4.0 2012 FIELD SURVEYS

The use of the general Project area by migratory birds in the fall season was evaluated using established survey protocols as outlined by the Canadian Wildlife Service (CWS 2007). The following survey types were implemented to target key groups of migrants:

- post-dusk surveys to assess groups of nocturnal migrants;
- stopover counts to assess flocks of migrating passerines using the area for foraging/roosting; and
- shorebird surveys to assess the use of coastal habitats in the general Project area by migrant shorebirds.

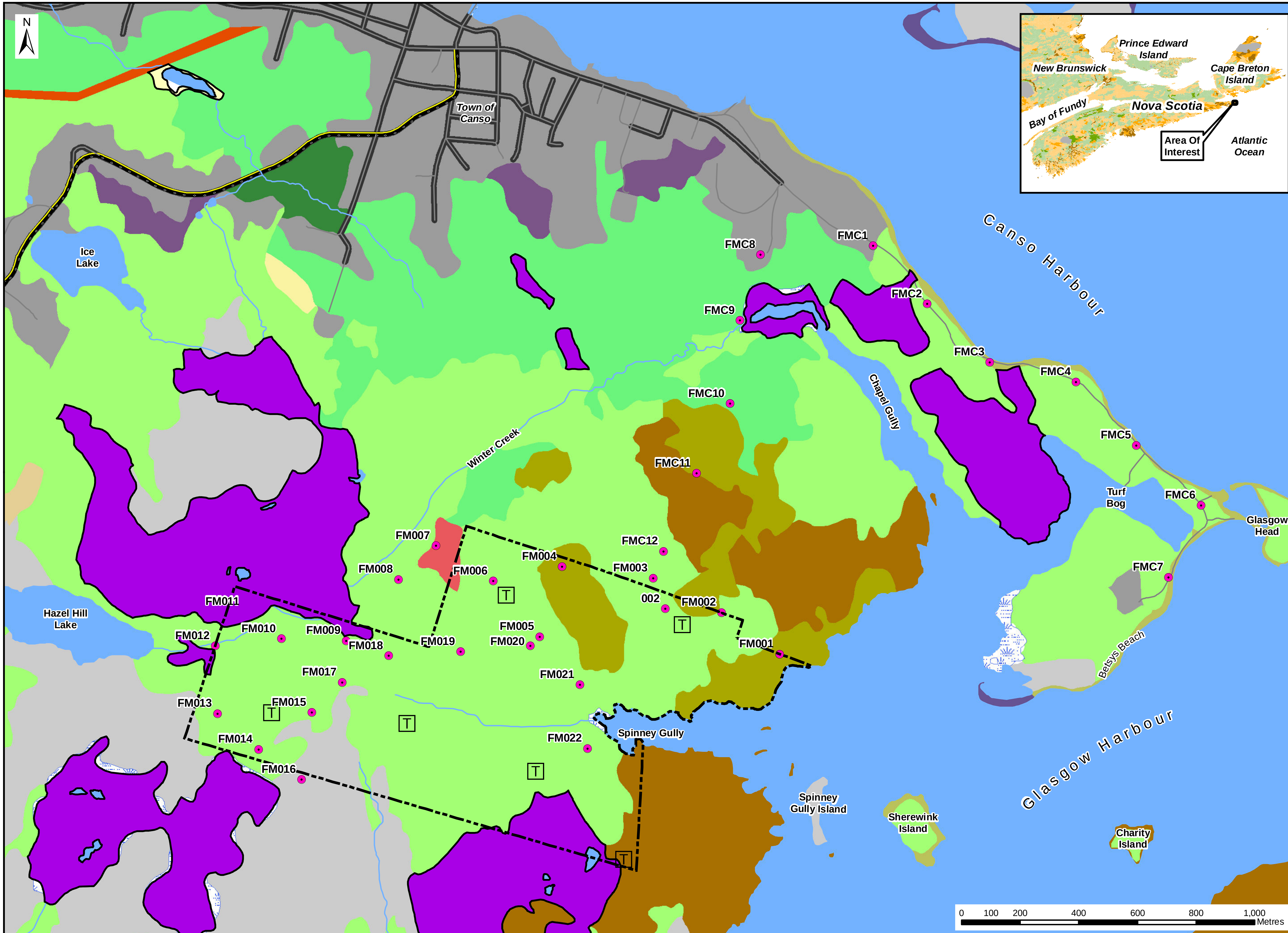
To facilitate comparisons and to elucidate key habitat characteristics, passerine migration surveys (stopover counts) were conducted both within the Project site boundaries and on the surrounding lands (control sites). This measure was taken to determine the suitability of the surrounding lands as potential alternative habitat for bird species occurring within the Project site, and to determine if key migratory corridors overlap with the Project site boundaries or occur elsewhere in the general Project area.

Every effort was made to ensure that surveys were completed in appropriate conditions; however, challenges associated with surveying in coastal lands (i.e., consistently high winds) resulted in some surveys being conducted in less than ideal conditions. However, these data are still useful to demonstrate patterns of bird habitat usage during potentially adverse weather conditions.

4.1 Passerine Fall Migration - Project Site Surveys

There were 68 stopover counts conducted at 18 locations within the Project site boundaries during site visits on September 4, 12, 13, and 25, and October 18, 19, 25, and 28, 2012 (Figure 8). Attempts were made to survey in a variety of conditions to gauge the response of migrating passerines to both upcoming and recent adverse weather events (e.g., high winds, heavy rains).

There were 66 bird species, representing 1854 individual birds, recorded at the Project site during the fall migration surveys (Table 10). American Crow (*Corvus brachyrhynchos*), Black-capped Chickadee (Po*ecile atricapillus*), Dark-eyed Junco (*Junco hyemalis*), and Yellow-rumped Warbler (*Dendroica coronata*) were the most abundant species, while American Crow, American Robin (*Turdus migratorius*), Black-capped Chickadee, and Yellow-rumped Warbler were the most frequently observed species.



Notes:

1. Reference: Digital Topographic Mapping By Nova Scotia Geomatics Centre.
2. Projection: NAD83(CSRS), UTM Zone 20 North.
3. GPS Points Taken Are Typically To +/-5m Accuracy.

Legend:

- Project Site Boundary
- Current Proposed Turbine Location
- Bog or Fen
- Marsh
- Fall Migration Survey Locations
- Watercourse
- Roads
- Major Roads and Highways
- Water Body
- Swamp
- Unclassified Forest
- Burned Stand
- Sugar Bush
- Brush
- Alders <75%
- Coastal Habitat
- Cliffs, Dunes, Coastal Rocks
- Rock Barren
- Barren
- Agriculture
- Urban
- Beach
- Powerline Corridor
- Road Corridor
- Softwood
- Mixedwood

2012 Fall Passerine Migration Survey Locations

Strum ENVIRONMENTAL

Date: Nov. 2012	Project #: 12-4469
Scale: 1:12,000	Figure #: 8
Drawn By: G. Gregory	
Checked By: M. Smith	

Table 10: Avifauna Observed At the Project Site During Fall Migration Surveys (2012)

Common Name	Scientific Name	NSDNR Status	COSEWIC Status	SARA Status	NSESA Status	Number of Times Observed	Number of Individuals Observed
American Black Duck	*Anas rubripes*	Green	Not Listed	Not Listed	Not Listed	4	25
American Crow	*Corvus brachyrhynchos*	Green	Not Listed	Not Listed	Not Listed	64	322
American Goldfinch	*Spinus tristis*	Green	Not Listed	Not Listed	Not Listed	5	10
American Redstart	*Setophaga ruticilla*	Green	Not Listed	Not Listed	Not Listed	1	1
American Robin	*Turdus migratorius*	Green	Not Listed	Not Listed	Not Listed	34	125
American Woodcock	*Scolopax minor*	Green	Not Listed	Not Listed	Not Listed	1	1
Bald Eagle	*Haliaeetus leucocephalus*	Green	Not at Risk	Not Listed	Not Listed	1	2
Bay-breasted Warbler	*Dendroica castanea*	Yellow	Not Listed	Not Listed	Not Listed	4	8
Black-and-white Warbler	*Mniotilta varia*	Green	Not Listed	Not Listed	Not Listed	10	19
Black-bellied Plover	*Pluvialis squatarola*	Green	Not Listed	Not Listed	Not Listed	1	1
Black-capped Chickadee	*Poecile atricapillus*	Green	Not Listed	Not Listed	Not Listed	29	163
Blackpoll Warbler	*Dendroica striata*	Yellow	Not Listed	Not Listed	Not Listed	3	5
Black-throated Blue Warbler	*Dendroica caerulescens*	Green	Not Listed	Not Listed	Not Listed	1	1
Black-throated Green Warbler	*Dendroica virens*	Green	Not Listed	Not Listed	Not Listed	3	5
Blue Jay	*Cyanocitta cristata*	Green	Not Listed	Not Listed	Not Listed	29	86
Blue-headed Vireo	*Vireo solitarius*	Green	Not Listed	Not Listed	Not Listed	10	13
Bohemian Waxwing	*Bombycilla garrulus*	Green	Not Listed	Not Listed	Not Listed	3	17
Boreal Chickadee	*Poecile hudsonicus*	Yellow	Not Listed	Not Listed	Not Listed	17	81
Broad-winged Hawk	*Buteo platypterus*	Green	Not Listed	Not Listed	Not Listed	1	1
Brown Creeper	*Certhia americana*	Green	Not Listed	Not Listed	Not Listed	9	9
Cedar Waxwing	*Bombycilla cedrorum*	Green	Not Listed	Not Listed	Not Listed	13	30
Chestnut-sided Warbler	*Dendroica pensylvanica*	Green	Not Listed	Not Listed	Not Listed	2	2
Common Loon	*Gavia immer*	Red	Not at Risk	Not Listed	Not Listed	2	2
Common Raven	*Corvus corax*	Green	Not Listed	Not Listed	Not Listed	23	35
Common Snipe	*Gallinaga gallinaga*	Yellow	Not Listed	Not Listed	Not Listed	1	3
Common Yellowthroat	*Geothlypis trichas*	Green	Not Listed	Not Listed	Not Listed	19	43
Dark-eyed Junco	*Junco hyemalis*	Green	Not Listed	Not Listed	Not Listed	27	144
Double-crested Cormorant	*Phalacrocorax auritus*	Green	Not at Risk	Not Listed	Not Listed	2	18

Common Name	Scientific Name	NSDNR Status	COSEWIC Status	SARA Status	NSESA Status	Number of Times Observed	Number of Individuals Observed
Downy Woodpecker	*Picoides pubescens*	Green	Not Listed	Not Listed	Not Listed	5	6
Evening Grosbeak	*Coccothraustes vespertinus*	Green	Not Listed	Not Listed	Not Listed	1	4
Golden-crowned Kinglet	*Regulus satrapa*	Yellow	Not Listed	Not Listed	Not Listed	27	101
Gray Jay	*Perisoreus canadensis*	Yellow	Not Listed	Not Listed	Not Listed	22	57
Great Black-backed Gull	*Larus marinus*	Green	Not Listed	Not Listed	Not Listed	1	2
Hairy Woodpecker	*Picoides villosus*	Green	Not Listed	Not Listed	Not Listed	7	9
Hermit Thrush	*Catharus guttatus*	Green	Not Listed	Not Listed	Not Listed	7	20
Herring Gull	*Larus argentatus*	Green	Not Listed	Not Listed	Not Listed	7	16
Horned Lark	*Eremophila alpestris*	Green	Not Listed	Not Listed	Not Listed	1	1
Magnolia Warbler	*Dendroica magnolia*	Green	Not Listed	Not Listed	Not Listed	16	34
Mallard	*Anas platyrhynchos*	Green	Not Listed	Not Listed	Not Listed	2	6
Merlin	*Falco columbarius*	Green	Not at Risk	Not Listed	Not Listed	1	1
Mourning Dove	*Zenaida macroura*	Green	Not Listed	Not Listed	Not Listed	3	4
Mourning Warbler	*Oporornis philadelphia*	Green	Not Listed	Not Listed	Not Listed	1	1
Nashville Warbler	*Vermivora ruficapilla*	Green	Not Listed	Not Listed	Not Listed	5	12
Northern Flicker	*Colaptes auratus*	Green	Not Listed	Not Listed	Not Listed	12	13
Northern Parula	*Parula americana*	Green	Not Listed	Not Listed	Not Listed	2	2
Palm Warbler	*Dendroica palmarum*	Green	Not Listed	Not Listed	Not Listed	10	19
Pileated Woodpecker	*Dryocopus pileatus*	Green	Not Listed	Not Listed	Not Listed	1	1
Pine Grosbeak	*Pinicola enucleator*	Red	Not Listed	Not Listed	Not Listed	2	3
Pine Siskin	*Spinus pinus*	Yellow	Not Listed	Not Listed	Not Listed	9	22
Purple Finch	*Carpodacus purpureus*	Green	Not Listed	Not Listed	Not Listed	7	12
Red Crossbill	*Loxia curvirostra*	Green	Not Listed	Not Listed	Not Listed	3	7
Red-breasted Nuthatch	*Sitta canadensis*	Green	Not Listed	Not Listed	Not Listed	8	9
Red-eyed Vireo	*Vireo olivaceus*	Green	Not Listed	Not Listed	Not Listed	4	7
Red-tailed Hawk	*Buteo jamaicensis*	Green	Not at Risk	Not Listed	Not Listed	1	1
Ruby-crowned Kinglet	*Regulus calendula*	Yellow	Not Listed	Not Listed	Not Listed	4	5
Ruffed Grouse	*Bonasa umbellus*	Green	Not Listed	Not Listed	Not Listed	2	2
Savannah Sparrow	*Passerculus sandwichensis*	Green	Not Listed	Not Listed	Not Listed	1	1

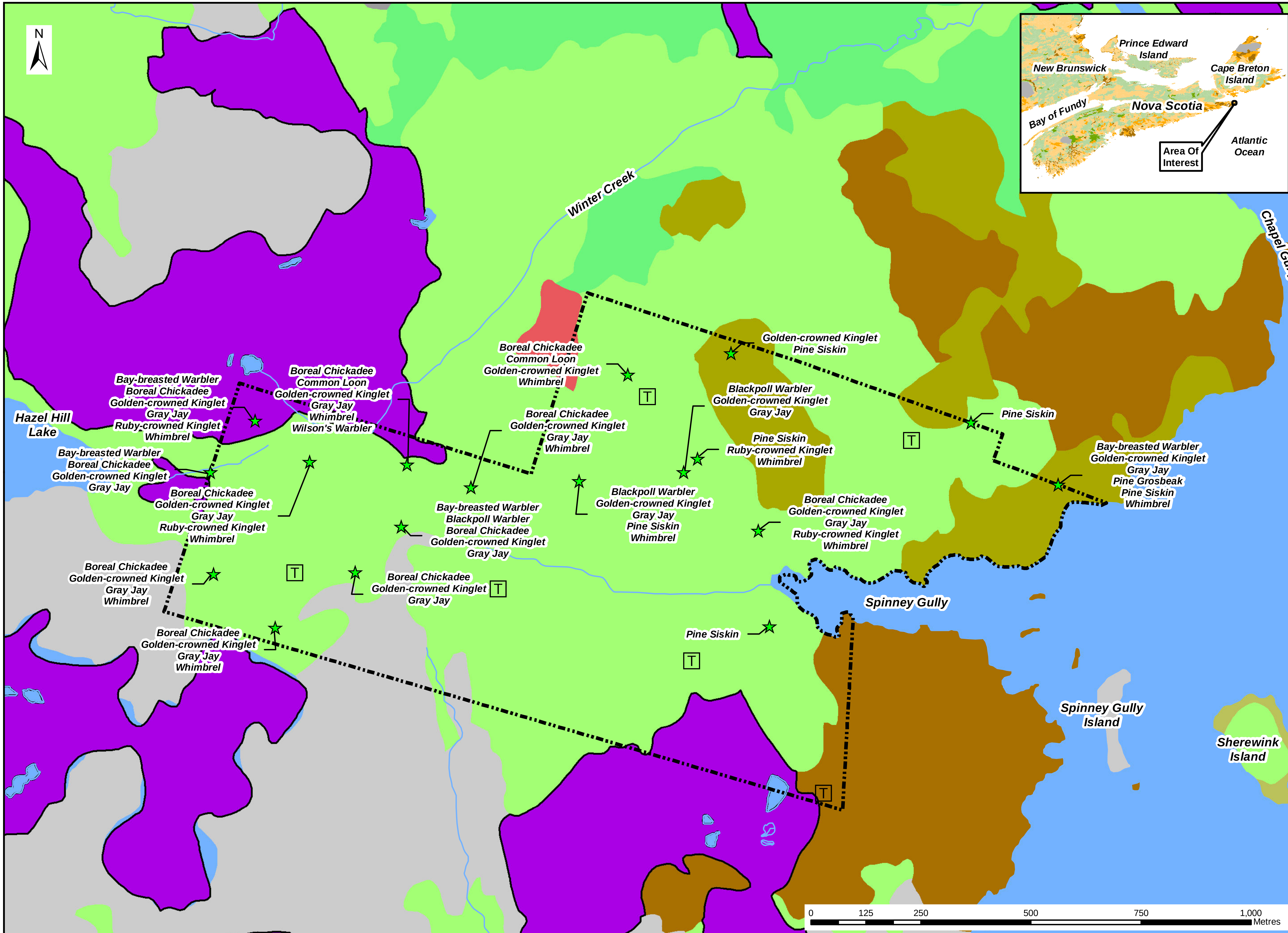
Common Name	Scientific Name	NSDNR Status	COSEWIC Status	SARA Status	NSESA Status	Number of Times Observed	Number of Individuals Observed
Song Sparrow	*Melospiza melodia*	Green	Not Listed	Not Listed	Not Listed	1	1
Spruce Grouse	*Falcipennis canadensis*	Green	Not Listed	Not Listed	Not Listed	1	1
Swainson's Thrush	*Catharus ustulatus*	Green	Not Listed	Not Listed	Not Listed	2	5
Swamp Sparrow	*Melospiza georgiana*	Green	Not Listed	Not Listed	Not Listed	3	4
Whimbrel	*Numenius phaeopus*	Yellow	Not Listed	Not Listed	Not Listed	16	24
White-throated Sparrow	*Zonotrichia albicollis*	Green	Not Listed	Not Listed	Not Listed	17	77
White-winged Crossbill	*Loxia leucoptera*	Green	Not Listed	Not Listed	Not Listed	13	57
Wilson's Warbler	*Wilsonia pusilla*	Yellow	Not Listed	Not Listed	Not Listed	1	1
Yellow-rumped Warbler	*Dendroica coronata*	Green	Not Listed	Not Listed	Not Listed	30	134

The following priority species were observed at the Project site during the 2012 fall migration surveys (Figure 9):

- Bay-breasted Warbler (*Dendroica castanea*) – "Yellow" (NSDNR 2010);
- Blackpoll Warbler (*Dendroica striata*) – "Yellow" (NSDNR 2010);
- Boreal Chickadee (*Poecile hudsonicus*) – "Yellow" (NSDNR 2010);
- Common Loon (*Gavia immer*) – "Red" (NSDNR 2010);
- Common Snipe (*Gallinago gallinago*) – "Yellow" (NSDNR 2010);
- Golden-crowned Kinglet (*Regulus satrapa*) – "Yellow" (NSDNR 2010);
- Gray Jay (*Perisoreus canadensis*) – "Yellow" (NSDNR 2010);
- Pine Grosbeak (*Pinicola enucleator*) – "Red" (NSDNR 2010);
- Pine Siskin (*Spinus pinus*) – "Yellow" (NSDNR 2010);
- Ruby-crowned Kinglet (*Regulus calendula*) – "Yellow" (NSDNR 2010);
- Whimbrel (*Numenius phaeopus*) – "Yellow" (NSDNR 2010); and
- Wilson's Warbler (*Wilsonia pusilla*) – "Yellow" (NSDNR 2010).

2.2 Passerine Fall Migration - Control Site Surveys

There were 51 stopover count surveys conducted at 16 locations on the lands surrounding the Project site during site visits on September 4, 12, 13, 14, 25, and 26, and October 17, 19, 25, and 28, 2012 (Figure 8). There were 83 bird species, representing 2804 individual birds, recorded during surveys on the lands surrounding the Project site (Table 11). American Crow, Black-capped Chickadee, and Yellow-rumped Warbler were the most abundant and frequently observed species.



