and
- Topographical maps.

Wherever possible, existing roads will be upgraded to minimize the construction footprint, rather than constructing a new road.

Impacts to wetland habitat throughout the Project Area were estimated using information obtained during the 2011 wetland surveys, topographical maps and the NS Significant Species and Habitats database. Based on the new optimized site layout, it is expected that 13 wetlands, totalling approximately 0.2 ha may be directly impacted by road upgrades and new construction. Most of the alterations are quite small ranging from 0.0008 ha to 0.05 ha, with the average alteration size of 0.02 ha. All alteration locations occurring adjacent to existing roads in the Project Area impact small portions of wetland edges and therefore, do not significantly increase overall habitat fragmentation. Impact areas across the remainder of the Project Area typically bisect narrow portions of large seepage wetlands. Wetland alterations for turbine pad construction have been avoided; additionally a minimum of a 30m buffer between the border of a pad installation and the delineated border of a wetland has been applied to the constraints of the layout. Minimal adverse effects to wetland function and hydrology are therefore expected.

Table 4.12 details the approximate impact area at each alteration location, based on the optimized site layout. Drawing 4.5 provides the location of each alteration within the Project Area.

N

North Canoe Lake

New Ross Road

Little Otter Lake

South Canoe Lake

Lake Lewis

A

G

H

Mud Lake

E

Big Otter Lake

Avon River

Highway 14

Hants County

B

Cooney Lake

C

F

L

D

J

I

K

M

Joe Long Lake

Long Bay

Halifax County

Bog Lake

Card Lake

Dam Bay

Lunenburg County

Card Lake

0 625 1,250 2,500 3,750 5,000 Metres

NS DNR Wetland Type

- Bog or Fen
- Fen
- Marsh
- Salt Marsh
- Swamp

Notes:

1. Reference: Nova Scotia Property Records. 1:10,000 digital topo mapping by Nova Scotia Geomatics Centre.
2. Projection: NAD83(CSRS), UTM Zone 20 North.

Legend:

- Buildings
- Wetland Impact Area
- Proposed Turbine Locations
- Proposed Roads
- Project Area
- County Boundary
- Major Roads
- Roads
- Access Roads / Trails
- Mapped Stream
- Mapped Indefinite Stream
- Mapped Wet Area
- Water Bodies

Preliminary Wetland Impact Areas

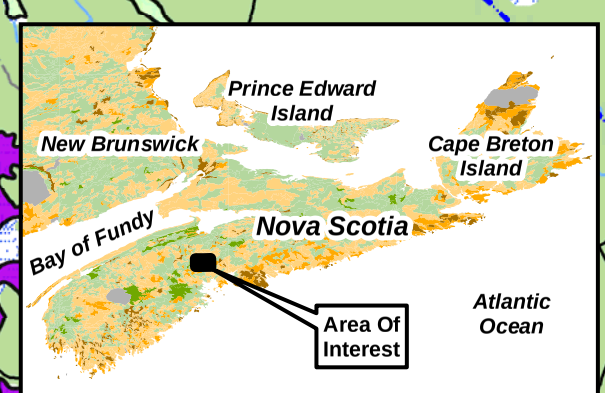

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Table 4.12: Details of Potential Wetland Alteration Locations

Alteration Location	Wetland Type	Area of Alteration (m^2)
A	Shrub Swamp[1]	14.96
B	Fen[1]	125.56
C	Treed Swamp/Shrub Fen[1]	259.65
D	Vernal Pool[1]	44.74
E	Unknown[1]	280.80
F	Unknown[1]	374.43
G	Unknown[1]	216.99
H	Unknown[1]	171.61
I	Treed Swamp[1]	59.97
J	Shrub Swamp[1]	8.59
K	Vernal Pool[1]	18.53
L	Fen/Treed Swamp[1]	543.38
M	Treed Swamp[2]	145.40

[1] Identification of wetland habitat completed via 2011 field surveys
[2] Identification of wetland habitat completed via Desktop Study

4.4.3 Effects and Mitigation

The potential effects on terrestrial habitats are mostly related to the construction phase of the Project, though some effects may also occur during maintenance and decommissioning activities. General habitats are susceptible to sedimentation and erosion, exposure of surface soils and subsequent habitat fragmentation due to clearing of vegetation in association with construction activities. Potential for colonization of invasive species exists in areas cleared of native vegetation.

As discussed above, the vast majority of wetland alterations are located along existing road edges and represent a small area of disturbance. Therefore, while wetland functions will be further evaluated during the permitting phase of the Project, it is expected that the Project will have a minimal effect on wetland habitat and hydrological functions. Indirect effects on wetlands could be triggered by other Project activities such as the management of water supplying and exiting wetland habitat via culverts and drainage ditches. In addition, the ongoing use of machinery and vehicles adjacent to wetland habitat could potentially cause water quality issues related to sediment and erosion and/or contamination via accidental spills and leaks during all phases of the Project.

Potential effects to terrestrial habitats, including wetlands, during the different phases of the Project, are identified in Table 4.13.

Table 4.13: Potential Effects on Terrestrial Habitats

Potential Effect	Source of the Effect	Project Phase*		
		C	M/O	D
General Habitats				
Sediment and erosion	Clearing, excavating, grubbing, and machine use.	✔		✔
Introduction of invasive species	Colonization of invasive species in areas of cleared vegetation.	✔	✔	
Habitat fragmentation	Clearing, grubbing, excavation.	✔		
Wetland Habitats				
Contamination	Fuel leaks and accidental spills from vehicles and machinery.	✔	✔	✔
Hydrologic imbalances	Landscape alterations, installing and maintaining culverts and drainage ditches.	✔	✔	✔
Habitat fragmentation	Infilling.	✔		
Loss of wetland habitat	Clearing, grubbing, infilling of wetland.	✔		
Disturbance to plant communities and substrates	Machine use within and adjacent to wetland habitat.	✔		✔

**C – Construction phase M/O Maintenance/Operational Phase D – Decommissioning Phase*

Provincial wetland alteration permits will be sought for each wetland alteration location, as required by the *Nova Scotia Wetland Alteration Application* process, during the permitting stage of the Project. This will include preliminary drawings and assessment information will be shared with NSE prior to the Wetland Alteration Application submission to ensure that the design options provide the maximum avoidance of wetlands, taking into account all other constraints presented within the EA registration document. The Proponent will complete a detailed delineation of the Project footprint within the growing season to confirm impact areas and characterizing functions of all impacted wetlands. Detailed mitigation measures and best management practices to reduce adverse effects on the altered wetlands, as well as the adjacent, non-altered wetlands will be outlined as part of this process. Compensation for direct impacts to wetlands will be provided in accordance with NSE Wetland Policy requirements.