Notes:

1. Reference: Site Plan Supplied by Client. Digital Topographic Mapping by Nova Scotia Geomatics Centre. Cover Type by Nova Scotia Forest Inventory.
2. Projection: NAD83(CSRS), UTM Zone 20N

Legend

- Current Project Site Boundary
- Current Proposed Turbine Location
- Priority Species Location - Fall 2012
- Bog or Fen
- Unclassified Forest
- Burned Stand
- Sugar Bush
- Brush
- Alders <75%
- Coastal Habitat
- Cliffs, Dunes, Coastal Rocks
- Rock Barren
- Barren
- Agriculture
- Urban
- Beach
- Road Corridor
- Softwood
- Mixedwood
- Water Body
- Roads
- Major Roads and Highways
- Watercourse

2012 Fall Passerine Migration Priority Species at Project Site

Strum Environmental

Date: Nov. 2012	Project #: 12-4469
Scale: 1:8,000	Figure #: 9
Drawn By: G. Gregory	
Checked By: M. Smith	

Table 11: Avifauna Observed At on Lands Around the Project Site During Fall Migration Surveys (2012)

Common Name	Scientific Name	Number of Times Observed	Total Individuals Observed	NSDNR Status	COSEWIC Status	SARA Status	NSESA Status
Alder Flycatcher	*Empidonax alnorum*	1	1	Green	Not Listed	Not Listed	Not Listed
American Black Duck	*Anas rubripes*	1	2	Green	Not Listed	Not Listed	Not Listed
American Crow	*Corvus brachyrhynchos*	72	418	Green	Not Listed	Not Listed	Not Listed
American Goldfinch	*Spinus tristis*	12	77	Green	Not Listed	Not Listed	Not Listed
American Redstart	*Setophaga ruticilla*	2	4	Green	Not Listed	Not Listed	Not Listed
American Robin	*Turdus migratorius*	20	110	Green	Not Listed	Not Listed	Not Listed
Bald Eagle	*Haliaeetus leucocephalus*	2	2	Green	Not at Risk	Not Listed	Not Listed
Baltimore Oriole	*Icterus galbula*	1	2	Red	Not Listed	Not Listed	Not Listed
Bay-breasted Warbler	*Dendroica castanea*	2	7	Yellow	Not Listed	Not Listed	Not Listed
Belted Kingfisher	*Megaceryle alcyon*	2	2	Green	Not Listed	Not Listed	Not Listed
Black-and-white Warbler	*Mniotilta varia*	6	9	Green	Not Listed	Not Listed	Not Listed
Black-backed Woodpecker	*Picoides arcticus*	1	1	Yellow	Not Listed	Not Listed	Not Listed
Black-bellied Plover	*Pluvialis squatarola*	4	5	Green	Not Listed	Not Listed	Not Listed
Blackburnian Warbler	*Dendroica fusca*	1	1	Green	Not Listed	Not Listed	Not Listed
Black-capped Chickadee	*Poecile atricapillus*	41	242	Green	Not Listed	Not Listed	Not Listed
Blackpoll Warbler	*Dendroica striata*	2	10	Yellow	Not Listed	Not Listed	Not Listed
Black-throated Blue Warbler	*Dendroica caerulescens*	1	1	Green	Not Listed	Not Listed	Not Listed
Black-throated Green Warbler	*Dendroica virens*	3	5	Green	Not Listed	Not Listed	Not Listed
Blue Jay	*Cyanocitta cristata*	31	107	Green	Not Listed	Not Listed	Not Listed
Blue-headed Vireo	*Vireo solitarius*	1	1	Green	Not Listed	Not Listed	Not Listed
Boreal Chickadee	*Poecile hudsonicus*	31	164	Yellow	Not Listed	Not Listed	Not Listed
Brown Creeper	*Certhia americana*	3	3	Green	Not Listed	Not Listed	Not Listed
Canada Warbler	*Wilsonia canadensis*	1	1	Red	Threatened	Threatened	Not Listed
Caspian Tern	*Hydroprogne caspia*	1	1	Green	Not Listed	Not Listed	Not Listed
Cedar Waxwing	*Bombycilla cedrorum*	11	27	Green	Not Listed	Not Listed	Not Listed

Common Name	Scientific Name	Number of Times Observed	Total Individuals Observed	NSDNR Status	COSEWIC Status	SARA Status	NSESA Status
Chestnut-sided Warbler	*Dendroica pensylvanica*	2	3	Green	Not Listed	Not Listed	Not Listed
Common Grackle	*Quiscalus quiscula*	2	6	Green	Not Listed	Not Listed	Not Listed
Common Loon	*Gavia immer*	1	1	Red	Not at Risk	Not Listed	Not Listed
Common Raven	*Corvus corax*	16	20	Green	Not Listed	Not Listed	Not Listed
Common Redpoll	*Acanthis flammea*	2	6	Green	Not Listed	Not Listed	Not Listed
Common Tern	*Sterna hirundo*	1	5	Yellow	Not at Risk	Not Listed	Not Listed
Common Yellowthroat	*Geothlypis trichas*	28	117	Green	Not Listed	Not Listed	Not Listed
Cooper's Hawk	*Accipiter cooperii*	1	1	Undetermined	Not at Risk	Not Listed	Not Listed
Dark-eyed Junco	*Junco hyemalis*	21	162	Green	Not Listed	Not Listed	Not Listed
Dickcissel	*Spiza americana*	1	2	Accidental	Not Listed	Not Listed	Not Listed
Double-crested Cormorant	*Phalacrocorax auritus*	4	35	Green	Not at Risk	Not Listed	Not Listed
Downy Woodpecker	*Picoides pubescens*	3	5	Green	Not Listed	Not Listed	Not Listed
European Starling	*Sturnus vulgaris*	1	12	Exotic	Not Listed	Not Listed	Not Listed
Evening Grosbeak	*Coccothraustes vespertinus*	1	2	Green	Not Listed	Not Listed	Not Listed
Field Sparrow	*Spizella pusilla*	1	1	Accidental	Not Listed	Not Listed	Not Listed
Golden-crowned Kinglet	*Regulus satrapa*	31	158	Yellow	Not Listed	Not Listed	Not Listed
Gray Jay	*Perisoreus canadensis*	2	8	Yellow	Not Listed	Not Listed	Not Listed
Gray-cheeked Thrush	*Catharus minimus*	1	1	Green	Not Listed	Not Listed	Not Listed
Great Black-backed Gull	*Larus marinus*	1	1	Green	Not Listed	Not Listed	Not Listed
Great Blue Heron	*Ardea herodias*	4	4	Green	Not Listed	Not Listed	Not Listed
Great Cormorant	*Phalacrocorax carbo*	1	7	Yellow	Not Listed	Not Listed	Not Listed
Greater Yellowlegs	*Tringa melanoleuca*	4	5	Yellow	Not Listed	Not Listed	Not Listed
Hairy Woodpecker	*Picoides villosus*	5	8	Green	Not Listed	Not Listed	Not Listed
Hermit Thrush	*Catharus guttatus*	3	5	Green	Not Listed	Not Listed	Not Listed
Herring Gull	*Larus argentatus*	10	15	Green	Not Listed	Not Listed	Not Listed
Lapland Longspur	*Calcarius lapponicus*	1	5	Green	Not Listed	Not Listed	Not Listed

Common Name	Scientific Name	Number of Times Observed	Total Individuals Observed	NSDNR Status	COSEWIC Status	SARA Status	NSESA Status
Lincoln's Sparrow	*Melospiza lincolnii*	1	1	Green	Not Listed	Not Listed	Not Listed
Magnolia Warbler	*Dendroica magnolia*	17	54	Green	Not Listed	Not Listed	Not Listed
Mourning Dove	*Zenaida macroura*	8	15	Green	Not Listed	Not Listed	Not Listed
Nashville Warbler	*Vermivora ruficapilla*	4	8	Green	Not Listed	Not Listed	Not Listed
Northern Flicker	*Colaptes auratus*	14	19	Green	Not Listed	Not Listed	Not Listed
Northern Parula	*Parula americana*	2	2	Green	Not Listed	Not Listed	Not Listed
Northern Waterthrush	*Seiurus noveboracensis*	1	1	Green	Not Listed	Not Listed	Not Listed
Northern Wheatear	*Oenanthe oenanthe*	1	1	Accidental	Not Listed	Not Listed	Not Listed
Palm Warbler	*Dendroica palmarum*	20	66	Green	Not Listed	Not Listed	Not Listed
Pine Grosbeak	*Pinicola enucleator*	1	6	Red	Not Listed	Not Listed	Not Listed
Pine Siskin	*Spinus pinus*	12	93	Yellow	Not Listed	Not Listed	Not Listed
Purple Finch	*Carpodacus purpureus*	24	81	Green	Not Listed	Not Listed	Not Listed
Red-breasted Nuthatch	*Sitta canadensis*	14	29	Green	Not Listed	Not Listed	Not Listed
Red-eyed Vireo	*Vireo olivaceus*	4	8	Green	Not Listed	Not Listed	Not Listed
Red-winged Blackbird	*Agelaius phoeniceus*	2	27	Green	Not Listed	Not Listed	Not Listed
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	1	1	Yellow	Not Listed	Not Listed	Not Listed
Ruby-crowned Kinglet	*Regulus calendula*	4	8	Yellow	Not Listed	Not Listed	Not Listed
Savannah Sparrow	*Passerculus sandwichensis*	3	16	Green	Special Concern	Special Concern	Not Listed
Sharp-shinned Hawk	*Accipiter striatus*	3	3	Green	Not at Risk	Not Listed	Not Listed
Song Sparrow	*Melospiza melodia*	18	112	Green	Not Listed	Not Listed	Not Listed
Summer Tanager	*Piranga rubra*	1	1	Accidental	Not Listed	Not Listed	Not Listed
Swamp Sparrow	*Melospiza georgiana*	14	36	Green	Not Listed	Not Listed	Not Listed
Whimbrel	*Numenius phaeopus*	14	19	Yellow	Not Listed	Not Listed	Not Listed
White-breasted Nuthatch	*Sitta carolinensis*	2	2	Green	Not Listed	Not Listed	Not Listed
White-crowned Sparrow	*Zonotrichia leucophrys*	1	1	Green	Not Listed	Not Listed	Not Listed
White-throated Sparrow	*Zonotrichia albicollis*	17	113	Green	Not Listed	Not Listed	Not Listed

Common Name	Scientific Name	Number of Times Observed	Total Individuals Observed	NSDNR Status	COSEWIC Status	SARA Status	NSESA Status
White-winged Crossbill	*Loxia leucoptera*	10	51	Green	Not Listed	Not Listed	Not Listed
Wilson's Warbler	*Wilsonia pusilla*	1	1	Yellow	Not Listed	Not Listed	Not Listed
Winter Wren	*Troglodytes troglodytes*	1	1	Green	Not Listed	Not Listed	Not Listed
Yellow Warbler	*Dendroica petechia*	1	2	Green	Not Listed	Not Listed	Not Listed
Yellow-billed Cuckoo	*Coccyzus americanus*	1	1	Accidental	Not Listed	Not Listed	Not Listed
Yellow-rumped Warbler	*Dendroica coronata*	38	288	Green	Not Listed	Not Listed	Not Listed

The following priority species were identified during passerine fall migration surveys on the lands surrounding the Project site (Figure 10):

- Baltimore Oriole (*Icterus galbula*) – “Red” (NSDNR 2010);
- Bay-breasted Warbler – “Yellow” (NSDNR 2010);
- Black-backed Woodpecker (*Picoides arcticus*) – “Yellow” (NSDNR 2010);
- Blackpoll Warbler – “Yellow” (NSDNR 2010);
- Boreal Chickadee – “Yellow” (NSDNR 2010);
- Canada Warbler (*Wilsonia canadensis*) – “Red” (NSDNR 2010), “Threatened” (COSEWIC 2012), “Threatened” (SARA 2012);
- Common Loon – “Red” (NSDNR 2010);
- Common Tern (*Sterna hirundo*) – “Yellow” (NSDNR 2010);
- Golden-crowned Kinglet – “Yellow” (NSDNR 2010);
- Gray Jay – “Yellow” (NSDNR 2010);
- Great Cormorant (*Phalacrocorax carbo*) – “Yellow” (NSDNR 2010);
- Greater Yellowlegs (*Tringa melanoleuca*) – “Yellow” (NSDNR 2010);
- Pine Siskin – “Yellow” (NSDNR 2010);
- Rose-breasted Grosbeak (*Pheucticus ludovicianus*) – “Yellow” (NSDNR 2010);
- Ruby-crowned Kinglet – “Yellow” (NSDNR 2010);
- Whimbrel – “Yellow” (NSDNR 2010); and
- Wilson's Warbler – “Yellow” (NSDNR 2010).

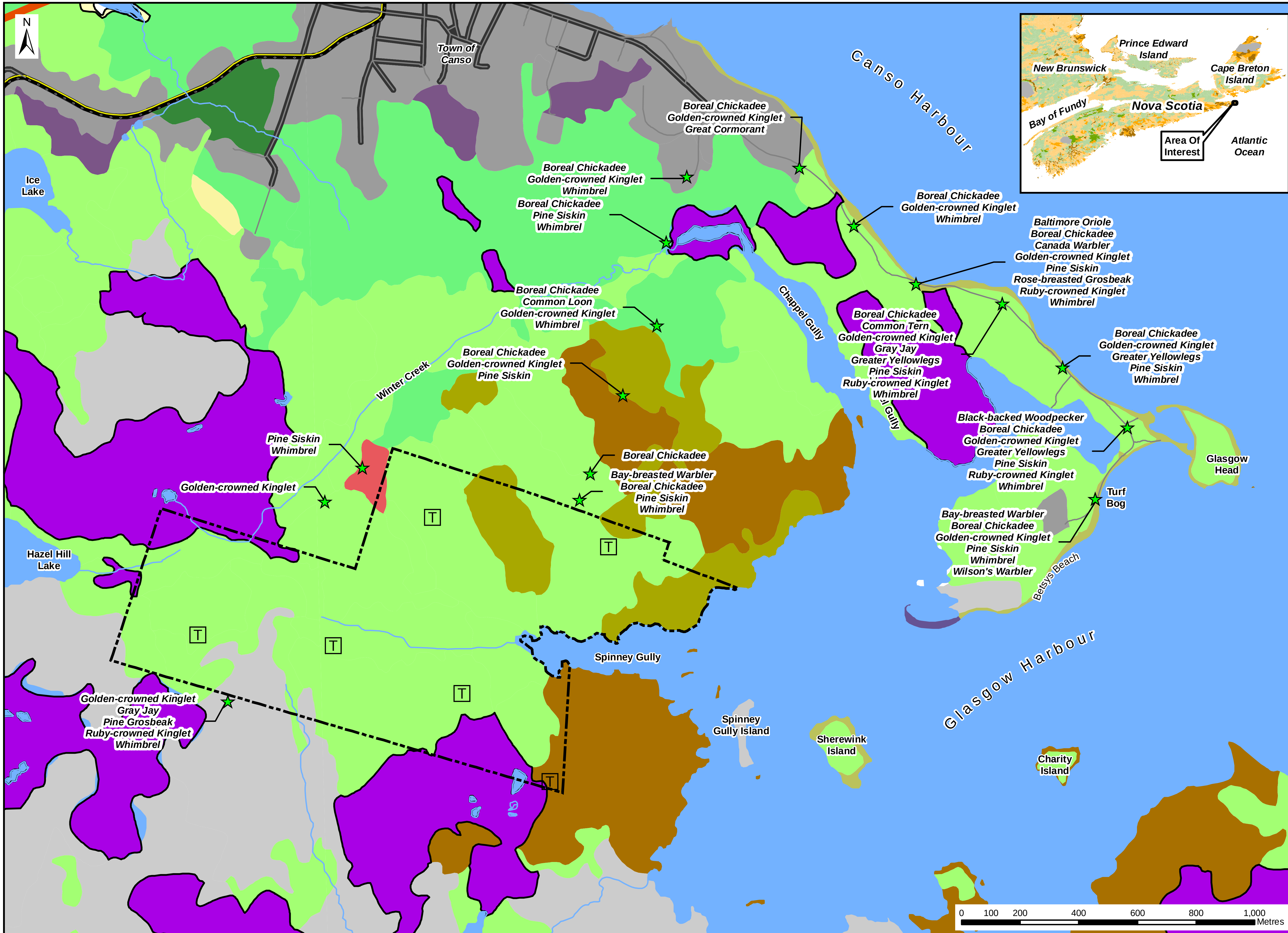
There were 14 species observed at the Project site but not identified in the surrounding lands, of which Common Snipe was the only priority species.

Common Snipe typically makes use of wetlands including bogs, fens, and marshes during fall migration (Mueller 1999). While these habitat types are present at the Project site, the same habitat also occurs in the nearby coastal lands (i.e., turf bog). Although no Common Snipe were observed in the control passerine migration surveys, the species was detected during shorebird surveys in adjacent coastal lands (refer to Section 2.4), therefore, suitable habitat is present for this species outside of the Project site boundaries.

4.3 Post-Dusk Migration Surveys

Post-dusk surveys were completed at two locations in the general Project area; at the head of the Chapel Gully Trail; and at Glasgow Camp (Figure 11). Eight surveys were conducted during site visits on September 11, 13, 25, and 26, as well as October 18, 19, 25, and 27, 2012. All surveys were carried out between 1854-2400 hrs, and consisted of an expert birder identifying individual/groups of birds migrating overhead on the basis of characteristic flight calls.

There were 26 bird species, comprising 582 individual birds, identified during nocturnal surveys in the general Project area (Table 12). Yellow-rumped Warbler was the most frequently identified species, followed by Magnolia Warbler (*Dendroica magnolia*), Black-capped Chickadee, and Black-and-white Warbler (*Mniotilta varia*). Most of the species recorded were passerines, although three species of shorebird and two species of waterbird were also observed. The reduced abundance and species diversity of nocturnal migrants at the Glasgow Camp site was likely due to a reduced survey effort at this location, and poor conditions during one survey.



Notes:

1. Reference: Digital Topographic Mapping By Nova Scotia Geomatics Centre.
2. Projection: NAD83(CSRS), UTM Zone 20 North.
3. GPS Points Taken Are Typically To +/-5m Accuracy.

Legend:

- Project Site Boundary
- T Current Proposed Turbine Location
- Priority Species Location - Control Site Fall 2012
- Bog or Fen
- Marsh
- Swamp
- Water Body
- Softwood
- Mixedwood
- Unclassified Forest
- Burned Stand
- Sugar Bush
- Brush
- Alders <75%
- Clearcut
- Coastal Habitat
- Cliffs, Dunes, Coastal Rocks
- Rock Barren
- Barren
- Agriculture
- Urban
- Beach
- Powerline Corridor
- Road Corridor
- Watercourse
- Roads
- Major Roads and Highways

2012 Fall Passerine MigrationPriority Species at Control Site

Strum ENVIRONMENTAL

Date: Nov. 2012	Project #: 12-4469
Scale: 1:12,000	Figure #: 10
Drawn By: H. Serhan	
Checked By: G. Gregory	

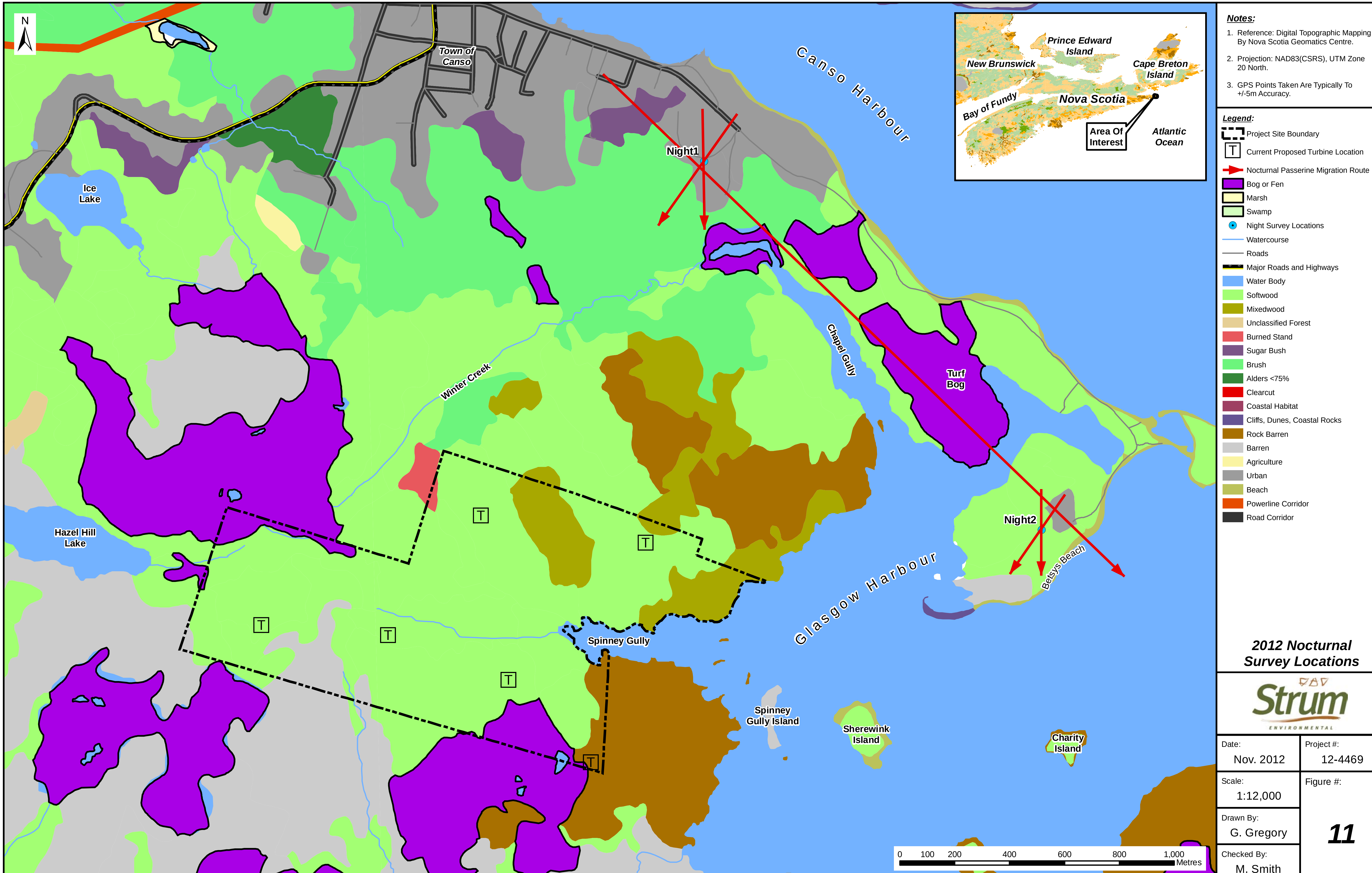

N
Town of Canso
Canso Harbour
Night1
Ice Lake
Winter Creek
Chapel Gully
Turf Bog
Night2
Betsys Beach
Glasgow Harbour
Hazel Hill Lake
Spinney Gully
Spinney Gully Island
Sherewink Island
Charity Island
Prince Edward Island
New Brunswick
Cape Breton Island
Nova Scotia
Bay of Fundy
Area Of Interest
Atlantic Ocean
0 100 200 400 600 800 1,000 Metres
Notes:
1. Reference: Digital Topographic Mapping By Nova Scotia Geomatics Centre.
2. Projection: NAD83(CSRS), UTM Zone 20 North.
3. GPS Points Taken Are Typically To +/-5m Accuracy.
Legend:
Project Site Boundary
Current Proposed Turbine Location
Nocturnal Passerine Migration Route
Bog or Fen
Marsh
Swamp
Night Survey Locations
Watercourse
Roads
Major Roads and Highways
Water Body
Softwood
Mixedwood
Unclassified Forest
Burned Stand
Sugar Bush
Brush
Alders <75%
Clearcut
Coastal Habitat
Cliffs, Dunes, Coastal Rocks
Rock Barren
Barren
Agriculture
Urban
Beach
Powerline Corridor
Road Corridor
2012 Nocturnal Survey Locations
Strum Environmental
Date: Nov. 2012
Project #: 12-4469
Scale: 1:12,000
Figure #: 11
Drawn By: G. Gregory
Checked By: M. Smith