The following additional mitigative measures will be implemented to minimize or eliminate impacts to terrestrial habitats:

- Development and implementation of a site specific EPP that will include best practices for erosion and sediment control, protection of vegetation, spill

prevention, and site drainage. EPP will be approved by NSE prior the commencement of construction.
- Use of existing road networks, to the extent possible.
- Machinery will be cleaned before and after use on site to prevent the spread of invasive species.
- Siting of roads and turbines 30 m minimum from expected wetland boundaries, where possible, otherwise use best design practices to minimize the footprint of alteration to as small are reasonability achievable.

Potential impacts to wetlands will be further evaluated, as a VEC, in Section 8.

4.5 Terrestrial Vegetation

4.5.1 Desktop Review

Plant surveys were completed across the site in 2007 and 2008 (Drawing 4.6).

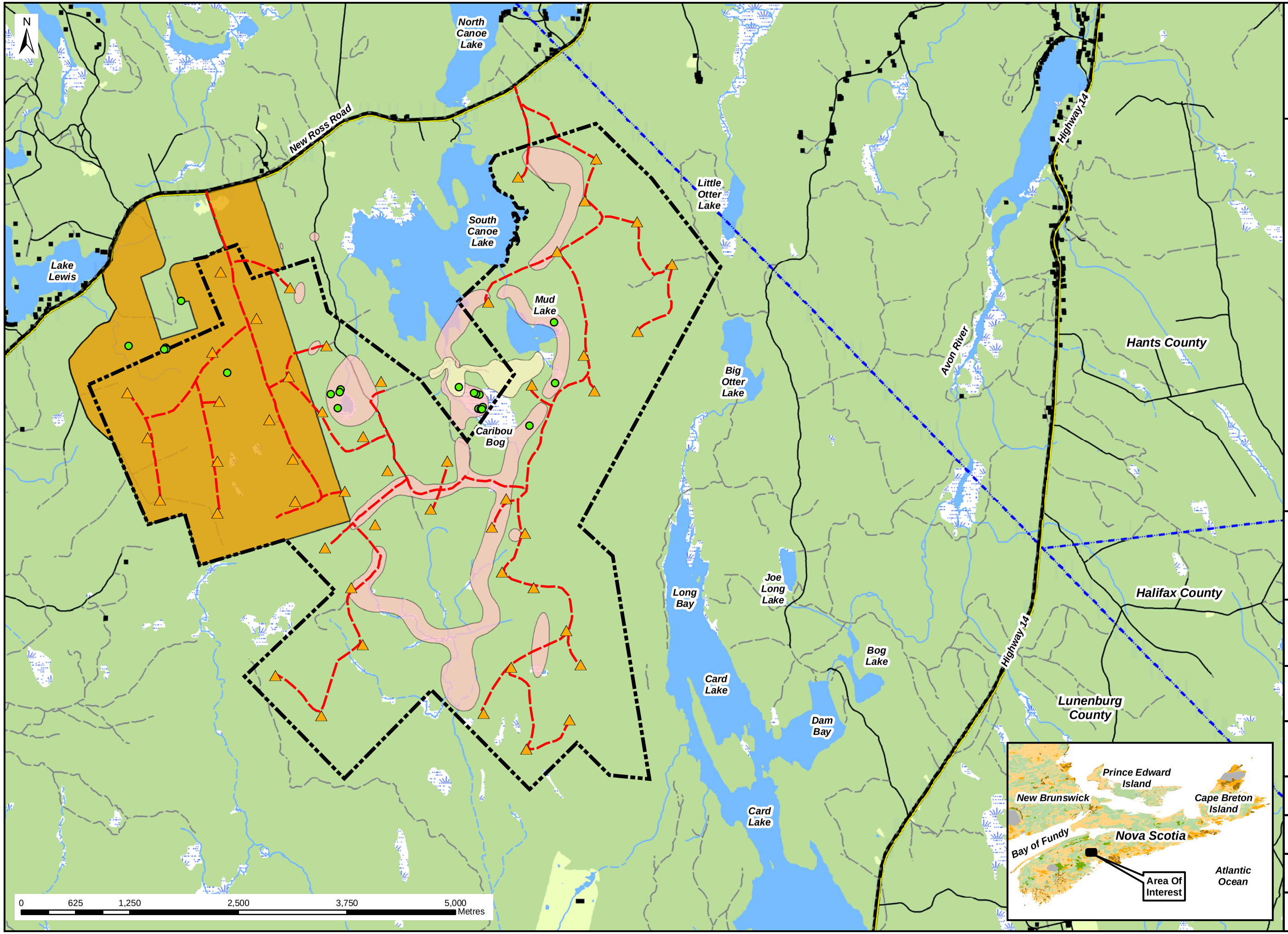
Prior to undertaking the 2007 surveys, the ACCDC database was reviewed to compile a list of recorded observations of flora species within 100 km of the Property Boundary. The 2007 list was subsequently updated with ACCDC data from 2011 (Table D1, Appendix D). Records from 2011 indicate that 296 vascular and 6 nonvascular flora species have been identified within 100 km of the Property Boundary. Of the 302 species identified by ACCDC, 60 vascular and 2 nonvascular flora Species at Risk (SAR) were identified within 100 km of the Property Boundary.

A short list of rare vascular plant species with the potential to occur at the Project Area was then developed and habitat requirements for each species were reviewed (Table D2, Appendix D). For the purpose of this assessment, SAR includes:

- Species listed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) (COSEWIC, 2009) or under the *Species at Risk Act* (SARA) (SARA, 2011) as endangered, threatened or of special concern;
- Species protected under the Nova Scotia Endangered Species Act (NSESA) (NSESA, 2007); and

- Species listed in the NSDNR General Status Ranks of Wild Species in Nova Scotia as “Red” or “Yellow”. ”.

The results of the desktop review were used by botanists to determine priority habitats for the field surveys.



Notes:

1. Reference: Nova Scotia Property Records. 1:10,000 digital topo mapping by Nova Scotia Geomatics Centre.
2. Projection: NAD83(CSRS), UTM Zone 20 North.

Legend:

- Buildings
- Proposed Turbine Locations
- Proposed Roads
- Boreal Felt Lichen Survey Areas (2007)
- Botany Survey Areas (2007)
- Botany Survey Areas (2008)
- Southern Twayblade Locations
- Project Area
- County Boundary
- Major Roads
- Roads
- Access Roads / Trails
- Mapped Stream
- Mapped Indefinite Stream
- Water Bodies
- Mapped Wet Area

Botanical and Boreal Felt Lichen Assessment Areas

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4.5.2 Plant Surveys – 2007

Spring and summer surveys were completed in 2007 to target ephemeral species and species that flower in late summer. During the spring survey, a habitat approach was employed to locate species of interest. Two days of surveying focussed on the following habitat locations:

Whitney River

Whitney River intercepts drainage via multiple small streams that drain water from bordering upland habitat in southern portions of the Project Area. Dominant species include red spruce, balsam fir, eastern white pine, sheep laurel, bunchberry and wild lily-of-the-valley *(Maianthemum canadense).* Species common along the small streams include: wild raisin *(Viburnum nudum),* false mountain holly *(Nemopanthus mucronata),* speckled alder *(Alnus incana),* sheep laurel, leatherleaf *(Chamaedaphane calculata),* and dwarf raspberry *(Rubus hispidus).* The banks of Whitney River are dominated by leatherleaf, labrador tea *(Ledum groenlandicum),* speckled alder and rhodora.

Caribou Bog

Caribou Bog, a large treed bog located in central portions of the Project Area, is dominated by black spruce, balsam fir, red maple, false holly, wild raisin, cinnamon fern *(Osmunda cinnamomea),* three-leaved false Solomon's seal *(Smilacina trifolia),* and sphagnum moss. Southern twayblade *(Listeria australis),* which has a NSDNR ranking of 'red' (known to be or is thought to be at risk), was observed five times within the bog.

Mud Lake Brook

A treed swamp exists to the east of Mud Lake Brook, and an open shrub bog to the south. Southern twayblade was observed in both habitats.

Cooney Lake

Treed bog habitat was identified along the west side of Cooney Lake. A population of southern twayblade was identified.

Four additional areas were surveyed in late summer. Locations were selected based on the expected proximity of future access roads.
South Canoe Lake Road (west of South Canoe Lake)

Due to considerable tree harvesting and large areas of clear cuts, the only significant habitat assessed was a treed bog located to the north of Cooney Lake. The location could provide habitat for southern twayblade.
Southern portions of the Project Area (East of Whitney River)

Two small treed bogs, providing suitable habitat for southern twayblade, and a low ericaceous shrub bog, containing ponds, were observed along this route. Characteristic species include leatherleaf, rhodora, sheep laurel, and labrador tea. Other species observed includebladderwort (*Utricularia vulgaris*), bog buckbean (*Menyanthes trifoliata*), cotton-grass (*Eriophorum virginicum*), and beak-rush (*Rhynchospora alba*).

East of South Canoe Lake

Three wetlands, including two shrub swamps and one treed bog, were surveyed. Common species included stunted black spruce and, cinnamon fern. There is possible southern twayblade habitat at this location.

4.5.3 Plant Surveys – 2008

Subsequent to the 2007 surveys, an additional rare plant survey was completed on June 29 and 30, 2008 throughout an approximate area of 800 hectares (Drawing 4.6). Dates and locations of the survey were chosen based on the phenology of the rare species identified on the 2007 priority list. The area surveyed has a long history of logging confirmed by numerous access roads, large expanses of harvested areas, stands of various ages of regenerating growth, and silvaculture activities. Almost all of the forest within the 2008 survey area had been disturbed by human activity. The exceptions are a number of small treed swamps associated with streams (Neily, 2007a). Significant habitats are limited to wetlands, which were largely undisturbed including Rocky Brook, Toad River, and associated wetlands. Southern twayblade was observed several times during the survey. GPS coordinates of the plant locations can be provided to DNR upon request.

4.5.4 Rare Plant Species

One species of concern (southern twayblade) was identified in the Project Area during the plant surveys. An additional species, Goodyera sp. was observed north of Mud Lake; however, confirmation to the species level was not possible due to seasonal conditions. (Table 4.14) (Drawing 4.6).Complete plant lists are provided in Appendix D (Table D3).

Table 4.14: Species of Conservation Concern Identified during Plant Surveys

Plant	NSDNR[1] Rank	NSESA[2] Rank	SARA[3] Rank	COSEWIC[4] Rank	ACCDC[5] Rank	Location and Numbers
2007 Plant Survey						
***Listeria australis* (Southern twayblade)**	Red	No status	No status	No status	S1	Caribou Bog (18 plants), Mud Lake (7 plants), South of Mud Lake (4 plants), Cooney Lake (6 plants)
Goodyera sp*	N/A	N/A	N/A	N/A	N/A	North of Mud Lake (1 plant)
2008 Plant Survey – Western Expansion						
***Listeria australis* (Southern twayblade)**	Red	No status	No status	No status	S1	Various locations in western portions of the site (17 plants)

[1] NSDNR, 2009b; [2] NSESA, 2007; [3] SARA, 2011; [4] COSEWIC, 2009; [5] ACCDC, 2011
Sources: Neily, 2007a; Neily 2008.
** Confirmation of species level not possible due to lack of flower*

A total of 35 southern twayblade and one rattlesnake-plantain species were observed during the 2007 plant survey. During the 2008 plant survey, 17 southern twayblade plants were observed. All rare plants identified during the surveys are located considerable distances from the Project road footprint. The closest observations are approximately 185 m, for southern twayblade, and 200 m for rattlesnake-plantain. The Proponent commits to avoidance to the rare species and its habitat.

4.5.5 Lichen Survey – 2007

A boreal felt lichen *(Erioderma pedicellatum)* survey was completed within the Project Area in October 2007. The boreal felt lichen is a cyanolichen listed as endangered under SARA and NSESA. Known populations occur in Nova Scotia, Newfoundland, Alaska and Scandinavia. Threats to the species include acid rain, air pollution and habitat destruction by forestry practices and development. Boreal felt lichen is found on balsam fir stands on north facing slopes near sphagnum dominated wetlands, generally within 25 km of the coast. Two other cyanolichen species (*Lobaria scrobiculata* and *Coccocarpia palmicola*) are considered indicator species for the boreal felt lichen and the presence of these species, on balsam fir, may indicate suitable habitat (Neily, 2007b).

Potential boreal felt lichen habitat was identified using mapping obtained from NSE. Suitable habitat is scattered throughout the Project Area, including wetland habitats south of South Canoe Lake and south of Mud Lake. These wetlands were surveyed in October 2007 (Drawing 4.6). The South Canoe Lake site did not have suitable habitat and lacked the necessary mature balsam fir, and the presence of indicator species.

Indicator species, *Coccocarpia palmicola* and *Lobaria scrobiculata*, were observed at one location, near Mud Lake which also provides suitable boreal felt lichen habitat. Three other cyanolichens: *Leptogoim laceroides; L. corticola;* and *Dendriscocaulon intriculatum*, all ranked 'yellow species' by NSDNR, were also observed near Mud Lake.