Table 12: Avifauna Observed During Post-Dusk Surveys in the General Project Area (2012)

Common Name	Scientific Name	NSDNR Status	COSEWIC Status	SARA Status	NSESA Status	Number of Times Observed	Number of Individuals Observed
American Redstart	*Setophaga ruticilla*	Green	Not Listed	Not Listed	Not Listed	7	8
American Robin	*Turdus migratorius*	Green	Not Listed	Not Listed	Not Listed	1	3
Bay-breasted Warbler	*Dendroica castanea*	Yellow	Not Listed	Not Listed	Not Listed	3	4
Black-and-White Warbler	*Mniotilta varia*	Green	Not Listed	Not Listed	Not Listed	35	42
Black-capped Chickadee	*Poecile atricapillus*	Green	Not Listed	Not Listed	Not Listed	36	57
Blackpoll Warbler	*Dendroica striata*	Yellow	Not Listed	Not Listed	Not Listed	11	13
Black-throated Green Warbler	*Dendroica virens*	Green	Not Listed	Not Listed	Not Listed	18	18
Chestnut-sided Warbler	*Dendroica pensylvanica*	Green	Not Listed	Not Listed	Not Listed	2	2
Common Yellowthroat	*Geothlypis trichas*	Green	Not Listed	Not Listed	Not Listed	8	8
Great Blue Heron	*Ardea herodias*	Green	Not Listed	Not Listed	Not Listed	4	5
Herring Gull	*Larus argentatus*	Green	Not Listed	Not Listed	Not Listed	2	2
Lapland Longspur	*Calcarius lapponicus*	Green	Not Listed	Not Listed	Not Listed	1	3
Magnolia Warbler	*Dendroica magnolia*	Green	Not Listed	Not Listed	Not Listed	80	108
Nashville Warbler	*Vermivora ruficapilla*	Green	Not Listed	Not Listed	Not Listed	1	1
Northern Parula	*Parula americana*	Green	Not Listed	Not Listed	Not Listed	11	11
Northern Waterthrush	*Seiurus noveboracensis*	Green	Not Listed	Not Listed	Not Listed	8	8
Palm Warbler	*Dendroica palmarum*	Green	Not Listed	Not Listed	Not Listed	8	10
Ruby-crowned Kinglet	*Regulus calendula*	Yellow	Not Listed	Not Listed	Not Listed	1	1
Semipalmated Plover	*Charadrius semipalmatus*	Green	Not Listed	Not Listed	Not Listed	4	6
Song Sparrow	*Melospiza melodia*	Green	Not Listed	Not Listed	Not Listed	1	2
Swamp Sparrow	*Melospiza georgiana*	Green	Not Listed	Not Listed	Not Listed	2	2
Whimbrel	*Numenius phaeopus*	Yellow	Not Listed	Not Listed	Not Listed	2	4
White-rumped Sandpiper	*Calidris fuscicollis*	Green	Not Listed	Not Listed	Not Listed	1	1

Common Name	Scientific Name	NSDNR Status	COSEWIC Status	SARA Status	NSESA Status	Number of Times Observed	Number of Individuals Observed
White-throated Sparrow	*Zonotrichia albicollis*	Green	Not Listed	Not Listed	Not Listed	5	12
Yellow Warbler	*Dendroica petechia*	Green	Not Listed	Not Listed	Not Listed	1	1
Yellow-rumped Warbler	*Dendroica coronata*	Green	Not Listed	Not Listed	Not Listed	140	226

The following priority species were identified during post-dusk surveys in the general Project area:

- Bay-breasted Warbler – "Yellow" (NSDNR 2010);
- Blackpoll Warbler – "Yellow" (NSDNR 2010);
- Ruby-crowned Kinglet – "Yellow" (NSDNR 2010); and
- Whimbrel – "Yellow" (NSDNR 2010).

In most cases (84.7%), birds were observed flying to the south/southwest. Five passerine species were recorded at both survey locations, including Black-capped Chickadee, Palm Warbler (*Dendroica palmarum*), Swamp Sparrow (*Melospiza georgiana*), White-throated Sparrow (*Zonotrichia albicollis*), and Yellow-rumped Warbler. Each of these species was also detected in passerine migration surveys along the Canso Peninsula, the area falling between the two nocturnal survey locations. This suggests that this tract of land lies within a passerine migratory corridor, as birds were observed in this area during nocturnal migration and during peak foraging times after sunrise.

4.4 Shorebird Surveys – Project Area

There were 20 shorebird surveys conducted at locations in the general Project area during site visits on September 3, 13, 14, 24 and 26, as well as October 17, 19, and 26, 2012 (Figure 12). Surveys were planned to coincide with the tidal cycle, such that both low tides and high tides were surveyed to evaluate shorebird behavior prior to, during, and after peak foraging times for this guild. In addition, attempts were made to survey in a variety of conditions to gauge the response of migrating shorebirds to adverse weather (e.g., high winds, heavy rains).

There were 25 species, comprising 468 individual birds, observed during shorebird surveys in the general Project area (Table 13). Semipalmated Plover (*Charadrius semipalmatus*) was the most abundant species observed (195 individuals), followed by Herring Gull (*Larus argentatus*) and Common Tern (*Sterna hirundo*). Whimbrel and Greater Yellowlegs (*Tringa melanoleuca*) were also commonly observed during these surveys.

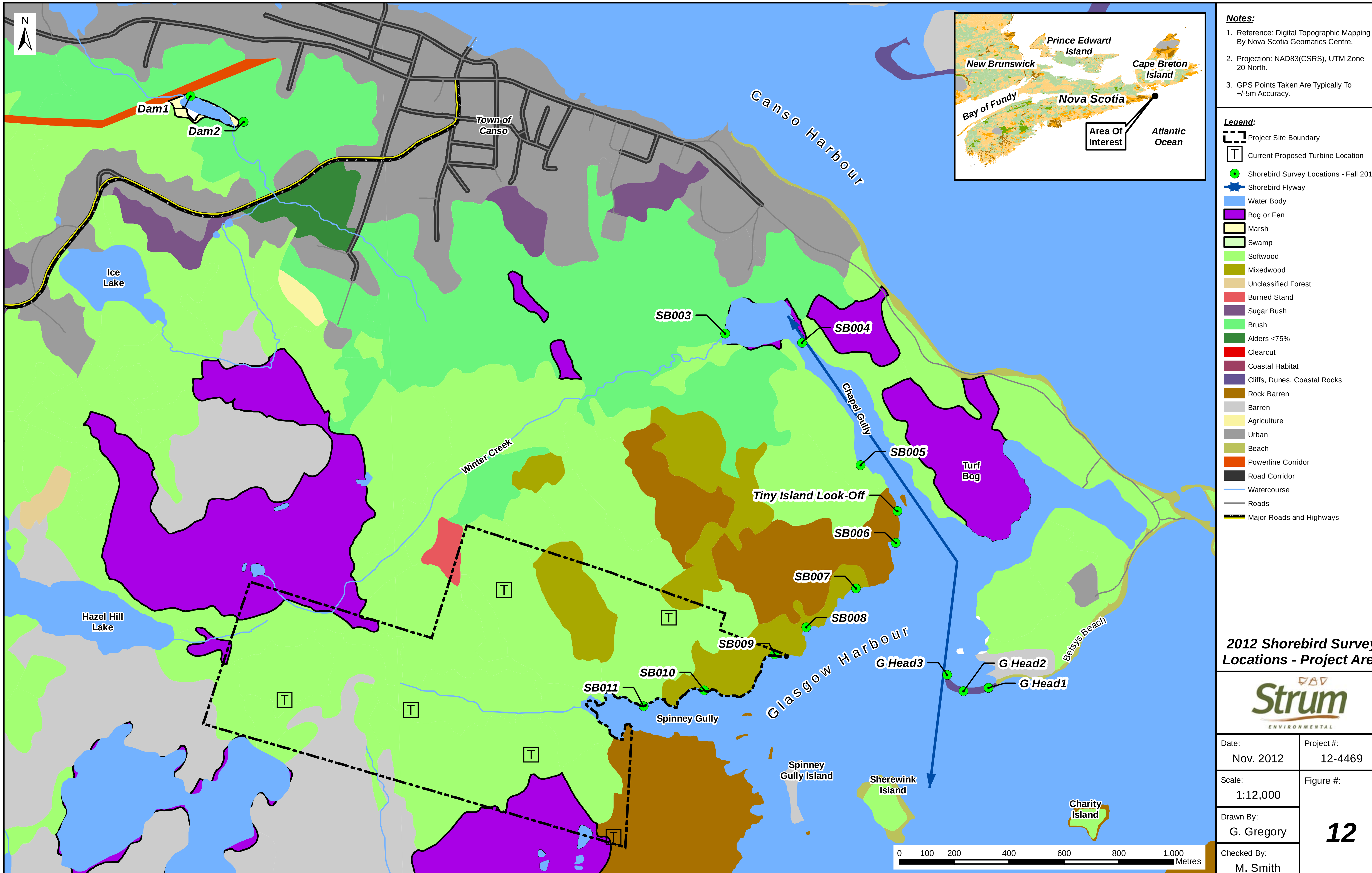

N
Dam1
Dam2
Town of Canso
Canso Harbour
Ice Lake
Hazel Hill Lake
Winter Creek
Chapel Gully
SB003
SB004
SB005
Turf Bog
Tiny Island Look-Off
SB006
SB007
SB008
SB009
SB010
SB011
Spinney Gully
Glasgow Harbour
G Head3
G Head2
G Head1
Betsys Beach
Spinney Gully Island
Sherewink Island
Charity Island
T
0 100 200 400 600 800 1,000 Metres
Prince Edward Island
New Brunswick
Cape Breton Island
Bay of Fundy
Nova Scotia
Area Of Interest
Atlantic Ocean
Notes:
1. Reference: Digital Topographic Mapping By Nova Scotia Geomatics Centre.
2. Projection: NAD83(CSRS), UTM Zone 20 North.
3. GPS Points Taken Are Typically To +/-5m Accuracy.
Legend:
Project Site Boundary
Current Proposed Turbine Location
Shorebird Survey Locations - Fall 2012
Shorebird Flyway
Water Body
Bog or Fen
Marsh
Swamp
Softwood
Mixedwood
Unclassified Forest
Burned Stand
Sugar Bush
Brush
Alders <75%
Clearcut
Coastal Habitat
Cliffs, Dunes, Coastal Rocks
Rock Barren
Barren
Agriculture
Urban
Beach
Powerline Corridor
Road Corridor
Watercourse
Roads
Major Roads and Highways
2012 Shorebird Survey Locations - Project Area
Strum Environmental
Date: Nov. 2012
Project #: 12-4469
Scale: 1:12,000
Figure #: 12
Drawn By: G. Gregory
Checked By: M. Smith

Table 13: Species Observed During Shorebird Surveys in the General Project Area (2012)

Common Name	Scientific Name	Number of Observations	Total Individuals Observed	NSDNR Status	COSEWIC Status	SARA Status	NSESA Status
American Black Duck	*Anas rubripes*	3	6	Green	Not Listed	Not Listed	Not Listed
American Golden-Plover	*Pluvialis dominica*	2	3	Yellow	Not Listed	Not Listed	Not Listed
Bald Eagle	*Haliaeetus leucocephalus*	2	2	Green	Not at Risk	Not Listed	Not Listed
Belted Kingfisher	*Megaceryle alcyon*	1	1	Green	Not Listed	Not Listed	Not Listed
Black-bellied Plover	*Pluvialis squatarola*	1	1	Green	Not Listed	Not Listed	Not Listed
Buff-breasted Sandpiper	*Tryngites subruficollis*	1	1	Accidental	Not Listed	Not Listed	Not Listed
Common Eider	*Somateria mollissima*	2	11	Green	Not Listed	Not Listed	Not Listed
Common Snipe	*Gallinaga gallinaga*	3	3	Yellow	Not Listed	Not Listed	Not Listed
Common Tern	*Sterna hirundo*	3	45	Yellow	Not at Risk	Not Listed	Not Listed
Double-crested Cormorant	*Phalacrocorax auritus*	4	5	Green	Not at Risk	Not Listed	Not Listed
Great Black-backed Gull	*Larus marinus*	7	8	Green	Not Listed	Not Listed	Not Listed
Great Blue Heron	*Ardea herodias*	6	7	Green	Not Listed	Not Listed	Not Listed
Greater Yellowlegs	*Tringa melanoleuca*	17	36	Yellow	Not Listed	Not Listed	Not Listed
Herring Gull	*Larus argentatus*	27	49	Green	Not Listed	Not Listed	Not Listed
Killdeer	*Charadrius vociferus*	1	1	Yellow	Not Listed	Not Listed	Not Listed
Least Sandpiper	*Calidris minutilla*	7	9	Green	Not Listed	Not Listed	Not Listed
Lesser Yellowlegs	*Tringa flavipes*	1	7	Green	Not Listed	Not Listed	Not Listed
Northern Harrier	*Circus cyaneus*	1	1	Green	Not at Risk	Not Listed	Not Listed
Osprey	*Pandion haliaetus*	1	1	Green	Not Listed	Not Listed	Not Listed
Pectoral Sandpiper	*Calidris melanotos*	2	2	Green	Not Listed	Not Listed	Not Listed
Semipalmated Plover	*Charadrius semipalmatus*	20	195	Green	Not Listed	Not Listed	Not Listed
Semipalmated Sandpiper	*Calidris pusilla*	11	26	Yellow	Not Listed	Not Listed	Not Listed
Spotted Sandpiper	*Actitis macularius*	3	3	Yellow	Not Listed	Not Listed	Not Listed
Whimbrel	*Numenius phaeopus*	18	34	Yellow	Not Listed	Not Listed	Not Listed
White-rumped Sandpiper	*Calidris fuscicollis*	6	11	Green	Not Listed	Not Listed	Not Listed

The following priority species were identified during shorebird surveys in the general Project area:

- American Golden-Plover (*Pluvialis dominica*) – "Yellow" (NSDNR 2010);
- Common Snipe – "Yellow" (NSDNR 2010);
- Common Tern – "Yellow" (NSDNR 2010);
- Greater Yellowlegs – "Yellow" (NSDNR 2010);
- Killdeer (*Charadrius vociferous*) – "Yellow" (NSDNR 2010);
- Semipalmated Sandpiper (*Calidris pusilla*) – "Yellow" (NSDNR 2010);
- Spotted Sandpiper (*Actitis macularius*) – "Yellow" (NSDNR 2010); and
- Whimbrel – "Yellow" (NSDNR 2010).

4.5 Shorebird Surveys – Control Site

Six shorebird surveys were conducted at a control site location approximately 38 km to the southwest of the Project site at New Harbour (Figure13). Surveys were carried out on September 2, 12, and 25, as well as October 17 and 25, 2012. Once again, surveys were planned to coincide with the tidal cycle, such that both low tides and high tides were surveyed to evaluate shorebird behavior prior to, during, and after peak foraging times for this guild. In addition, attempts were made to survey in a variety of conditions to gauge the response of migrating shorebirds to adverse weather (e.g., high winds, heavy rains).

There were 17 species, comprising 1,265 individual birds, observed during shorebird surveys at the control site location (Table 14). Semipalmated Plover, and Semipalmated Sandpiper were the most abundant species, accounting for 74% of the individuals observed. Other commonly observed species included White-rumped Sandpiper (*Calidris fuscicollis*), Greater Yellowlegs, and Sanderling (*Calidris alba*).

Notes:

1. Reference: Digital Topographic Mapping By Nova Scotia Geomatics Centre.
2. Projection: NAD83(CSRS), UTM Zone 20 North.
3. GPS Points Taken Are Typically To +/-5m Accuracy.

Legend:

- Project Site Boundary
- Shorebird Survey Control Sites
- Water Body

2012 Shorebird Survey Locations - Control Sites

Strum ENVIRONMENTAL

Date: Nov. 2012	Project #: 12-4469
Scale: 1:125,000	Figure #: **13**
Drawn By: G. Gregory	
Checked By: M. Smith	

Table 14: Species Observed During Shorebird Surveys at New Harbour (2012)

Common Name	Scientific Name	Number of Observations	Total Individuals Observed	NSDNR Status	COSEWIC Status	SARA Status	NSESA Status
Baird's Sandpiper	*Calidris bairdii*	1	6	Green	Not Listed	Not Listed	Not Listed
Black-bellied Plover	*Pluvialis squatarola*	3	26	Green	Not Listed	Not Listed	Not Listed
Common Snipe	*Gallinaga gallinaga*	1	4	Yellow	Not Listed	Not Listed	Not Listed
Greater Yellowlegs	*Tringa melanoleuca*	4	48	Yellow	Not Listed	Not Listed	Not Listed
Hudsonian Godwit	*Limosa haemastica*	1	3	Yellow	Not Listed	Not Listed	Not Listed
Least Sandpiper	*Calidris minutilla*	5	76	Green	Not Listed	Not Listed	Not Listed
Lesser Yellowlegs	*Tringa flavipes*	3	11	Green	Not Listed	Not Listed	Not Listed
Ruddy Turnstone	*Arenaria interpres*	1	3	Green	Not Listed	Not Listed	Not Listed
Sanderling	*Calidris alba*	4	42	Green	Not Listed	Not Listed	Not Listed
Semipalmated Plover	*Charadrius semipalmatus*	4	564	Green	Not Listed	Not Listed	Not Listed
Semipalmated Sandpiper	*Calidris pusilla*	6	372	Yellow	Not Listed	Not Listed	Not Listed
Short-billed Dowitcher	*Limnodromus griseus*	2	39	Green	Not Listed	Not Listed	Not Listed
Solitary Sandpiper	*Tringa solitaria*	1	1	Green	Not Listed	Not Listed	Not Listed
Spotted Sandpiper	*Actitis macularius*	3	3	Yellow	Not Listed	Not Listed	Not Listed
Whimbrel	*Numenius phaeopus*	1	1	Yellow	Not Listed	Not Listed	Not Listed
White-rumped Sandpiper	*Calidris fuscicollis*	4	62	Green	Not Listed	Not Listed	Not Listed
Willet	*Tringa semipalmata*	2	4	Red	Not Listed	Not Listed	Not Listed

The following priority species were observed during shorebird surveys at the control site:

- Common Snipe – "Yellow" (NSDNR 2010);
- Greater Yellowlegs – "Yellow" (NSDNR 2010);
- Hudsonian Godwit (*Limosa haemastica*) – "Yellow" (NSDNR 2010);
- Semipalmated Sandpiper – "Yellow" (NSDNR 2010);
- Spotted Sandpiper – "Yellow" (NSDNR 2010);
- Whimbrel – "Yellow" (NSDNR 2010); and
- Willet (*Tringa semipalmata*) – "Red" (NSDNR 2010).

4.6 2012 Field Data Analysis and Interpretation

Post-construction monitoring at wind energy installations across Canada indicates that passerines are the group most commonly affected, accounting for 70% of all bird fatalities (EC *et al.* 2012). In general, the data obtained from avian surveys conducted in the fall of 2012 do not suggest that the Project site is of particular significance to migrating passerines or that the Project poses a high risk to the area's migrant passerine community. The Canso area is known as a hotspot for reverse migrants (i.e., vagrant species), but fall migrant passerine abundances were actually somewhat lower than anticipated when considering the time period encompassed. Post-dusk surveys indicated that Yellow-rumped Warbler and Magnolia Warbler were the most abundant nocturnal migrant species in the area, but these abundances did not suggest that the area is of particular importance to these species. J. Kearney (2012), for example, identified 368 night-migrating Yellow-rumped Warblers in Antigonish County between September 28 and October 5, 2012. This abundance over a one-week period exceeds the total number of Yellow-rumped Warblers observed during the eight surveys carried out as part of the current study. The post-dusk surveys also revealed surprisingly few migrating sparrows. It is possible, however, that these surveys did not coincide with the peak migration period for this group. This possibility is supported by the results of key sparrow movements by J. Kearney (2012) who identified the peak migration for this species, in Antigonish, as occurring between September 27 and October 9, 2012.