4.5.6 Effects and Mitigation

Potential effects on flora species within the Project Area has been significantly reduced by incorporating the use of existing roads and logging trails into the Project design. However, site preparation, construction, and decommissioning activities, as well as maintenance will result in the removal and loss of some flora. Improper disposal and management of fluids can also affect plant health. Potential effects to flora during the different phases of the Project are identified in Table 4.15.

Table 4.15: Potential Effects on Flora

Effect	Source of Effect	*Phase applicable to		
		C	M/O	D
Loss and physical damage	Clearing, grubbing, infilling, heavy machinery, implementation of watercourse crossings.	✔		✔
	Vegetation management.		✔	
Contamination	Release of hazardous materials chemicals, fuels, lubricants or hydraulic fluids.	✔	✔	✔

**C – Construction phase M/O Maintenance/Operational Phase D – Decommissioning Phase*

The following mitigation measures will be implemented to minimize or eliminate impacts to flora:

- Development and implementation of an EPP for the Project, which will include provisions for erosion and sediment control, protection of flora, spill prevention, and post-construction monitoring (as necessary). EPP will be approved by NSE prior to the start of construction.
- Minimization of the footprint of physical disturbance by:
  - alignment of access roads with existing roads and logging trails, wherever possible;
  - locating turbines on previously disturbed land (i.e. clear cut) where possible;
  - identification and avoidance of sensitive areas and areas where SAR are known to be present;
  - maintenance of a 30 m buffer around sensitive habitats such as watercourses, lake edges, and wetlands, where possible; and
  - minimization of routine vegetation clearing.
- Completion of pre-construction plant surveys within the Project footprint, once the

layout has been finalized.
- Consultation with NSDNR and NSE if avoidance of flora SAR is not possible.

Many of the mitigation measures described above are considered to be standard best practices, and are expected to address potential impacts. Although flora species considered to be SAR or of conservation concern will remain a VEC, general flora is not further assessed.

4.6 Terrestrial Fauna

4.6.1 Mammals

The landscape of Nova Scotia features a variety of habitats for mammalian fauna, including forests, fields, mountains, wetlands, and shorelines (Davis and Browne, 1996). These environments provide habitat for 57 species of terrestrial and semi-aquatic species, ranging from small rodents such as the Deer mouse (*Perymyscus maniculatis*) and Red-backed vole (*Clethrionomys gapperi*) to large ungulates such as Mainland moose (*Alces alces americana*) (Davis and Browne,1996).

The distribution of mammals in the province is driven by species specific cover and food requirements, and is influenced by other factors such as local climate, introductions and extirpations, and natural barriers to dispersal/migration (Davis and Browne, 1996). Some species, such as the American red squirrel (*Tamiasciursus hudsonicus*), are common and abundant throughout the province, while others, such as the American marten (*Martes americana*), occupy restricted ranges and exist in disjunct populations (Davis and Browne, 1996; MTRI, 2008).

Information regarding the mammalian community in the vicinity of the Project Area, including any SAR, was obtained through a combination of desktop review and field studies. The desktop component included a review of the Nova Scotia Significant Species and Habitat Database and ACCDC data on species recorded within a 100 km radius of the Property Boundary, and the comparison of habitat mapping data (Section 4.4) against known habitat requirements for species expected to occur within the Project Area, and for all SAR.

Table 4.16 lists the mammalian species recorded within 100 km of the Property Boundary.

Table 4.16: Mammal Species Recorded within a 100 km radius of the Property Boundary

Common Name	Scientific Name	NSDNR Status[1]	COSEWIC Status[2]	NSESA Status[3]
American marten	*Martes americana*	Red	Not Listed	Not Listed
Fisher	*Martes pennant*	Yellow	Not Listed	Not Listed
Long-tailed shrew	*Sorex dispar*	Yellow	Not Listed	Not Listed
Maritime shrew	*Sorex maritimensis*	Green	Not Listed	Not Listed
Lynx	*Lynx lynx*	Red	Not at Risk	Endangered
Mainland moose	*Alces alces americana*	Red	Not Listed	Endangered
Southern Flying squirrel	*Glaucomys volans*	Yellow	Not at Risk	Not Listed

[1] NSDNR, 2009b; [2] COSEWIC, 2009; [3] NSESA, 2007
Source: ACCDC, 2011

Of note is that sightings of many of the most common species are unreported to ACCDC, and are therefore under-represented or absent from the database. Consequently, a review of the ACCDC data reveals predominantly rare or noteworthy species despite the fact that these species certainly represent a small fraction of the existing mammal community in an area.

Field studies of mammalian fauna at the Project Area consisted of direct observation, as well as the indirect identification of species through sound and/or sign (i.e. scat, tracks, scent, dens, lodges, etc). Mammal surveys were conducted between September 2011 and January 2012. Table 4.17 lists the mammal species observed/identified at or near the Project Area.

Table 4.17: Mammal Species at or near the Project Area

Common Name	Scientific Name	NSDNR Status[1]	COSEWIC Status[2]	NSESA Status[3]
American beaver	*Castor canadensis*	Green	Not Listed	Not Listed
American black bear	*Ursus americanus*	Green	Not at Risk	Not Listed
American mink	*Mustela vision*	Green	Not Listed	Not Listed
American porcupine	*Erithizon dorsatum*	Green	Not Listed	Not Listed
American red squirrel	*Tamiasciursus hudsonicus*	Green	Not Listed	Not Listed
Bobcat	*Lynx rufus*	Green	Not Listed	Not Listed
Coyote	*Canis latrans*	Green	Not Listed	Not Listed
Eastern chipmunk	*Tamias striatus*	Green	Not Listed	Not Listed
Fisher	*Martes pennant*	Yellow	Not Listed	Not Listed
Raccoon	*Procyon lotor*	Green	Not Listed	Not Listed
Red fox	*Vulpes vulpes*	Green	Not Listed	Not Listed
Snowshoe hare	*Lepus americanus*	Green	Not Listed	Not Listed
White-tailed deer	*Odocoileus virginianus*	Green	Not Listed	Not Listed

[1] NSDNR, 2009b; [2] COSEWIC, 2009; [3] NSESA, 2007

Although evidence of the presence of other mammals was not confirmed during field studies, other mammal species are expected to occur at the Project Area, based upon habitat observations. These species include many that are difficult to locate, due to specific habits and/or small size, without employing a more focused approach (i.e. trapping). Species not identified by the ACCDC data or noted during field studies, but that have a high likelihood of occurring at the Project Area include: Common shrew (*Sorex cinereus*), Smoky shrew (*Sorex fumeus*), Water shrew (*Sorex palustris*), Short-tailed shrew (*Blarina brevicauda*), Star-nosed mole (*Condylura cristata*), Short-tailed weasel (*Mustela erminea*), Striped skunk (*Mephitis mephitis*), River otter (*Lontra canadensis*), Northern flying squirrel (*Glaucomys sabrinus*), Deer mouse, White-footed mouse (*Peromyscus leucopus*), Red-backed vole (*Clethrionomys gapperi*), Southern bog lemming (*Synaptomys cooperi*), Muskrat (*Ondatra zibethicus*), Meadow vole (*Microtus pennsylvanicus*), Woodland jumping mouse (*Napaeozapus insignis*), and Meadow jumping mouse (*Zapus hudsonius*).