Post-dusk survey results indicated that most nocturnal migrants in the general Project area move in a south/southwest direction, a path which likely coincides with Project infrastructure. However, the maximum effective turbine height (turbine tower height + blade length + height of landform) is less than 200 m below the usual flight height for migrating passerines (particularly nocturnal migrants) (as reviewed by Kingsley and Whittam 2005). During passerine migration surveys at the Project site, surveys at the locations of two distinct hills did not indicate that increased numbers of birds were using these areas relative to other areas at the site. The area does not appear to possess landform features, including high ridges or mountains, which might concentrate migrating birds (Kingsley and Whittam 2005).

Weather conditions can strongly influence migratory patterns. Low cloud banks, drizzle, and fog can cause migrants to fly at lower altitudes, potentially bringing birds into the rotor-swept zone of turbines (Kingsley and Whittam 2005). Furthermore, adverse conditions encountered during migration may force large numbers of nocturnal migrants to land (Richardson 1977). In recognition of this pattern, advanced forecasts were scanned for weather systems that could potentially force migrants to ground themselves. Avian surveys were then carried out immediately prior to and just after heavy rain and wind events to evaluate the potential use of the Project site as a hold-over site during adverse weather conditions. Surveys on September 12, for example, were carried out two days after a weather event in which the region received in excess of 90 mm of rain, with wind gusts exceeding 50 km/hr from the north, and reduced visibility. The average number of birds/survey for this date was 44.6 and 57 for the Project site and control sites in the surrounding area, respectively. These abundances were among the highest observed during the fall passerine migration period. It is difficult to determine if the higher abundances at both the Project site and in the surrounding lands were due to birds holding over after the September 10 storm, or if the results simply coincided with a migratory peak. Regardless, the numbers observed do not indicate that the Project site is a major hold-over site for migrating birds during adverse weather conditions.

It is thought that if suitable habitat is available for birds in areas near a wind energy development site, than birds will move into this alternative habitat (Kingsley and Whittam 2005). The coastal coniferous habitats found at the Project site are attractive to boreal species, including Boreal Chickadee and Gray Jay, although the site lacks significant old growth or prominent berry-crops that might attract large numbers of other passerine species. There were 14 species observed at the Project site but not identified in the surrounding lands, suggesting that the Project site may contain unique habitat features that make it more attractive to these species. Common Snipe was the only priority species among this group. This species typically makes use of wetlands including bogs, fens, and marshes during fall migration (Mueller 1999). While these habitat types are present at the Project site, the same habitat type also occurs in the nearby coastal lands (i.e., turf bog). Although no Common Snipe were observed in the control passerine migration surveys, the species was detected during shorebird surveys in adjacent coastal lands (refer to Section 2.4), therefore, suitable habitat is present for this species outside of the Project site boundaries.

Waterbirds represent approximately 4% of bird fatalities at wind energy facilities for which post-construction monitoring data is available (EC *et al.* 2012). Shorebird surveys conducted in the general Project area revealed that relatively few shorebirds make use of the near shore areas surrounding the Project site, as compared to control sites approximately 38 km away. Only one bird was observed at three locations along Spinney Gully, which borders the Project site, despite the fact that surveys were carried out in a range of conditions. It appears that the rocky coastline present in this area does not attract migrating shorebirds. There were 11 species, totaling 82 individuals, observed feeding/flying in nearby Chapel Gully (Figure 12), and 303 individuals were seen recorded from Glasgow Head, which guards the entrance to Chapel Gully. Birds were regularly observed flying to and from nearshore islands including Spinney Gully Island, Sherewink Island, and Charity Island, into Chapel Gully, suggesting that this constitutes a flyway for shorebirds in the area. It appears that shorebirds therefore bypass coastal areas bordering the Project site in favour of Chapel Gully.

Shorebirds were observed in greater abundance at New Harbour, located 38 km to the southwest of the Project site (Figure 13). In particular, relatively large flocks of Semipalmated Plovers and Semipalmated Sandpipers were observed from this location during periods when substantially smaller numbers of these species were detected in the general Project area. It thus appears that fall migration corridors for these shorebird species do not encompass coastal habitats bordering the Project site.

5.0 COMPARISON OF 2004 AND 2012 FALL MIGRATION DATA

There were 58 species recorded during passerine migration surveys at the Project site that were not observed/reported from the same surveys carried out in 2004. These include the following priority species:

- Black-backed Woodpecker – "Yellow" (NSDNR 2010);
- Boreal Chickadee – "Yellow" (NSDNR 2010);
- Common Loon – "Red" (NSDNR 2010);
- Common Snipe – "Yellow" (NSDNR 2010);
- Common Tern – "Yellow" (NSDNR 2010);
- Golden-crowned Kinglet – "Yellow" (NSDNR 2010);
- Gray Jay – "Yellow" (NSDNR 2010);
- Great Cormorant – "Yellow" (NSDNR 2010);
- Greater Yellowlegs – "Yellow" (NSDNR 2010);
- Pine Grosbeak – "Red" (NSDNR 2010); and
- Whimbrel – "Yellow" (NSDNR 2010).

Common Tern was the only species not recorded at the Project site during any surveys conducted in 2004/2005. It thus appears that the overall bird community in the general Project area has remained relatively consistent in the interim between these two survey programs. One notable difference with regards to the fall migrants is the apparent decline in the numbers of Pine Siskin passing through the area. In 2004, upwards of 32,000 Pine Siskins were observed at various locations in the area, while in the current study just 115 individuals were recorded at both the Project site and on surrounding lands. Pine Siskin is an irruptive species whose movements are tied closely to cone crops. A failure of the cone crop in the northeast this year might have prompted large-scale movements of the species to the south. This trend however, was not observed in the results of the passerine migration surveys. It is likely that large numbers of the species instead wandered west to northwestern Ontario and western Canada, bypassing the Project site (Pittaway 2012). Common Grackle (*Quiscalus quiscula*) also showed a measurable decline in numbers, from over 1000 in 2004 to just 6 in 2012.

Identified migration corridors in 2004 were corroborated by the results from the current study. Mixed-flocks of migrating passerines were observed at survey locations along the Canso Peninsula, indicating that the area remains a landfall site as reported in 2006. Post-dusk surveys indicated that the majority of nocturnal migrants at the head of Chapel Gully Park move in a south/southwest direction, similar to the pattern reported in 2006. The existence of a migratory corridor in the valley behind the Canso Water Tower was unable to be verified in the current study because the surveyed region did not include this area. However, surveyed locations to the immediate southeast of this valley (FMC8, FMC9, FMC10, and FMC11) consistently featured migrant passerines, so it is likely that the reported migratory corridor is still in use. It should be emphasized that although such corridors have been identified in the general Project area, the abundances observed suggest that the use of these corridors is relatively low and are not part of a major migratory flyway for passerines.

Similarly, the results of the current study suggest that important migratory routes for shorebirds do not encompass coastal areas of the Project site. As in 2004, shorebird abundances were much higher at New Harbour, 38 km to the southwest of the Project site, particularly for Semipalmated Plovers and Semipalmated Sandpipers. This is likely due to the greater availability of foraging habitat for these species, especially intertidal mudflats that are generally lacking in the Project area. Whimbrel, however, were more prevalent in the Project area than at the New Harbour control site. In fact, the observation of 34 Whimbrels is the most significant finding of the shorebird surveys. During fall migration, Whimbrels are known to make use of rock barrens, especially those featuring Crowberry (*Empetrum* spp.). Rock barrens are common in the Canso area, so it is likely that this area is relatively important to migrating Whimbrels. The Grassy Island flyway that was described in 2004, however, was not observed in the 2012 fall migration surveys.

In Europe, certain shorebird species have been shown to avoid wind turbines (as cited in Arnett *et al.* 2007), and previous studies suggest that collision risk of shorebirds with wind turbines is quite low (reviewed by Kingsley and Whittam 2005). The reduced footprint of the Project, the fact that the area is not well used by migrating shorebirds, as determined by surveys in both 2004 and 2012, and the established knowledge of wind turbine/shorebird interactions suggests that it is very unlikely that the Project will have a significant impact on the area's shorebird community.

6.0 REFERENCES

AMEC. 2006. Canso Wind Farm Environmental Impact Statement. 257 pp.

Arnett, E.B., Inkley, D.B., Johnson, D.H., Larkin, R.P., Manes, S.M., Manville, A.M., Mason, J.R., Morrison, M.L., Strickland, M.D., and R. Thresher. 2007. Impacts of wind energy facilities on wildlife and wildlife habitat. Wildlife Society Technical Review 07-2. The Wildlife Society, Bethesda, Maryland, USA. 49 pp.

CWS (Canadian Wildlife Service).2003. Baseline information requirements for evaluation of effects of wind power facilities on migratory birds in Atlantic Canada. Unpublished summarized excerpt from draft document on EA guidelines for wind and migratory birds. 8 pp.

CWS (Canadian Wildlife Service). 2007. Recommended protocols for monitoring impacts of wind turbines on birds. 33 pp.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada).2012. Database of wildlife species assessed by COSEWIC. Available at: http://www.cosewic.gc.ca/eng/sct1/index_e.cfm. Accessed November 5th, 2012.

EC (Environment Canada), CANWEA (Canadian Wind Energy Association), BSC (Bird Studies Canada), and OMNR (Ontario Ministry of Natural Resources). 2012. Wind energy bird and bat monitoring database: summary of the findings from post-construction monitoring reports. 22 pp.

Kearney, J.F. 2012. Nocturnal migration monitoring at Doctor's Brook, Antigonish County, Nova Scotia, Autumn 2012. Available at: http://www.johnfkearney.com/Nocturnal_Migration.html. Accessed on November 8th, 2012.

Kingsley, A., and B. Whittam. 2005. Wind turbines and birds: a background review for environmental assessment. Prepared for Environment Canada/Canadian Wildlife Service. 81 pp.

Mueller, H. 1999. Wilson's Snipe (*Gallinago delicata*). The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology. Available at: http://bna.birds.cornell.edu/bna/species/417. Accessed on October 31st, 2012.

NSDNR (Nova Scotia Department of Natural Resources).2010. Wild Species 2010: The General Status of Species in Canada – Nova Scotia Species. Available at: http://www.wildspecies.ca/wildspecies2010/downloads.cfm?lang=e. Accessed November 7th, 2012.

NSE (Nova Scotia Environment). 2009. A guide to addressing wildlife species and habitats in an EA registration document. 8 pp.

NS*ESA* (Nova Scotia *Endangered Species Act*). 2007. *Endangered Species Act* as amended up to Reg. 393/200. Available at: http://www.gov.ns.ca/just/regulations/regs/eslist.htm. Accessed November 5th, 2012.

Pittaway, R. 2012. Winter finch forecast 2012-2013. 3 pp.
Richardson, W.J. 1978. Timing and amount of bird migration in relation to weather: a review. *Oikos* **30**: 224-272.

SARA (*Species at Risk Act*). 2012. Species at Risk Public Registry. Available at: https://www.registrelep-sararegistry.gc.ca/species/default_e.cfm. Accessed November 6th, 2012.

APPENDIX C

Preliminary Avian Assessment and Research Plan for Baseline Study

Preliminary Avian Assessment
And
Research Plan for Baseline Study
Sable Wind Project

Prepared for:
Municipality of the District of Guysborough
And
Nova Scotia Power Incorporated

By:
John Kearney
John F. Kearney & Associates

December 2012

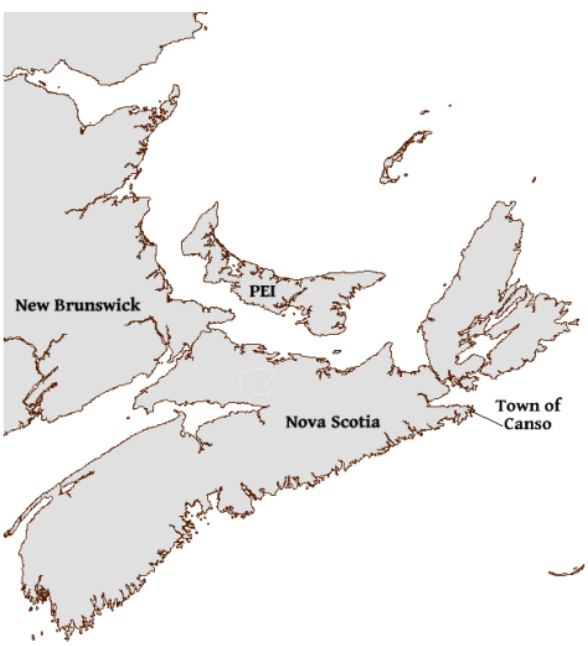
Introduction

The Municipality of the District of Guysborough and Nova Scotia Power Incorporated have proposed the construction of a 6-turbine wind power facility with a capacity of 13.8 megawatts near the Town of Canso, Nova Scotia. This coastal location is well known for the high numbers of birds passing through this area during the migration seasons, including the frequent occurrence of rare vagrants. Wind energy facilities have the potential to impact bird populations. The most significant impacts would be through collisions with wind turbines, alteration of important breeding or migration stop-over habitats, and creation of a physical barrier along bird flight paths. Thus, the proposed construction of a wind energy facility in an area where there may be high avian traffic during a significant portion of the year requires detailed and comprehensive studies to determine the risk to birds and what mitigation measures are possible.

Definition of Study Area

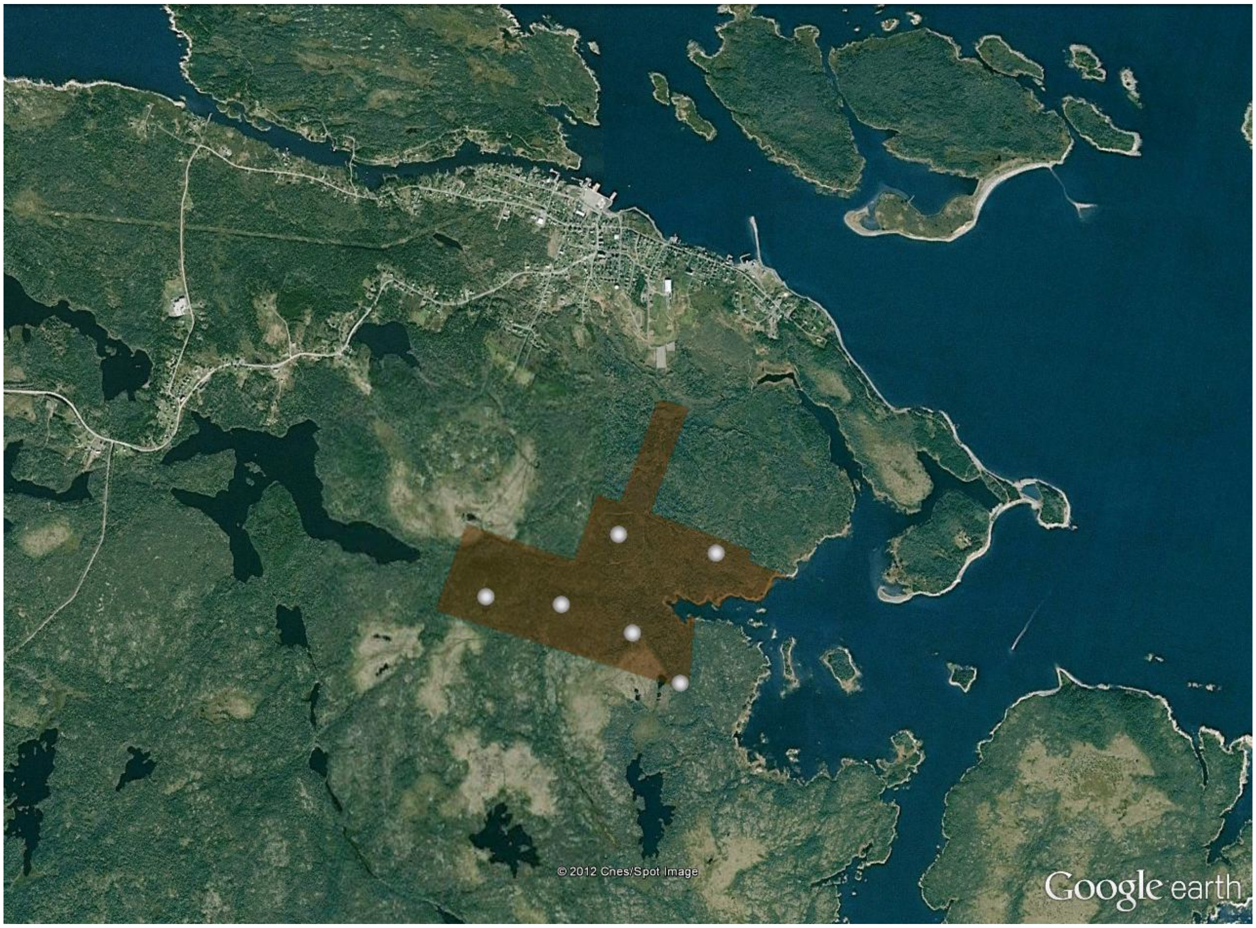
The location of the project area (near the Town of Canso) in relation to the geography of the Maritime Provinces is shown in Figure 1.

Figure 1: Location of Study Area in Maritime Provinces



An aerial view of the project area in Figure 2 shows its proximity to the Town of Canso and its placement in a coastal forest on a headland on the south side of Chedabucto Bay. *The study area is defined here as the project area plus those locations in the surrounding lands and waters where specific bird surveys will be carried out as described later in this document (see especially Figure 6).*

Figure 2: Aerial View of the Study Area Showing Project Area and Turbine Locations



Land Use, Forest Cover, and Topography

Figure 3 shows the boundaries of the project area and the land use in adjacent areas. The turbines would be about 1.5 kilometers from the closest residential areas in the Town of Canso. The predominant natural features of the project area and surrounding areas are coastal forest composed of Balsam Fir and Black Spruce, coastal barrens and beaches, marshes, bogs, and lakes. Figure 4 shows the forest cover in the study area. Softwoods are dominant along with some mixed woods.

Figure 3: Land Use in the Study Area

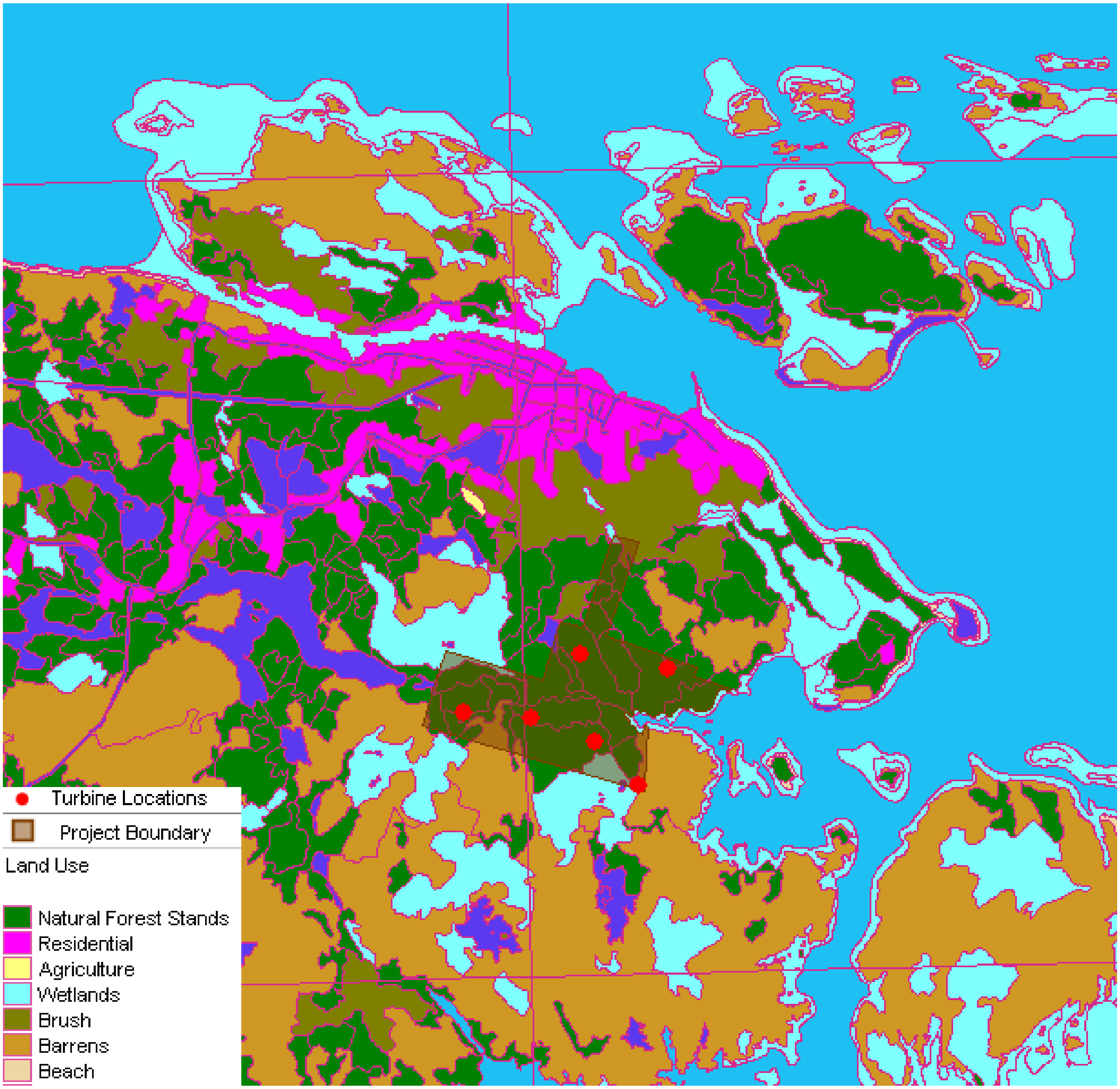
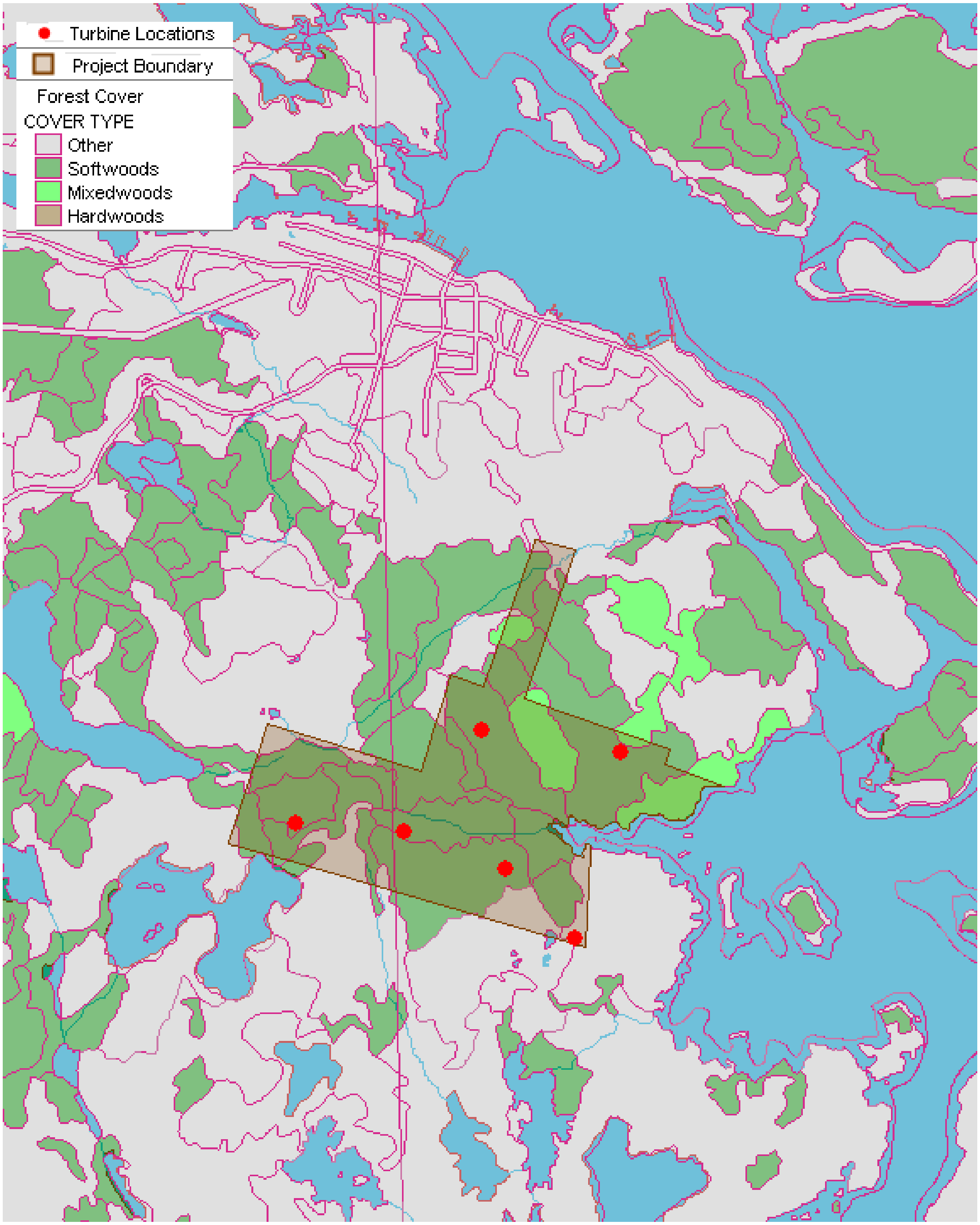