Significant Habitats

Significant habitats are identified in the Nova Scotia Significant Species and Habitat Database and include sites where:

- species at risk or other species of conservation concern can be found; and/or,
- where unusually large concentrations of wildlife occur; and/or
- habitats that are rare in the province.

One area of significant habitat was identified in the vicinity of the Project Area. Deer wintering grounds, located approximately 4 km to the east of the Project Area, (Drawing 4.4) assist with Deer survival by providing cover that adds protection from winter wind, snow and cold temperatures.

Species at Risk

Mammal species identified during field studies or that have been recorded within a 100 km radius of the Property Boundary were screened against the criteria outlined in the "*Guide to Addressing Wildlife Species and Habitat in an EA Registration Document*" (NSE, 2005) to develop a list of priority species. These priority species include:

- American marten – "Red" (NSDNR, 2009b), "Endangered" (NSESA ,2007);
- Canada lynx – "Red" (NSDNR, 2009b), "Endangered" (NSESA, 2007);
- Fisher – "Yellow" (NSDNR, 2009b);
- Long-tailed shrew – "Yellow" (NSDNR, 2009b);
- Mainland moose – ""Red" (NSDNR, 2009b), "Endangered" (NSESA, 2007); and
- Southern flying squirrel – "Yellow" (NSDNR, 2009b), "Special Concern" (SARA, 2011).

American marten prefer mature coniferous forests, and have been more recently observed in mixed forests and cutovers (MTRI, 2008). Although these types of habitat are prominent at the Project Area, the current known distribution of American marten in Nova Scotia is limited to Cape Breton and the southwestern part of the province. Therefore, it is unlikely that Project activities will interact with and/or impact American marten populations.

Long-tailed shrew in Nova Scotia were thought to be found only in the Cobequid Mountains, but recent research has identified an additional population 60 km to the southwest, near Wolfville (Shafer and Stewart, 2006). The species appears to favour rocky areas and sites adjacent to cool, mountain streams, and the presence of rocks is considered a principal habitat component (Kirkland, 1981). The watercourses and rocky barrens found on the Project Area may provide adequate secondary habitat for the species, but do not constitute preferable long-tailed shrew habitat. This fact, combined with the current knowledge of the range of this species in Nova Scotia, suggests that it is unlikely that Project activities will impact Long-tailed shrew populations.

The distribution of Canada lynx is limited to the availability of extensive coniferous forests and snowshoe hare (main prey item), and, in Nova Scotia, the Canada lynx is limited to the Cape Breton Highlands (MTRI, 2008). Although Canada lynx may travel great distances in times of food scarcity, potentially passing through the Project Area, the possibility of this occurring during the construction phase of the Project is highly unlikely. The Project, therefore, will not have any impact on this species.

Concentrations of Mainland moose in Nova Scotia occur in the Tobeatic Wilderness and the Cobequid Mountains areas, although the current range of the species extends across much of the province (MTRI, 2008). The successional growth provided by recent cutovers at the Project Area offers quality foraging habitat and the interspersed wetlands provide suitable summer habitat for cows and calves (Parker, 2003). According to the ACCDC database, the closest sighting of the Mainland moose was 16±10 km from the Project Area. Although no indication of the species was observed during field studies, and there is no evidence to suggest that a viable population exists in the area, Project activities will be aware of the potential for Mainland moose to occur within the Project Area.

The Project Area occurs within the known range of the Southern flying squirrel in Nova Scotia, which includes the New Ross area in northeast Lunenburg County (COSEWIC, 2006). The species requires mast bearing trees for forage and tree cavities for nesting and, in the Atlantic Region, Southern flying squirrels select older forest stands (COSEWIC, 2006). Portions of habitat within the Property Boundaries feature large, mature trees which likely provide suitable habitat for this species. Although not noted during field studies, this species' nocturnal habits often preclude it from being identified in wildlife surveys. It is likely that Southern flying squirrels occur at or near the Project Area.

Fisher was identified within the Project Area during field studies. An individual was observed crossing an access road in the vicinity of a large bog/fen. This species is listed as "Yellow" by NSDNR (2009b), meaning it is sensitive to human activities or natural events. The Fisher generally requires dense mixed wood forests with continuous overhead cover (as cited in Allen, 1983). Extensive logging in the area has reduced the availability of suitable Fisher habitat within the Project Area.

4.6.2 Herpetofauna

Nova Scotia's reptile and amphibian community consists of 25 species, a relatively low level of diversity when compared to mainland areas of the continent (Davis and Browne, 1996). However, the same factors that have limited post-glacial species colonization in the province, namely climatic changes, have caused amphibian and reptile populations to become isolated leading to a higher degree of morphologic variation than seen in continental populations (Davis and Browne, 1996).

Information regarding the amphibian and reptile fauna at the Project Area was obtained via a desktop review of the ACCDC database, a review of available habitat mapping for the Property Boundaries and comparison to known habitat requirements, and by field studies. Table 4.18 lists the amphibian and reptile species recorded within a 100 km radius of the Property Boundaries.

Table 4.18: Reptile and Amphibian Species Recorded within a 100 km Radius of the Property Boundary

Common Name	Scientific Name	NSDNR Status[1]	COSEWIC Status[2]	NSESA Status[3]
Four-toed salamander	*Hemidactylium scutatum*	Green	Not at Risk	Not Listed
Wood turtle	*Clemmys insculpta*	Yellow	Threatened	Vulnerable
Blanding's turtle	*Emydoidea blandingi*	Red	Endangered	Endangered
Eastern ribbonsnake	*Thamnophis sauritus septentrionalis*	Yellow	Threatened	Threatened

[1]NSDNR, 2009b; [2] COSEWIC, 2009; [3] NSESA, 2007
Source: ACCDC, 2011

The same data limitations and interpretations as noted for the mammalian fauna (Section 4.6.1) are also applicable to the reptile and amphibian data.