Figure 4: Forest Cover in the Study Area



Conservation Areas

Lands and waters of conservation significance are described in the environmental assessment for the project (Municipality of the District of Guysborough and Nova Scotia Power Incorporated 2012).

Lands designated by the Nova Scotia Department of Natural Resource as significant habitat for Harlequin Ducks, listed as "Special Concern" under the Canadian Species at Risk Act (SARA), are situated in the coastal area close to the project. The closest provincial park, Black Duck Cove Provincial Park, is 4.5 kilometers. The Canso Island National Historic Site (Grassy Island) is 2 kilometers. Canso Coastal Wilderness Area is 2.3 kilometers to the west and Bonnet Lake Wilderness Area is 14 kilometers. The closest Important Bird Area (IBA), County Island Complex IBA is 18 kilometers and is a breeding area for the "Endangered" Roseate Tern that is SARA listed, the provincially listed as "May be At Risk" Arctic Tern, and the provincially listed as "Sensitive" Common Tern.

The location of most of these conservation areas can be seen in Figure 2.1 of the environmental assessment (Municipality of the District of Guysborough and Nova Scotia Power Incorporated 2012).

Birds in the Study Area

The geographic location of the project area is probably the single most important factor influencing the numbers and kinds of birds to be found there. According to McLaren (2012), a variety of meteorological conditions, as well as navigation error, can result in night migrating birds in Nova Scotia being out over the ocean in large numbers. At daybreak, these birds must find their way back to the coast, thus heading to the nearest land, usually coastal islands and headlands. A number of these islands and headlands in Nova Scotia are known for the "fallouts" or bird concentrations that can occur there. Among the places listed by McLaren (2012) as the most significant is the headland upon which the Town of Canso and the project area is located. Thus, the Sable Wind Project is potentially located in a high traffic area for migrating birds. This raises important concerns about the potential risk to birds from collisions, especially in an area with up to 100 days of fog per year as calculated in the environmental assessment registration document (Municipality of the District of Guysborough and Nova Scotia Power Incorporated 2012).

To gain a greater insight into this issue, a desktop review of the birds known to occur in or near the study area was conducted. A variety of sources were consulted including: the Maritimes Breeding Bird Atlas data from 1986-1990 and 2006-2010 (Bird Studies Canada et al. 2012), eBird (2012), the first Canso Wind Farm environmental assessment (AMEC and Barrington Wind Energy Ltd. 2006), the Sable Wind Project Environmental Assessment (Municipality of the District of Guysborough and Nova Scotia Power Incorporated 2012) and the field work conducted in 2012 (Strum Environmental 2012). In addition, a list was compiled of all the bird species in Nova Scotia that are of conservation concern as determined by the Nova Scotia Department of Natural Resources (Canadian Endangered Species Conservation Council 2011), the federal Species at Risk Act (SARA) (Canada 2012a), and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) (Canada 2012b). These rankings are summarized in Table 1 and provide a basis for gauging the relative importance of study area to the total picture of conservation concerns in Nova Scotia. In total, there were 83 species of conservation concern in the province.

Table 1: Status of Species of Conservation Concern in Nova Scotia

	NSDNR	SARA	COSEWIC	COSEWIC
				Priority
Species	Rank	Schedule 1	Listed	Candidates
Brant	Sensitive			
Gadwall	May be at Risk			
Blue-winged Teal	May be at Risk			
Northern Shoveler	May be at Risk			
Northern Pintail	May be at Risk			
Greater Scaup				Low
Lesser Scaup				Low
Harlequin Duck	At Risk	Special Concern	Special Concern	
Barrow's Goldeneye	At Risk	Special Concern	Special Concern	
Common Loon	May be at Risk			
Pied-billed Grebe	Sensitive			
Great Cormorant	Sensitive			
Least Bittern		Threatened	Threatened	
American Bittern	Sensitive			

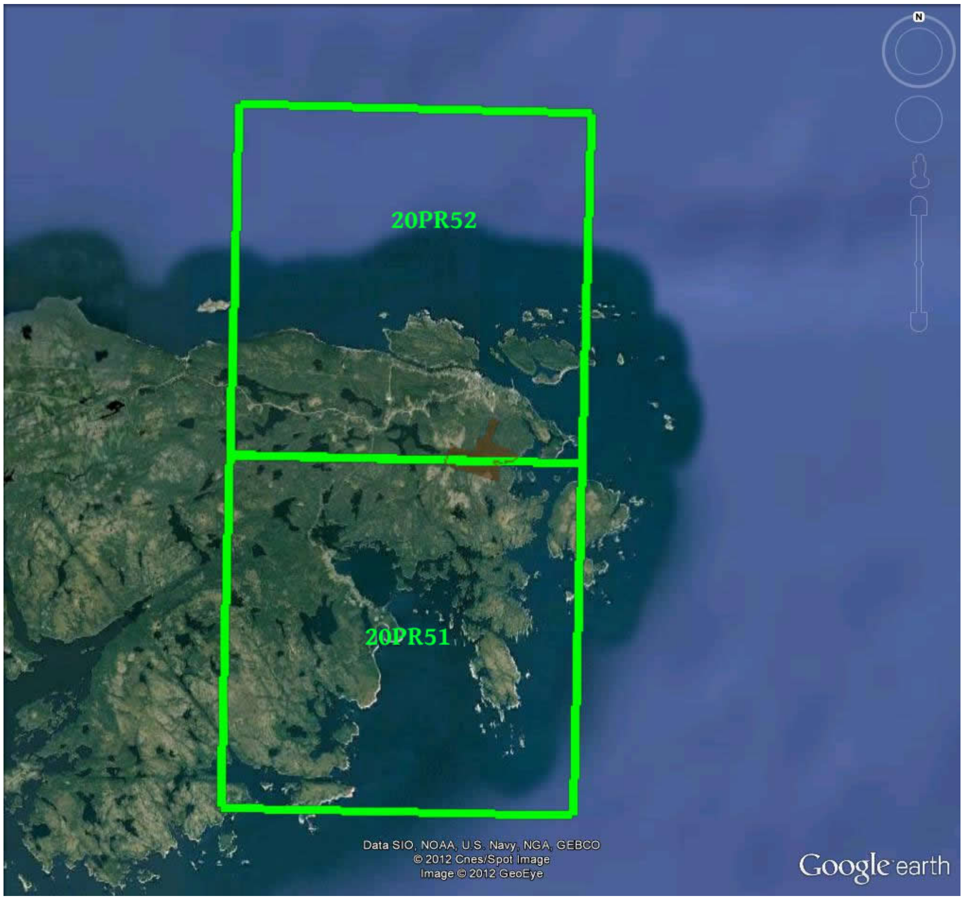
Black-crowned Night-Heron	May be at Risk			
Turkey Vulture	Sensitive			
American Kestrel				Mid
Peregrine Falcon	Sensitive	Threatened	Special Concern	
American Golden-Plover	Sensitive			
Piping Plover	At Risk	Endangered	Endangered	
Killdeer	Sensitive			Low
Greater Yellowlegs	Sensitive			
Willet	May be at Risk			
Spotted Sandpiper	Sensitive			
Whimbrel	Sensitive			
Hudsonian Godwit	Sensitive			Mid
Red Knot	At Risk	Endangered	Endangered	
Semipalmated Sandpiper	Sensitive			
Purple Sandpiper	Sensitive			
Wilson's Snipe	Sensitive			
Red-necked Phalarope	Sensitive			
Red Phalarope	Sensitive			Low
Black-legged Kittiwake	Sensitive			
Roseate Tern	At Risk	Endangered	Endangered	
Common Tern	Sensitive			
Arctic Tern	May be at Risk			
Black Tern	May be at Risk			
Razorbill	Sensitive			
Atlantic Puffin	Sensitive			
Black-billed Cuckoo	May be at Risk			
Short-eared Owl	May be at Risk	Special Concern	Special Concern	
Long-eared Owl	May be at Risk			
Whip-poor-will	At Risk	Threatened	Threatened	
Common Nighthawk	At Risk	Threatened	Threatened	
Chimney Swift	At Risk	Threatened	Threatened	
Belted Kingfisher				High
Black-backed Woodpecker	Sensitive			
Olive-sided Flycatcher	At Risk	Threatened	Threatened	
Eastern Wood-Pewee	Sensitive		Special Concern	
Yellow-bellied Flycatcher	Sensitive			
Willow Flycatcher	Sensitive			
Eastern Phoebe	Sensitive			
Eastern Kingbird	Sensitive			Low
Great Crested Flycatcher	May be at Risk			

Gray Jay	Sensitive			
Purple Martin	May be at Risk			
Tree Swallow	Sensitive			
Bank Swallow	May be at Risk			
Cliff Swallow	May be at Risk			
Barn Swallow	Sensitive		Threatened	
Boreal Chickadee	Sensitive			
Golden-crowned Kinglet	Sensitive			
Ruby-crowned Kinglet	Sensitive			
Eastern Bluebird	Sensitive			
Bicknell's Thrush	At Risk	Threatened	Threatened	
Wood Thrush			Threatened	
Gray Catbird	May be at Risk			
Tennessee Warbler	Sensitive			
Cape May Warbler	Sensitive			
Bay-breasted Warbler	Sensitive			
Blackpoll Warbler	Sensitive			
Wilson's Warbler	Sensitive			
Canada Warbler	At Risk	Threatened	Threatened	
Vesper Sparrow	May be at Risk			
Savannah (Ipswich) Sparrow		Special Concern	Special Concern	
Rose-breasted Grosbeak	Sensitive			
Bobolink	Sensitive		Threatened	
Eastern Meadowlark	Sensitive		Threatened	
Rusty Blackbird	May be at Risk	Special Concern	Special Concern	
Baltimore Oriole	May be at Risk			
Pine Grosbeak	May be at Risk			
Pine Siskin	Sensitive			
Evening Grosbeak				High

Research on the breeding birds in the study area was based on a number of sources.

The data from 1st (1986-1990) and the 2nd (2006-2010) Maritimes Breeding Bird Atlas (Bird Studies Canada et al. 2012) was compiled using data from those survey squares encompassing the project area and beyond. These are the squares 20PR51 and 20PR52 (see Figure 5).

Figure 5: Maritimes Breeding Bird Atlas Squares in Study Area



Second, breeding information was obtained from the AMEC bird surveys (AMEC and Barrington Wind Energy Ltd. 2006) conducted in 2004-2005. This study listed breeding birds that were in the project area, those that were within 5 kilometers of the project area, and those within 20 kilometers of the project area. Third, a breeding bird survey by the Sable Wind Project in 2012 (Municipality of the District of Guysborough and Nova Scotia Power Incorporated 2012) was consulted. However, this study was done in May, before the breeding period of many birds, and thus yielded limited results. Breeding records from eBird (2012) helped document the species occurring in similar habitats throughout Chedabucto Bay and the Canso Peninsula (within 30 km of study area). Finally, a database on the breeding status of birds in Guysborough County was used (Atlantic Canada Conservation Data Centre 2012).

Table 2 shows the results of the breeding bird research.

Table 2: Records of Breeding Birds of Conservation Concern in or near the Study Area

	Maritimes Breeding Bird Atlas						AMEC EA 2004-2005			EA 2012	ACCDC
	20PR52	20NR52	# of Point	20NR51	20NR51	eBird	Project	Within	Within	Project	Guysborough
Species	1st	2nd	Counts	1st	2nd	# of Records	Area	5 KM	20 KM	Area (May only)	County
Blue-winged Teal									Confirmed		Uncommon
Northern Pintail											Rare
Common Loon	Confirmed	Possible	2			3			Confirmed		Uncommon
Pied-billed Grebe											Uncommon
Great Cormorant									Confirmed		Uncommon
American Bittern									Possible		Uncommon
Turkey Vulture									Present		Not listed
American Kestrel	Possible	Possible				3			Confirmed		Abundant
Piping Plover											Extremely rare
Killdeer						1					Uncommon
Greater Yellowlegs											Uncommon
Willet		Possible		Possible	Possible	9		Confirmed	Confirmed		Uncommon
Spotted Sandpiper	Possible	Probable		Possible	Possible	4		Confirmed	Confirmed		Uncommon
Wilson's Snipe				Possible		1			Confirmed		Uncommon
Black-legged Kittiwake									Present		Not listed
Roseate Tern								Possible	Confirmed		Extremely rare
Common Tern		Possible				8			Confirmed		Uncommon
Arctic Tern				Confirmed					Confirmed		Uncommon
Atlantic Puffin									Possible		Not listed
Black-billed Cuckoo											Uncommon
Long-eared Owl							Possible				Rare
Common Nighthawk											Uncommon
Chimney Swift											Rare
Belted Kingfisher	Possible	Possible	1			7	Probable	Confirmed	Confirmed		Abundant
Black-backed Woodpecker	Possible	Possible					Confirmed	Confirmed	Confirmed		Uncommon
Olive-sided Flycatcher	Possible	Probable					Possible				Uncommon
Eastern Wood-Pewee	Probable					1					Uncommon
Yellow-bellied Flycatcher		Possible					Possible	Possible	Confirmed		Uncommon
Willow Flycatcher											Rare
Eastern Phoebe						1					Uncommon
Eastern Kingbird	Possible										Uncommon
Gray Jay	Possible	Possible				5	Confirmed	Confirmed	Confirmed	Present	Uncommon
Purple Martin											Extremely rare
Tree Swallow	Confirmed	Possible		Confirmed	Possible	6		Possible	Confirmed		Fairly common
Bank Swallow				Possible		2			Possible		Uncommon
Cliff Swallow									Confirmed		Uncommon
Barn Swallow	Confirmed			Possible	Possible	1			Confirmed		Uncommon
Boreal Chickadee	Possible	Possible	1	Confirmed		5	Possible	Confirmed	Confirmed	Present	Uncommon
Golden-crowned Kinglet	Probable	Possible		Probable			Possible	Confirmed	Confirmed	Present	Fairly common
Ruby-crowned Kinglet		Probable	3	Possible		4	Possible	Possible			Fairly common
Eastern Bluebird									Confirmed		Uncommon
Gray Catbird	Confirmed	Possible	1								Uncommon
Tennessee Warbler	Possible	Probable	3	Possible			Possible				Uncommon
Cape May Warbler	Possible								Confirmed		Uncommon
Bay-breasted Warbler	Possible	Possible							Confirmed		Uncommon

Blackpoll Warbler	Possible			Possible		Confirmed	Confirmed	Confirmed	Uncommon
Wilson's Warbler	Possible	Possible		Possible		Confirmed	Confirmed	Confirmed	Uncommon
Canada Warbler	Possible								Uncommon
Savannah Sparrow (Ipswich)									Extremely rare
Vesper Sparrow									Rare
Rose-breasted Grosbeak	Probable								Uncommon
Bobolink	Possible			Probable					Uncommon
Rusty Blackbird	Possible								Rare
Pine Grosbeak	Confirmed				1		Possible		Uncommon
Pine Siskin	Confirmed	Possible	1	Possible	2	Confirmed	Confirmed	Confirmed	Uncommon
Evening Grosbeak	Probable	Possible				Confirmed	Confirmed	Confirmed	Fairly common

A total of 45 species of conservation concern were possible to confirmed breeders within 30 kilometers of the study area while 56 species were extremely rare to uncommon with the county of the project area (Guysborough County). At least 17 species of conservation concern were believed to be breeding within 5 kilometers of the study area while at least 14 species of conservation concern were believed to be nesting within the project area as it was configured in 2004/2005 and 12 species of conservation concern as it is configured in 2012. One SARA listed species, the Olive-sided Flycatcher, was noted as a possible breeding bird in the current project area in 2005.

The potential significance of the study area for birds can also be seen in looking at the data for the migration seasons, particularly the autumn migration. The data are recorded specifically for the current project area only in the autumn of 2012. Thus, the tabulation of the occurrence of species of conservation concern during the non-breeding seasons; fall migration, spring migration, and winter period is shown in Table 3.

Table 3: Records of Non-Breeding Birds of Conservation Concern in the Study Area

	eBird	Strum 2012 Autumn		AMEC EA 2004-2005		
	Non-Breeding			Autumn	Winter	Spring
Species	# of Records	Project	Control	Total #	Status	Status
Gadwall					Occasional	
Northern Pintail	2				Occasional	Uncommon
Greater Scaup	3				Common	Uncommon
Lesser Scaup					Uncommon	Uncommon
Harlequin Duck	1				Occasional	Common
Barrow's Goldeneye	1				Uncommon	Uncommon
Common Loon	26	3			Common	Common

Pied-billed Grebe				Occasional	Uncommon
Great Cormorant	10		7	Common	Common
Turkey Vulture	4				
American Kestrel	1				Common
Peregrine Falcon	1				
Killdeer			1		
Greater Yellowlegs	3	5	101	Occasional	
Spotted Sandpiper			37		
Whimbrel		43	320		
Hudsonian Godwit			2		
Semipalmated Sandpiper			392		
Purple Sandpiper	1			Common	
Wilson's Snipe		3	1	Occasional	
Black-legged Kittiwake	2			Occasional	
Common Tern	1	5			
Arctic Tern	2				
Razorbill				Uncommon	
Long-eared Owl					Uncommon
Belted Kingfisher	3	2		Occasional	Uncommon
Black-backed Woodpecker		1		Uncommon	Uncommon
Eastern Phoebe					Uncommon
Eastern Kingbird			1		
Gray Jay	3	65		Uncommon	Uncommon
Boreal Chickadee	16	145		Common	Common
Golden-crowned Kinglet	12	259		Uncommon	Uncommon
Ruby-crowned Kinglet		13	40	Occasional	Uncommon
Eastern Bluebird			1		
Tennessee Warbler			10		
Cape May Warbler			5		
Bay-breasted Warbler		15	35		
Blackpoll Warbler	1	15	80		
Wilson's Warbler	2	2	20		
Canada Warbler		1	10		
Rose-breasted Grosbeak		1	4		Rare
Bobolink			8		
Eastern Meadowlark			2		
Baltimore Oriole	6		4		Rare
Pine Grosbeak	1	9		Uncommon	Uncommon
Pine Siskin	9	93	32,000	Common	Common
Evening Grosbeak	1	6		Common	

Table 3 demonstrates that 47 of the possible 83 species of conservation concern or 57% have been observed in or within 30 kilometres of the study area during the non-breeding seasons. Nineteen species or 23% were recorded within the current project area in 2012. One of these, the Canada Warbler, is a SARA listed species.

During the fall migration, counts of birds can be very high. At the species level, for example, 320 Whimbrels and 32,000 Pine Siskins were recorded in 2004. For total birds, it appears that thousands of birds have been seen in relatively short periods. The AMEC study (2006) of the autumn migration in 2004 suggests that 3,000 passerine birds were seen in the first week of September. The Strum Environmental (2012) field study in 2012 indicates that the mean number of birds recorded per stop-over point count was 27.3 in the project area and 55.0 in the adjacent areas. These numbers rose to 44.6 and 57.0 respectively when birds were grounded due to poor weather. In comparison, at two other coastal wind energy installations in Nova Scotia, birds recorded per stop-over point count were 8.2 and 25.1 over the entire autumn migration while counts averaged between 4 to 6 birds per point count at two inland wind farms (John Kearney, unpublished data).

The Strum Environmental study (2012) also indicates a south to southwest direction of flight of many birds in nocturnal passage that would potentially put them on a path toward the proposed wind turbines. While the authors note that relatively small numbers of birds were detected during their aural surveys, the surveys took place on only 8 nights for about 5 hours per night. An acoustic study in northern Nova Scotia in 2012 recording the flight calls of autumn migrants for 101 nights from civil sunset to civil sunrise showed that about a third of all flight calls were recorded on 5 nights while about 45% of all nights recorded zero to a few calls per night (Kearney 2012). Thus the nocturnal data is too limited to draw any conclusions regarding nocturnal passage over the project area.

Overall, the available data suggest that the south shore of Chedabucto Bay supports a high diversity of avifauna, with its combination of coastal spruce/fir forest, wetlands, shoreline habitats, and coastal barrens. Combining all seasons of the year, a total of 61 out of a total possible 83 species of conservation concern in Nova Scotia, or 73%, have occurred within 30 kilometers of the study area. At the same time, the data suggest that there can be concentrations of many species of birds in or near the study and project areas during the migration seasons.

All of this evidence points to the need for more detailed, quantitative studies and a precautionary approach in assessing the potential impact of a wind energy project on birds in the area.

Information Gaps

There are two major gaps in our understanding of the birds in the study area which are necessary for understanding the impact of a wind energy facility.

The first is the lack of quantitative studies that can lead to statistically significant determinations about the abundance of birds in the study area so as to measure:

1) The significance of bird populations in the study area compared to other areas where wind farms have been constructed, and
2) The significance of changes in bird populations before and after construction of a wind farm.

The first gap will be addressed by using survey methods that are subject to quantitative analysis to determine when and where there are statistically significant changes in bird numbers, behaviour, or habitats. Critical to this approach will be the establishment of control areas for pre- and post-construction impact analysis.

The second major gap is the lack of information on migratory birds passing over the study area at night, the time when many birds, including most songbirds, migrate. This is also the time when birds may be most vulnerable to foggy conditions and may be forced to fly at lower altitudes bringing then closer to the blade sweep of a wind turbine. Therefore this report is recommending that both radar and acoustic studies be conducted to ensure that the most comprehensive analysis of the risk to birds has been carried out before proceeding to construction.

Objectives of the Baseline Study

The avian baseline study has three major objectives:

1) To provide information on birds such that the proposed project complies with the federal *Migratory Birds Convention Act*, the *Species at Risk Act*, and associated laws and policies of the Province of Nova Scotia,
2) To provide diurnal and nocturnal information to inform the siting, operation, and monitoring of the proposed project in regard to the direct (mortality from

collision and construction activities) and indirect (displacement from habitat, fragmentation of habitat, avoidance of habitat, and flight path barrier) effects on birds, and

3) To provide a quantitative baseline for measuring the impacts of the project in the short and long term and to contribute to a global understanding of wind energy projects on birds.

These objectives will be met through the studies to:

1. Determine the relative abundance of breeding birds in the study area, including an analysis of keystone species and species guilds in its predominately forest habitat and associated fresh water and coastal wetlands.
2. Determine the abundance of birds in migration stop-over in the study area,
3. Determine the numbers of birds wintering in the study area,
4. Determine the abundance, species composition, and movement patterns of birds in diurnal and nocturnal passage and the risk of collision with wind turbines,
5. Determine the possible effects, besides collisions, of wind turbines and human activities on the breeding, wintering, and migrating birds in the study area including
    a. the use of habitats by breeding and wintering birds and migrating birds in stop-over,
    b. displacement from habitats,
    c. avoidance of habitats,
    d. the possible effects of habitat fragmentation on bird populations, and
    e. the possible barrier effects on flight pathways.
6. Determine the presence and abundance of species of conservation concern in the study area, the kinds and amount of habitat they require, and the measures required by the project proponents for avoidance or mitigation,
7. Make recommendations for adaptive management of bird habitats and risk abatement at wind energy facilities,
8. Make recommendations for post-construction studies, and

9. Contribute to the national database on avian wind facility studies.

Survey Methods

Ten types of survey methodologies will be used to meet the objectives of the study. All studies will include quantitative survey methodologies consisting of counts within the project area and in control areas surrounding the project area. The combination of the project area and control areas is the study area.

1. EARLY SPRING NOCTURNAL SURVEY ROUTE

During the month of April, nocturnal surveys will be conducted throughout the study area following the Guidelines for Nocturnal Owl Monitoring in North America published by Bird Studies Canada (Takats et al. 2001). This method will provide data about the owls, American Woodcocks, and other crepuscular and nocturnal species that are not otherwise detected adequately during daytime studies

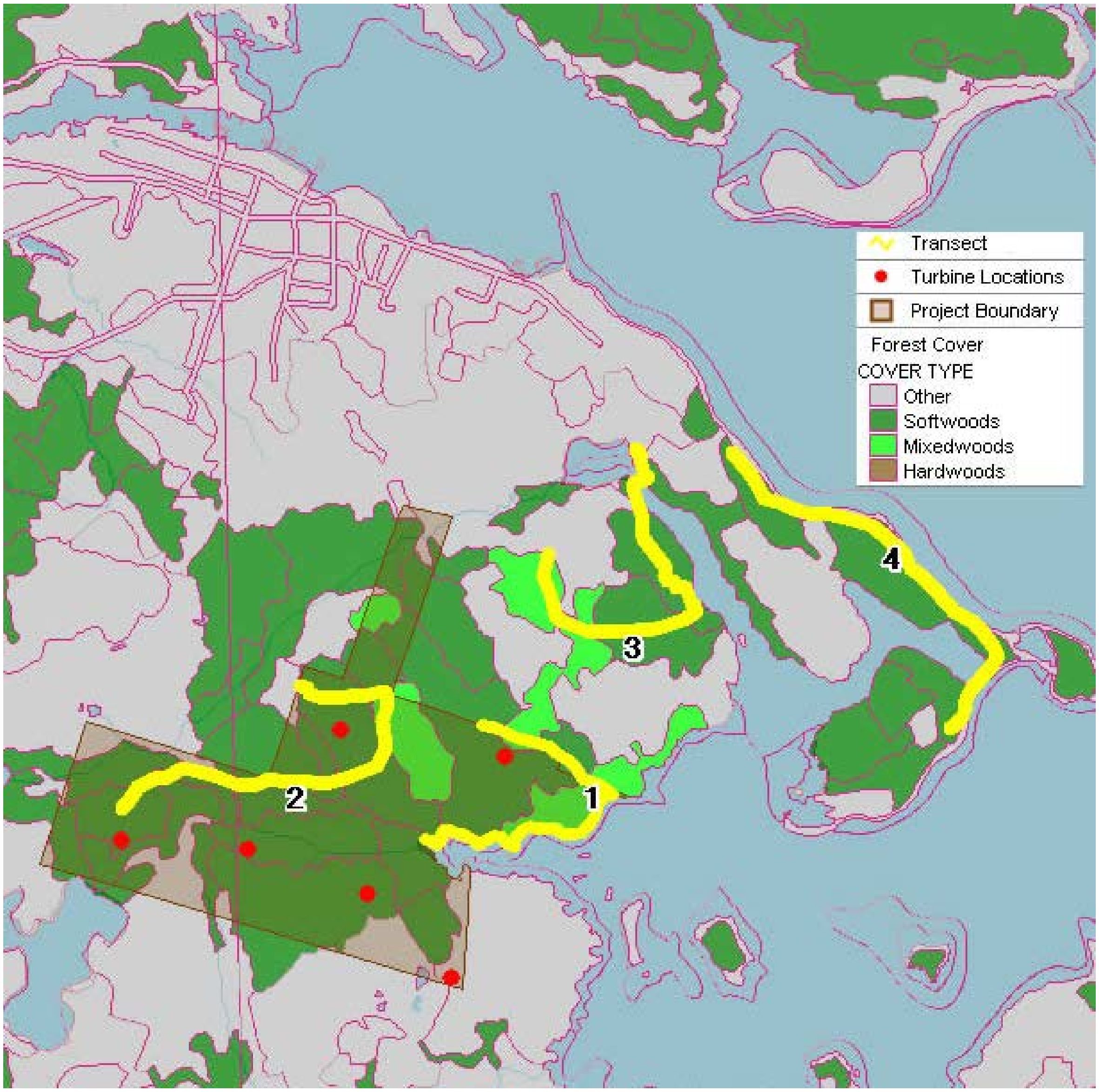
2. MIGRATION STOP-OVER TRANSECTS WITH POINT COUNTS

Four transects will be used for the study of stop-over migration. These transects are shown in Figure 6. These transects are chosen so as to sample representative habitats in the study area, two in the project area (Transects 1 & 2) and two in control areas (Transects 3 & 4).

Each transects will be surveyed once every two weeks on a rotational basis during the migration period, April 15-May 31, 2011 and August 15-October 31, 2011. The transects will be 1,500 metres in length with all birds recorded in the following distance categories from the observer: <50 metres, 50-100 metres, >100 metres, and flying overhead. The transects are divided into three equal 500-meter segments which represent, when possible, distinct habitat types. Along each transect are six point counts.

The duration of each point count is ten minutes with birds recorded in the same distance categories as the rest of the transect. While point counts are normally associated with breeding, rather than migration studies, point counts during migration, when used in conjunction with linear transects, can provide a finer resolution of habitat utilization by birds in stop-over.

Figure 6: Location of Stop-Over Transects



In the migration stop-over of shorebirds and water birds, a series of observation points will be chosen on both the outer coast (along Transect 4) and inner coast (along transects 1 and 3 and between them) to make 30 minute counts of birds.

3. EARLY BREEDING SURVEY POINT COUNTS

The early breeding survey will take place simultaneously with the spring migration stop-over survey. The twenty-four point counts from the four survey transects will provide the primary data on early breeding woodpeckers and passerine birds. Some of these birds are on territory and commencing breeding activities by late April and early May. Breeding point counts which are repeated five to six times at the same station are very effective in detecting all or most of the birds breeding in that particular habitat (Ralph, Droege, and Sauer 1995). In addition, other early breeding point counts will be made, separate from the transects, when weather and time permits.

4. PEAK BREEDING SURVEY POINT COUNTS

Point counts will be made throughout the study area during the month of June in both project and control areas.

5. PEAK BREEDING NOCTURNAL SURVEY

During moonlit nights in June, a nocturnal survey for Common Nighthawks, Whip-poor-wills, owls, and other crepuscular and nocturnal breeders will be conducted following the guidelines of Bird Studies Canada (2011).

6. DIRECTED SEARCHES FOR SPECIES OF CONSERVATION CONCERN DURING THE EARLY AND PEAK BREEDING SEASONS

In addition to transects and point counts, it will be necessary to search out habitats that may be the residences of species of conservation concern. This is especially true for the COSEWIC and SARA listed species that are likely to be found in the study area. Potential habitats for these species will be described, surveyed through general area searches using recordings of the call or song of these bird where appropriate and when it is not disruptive of or detrimental to breeding activities.

7. DIURNAL PASSAGE OBSERVATION AND COLLISION RISK ANALYSIS

Observation posts which give a 180-360 degree view of the airspace over sections of the study area will be chosen for the study of diurnal passage. All birds flying through a given air space will be noted by species, flock size, altitude, direction of flight, and distance from a proposed turbine. For woodpeckers and passerines these observations will be focused in the early morning hours, for raptors peak numbers are to be expected from mid-morning to early afternoon, and for many water birds and shorebirds according to the tides. These observations will be used to estimate collision risk using a modified version of the "Band Collision Risk Model" described by Kearney (2010b) and Madders and Whitfield (2006).

8. ACOUSTIC MONITORING OF NOCTURNAL PASSAGE

Acoustic monitoring of nocturnal passage provides data on the species of birds migrating through an area, their relative abundance, and migration timing. Two recording stations will be set up; one in a control area, close to the town of Canso, and one on a high location within the project area. Both locations will have two operational microphones to back each other up in case of technology failures (most likely due to heavy rains in driving winds). Recording will take place every night from civil sunset to civil sunrise from late March to early June and mid-July to early November 2013.

9. RADAR MONITORING OF NOCTURNAL PASSAGE

Radar provides information about the total numbers of birds passing over an area at night, their altitude, and flight path. As described in the birds and wind energy guidance document of the Canadian Wildlife Service, radar and acoustic monitoring should be combined when it is necessary to have a complete picture of nocturnal passage especially if important flyways may be present in an area of wind energy development (Environment Canada 2007). While radar and acoustic monitoring are still developing technologies in avian research, they are the best tools available for the study of nocturnal migration.

10. WINTER SURVEY

Area searches will be conducted twice a month over broad areas of the study area with two to three standardized area searches for each visit. These standardized area searches consist of a line transect of variable length, using distance sampling, and focused on particular habitat types in terrestrial habitats. They consist of point counts in aquatic habitats.

Data Analysis and Reporting

Data will be analyzed using a variety of statistical procedures performed by SPSS and SYSTAT software. Acoustic files will be analyzed using RAVEN software.

For all the above studies, detailed fog and other weather measurements will be made. This data will be used in automated backward stepping general linear models to determine the effects of weather on the movements of birds during the migration period.

Further advice for the analysis of data will be sought from the Canadian Wildlife Service and university scientists, in particular with a view to fulfil the objectives of the framework for the scientific assessment of projects as they impact on birds, as described by Hanson *et al.* (2009).

Finally, all data will be submitted to the Wind Energy Bird and Bat Monitoring Database, operated by the Canadian Wind Energy Association, the CWS, the Ontario Ministry of Natural Resources, and Bird Studies Canada.

Conclusion

This document has summarized the available avian data about the significance of the study area for birds. The data tend to be descriptive and qualitative rather than quantitative and statistical. Nonetheless, the data indicate that comprehensive studies are required to determine the importance of the area for the passage and stop-over of migrating birds. The research plan in this document provides a means of taking a precautionary approach so that the best scientific information and technologies can be brought to bear on decisions pertaining to wind power development in the Canso area.

References

AMEC, and Barrington Wind Energy Ltd. 2006. Canso Wind Farm Environmental Impact Statement.

Atlantic Canada Conservation Data Centre. 2012. Bird Taxa List for Guysborough County, Nova Scotia. Sackville, N.B.

Bird Studies Canada. 2011. Whip-poor-will Roadside Survey, Participant's Guide. Port Rowen, Ontario: Ontario Whip-poor-will Project.

Bird Studies Canada, Environment Canada-Canadian Wildlife Service, New Brunswick Department of Natural Resources, Nova Scotia Department of Natural Resources, and

Prince Edward Island Department of Agriculture and Forestry. *Maritimes Breeding Bird Atlas Database* 2012. Available from http://www.mba-aom.ca/.

Canada. *Species at Risk Public Registry* 2012a. Available from http://www.registrelep-sararegistry.gc.ca.

Canada, Committee on the Status of Endangered Wildlife in Canada. *Wildlife Species Assessments* 2012b. Available from http://www.cosewic.gc.ca.

Canadian Endangered Species Conservation Council. 2011. Wild Species 2010: The General Status of Species in Canada. National Status Working Group.

eBird. *An Online Database of Bird Distribution and Abundance* 2012. Available from http://www.ebird.org.

Environment Canada, Canadian Wildlife Service. 2007. Recommended Protocols for Monitoring Impacts of Wind Turbines on Birds.

Hanson, Alan, Ian Goudie, Anthony Lang, Carina Gjerdrum, Richard Cotter, and Garry Donaldson. 2009. A Framework for the Scientific Assessment of Potential Project Impacts on Birds. Atlantic Region: Canadian Wildlife Service Technical Report Series Number 508.

Kearney, John. 2010b. The Flight Behaviour of Soaring Birds at the Scarp Face: Glen Dhu Wind Farm Site. John F. Kearney & Associates. Original edition, For Shear Wind Inc.

Kearney, John. *Nocturnal Migration Monitoring at Doctor's Brook, Antigonish County, Nova Scotia, Autumn 2012* 2012. Available from http://www.johnfkearney.com/Nocturnal_Migration.html.

Madders, Mike, and D. Philip Whitfield. 2006. "Upland raptors and the assessment of wind farm impacts." *Ibis* no. 148 (s1):43-56.

McLaren, Ian A. 2012. *All the Birds of Nova Scotia: Status and Critical Identification*. Kentville, Nova Scotia: Gaspereau Press.

Municipality of the District of Guysborough, and Nova Scotia Power Incorporated. 2012. Sable Wind Project: Environmental Assessment Registration Document.

Ralph, C. John, Sam Droege, and John R. Sauer. 1995. "Managing and Monitoring Birds Using Point Counts: Standards and Applications." In *Monitoring Bird Populations by Point Counts*, edited by C. John Ralph, John R. Sauer and Sam Droege, 161-169. Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture.

Strum Environmental. 2012. Historical Bird Data Review and 2012 Fall Migration Surveys, Sable Wind Project. Bedford, N.S.

Takats, D. Lisa, Charles M. Francis, Geoffrey L. Holroyd, James R. Duncan, Kurt M. Mazur, Richard J. Cannings, Wayne Harris, and Denver Holt. 2001. Guideline for Nocturnal Owl Monitoring in North America. Edmonton, Alberta.

Acknowledgements

Cover photo and maps by John Kearney

This document conforms to Google Earth policies for commercial use: http://www.google.com/permissions/geoguidelines.html.

APPENDIX D

Pre-construction Survey to Determine Bat Species Composition and Activity at the Proposed Sable Wind Project, Canso, Nova Scotia

Pre-construction survey to determine bat species composition and activity at the proposed Sable Wind Project, Canso, Nova Scotia

Final Report Prepared For:

Nova Scotia Power
1223 Lower Water Street
Halifax, Nova Scotia
B3J 3S8
Attn: Stephanie Fuller

Prepared By:

Lesley Farrow, M.Sc.
Hugh Broders, Ph.D.

Department of Biology
Saint Mary's University
Halifax, Nova Scotia
B3H 3C3

November 2012

CONTENTS

Context 3
Background 4
Direct Mortality 4
Habitat Availability 5
Movement Patterns 6
Nova Scotia Bats 7
Ecology of Resident Species 7
White Nose Syndrome 8
Potential for Hibernacula 9
Methods 11
Study Area 11
Acoustic Surveys 11
Results 12
Discussion 14
Recommendations 15
Literature Cited 17
Appendix A – Photographs 23

TABLES

Table 1. Over-wintering strategy and conservation status of bat species recorded in Nova Scotia. 10

Table 2. Locations of acoustic sampling sites for the 2012 late-fall survey of bat activity in Canso, Guysborough County, Nova Scotia. 12

Table 3. Site descriptions for acoustic sampling sites for the 2012 late-fall survey of bat activity in Canso, Guysborough County, Nova Scotia. 12

Table 4. Number of echolocation files recorded per night at two sites along the Chapel Gully Trail in Canso, Nova Scotia, 2012. 13

CONTEXT

The Municipality of the District of Guysborough and Nova Scotia Power Inc. are proposing to install six electricity generating wind turbines with a total capacity of approximately 13.8 MW on privately owned lands near the communities of Canso, Hazel Hill, and Little Dover, Guysborough County. The commission of the development, titled the Sable Wind Project, is anticipated before 2015 (Municipality of the District of Guysborough and Nova Scotia Power Inc. 2012).

Industrial wind energy production is among the fastest growing sectors of the global energy industry as the demand for renewable energy sources continues to increase (Nelson 2009). Advances in wind turbine technology have made the wind energy sector more cost-competitive, contributing to a significant increase in the number of wind energy installations during the last decade. In Canada, energy production and regulation falls under provincial jurisdiction, therefore most renewable energy targets are set at the provincial level. In the province's Renewable Electricity Plan, the Government of Nova Scotia sets an aggressive target of 40% of electricity needs met by renewable energy by the year 2020 (Nova Scotia Department of Energy 2010). Of this amount, 25% has been set as coming from made-in-Nova Scotia sources by 2015, and the wind energy sector is expected to be the largest contributor in meeting this goal (Nova Scotia Department of Energy 2010).

Despite the many environmental benefits of wind energy, the rapid growth of the wind energy sector around the globe has raised concerns regarding the impacts of these developments on both resident and migratory populations of wildlife (Arnett et al. 2008). Documentation of large numbers of bat fatalities at wind energy facilities has been a relatively recent development (Johnson 2005), gaining considerable attention. As a result, fatalities of bats have become a primary environmental concern associated with wind energy development.