Field studies of amphibian and reptile species were conducted in conjunction with other surveys completed between September 2011 and January 2012. Species were either identified directly through visual observation, or indirectly using other evidence or their presence (i.e. calls, egg masses, tadpoles, etc). Table 4.19 lists the amphibian and reptile species identified at or near the Project Area during field studies.

Table 4.19: Reptile and Amphibian Species Observed during Field Studies

Common Name	Scientific Name	NSDNR Status[1]	COSEWIC Status[2]	NSESA Status[3]
Green frog	*Rana clamitans melanota*	Green	Not Listed	Not Listed
Pickerel frog	*Rana palustris*	Green	Not Listed	Not Listed
Northern leopard frog	*Rana pipiens*	Green	Not at Risk	Not Listed
Wood frog	*Rana sylvatica*	Green	Not Listed	Not Listed
Northern spring peeper	*Pseudocaris crucifer crucifer*	Green	Not Listed	Not Listed
Maritime garter snake	*Thamnophis sirtalis pallidula*	Green	Not Listed	Not Listed
Eastern painted turtle	*Chrysemys picta picta*	Green	Not Listed	Not Listed

[1] NSDNR, 2009b; [2] COSEWIC, 2009; [3] NSESA, 2007

Although evidence of the presence of these species was not confirmed during field studies, other amphibian and reptile species are expected to occur at the Project Area, based upon habitat observations. These species include: Yellow-spotted salamander (*Ambystoma maculatum*), Red-spotted newt (*Notophthalmus viridescens viriescens*), Eastern redback salamander (*Plethodon cinereus*), Eastern American toad (*Bufo americanus americanus*), Bullfrog (*Rana catesbeiana*), Mink frog (*Rana septentrionalis*), Common snapping turtle (*Chelydra serpentina serpentina*), Northern redbelly snake (*Storeria occipitomaculata occipitomaculata*), Northern ringneck snake (*Diadophis punctatus edwardsi*), and Eastern smooth green snake (*Liochlorophis vernalis borealis*).

Species at Risk

Amphibian or reptile species identified during field studies or that have been recorded within a 100 km radius of the Property Boundary were screened against the criteria outlined in the "*Guide to Addressing Wildlife Species and Habitat in an EA Registration Document*" (NSE, 2005) to develop a list of priority species. These priority species include:

- Blanding's turtle – "Red" (NSDNR, 2009b), "Endangered" (COSEWIC, 2009), "Endangered" (NSESA, 2007);
- Eastern ribbonsnake – "Yellow" (NSDNR, 2009b), "Threatened" (COSEWIC, 2009), "Threatened" (SARA, 2011), "Threatened" (NSESA, 2007); and
- Wood turtle – "Yellow" (NSDNR, 2009b), "Threatened" (COSEWIC, 2009), "Threatened" (SARA, 2011), "Vulnerable" (NSESA, 2007).

None of the priority species listed above were observed during the field surveys.

Suitable Wood turtle habitat is present at the Project Area. The species prefers clear, moderately flowing watercourses in forests and is often associated with alder riparian zones. Wood turtles are found throughout the province, with a known concentration east

of the Project Area in Guysborough County (MTRI, 2008). It is possible that Wood turtles occur in association with the watercourses and wetlands found within the Project Area.

The Blanding's turtle exploits freshwater wetlands such as marshes, swamps, and bogs; habitat types which are present throughout the Project Area. However, the known distribution of this species in Nova Scotia is restricted to the area near Kejimkujik National Park, with sporadic sightings in southwestern parts of the province (MTRI, 2008). Due to the geographic separation between the known range of the species and the Project Area, it is unlikely that Project activities will affect the Blanding's turtle.

Similarly, the Eastern ribbonsnake is found in freshwater habitat types that are present throughout the Project Area (MTRI, 2008). However, this species appears to be restricted to southwestern parts of the province, such that it is unlikely that the Eastern ribbon snake would be present at or near the Project Area. For this reason, it is not expected that Project activities will impact this species.

4.6.3 Butterflies

There are approximately 13,000 species of insects in Nova Scotia of which 2,000 are moths and butterflies (Davis and Browne, 1996). Some species have ranges limited by habitat type and/or the availability of host species (Davis and Browne, 1996), and others are present only at certain times of year (Butterflies of Nova Scotia, 2008).

Information regarding the butterfly community at the Project Area was obtained through a desktop review of ACCDC data and through incidental observations while conducting other field studies. Table 4.20 lists the butterfly species recorded within a 100 km radius of the Property Boundaries.

Table 4.20: Butterfly Species Recorded within a 100 km radius of the Property Boundary

Common Name	Scientific Name	NSDNR Status[1]	COSEWIC Status[2]	**NSESA Status[3]**
Aphrodite fritillary	*Speyeria aphrodite*	Green	Not Listed	Not Listed
Arctic (Titania) fritillary	*Boloria chariclea*	Yellow	Not Listed	Not Listed
Baltimore checkerspot	*Euphydryas phaeton*	Green	Not Listed	Not Listed
Banded hairstreak	*Satyrium calanus*	Undetermined	Not Listed	Not Listed
Bog elfin	*Incisalia lanoraieensis*	Red	Not Listed	Not Listed
Bronze copper	*Lycaena hyllus*	Green	Not Listed	Not Listed
Common branded Skipper	*Hesperia comma*	Green	Not Listed	Not Listed
Compton tortoiseshell	*Nymphalis vau-album*	Green	Not Listed	Not Listed
Eastern comma	*Polygonia comma*	No Status	Not Listed	Not Listed
Eastern pine elfin	*Incisalia niphon*	Green	Not Listed	Not Listed
Gray comma	*Polygonia progne*	Green	Not Listed	Not Listed
Gray hairstreak	*Strymon melinus*	Green	Not Listed	Not Listed