Efforts to minimize conflicts between wildlife and wind energy have focused mainly on two areas: risk avoidance and impact mitigation (Weller and Baldwin 2012). Impact mitigation refers to those efforts focused on developing methods to reduce wildlife fatalities at operational wind facilities and does not apply to this project at this time. Risk avoidance involves conducting surveys prior to construction to avoid sites, or areas within sites, with high levels of usage by wildlife (Weller and Baldwin 2012). The assumption of this approach is that low indices of activity prior to construction should translate to low fatality rates post-construction (Baerwald and Barclay 2009). This report summarizes the methods and results of a late-fall, pre-construction survey to assess the potential for the proposed Sable Wind Project to negatively impact local bat populations.

The objectives of this project were to:

(1) Provide information on the occurrence and relative magnitude of bat activity adjacent to the proposed development area, based on analysis of a late-fall acoustic survey;
(2) Provide relevant information on the resource requirements of local bat species that may be useful for the decision-making process on the proposed development; and
(3) Make relevant recommendations based on the results of this project and recent developments in the field of bats and wind energy.

BACKGROUND

Currently in Nova Scotia there are >50 wind turbines in operation and, as of yet, there have not been any incidents of major mortality that we are aware of, though a number of bats have been killed. For context and qualification, most of these turbines have been in operation for only a short period of time (months to a few years) and it is not known how thoroughly existing operational turbines have been surveyed for bat fatalities and how well documented and reported the findings are.

In the following sections we discuss the various means by which bats may be impacted by wind energy developments, including by direct mortality, changes to habitat availability, and disruption of movement patterns (e.g., foraging, mating, migrations, or abandonment of sites).

Direct Mortality

The proximate cause of bat fatalities at wind energy developments may be due to direct strike by the rotating turbine blades, collision with turbine towers, or by barotrauma, which involves tissue damage to the lungs due to rapid or excessive air-pressure reduction near moving turbine blades (Baerwald et al. 2008; Cryan and Barclay 2009), although the discussion as to the relative role of barotrauma in the death of bats is on-going (Capparella et al. 2012; Rollins et al. 2012). In North America, significant bat fatality events at wind energy developments occur primarily in the late summer and early fall, peaking during the period that coincides with fall migration (Arnett et al. 2008; Cryan and Brown 2007; Johnson 2005). These trends have led researchers to believe that migration plays a key role in the susceptibility of certain bat species to wind turbine fatalities (Cryan and Barclay 2009). Although some fatality has also been documented during the spring (Arnett et al. 2008; Brown and Hamilton 2006), numbers are much lower, thought to be a result of more scattered migratory behaviour, or possibly the use of different routes compared to fall migration.

The species most affected are the long-distance migratory tree bats, including the hoary bat (*Lasiurus cinereus*), the eastern red bat (*L. borealis*), and the silver-haired bat (*Lasionycteris noctivagans*). In North America, these species make up about 75-80% of the documented fatalities at wind energy developments, with the hoary bat alone comprising about half of all fatalities (Arnett et al. 2008; Kunz et al. 2007). The cumulative impacts of current mortality rates as a result of wind turbines on these affected species could have long-term population effects (Kunz et al. 2007). Bat fatalities have also been reported in smaller numbers for resident hibernating bat species, including the big brown bat (*Eptesicus fuscus*), the little brown bat (*Myotis lucifugus*), the northern long-eared bat (*M. septentrionalis*), and the tri-colored bat (*Perimyotis subflavus*) (Arnett et al. 2008; Jain et al. 2007; Johnson 2005; Nicholson 2003). At some sites in the eastern United States, however, high numbers of fatalities of these resident, hibernating species have also been reported (Kunz et al. 2007).

Various explanations for the high incidence of bat fatalities at wind energy developments have been proposed (Arnett et al. 2008; Cryan and Barclay 2009; Johnson 2005; Kunz et al. 2007). Estimates of the number of bat fatalities vary widely from less than 3 bats/turbine/year (Johnson et al. 2003; Johnson et al. 2004) to upwards of 50 bats/turbine/year (Jain et al. 2007; Kerns et al. 2005; Nicholson 2003). Given the considerable variability in species composition and rates of bat fatalities among wind energy facilities, it is likely that location-specific qualities of individual facilities are important (e.g., located along migration routes or other flight corridors). It has also been proposed that the use of turbines with increasing height has extended developments further into the flight space used by migrating bats (Barclay et al. 2007). However, behavioural observations of bats displaying flight patterns typical of foraging activity prior to collisions with turbines puts the migration hypothesis to question (Horn et al. 2008). Others have hypothesized that collisions may result from bats being attracted to turbines out of curiosity, misperception, or as potential feeding, roosting, and mating opportunities (reviewed in Cryan and Barclay 2009). To date, the cause(s) of bat fatalities at turbines remains unclear and is an active area of research.

As mortalities may be the result of site-specific and design-specific characteristics and conditions, it is important to conduct site-specific monitoring studies to make reliable inferences on the potential impacts of a wind energy development on local bat populations (American Society of Mammalogists 2008).

Habitat Availability

In forested landscapes, habitat availability for bats may be impacted by the alteration or removal of vegetation to accommodate roads and wind turbine installations. This may include the direct loss of resources (e.g., roost trees), fragmentation of habitat components (e.g., foraging and roosting areas), or other disturbance that may cause bats to vacate certain areas, likely acting to degrade the local environment for bat colonies/populations that reside in the area during the summer. This negative impact of new wind energy developments is likely to occur, and will contribute to the cumulative effect of habitat loss that is occurring throughout the range of most bat species.

At the site level, small-scale clearings in forested landscapes have been shown to attract certain bat species, which utilize these areas for foraging (Grindal and Brigham 1998; Hayes and Loeb

2007). Removal of vegetation can create edge habitat or small clearings which can act to concentrate prey for bats. The extent to which this loss of vegetation can be perceived to be beneficial to bats is not known and will vary from site to site, as there must be a balance between the availability of suitable roosting resources with the availability of suitable foraging areas within commuting distance to provide conditions that favour the occupancy of resident bat species (Henderson and Broders 2008).

Movement Patterns

From the perspective of bat movement, resident bats may be affected by wind energy developments through alterations to foraging areas and possible disruption of commuting movements between roosting and foraging areas. There is some genetic evidence to suggest that bat movements can be impeded by fragmentation of habitat, which can scale up to population or distributional level effects (Kerth and Petit 2005). However, this is not well understood for most species.

Little is known about the dynamics of movement (e.g., altitude and travel routes) of resident, hibernating bats to and from hibernation sites. Anecdotal evidence suggests that bats likely use ridges and other linear landscape elements (e.g., riparian corridors) as travel routes, depending on the landscape (Arnett 2005; Lausen 2007). In the late summer and early autumn large numbers of bats congregate at the entrances to underground hibernacula in an activity referred to as 'swarming' (Davis and Hitchcock 1965; Fenton 1969; Glover and Altringham 2008; Thomas and Fenton 1979). During the swarming period bats do not roost in the hibernacula; research being conducted in Nova Scotia indicates that resident bats are 'on the move', roosting transiently on the landscape, though we do not have a full understanding of the dynamics of these behaviours. Swarming may serve several functions, including courtship, copulation, and orienting young-of-the-year to over-wintering sites (Fenton 1969; Thomas and Fenton 1979).

Movement data from Ontario and Manitoba suggests that resident bats may move up to at least 120 km between hibernacula within a year, and up to at least 500 km between years (Fenton 1969; Craig Willis, Pers. Comm.). In New England, there are records of bats moving 214 km between hibernacula within one year, with one female moving 128 km in only three nights during spring emergence from hibernation (Davis and Hitchcock 1965). Obviously these resident hibernating species are at least capable of large scale migratory movements. It is not known whether flight behaviour (e.g., height, routes, etc.) during this time differs from when resident species are in their summering area; the paucity of information on this aspect of their biology would appear to be one of the largest impediments in accurately predicting the impact of wind energy developments on local bat populations (Weller et al. 2009).

Nova Scotia Bats

In Nova Scotia there are occurrence records for seven species of bats (Table 1; Broders et al. 2003; van Zyll de Jong 1985), and each have been documented to have experienced fatalities at wind turbine sites (Arnett et al. 2008). There are three species of migratory bats recorded in the province, the hoary bat, the eastern red bat, and the silver-haired bat. These three species have extensive distributional ranges throughout North American, with Nova Scotia at or near their northern range limit (van Zyll de Jong 1985). Low numbers of echolocation recordings of migratory species in Nova Scotia by Broders (2003) and other unpublished work suggests that there are no significant populations or migratory movements of these species in the province. Two species of bats in the genus Myotis, the little brown bat and the northern long-eared bat, are the only abundant and widely distributed bats in Nova Scotia (Broders et al. 2003; Henderson et al. 2009). These 5–8g insectivorous bats are sympatric over much of their range (Caceres and Barclay 2000; Fenton and Barclay 1980; van Zyll de Jong 1985). A third species, the tri-coloured bat, has a significant population in the province, however they are likely restricted to southwest Nova Scotia (Broders et al. 2003; Farrow and Broders 2011; Rockwell 2005). These three species are gregarious species that over-winter in caves and abandoned mines in the region (Moseley 2007; Randall 2011). There is only one unconfirmed observation of the big brown bat, also a gregarious species, hibernating at a cave in central Nova Scotia (Moseley 2007; Taylor 1997).

Ecology of Resident Species

Northern long-eared and little brown bats are expected to be the most likely species to occupy the proposed development area. The life history of both of these species is typical for temperate, insectivorous bats. Their annual cycle consists of a period of activity (reproduction) in the summer, and a hibernation period in the winter. Females of the two species bear the full cost of reproduction in the summer, from pregnancy to providing sole parental care to juveniles (Barclay 1991; Broders 2003; Hamilton and Barclay 1994).

The northern long-eared bat is a forest interior species that primarily roosts and forages in the interior of forests (Broders 2003; Henderson and Broders 2008; Jung et al. 2004). Females form maternity colonies, roosting in coniferous or deciduous trees, depending on availability (Broders et al. 2006; Foster and Kurta 1999; Garroway and Broders 2008). Males typically roost solitarily in either deciduous or coniferous trees (Ford et al. 2006; Jung et al. 2004; Lacki and Schwierjohann 2001). The little brown bat is a generalist species that is associated with forests, as well as human-dominated environments (Barclay 1982; Jung et al. 1999). This species has been found to forage over water and in forests (Anthony and Kunz 1977; Fenton and Barclay 1980), and both males and females (i.e. maternity colonies) have been documented in buildings and trees (Broders and Forbes 2004; Crampton and Barclay 1998). During the summer, it appears that most of the commuting and foraging activity of northern long-eared and little brown bats occurs close to the ground (Broders 2003). Nonetheless, our ability to survey bat activity at high altitudes is extremely limited, and therefore our ability to make inference on the vertical distribution of bats is also limited.

A third species that occurs in Nova Scotia, the tri-colored bat, is not likely to occur in the proposed development area (Farrow and Broders 2011). In Nova Scotia, work that we have done in Kejimkujik National Park suggests that this species roost in Usnea spp. lichen and forages over waterways (Poissant et al. 2010).

White Nose Syndrome

In 2012, three species of bats found in Nova Scotia (four if you include the big brown bat) were listed by COSEWIC as Endangered, primarily due to the spread of an emerging infectious disease known as White Nose Syndrome (WNS) that is responsible for unprecedented mortality in hibernating bats through much of eastern North America (Blehert et al. 2009; United States Fish & Wildlife Service 2012). The condition is caused by *Geomyces destructans*, a cold-loving fungus that thrives in cave conditions and as such, impacts bat population directly during the winter hibernation period (Blehert 2012; Lorch et al. 2011). It is thought to disrupt patterns of torpor and possibly result in death by starvation or dehydration (Cryan et al. 2010; Reeder et al. 2012). First documented in New York State in 2006 (Blehert et al. 2009), WNS spread rapidly to 19 states and four Canadian provinces by 2011 and is thought to be responsible for the death of more than 5.5 million bats (United States Fish & Wildlife Service 2012). White Nose Syndrome has been confirmed among populations of seven species of bats; the little brown bat, the most abundant species in the region currently affected by WNS, has experienced the most dramatic population declines (Frick et al. 2010). Some hibernacula have seen mortality rates of 90 to 100 percent of resident hibernating bats as a result of infection with WNS (United States Fish & Wildlife Service 2012), leading researchers to believe that WNS could lead to local extinctions of the little brown bat, as well as other species (Frick et al. 2010).

White Nose Syndrome was first documented in Nova Scotia in April 2011. It is not known to what extent bats in the province will be impacted, though all three of the resident hibernating bat species found in the province (four if you include the big brown bat) have been affected by WNS elsewhere in their range. Therefore it would be prudent to protect any surviving animals which may be genetically predisposed to surviving the infection. Even prior to WNS, bats were increasingly recognized as a conservation priority in North America. Now, in consideration of the sharp declines and rapid spread of WNS, serious concerns have been raised about the impact of WNS on the population viability of affected bat species, consequently impacting the conservation status of bat species at the local, national and global level (Table 1). Given that hibernacula represent one of the more critical resources for bats, as they allow successful over-wintering, and they are important to protect.

Potential for Hibernacula

The Nova Scotia Proponent's Guide to Wind Power Projects (Nova Scotia Environment 2012) states that wind farm sites within 25 km of a known bat hibernacula have a 'very high' site sensitivity. There are no known hibernacula within 25 km of the Sable Wind Project area (Moseley 2007; Randall 2011); the nearest known hibernaculum is Hirschefield Galena Prospect, in Glenelg, a significant hibernaculum possibly containing 200-300 hibernating bats in the winter. Randall (2011) surveyed this site for bat activity over two nights in 2010 and caught bats in sufficient numbers (n=108) to classify this site as a swarming site for bats. This mine adit is located approximately 85 km from the proposed development area.

According to the Nova Scotia Abandoned Mine Openings Database (Fisher and Hennick 2009), there are no documented abandoned mine openings within 25 km of the proposed development area. The closest underground abandoned mine working with original depths greater than 50 m is at Isaacs Harbour. These workings, located approximately 50 km from the proposed development area, contain close to 200 documented abandoned mine openings, however, only a dozen have original depths greater than 50 m. Randall (2011) conducted ultrasonic monitoring at one of these sites in 2010 and concluded that the site did not exhibit evidence of being a fall swarming site for bats.

Table 1. Over-wintering strategy and conservation status of bat species recorded in Nova Scotia.

Species	Over-wintering Strategy	Global Ranking[1]	COSEWIC Status	ACCDA Status[2]	GSRWSNS[4]
Little brown bat	Resident hibernator (NS and NB)	G3	Endangered[3]	S1	Yellow
Northern long-eared bat	Resident hibernator (NS and NB)	G2	Endangered[3]	S1	Yellow
Tri-colored bat	Resident hibernator (NS and NB)	G3	Endangered[3]	S1	Yellow
Big brown bat	Resident hibernator (NB)	G5	Not assessed	N/A	Undetermined
Hoary bat	Migratory	G5	Not assessed	S1	Undetermined
Silver-haired bat	Migratory	G5	Not assessed	S1	Undetermined
Eastern red bat	Migratory	G5	Not assessed	S1	Undetermined

[1] Global Ranking based on the NatureServe Explorer: G1 = Critically Imperiled, G2 = Imperiled, G3 = Vulnerable, G4 = Apparently Secure, G5 = Secure. All the above species were reassessed in July 2012.
[2] Atlantic Canada Conservation Data Centre ranking, based on occurrence records from NB and NS: S1 = Extremely rare: May be especially vulnerable to extirpation (typically five or fewer occurrences or very few individuals).
[3] Assessed by COSEWIC and designated in an emergency assessment on February 3, 2012.
[4] General Status Ranks of Wild Species in Nova Scotia based on published scientific literature, wildlife atlasing projects, unpublished data, and expert opinion, providing an overall indication of a species` status in Nova Scotia. Yellow = Sensitive to human activities or natural events; Undetermined = Insufficient data exists to assess status.

METHODS

Study Area

The project area is located southwest of the coastal community of Canso, Guysborough County, Nova Scotia, which is situated on the end of a peninsula jutting into the Atlantic Ocean next to Chedabucto Bay. This is within the Granite Barrens District of the Atlantic Coast Region, which is characterized by thin acidic soils, frequent rock outcrops, and restricted tree growth (Davis and Browne 1996). Throughout the region, barrens or semi-barrens are common, supporting mostly low, ericaceous vegetation, with abundant sphagnum bogs. Where conditions favour the growth of trees, dense stands of balsam fir, black spruce, and white spruce are typical, though deciduous trees can be found in elevated, well-drained areas that are sheltered from coastal winds (Davis and Browne 1996). The project area is adjacent to the Chapel Gully Trail, a park used for hiking and walking that contains a salt marsh that has been designated as significant habitat by the Nova Scotia Department of Natural Resources.

The Atlantic Ocean is the dominant influence on the region's climate, which is characterized by moderated seasonal and daily temperatures, high precipitation and humidity, strong winds, and fog (Davis and Browne 1996). Along the coast, winters are relatively mild with long, cool springs, and short, cool summers. Because of frequent fog and the cooling influence of ocean waters, mean daily July temperatures typically stay below 15°C (Davis and Browne 1996).

Acoustic Surveys

We used one SM2BAT ultrasonic recorder (Wildlife Acoustics Inc., Concord, MA, USA) and one Anabat II detector (Titley Electronics, Ballina, NSW, Australia) to passively record the echolocation calls of bats at two locations along the Chapel Gully Trail (Table 2). The seasonal timing of sampling likely corresponded to late-fall migration activity by migratory species and possible movement by resident species to local hibernacula. Detectors were placed along the edges of waterways (Table 3) in an effort to maximize recordings of bats as they commute through these areas or utilizing them for foraging.

Identification of many bat species is possible because of the distinctive nature of their echolocation calls (Fenton and Bell 1981; O'Farrell et al. 1999). Species were qualitatively identified from recorded echolocation call sequences by comparison with known echolocation sequences recorded in this and other geographic regions using frequency-time graphs in ANALOOK software (C. Corben, www.hoarybat.com). In the case of species in the genus Myotis (northern long-eared and little brown bat), we did not identify sequences to the species level as their calls are too similar to be reliably separated. Call sequences that were clearly bat generated ultrasound, but could not be confidently classified due to poor quality of the recordings were classified as “unknown”.

As the unit of activity, we used the number of recorded echolocation files, which approximate an echolocation call sequence, defined as a continuous series of greater than two calls (Johnson et al. 2004). Because an individual bat may be recorded making multiple passes, the data presented represent a measure of bat activity, and cannot be used as a direct measure of the number of bats within or passing through an area.

Table 2. Locations of acoustic sampling sites for the 2012 late-fall survey of bat activity in Canso, Guysborough County, Nova Scotia.

Site	Location	Coordinates NAD83 UTM Zone 21T		Orientation	Deployed	Retrieved
1	Stream Anabat	657723 E	5020669 N	330°	Sept 22	Oct 20
2	Wetland SM2	657955 E	5021358 N	90°	Sept 22	Oct 20

Table 3. Site descriptions for acoustic sampling sites for the 2012 late-fall survey of bat activity in Canso, Guysborough County, Nova Scotia.

Site	Description
1	Located adjacent to a slow-moving stream bed, oriented upstream, and surrounded by ericaceous shrubs and stunted softwood species (canopy height 6-8 m).
2	Located adjacent to a wetland area, oriented downstream from a flowing stream (forest canopy height at edge of salt marsh 8-10 m).

RESULTS

Bat detectors were deployed from September 22 to October 13, 2012 (Table 4). However, due to heavy rains and unexpected flooding, one of the units was inundated with water and stopped recording on 30 September 2012. There were 156 echolocation sequences recorded. Other than 12 files that were classified as unknown (7.7% of the total number of bat files recorded), all of the recorded sequences were attributable to Myotis bats (i.e., the little brown bat and the northern long-eared bat); there were no recorded calls with characteristics of the calls of any of the other bat species recorded in Nova Scotia.

The average number of recorded sequences per night in the study area (average for both locations) was 7.09 (SD = 8.90) during the late-fall sampling period. To place the relative magnitude of activity recorded in the study area into context, in 129 nights of monitoring along five forested edges in the Greater Fundy National Park Ecosystem from June to August 1999, the average number of sequences per night was 27 (SD = 44; Broders unpublished data).

Table 4. Number of echolocation files recorded per night at two sites along the Chapel Gully Trail in Canso, Nova Scotia, 2012.

	Site 1[1]	**Site 2**		
Evening	**Myotis**	**Myotis**	**Unknown**	**Total**
22-Sep-12	0	0	1	1
23-Sep-12	20	7	4	31
24-Sep-12	2	2	2	6
25-Sep-12	1	9	0	10
26-Sep-12	1	10	1	12
27-Sep-12	0	0	2	2
28-Sep-12	2	19	0	21
29-Sep-12	0	1	0	1
30-Sep-12	-	2	0	2
1-Oct-12	-	27	0	27
2-Oct-12	-	13	0	13
3-Oct-12	-	0	0	0
4-Oct-12	-	10	1	11
5-Oct-12	-	3	0	3
6-Oct-12	-	3	0	3
7-Oct-12	-	3	1	4
8-Oct-12	-	1	0	1
9-Oct-12	-	2	0	2
10-Oct-12	-	1	0	1
11-Oct-12	-	1	0	1
12-Oct-12	-	0	0	0
13-Oct-12	-	4	0	4
Total	**26**	**118**	**12**	**156**
Sequences/night	**3.25**	**5.36**	**-**	**7.09**

1: Unit was inundated with water due to extreme flooding by 30 September and malfunctioned.