Common Name	Scientific Name	NSDNR Status[1]	COSEWIC Status[2]	NSESA Status[3]
Green comma	*Polygonia faunus*	Green	Not Listed	Not Listed
Greenish blue	*Plebejus saepiolus*	No Status	Not Listed	Not Listed
Harvester	*Feniseca tarquinius*	Green	Not Listed	Not Listed
Henry's elfin	*Incisalia henrici*	Green	Not Listed	Not Listed
Hoary elfin	*Incisalia polia*	Green	Not Listed	Not Listed
Jutta arctic	*Oeneis jutta*	Red	Not Listed	Not Listed
Juvenal's duskywing	*Erynnis juvenalis*	Green	Not Listed	Not Listed
Milbert's tortoiseshell	*Nymphalis milberti*	Green	Not Listed	Not Listed
Monarch	*Danaus plexippus*	Yellow	Special Concern	Not Listed
Mustard white	*Pieris oleracea*	Undetermined	Not Listed	Not Listed
Northern cloudywing	*Thorybes pylades*	Yellow	Not Listed	Not Listed
Northern pearly eye	*Enodia anthedon*	Green	Not Listed	Not Listed
Pepper and salt skipper	*Amblyscirtes hegon*	Green	Not Listed	Not Listed
Question mark	*Polygonia interrogationis*	Green	Not Listed	Not Listed
Roadside skipper	*Amblyscirtes vialis*	Green	Not Listed	Not Listed
Satyr anglewing comma	*Polygonia satyrus*	Yellow	Not Listed	Not Listed
Silvery checkerspot (Crescentspot)	*Chlosyne nycteis*	Undetermined	Not Listed	Not Listed
Striped hairstreak	*Satyrium liparops*	Undetermined	Not Listed	Not Listed

[1] NSDNR, 2009b; [2] COSEWIC, 2009;[3] NSESA
Source: ACCDC, 2011

Incidental observations of butterflies were made during field studies conducted between September 2011 and January 2012. Species were identified by direct observation of individuals. Table 4.21 lists the butterfly species found at or near the Project Area during field studies.

Table 4.21: Butterfly Species Observed During Field Studies

Common Name	Scientific Name	NSDNR Status[1]	COSEWIC Status[2]	NSESA Status[3]
Bog fritillary	*Boloria eunomia*	No Status	Not Listed	Not Listed
Clouded sulphur	*Colias philodice*	Green	Not Listed	Not Listed
Harvester	*Feniseca tarquinius*	Green	Not Listed	Not Listed
Little (American) copper	*Lycaena phlaeas*	Green	Not Listed	Not Listed
Monarch	*Danaus plexippus*	Yellow	Special Concern	Not Listed
Mourning cloak	*Nymphalis antiopa*	Green	Not Listed	Not Listed
Painted lady	*Vanessa cardui*	Green	Not Listed	Not Listed
Viceroy	*Limenitis archippus*	Green	Not Listed	Not Listed

[1] NSNDR, 2009b; [2] COSEWIC, 2009; [3] NSESA, 2007

Although not confirmed during field studies or through analysis of ACCDC data, other butterfly species expected to occur within the Project Area, based upon habitat observations and known ranges, include Dreamy duskywing (*Erynnis icelus*), Arctic skipper (*Carterocephalus palaemon*), Least skipper (*Ancyloxypha numitor*), European skipper (*Thymelicus lineola*), Peck's skipper (*Polites peckius*), Tawny-edged skipper (*Polites themistocles*), Long dash skipper (*Polites mystic*), Hobomok skipped (*Paones hobomok*), Dun skipper (*Euphyes vestris*), Black swallowtail (*Papilio polyxenes*), Canadian tiger swallowtail (*Papilio canadensis*), Cabbage white (*Pieris rapae*), Orange suphur (*Colias eurytheme*), Pink-edged sulphur (*Colias interior*), Bog copper (*Lycaena epixantha*), Acadian hairstreak (*Satyrium acadicum*), Brown elfin (*Callophrys augustinus*), Spring azure (*Celastrina echo*), Summer azure (*Celastrina neglecta*), Silvery blue (*Glaucopsyche lygdamus*), Great spangled fritillary (*Speyeria cybele*), Atlantis fritillary (*Speyeria atlantis*), Silver-bordered fritillary (*Boloria selene*), Harris' checkerspot (*Chlosyne harrisii*), Northern crescent (*Phyciodes cocyta*), Red admiral (*Vanessa atalanta*), White admiral (*Limenitis arthemis*), Eyed brown (*Satyrodes eurydice*), Common ringlet (*Coenonympha tullia*), and Common wood-nymph (*Cercyonis pegala*).

Species at Risk

Butterfly or moth species identified during field studies or that have been recorded within a 100 km radius of the Property Boundaries were screened against the criteria outlined in the "*Guide to Addressing Wildlife Species and Habitat in an EA Registration Document*" (NSE, 2005) to develop a list of priority species. These priority species include:

- Arctic fritillary – "Yellow" (NSDNR, 2009b);
- Bog elfin – "Red" (NSDNR, 2009b);
- Jutta arctic – "Red" (NSDNR, 2009b);
- Monarch – "Yellow" (NSDNR, 2009b), "Special Concern" (COSEWIC, 2009), "Special Concern" (SARA, 2011);
- Northern cloudywing – "Yellow" (NSDNR, 2009b); and
- Satyr comma – "Yellow" (NSDNR, 2009b).

The Arctic fritillary is generally found in boreal woodlands and bogs in the eastern part of its range (Layberry et al., 1998). These habitats are found within the Project Area, so it is possible that this species occurs in the vicinity of the proposed Project.

The Bog elfin is known from only four bogs in Nova Scotia (Layberry et al., 1998), although it is easily overlooked in the field due to its small size and habit of using the most inaccessible parts of bog habitat. The species is closely tied to black spruce, which is found in abundance in many of the wetlands throughout the Project Area. Although it is possible that this species may occur at the Project Area, given its restricted known range in Nova Scotia and preference for inaccessible bog habitat, it is

unlikely that Project activities will affect the species.

Although the Jutta arctic is listed as a "Red" species (i.e. at risk) by NSDNR (2009b), it is known to be locally common in some parts of its range (Layberry et al., 1998). The species is closely tied to black spruce-eastern larch bogs, which is similar habitat as used by the Bog elfin. Previous work has shown the species to be found in only two areas in Nova Scotia: Mt. Uniacke, and Cape Breton (Ferguson, 1955). It is thus unlikely that Project activities will impact Jutta arctic populations.

The Monarch is common to abundant in Nova Scotia during the species' fall migration (Butterflies of Nova Scotia, 2008). This species is known to gather in large numbers during migration and this concentration of the population is one reason why the Monarch has garnered conservation concern. The Monarch was identified within the Project Area during the fall, at a time when the species can be abundant.

The Northern cloudywing is common and widespread, but rarely abundant (Layberry et al., 2008). Ferguson (1955) indicated only three records of this species in Nova Scotia, from Pictou and Colchester Counties, and no recent sightings have been reported to the ACCDC (Maritime Butterfly Atlas, 2011). Little is known of the status of this species in Nova Scotia, although it is known that the Northern cloudywing rarely occurs in developed areas (Layberry et al., 1998). Due to the relative scarcity of this species in Nova Scotia, it is unlikely that Project activities will have any appreciable impact.