DISCUSSION

There was no acoustic evidence of a significant movement or concentration of bats through the area investigated during this late-fall survey of bat activity. The magnitude of activity was low compared to baseline levels expected in a forested ecosystem in the region. However, this survey was not started until 20th of September, at which point many of the Myotis spp. bats in Nova Scotia would have been starting the winter hibernation period and would not be active on the landscape.

All of the identified echolocation call sequences recorded for this project were attributable to the two species of Myotis bats known to occur in Nova Scotia, the little brown bat and the northern long-eared bat. This was expected as they are the only abundant and widely-distributed species in the province, and are two of only three species with significant populations in the province (Broders et al. 2003). Although we did not distinguish the calls of Myotis species, the recorded sequences most likely represent the little brown bat, as this species is known to forage in open areas and over water. The northern long-eared bat is a recognized forest interior species (Henderson and Broders 2008; Jung et al. 1999), and is less likely to use open areas for foraging and commuting (Henderson and Broders 2008). Additionally, the northern long-eared bat has lower intensity echolocation calls and is thus not recorded as well as the little brown bat (Broders et al. 2004; Miller and Treat 1993).

There were no echolocation sequences that were attributable to the tri-colored bat, which was expected as this species is only locally abundant in southwest Nova Scotia and the proposed development is outside of the provincial distribution for this species (Farrow and Broders 2011). There were also no echolocation sequences that were attributable to any of the three migratory species known to occur in the province, the hoary bat, the silver-haired bat, or the eastern red bat. This may suggest that there were no significant movements of these species through the area, however, the study period may have missed the peak migration period for these species (mid-August to mid-September). Regardless, current data would suggest that these species do not occur in large numbers in the region, though they may occur irregularly, especially during the migration season.

Myotis bats are relatively new to the list of species among fatalities at wind turbines sites. This may be due to the fact that the first large scale wind developments were located primarily in western North America, typically in agricultural and open prairie landscapes (reviewed in Johnson 2005). Fatalities of these resident, non-migratory species were largely absent from these sites, likely due to the association of these species with forested landscapes. More recently, evidence of Myotis fatalities resulting from collisions with wind turbines have been noted at sites in eastern North America (reviewed in Arnett et al. 2008; Jain et al. 2007; Johnson 2005). Although there are fewer documented fatalities of Myotis bats compared to migratory species, there is still a risk.

Other than direct bat mortality as a result of collisions with the turbines, there is also the potential that disruption of the forest structure (e.g., removal of trees and fragmentation of forest stands for roads and clearings) will degrade the local environment for colonies/populations of Myotis bats that reside in the area during the summer. This can occur by the elimination of roost trees, the isolation of trees left standing, as well as the elimination or degradation of foraging areas for bats. These negative impacts will almost certainly occur and will add to the cumulative impact of habitat loss that is occurring throughout the ranges of these species.

RECOMMENDATIONS

1. Pre-construction monitoring - this project was initiated late in the active season for bats. Therefore, one must make inference from these data with a higher degree of caution. It is strongly recommended that further surveys be conducted in summer-fall 2013 to make more informed inferences on bat activity in the area. Such a survey should include acoustic surveys over a longer time span and trapping to determine: (1) whether there are any northern long-eared bats present and (2) whether there are any maternity colonies of either species present.

2. Post-construction monitoring - A rigorous post-construction monitoring program, appropriately designed to account for searcher efficiency and scavenger rates, needs to be established to quantify bat fatality rates. These surveys should be conducted over an entire season (April to October), but especially during the fall migration period (mid-August to late-September) for at least two years. Should fatalities occur, they should be investigated with respect to their spatial distribution relative to wind turbines, turbine lighting, weather conditions, and other site specific factors, and should trends be identified, operations should be adjusted in an adaptive management framework. In this manner, mitigation can be focused on any identified high risk areas/infrastructure to minimize future fatalities. These data are essential for assessing potential risks at future developments in the region; therefore it is critical that the results of these surveys be appropriately reported.

3. Minimize project footprint – To the extent possible, minimize the direct loss of bat habitat resources (e.g., wetlands, riparian areas, mature deciduous-dominated forest stands), and minimize the extent of bat habitat impacted by the development.

4. Retain key bat habitat – Key bat habitat should be identified and retained in the project area to continue to support existing summer colonies/populations of bats. Retention of these bat habitat resources should be in a spatial manner that provides connectivity in the project area and with the larger landscape to ensure foraging and roosting areas remain well connected. Consideration of the potential for fragmentation of bat habitat resources should also be taken with regards to the development of road networks and transmission lines in the project area.

5. Return to pre-project state upon decommissioning – The project area should be returned to the state that existed prior to the development of the site once the project is decommissioned. This should include planning to ensure the continuity of forest stand succession to provide and maintain appropriate roosting areas well into the future as existing roost trees die off. Retention of forest stands of a range of ages will provide mature trees for bat roosting resources in the future.

6. Remain up to date with current research – There is presently an abundance of on-going research aimed at determining the impacts of wind energy developments on populations of bats. Other studies are focusing on investigating the efficacy of potential mitigation measures, including the effects of weather on bat activity patterns and collisions with wind turbines, and possible bat deterrents (including acoustic and radar emissions). As these are active areas of research, it is essential that the most current studies and guidelines are used to guide management decisions and development plans for wind energy projects.

LITERATURE CITED

American Society of Mammalogists. 2008. Effects of wind-energy facilities on bats and other wildlife. http://www.mammalsociety.org/uploads/WindEnergyResolution.pdf.

Anthony, E. L. P., and T. H. Kunz. 1977. Feeding strategies of the little brown bat, *Myotis lucifugus*, in southern New Hampshire, Ecology 58:775-786.

Arnett, E. B. 2005. Relationships between bats and wind turbines in Pennsylvania and West Virginia: an assessment of bat fatality search protocols, patterns of fatality, and behavioural interactions with wind turbines. A final report submitted to the Bats and Wind Energy Cooperative, Bat Conservation International, Austin.

Arnett, E. B., et al. 2008. Patterns of bat fatalities at wind energy facilities in North America, Journal of Wildlife Management 72:61-78.

Baerwald, E. F., and R. M. R. Barclay. 2009. Geographic variation in activity and fatality of migratory bats at wind energy facilities, Journal of Mammalogy 90:1341-1349.

Baerwald, E. F., G. H. D'Amours, B. J. Klug, and R. M. R. Barclay. 2008. Barotrauma is a significant cause of bat fatalities at wind turbines, Current Biology 18:R695-R696.

Barclay, R. M. R. 1982. Night roosting behavior of the little brown bat, *Myotis lucifugus*, Journal of Mammalogy 63:464-474.

Barclay, R. M. R. 1991. Population structure of temperate zone insectivorous bats in relation to foraging behavior and energy demand, Journal of Animal Ecology 60:165-178.

Barclay, R. M. R., E. F. Baerwald, and J. C. Gruver. 2007. Variation in bat and bird fatalities at wind energy facilities: assessing the effects of rotor size and tower height, Canadian Journal of Zoology 85:381-387.

Blehert, D. S. 2012. Fungal disease and the developing story of bat White-nose Syndrome, Plos Pathogens 8.

Blehert, D. S., et al. 2009. Bat White-Nose Syndrome: An emerging fungal pathogen?, Science 323:227-227.

Broders, H., C. Findlay, and L. Zheng. 2004. Effects of clutter on echolocation call structure of *Myotis septentrionalis* and *M. lucifugus*, Journal of Mammalogy 85:273-281.

Broders, H., and G. Forbes. 2004. Interspecific and intersexual variation in roost-site selection of northern long-eared and little brown bats in the Greater Fundy National Park ecosystem, Journal of Wildlife Management 68:602-610.

Broders, H. G. 2003.Summer roosting and foraging behaviour of sympatric *Myotis septentrionalis* and *M. lucifugus*. Ph.D. dissertation, University of New Brunswick, Fredericton.

Broders, H. G., G. J. Forbes, S. Woodley, and I. D. Thompson. 2006. Range extent and stand selection for roosting and foraging in forest-dwelling northern long-eared bats and little brown bats in the Greater Fundy Ecosystem, New Brunswick, Journal of Wildlife Management 70:1174-1184.

Broders, H. G., G. M. Quinn, and G. J. Forbes. 2003. Species status, and the spatial and temporal patterns of activity of bats in southwest Nova Scotia, Canada, Northeastern Naturalist 10:383-398.

Brown, W. K., and B. L. Hamilton. 2006. Monitoring of bird and bat collisions with wind turbines at the Summerview Wind Power Project, Alberta 2005-2006. Report prepared for Vision Quest Windelectric, Calgary.

Caceres, C., and R. M. R. Barclay. 2000. *Myotis septentrionalis*, Mammalian Species No. 634:1-4.

Capparella, A., S. Loew, and D. K. Meyerholz. 2012. Bat deaths from wind turbine blades, Nature 488:32-32.

Crampton, L. H., and R. M. R. Barclay. 1998. Selection of roosting and foraging habitat by bats in different aged aspen mixedwood stands, Conservation Biology 12:1347-1358.

Cryan, P. M., and R. M. R. Barclay. 2009. Causes of bat fatalities at wind turbines: hypotheses and predictions, Journal of Mammalogy 90:1330-1340.

Cryan, P. M., and A. C. Brown. 2007. Migration of bats past a remote island offers clues toward the problem of bat fatalities at wind turbines, Biological Conservation 139:1-11.

Cryan, P. M., C. U. Meteyer, J. G. Boyles, and D. S. Blehert. 2010. Wing pathology of white-nose syndrome in bats suggests life-threatening disruption of physiology, Bmc Biology 8.

Davis, D., and S. Browne. 1996. The Natural History of Nova Scotia, Volume 2: Theme Regions. Nimbus Publishing and the Nova Scotia Museum of Natural History, Halifax.

Davis, W. H., and H. B. Hitchcock. 1965. Biology and migration of the bat, *Myotis lucifugus*, in New England, Journal of Mammalogy 46:296-313.

Farrow, L. J., and H. G. Broders. 2011. Loss of forest cover impacts the distribtuion of the forest-dwelling tri-colored bat (*Perimyotis subflavus*), Mammalian Biology 76:172-179.

Fenton, M. B. 1969. Summer activity of *Myotis lucifugus* (Chiroptera: Vespertilionidae) at hibernacula in Ontario and Quebec, Canadian Journal of Zoology 47:597-602.

Fenton, M. B., and R. M. R. Barclay. 1980. *Myotis lucifugus*, Mammalian Species 142:1-8.

Fenton, M. B., and G. Bell. 1981. Recognition of species of insectivorous bats by their echolocation calls, Journal of Mammalogy 62:233-234.

Fisher, B. E., and E. W. Hennick. 2009. Nova Scotia Abandoned Mine Openings Database, DP ME 10, Version 4 Mineral Resources Branch, Nova Scotia Department of Natural Resources.

Ford, W. M., S. F. Owen, J. W. Edwards, and J. L. Rodrigue. 2006. *Robinia pseudoacacia* (black locust) as day-roosts of male *Myotis septentrionalis* (northern bats) on the Fernow Experimental Forest, West Virginia, Northeast Naturalist 13:15-24.

Foster, R. W., and A. Kurta. 1999. Roosting ecology of the northern bat (*Myotis septentrionalis*) and comparisons with the endangered Indiana bat (*Myotis sodalis*), Journal of Mammalogy 80:659-672.

Frick, W. F., et al. 2010. An emerging disease causes regional population collapse of a common North American bat species, Science 329:679-682.

Garroway, C. J., and H. G. Broders. 2008. Day roost characteristics of northern long-eared bats (*Myotis septentrionalis*) in relation to female reproductive status, Ecoscience 15:89-93.

Glover, A., and J. Altringham. 2008. Cave selection and use by swarming bat species, Biological Conservation 141:1493-1504.

Grindal, S. D., and R. M. Brigham. 1998. Short-term effects of small-scale habitat disturbance on activity by insectivorous bats, Journal of Wildlife Management 62:996-1002.

Hamilton, I. M., and R. M. R. Barclay. 1994. Patterns of daily torpor and day-roost selection by male and female big brown bats (*Eptesicus fuscus*), Canadian Journal of Zoology 72:744-749.

Hayes, J. P., and S. C. Loeb. 2007. The influences of forest management on bats in North America, Pp. 207-234 in Bats in Forests: Conservation and Management (M. J. Lacki, A. Kurta and J. P. Hayes, eds.). John Hopkins University Press, Baltimore.

Henderson, L. E., and H. G. Broders. 2008. Movements and resource selection of the northern long-eared myotis (*Myotis septentrionalis*) in a forest-agriculture landscape, Journal of Mammalogy 89:952-963.

Henderson, L. E., L. J. Farrow, and H. G. Broders. 2009. Summer distribution and status of the bats of Prince Edward Island, Canada, Northeastern Naturalist 16:131-140.

Horn, J. W., E. B. Arnett, and T. H. Kunz. 2008. Behavioral responses of bats to operating wind turbines, Journal of Wildlife Management 72:123-132.

Jain, A., P. Kerlinger, P. Curry, and L. Slobodnik. 2007. Annual report for the Maple Ridge Wind Power Project post-construction bird and bat fatality study - 2006. Curry and Kerlinger, LLC, Syracuse.

Johnson, G. D. 2005. A review of bat mortality at wind-energy developments in the United States, Bat Research News 46:45-50.

Johnson, G. D., W. P. Erickson, J. White, and R. McKinney. 2003. Avian and bat mortality during the first year of operations at the Klondike Phase I Wind Project, Sherman County, Oregon, Goldendale.

Johnson, G. D., M. K. Perlik, W. P. Erickson, and M. D. Strickland. 2004. Bat activity, composition, and collision mortality at a large wind plant in Minnesota, Wildlife Society Bulletin 32:1278-1288.

Jung, T. S., I. D. Thompson, and R. D. Titman. 2004. Roost site selection by forest-dwelling male Myotis in central Ontario, Canada, Forest Ecology and Management 202:325-335.

Jung, T. S., I. D. Thompson, R. D. Titman, and A. P. Applejohn. 1999. Habitat selection by forest bats in relation to mixed-wood stand types and structure in central Ontario, Journal of Wildlife Management 63:1306-1319.

Kerns, J., W. P. Erickson, and E. B. Arnett. 2005. Bat and Bird Fatality at Wind Energy Facilities in Pennsylvania and West Virginiain Relationships between bats and wind turbines in Pennsylvania and West Virginia (E. B. Arnett, ed.). A final report submitted to the Bats and Wind Energy Cooperative, Bat Conservation International, Austin.

Kerth, G., and E. Petit. 2005. Colonization and dispersal in a social species, the Bechstein's bat (*Myotis bechsteinii*), Molecular Ecology 14:39943-3905.

Kunz, T. H., et al. 2007. Ecological impacts of wind energy development on bats: questions, research needs, and hypotheses, Frontiers of Ecology and the Environment 5:315-324.

Lacki, M. J., and J. H. Schwierjohann. 2001. Day-roost characteristics of northern bats in mixed mesophytic forest, Journal of Wildlife Management 65:482-488.

Lausen, C. L. 2007.Roosting ecology and landscape genetics of prairie bats. Ph.D. Dissertation, University of Calgary, Calgary.

Lorch, J. M., et al. 2011. Experimental infection of bats with Geomyces destructans causes white-nose syndrome, Nature 480:376-U129.

Miller, L. A., and A. E. Treat. 1993. Field recordings of echolocation and social signals from the gleaning bat *Myotis septentrionalis*, Bioacoustics 5:67-87.

Moseley, M. 2007. Records of bats (Chiroptera) at caves and mines in Nova Scotia. Curatorial report number 99. Nova Scotia Museum, Halifax.

Municipality of the District of Guysborough, and Nova Scotia Power Inc. 2012. Sable Wind Project. Environmental Assessment Registration Document.

Nelson, V. 2009. Wind Energy: Renewable Energy and the Environment. CRC Press, Taylor & Francis Group, Boca Raton.

Nicholson, C. P. 2003. Buffalo Mountain windfarm bird and bat mortality monitoring report, Knoxville, Tennessee.

Nova Scotia Department of Energy. 2010. Renewable Electricity Plan: A path to good jobs, stable prices, and a cleaner environment, Halifax.

Nova Scotia Environment. 2012. Proponent's Guide to Wind Power Projects: Guide for preparing an Environmental Assessment Registration Document. Policy and Corporate Services Division Environmental Assessment Branch.

O'Farrell, M., B. Miller, and W. Gannon. 1999. Qualitative identification of free-flying bats using the Anabat detector, Journal of Mammalogy 80:11-23.

Poissant, J. A., H. G. Broders, and G. M. Quinn. 2010. Use of lichen as a roosting substrate by *Perimyotis subflavus*, the tri-colored bat, in Nova Scotia, Ecoscience 17:372-378.

Randall, J. 2011.Identification and characterization of swarming sites used by bats in Nova Scotia. M.Sc. dissertation, Dalhousie University, Halifax.

Reeder, D. M., et al. 2012. Frequent arousal from hibernation linked to severity of infection and mortality in bats with White-Nose Syndrome, Plos One 7.

Rockwell, L. 2005.Summer distribution of bat species on mainland Nova Scotia. Honours dissertation, Saint Mary's University, Halifax.

Rollins, K. E., D. K. Meyerholz, G. D. Johnson, A. P. Capparella, and S. S. Loew. 2012. A forensic investigation into the etiology of bat mortality at a wind farm: barotrauma or traumatic Injury?, Veterinary Pathology 49:362-371.

Taylor, J. 1997.The development of a conservation strategy for hibernating bats of Nova Scotia, Dalhousie University, Halifax.

Thomas, D., and M. Fenton. 1979. Social-behaviour of the little brown bat, *Myotis-lucifugus.* I. Mating-behavior, Behavioral Ecology and Sociobiology 6:129-136.

United States Fish & Wildlife Service. 2012. North American bat death toll exceeds 5.5 million from white-nose syndrome in News Release published on: Tuesday, January 17, 2012, http://www.fws.gov/northeast/feature_archive/Feature.cfm?id=794592078.

van Zyll de Jong, C. G. 1985. Handbook of Canadian Mammals. Vol. 2 (Bats). National Museums of Natural Sciences, Ottawa, Ontario.

Weller, T. J., and J. A. Baldwin. 2012. Using echolocation monitoring to model bat occupancy and inform mitigations at wind energy facilities, Journal of Wildlife Management 76:619-631.

Weller, T. J., P. M. Cryan, and T. J. O`Shea. 2009. Broadening the focus of bat conservation and research in the USA for the 21st century, Endangered Species Research 8:129-145.

APPENDIX A – PHOTOGRAPHS

Figure 1. Typical vegetation along the Chapel Gully Trail, consisting of ericaceous shrubs, and stunted conifer species.

Figure 2. Acoustic sample site 1; the arrow indicates the location of the Anabat detector.

Figure 3. Acoustic sample site 2; the arrow indicates the location of the SM2BAT ultrasonic recorder.

APPENDIX E

2013 Bat Survey Proposal

Characterization of bat movement patterns to inform the decision-making process about the potential risks of local wind energy developments on bat populations- Canso

Hugh Broders, Saint Mary's University, Halifax, NS, B3H 3C3

9 Nov 2012

Context

In the late fall of 2012 surveys were conducted at the proposed Canso Wind Farm. The results of that project found a lower than expected activity level of bats and there were no long distant migrant bats recorded. However, that project did not start until 22 September and we therefore missed the optimal period for surveying for bats. As a result, a major recommendation of that project was that there should be follow-up surveys conducted in 2013 to complement these efforts. The 2013 work should occur in the summer and early fall.

Particulars

- We will conduct bat acoustic surveys in the survey area during the late summer/early fall of 2013. Ideally we will mount bat detectors on met towers in the area. If possible, we would require the support and assistance of your technical personnel.
- We will seek to locate maternity colonies of little brown bats in the area.
- We will conduct trapping surveys in the project area to determine whether there is any evidence that northern long-eared bats are present in the project area. If yes, are there maternity colonies. This species is forest-dwelling and the only way to confirm presence is to conduct trapping surveys.

APPENDIX F

Moose Monitoring Plan

Moose monitoring plan for Sable wind farm

Following discussions with Peter McDonald at DNR on Tuesday October 16th snow tracking transects will be carried out in December 2012, January and March 2012 as per the DNR moose monitoring protocol.

Moose often use linear developments to move around and as such roads, trails and game trails will be utilised where possible for monitoring purposes.

Option 1: Snowmobile / ATV

Surveyors will work in pairs to drive existing roads and trails (on ATVs or snowmobiles depending on snow conditions) in December, January and March looking for tracks crossing them.

Surveyors will record any observations of moose tracks, browse and pellets, including GPS, photo, time, date and direction of travel. Also note habitat surrounding observation.

Other interesting tracks will also be recorded for additional information, particularly where carnivore and moose tracks are seen to intersect.

Option 2: transects on foot

Where the trails and roads do not allow for reasonable coverage of the site, some transects will be carried out on foot.

Transects involve walking 1 km on a designated route, looking for moose tracks, and browse. When an observation is made, GPS location, photo and description of the observation are made. Description should include type of evidence (browse, track or scat) direction of travel if tracks and any other tracks in the immediate area.

Potential transects, based on desktop research will be plotted on a project map and forwarded to DNR (Peter McDonald) to review.

Transects are subject to change once on site, due to ground conditions including access. Transects would be walked in December and January. See attached map for transect locations.

Option 3: pellet group counts

If there is no snow that is deep enough to show moose tracks through December 2012, January and March 2013, pellet group counts will be required in March 2013 in lieu of snow tracking.

In early spring, 1 km transects (different from the snow tracking transects) should be walked and pellet groups counted to determine approximate number of moose on the project site.