The Satyr comma occurs sporadically in the eastern provinces (Layberry et al., 1998) and exploits boreal forest habitat in the region. Much of the Project Area features coniferous stands, although extensive logging has reduced the availability of this habitat at the site. This species may occur in the remaining softwood dominated habitats at the site, and if Project activities were to displace some individual species, adequate habitat should be available. It is therefore unlikely that the Project will negatively affect Satyr comma populations.

4.6.4 Effects and Mitigation

It is widely acknowledged that wind energy development can have a suite of potential direct and indirect impacts on terrestrial fauna, including direct mortality, habitat fragmentation by access roads and transmission corridors, and habitat alteration through the introduction of exotic species (Kuvlevsky, Jr. et al., 2007).

Sensory disturbance related to noise and increased visual stimuli have the potential to affect wildlife populations in the vicinity of the Project. These types of disturbances will occur throughout all phases of the Project. Disturbance will be greatest during construction, where the increased presence of site personnel, vehicles, and heavy equipment will likely disturb local wildlife and may result in the temporary avoidance of work areas. This is most likely to affect diurnal species because work will be restricted

to daylight hours whenever possible. However, these effects are not expected to persist in the long-term and should subside after the construction phase has been completed.

During the operational phase of the Project, sensory disturbance to wildlife will be limited to the presence of on site personnel conducting maintenance on Project infrastructure. Since the area is used extensively for logging, local wildlife are likely habituated to the presence of humans and infrequent site visits conducted by Project personnel, are therefore not expected to have adverse effects on wildlife.

The likelihood of direct mortality of wildlife resulting from the Project is very low. Most wildlife species are mobile, and thus are able to actively avoid areas of disturbance. Furthermore, many of the more prominent species should be detected by site personnel during construction activities such that work will not endanger observed wildlife. Nonetheless, there is potential for small mammals to suffer mortality during the construction phase of the Project, especially during site and road clearing stages.

Once the Project enters the operational phase, no direct mortality of terrestrial wildlife is expected. Possible mortality of wildife may occur as a result of collisions with vehicles at the Project Area, but these events will be minimized by the implementation of safe work practices (strict adherence to speed limits, obeying all warning signs, etc). Collisions, should they occur, will be infrequent and will not have significant population level effects.

Potential effects on terrestrial fauna, during different phases of the Project, are summarized in Table 4.22.

Table 4.22: Potential Effects on Terrestrial Fauna

Effect	Source of Effect	*Phase Applicable to		
		C	M/O	D
Habitat loss	Clearing of vegetation, hydrologic alterations leading to wetland loss.	✓	✓	✓
Mortality	Heavy equipment operation; vehicle collision.	✓	✓	✓
Displacement/local extirpation	Noise, vibration, and/or visual disturbance from site personnel, equipment, and/or turbines.	✓	✓	✓
Changes to local breeding/activity patterns	Noise, vibration, and/or visual disturbance from site personnel, equipment, and/or turbines.	✓	✓	✓

**C – Construction phase M/O Maintenance/Operational Phase D – Decommissioning Phase*

The following mitigative measures will be implemented to minimize or eliminate impacts to the terrestrial fauna (not including avifauna) and associated habitat:

- Minimization of the footprint of physical disturbance by:
  - alignment of access roads with existing roads and logging trails, wherever

possible;
  - where the aforementioned is not possible, design and construction of access roads to avoid environmentally sensitive habitats and ensure the most efficient means to access turbines is achieved;
  - locating turbines and access roads on previously disturbed land (i.e. clear cut) where possible;
  - identification and avoidance of sensitive areas and known locations of SAR;
  - maintenance of a 30 m buffer around sensitive habitats such as watercourses and wetlands, where possible;
  - minimization of routine vegetation clearing;
  - clearing of land only if required for construction area footprint;
  - restoration of areas of disturbance where possible, post construction phase completion;
  - location of all site construction compounds, parking lot or office on non-sensitive areas and/or areas of previous disturbance; and
  - use of existing access roads during Project operation and decommissioning phases to avoid additional disruption.
- Completion of pre-construction fauna surveys within the Project footprint, once finalized, if required by DNR.
- Completion of a comprehensive schedule and determination of timelines to efficiently complete site activities within the shortest time frames possible.

Species-Specific Mitigation

Desktop and field species at risk analyses have revealed several priority species that have the potential to occur within the Project Area. Addressing the potential impacts of the Project on these species will require species-specific mitigation techniques, as described below.

Fisher:

- Project activities will be planned to minimize disturbance to remaining Fisher habitat at the site, particularly mature, mixed wood stands featuring large, hollow trees for suitable for denning. During site optimization, mixed wood habitat within the Project Area has been reduced from 14% to 3% in an effort to minimize disturbance to Fisher habitat.

Mainland Moose:

- Evidence of Moose habitation within the Project Area will be noted and consultation with NSDNR regarding strategies to minimize and mitigate potential impacts will be initiated.

Wood Turtle:

Based on recommendations from Nova Scotia's Stewardship Plan for Wood Turtles (MacGregor and Elderkin, 2003), and NS Transportation and Public Works "*Generic Environmental Protection Plan (EPP) for the Construction of 100 Series Highways*" (2007), the following general procedures should be implemented to ensure the protection of Wood turtles:

- Immediately prior to grubbing in areas of potential Wood turtle habitat, a herpetologist and/or other qualified searchers will attempt to locate any foraging wood turtles, or any turtle SAR.
- Any turtles found shall be relocated outside of the construction zone, preferably upstream within the riparian habitat corridor in which they were found.
- In addition, construction crews shall be provided with environmental awareness training including Wood turtle identification and management procedures.
- If Wood turtles are found during construction, they should be moved off site, along the same habitat corridor in the direction of travel the turtle was originally oriented. Moving the turtles 100 m to 400 m from the original site where they were found should not unduly disrupt the turtle.
- Adequate, permanent buffers of vegetation shall be left around important Wood turtle habitat. If necessary (i.e. in the event that wood turtles are confirmed at the site), an appropriate mixture of shrubs and trees shall be planted to create a buffer.

These mitigation measures are only to be used in areas that do not offer either good nesting sites or over-wintering habitat. If required, a more detailed site-specific protection plan, with timing constraints, can be developed for work in or near these specific habitats through consultation with NSDNR.

Arctic fritillary:

- Where possible, Project activities will avoid bog habitats used by this species.

Monarch:

- If large congregations of Monarchs are found within the Project Area, Project activities should cease until the migrating group has left the site. This is most likely to occur in late summer, prior to the fall migration.

Many of the mitigation measures described above are considered to be standard best practices, and are expected to address potential impacts. Although fauna species considered to be SAR or of conservation concern will remain a VEC, general fauna is not further assessed.