

Stantec

DIGBY WIND POWER PROJECT ENVIRONMENTAL ASSESSMENT

Appendices

APPENDIX E

AVIAN FIELD PROGRAM INFORMATION

WIND TURBINE STUDY PRE-CONSTRUCTION (BASELINE) BIRD MONITORING PROTOCOL

1.0 INTRODUCTION

This bird survey protocol will be used as a guideline to gather information on pre-construction (baseline) information on birds that use and move through sites proposed for wind farm development. Specifically, this protocol applies to proposed Digby wind farm (refer to Appendix A for site location maps). Preliminary desktop studies have determined these sites to have High and Very High Level of Concern scores based on Environment Canada's Guidance Document for Environmental Assessment (Environment Canada 2007a). The proposed sampling program and level of effort is reflective of these scores which takes into account size of the site, the nature of the habitats at the site, and the numbers and species of birds expected.

The protocol was developed based on previous protocols developed in consultation with the Canadian Wildlife Service (CWS), as well as Environment Canada's Recommended Protocols for Monitoring Impacts of Wind Turbines on Birds (Environment Canada 2007b). This protocol is intended as a guideline only and adjustments may have to be made in response to weather conditions or changes in bird activities that can vary somewhat from one year to the next.

Field workers hired to perform these surveys will be skilled at identifying birds by song and call and by sight and will be familiar with the birds in the region where the survey is being undertaken. Results of these surveys will be included in the environmental assessment reports for the proposed wind farm developments. Data will be collected and presented in such a manner to allow comparison of baseline data with post-construction survey and monitoring results that will be required as follow-up.

2.0 BREEDING SEASON

During the breeding season, surveys will determine which species regularly use the area for nesting, for foraging during the breeding season, or for raising their young, and to obtain measures of abundance of bird species using the area. Such data will be used to predict the potential impact to breeding birds of developing turbines on a site and (when combined with post-assessment monitoring) to quantify the actual impact, if construction proceeds, in order to test the predictions.

The following describes specific sampling methods to be used and proposed sampling schedule.

2.1 Sampling Methods

Area searches, standardized area searches and point counts will be used as the effective means for developing a species list for the site. Point counts will follow Environment Canada guidelines, and will be used for the purpose of contributing to existing knowledge of the use of the site by birds during the breeding season, and to facilitate comparisons with the post-construction breeding bird community. For some bird species, such as marsh birds and some raptors, playback methods may also be used. Surveys require a field worker who is familiar with the methodology, and the songs and calls of all bird species likely to be encountered. Surveys will be undertaken twice during the early breeding season. Representative sampling will be undertaken in each major habitat type.

2.2 Schedule and Frequency

The following survey periods are proposed to obtain information on bird breeding behavior in the area.

- Two surveys in the early breeding season, from late May to early July.

3.0 SPRING AND FALL MIGRATION

For migrating birds, areas that contain habitats that may be important for migrants as stopover sites or wintering areas will be surveyed to determine whether they support large numbers of birds in these seasons. Some areas may also have high concentrations of birds flying through them, in which case there is a concern whether they may be flying at heights comparable to the blades of the wind turbines.

3.1 Sampling Methods

Surveys will be conducted during both spring and autumn migration. Passage migration counts and stopover counts will be conducted to determine how the site is used by migrant birds. Behavioral studies will also be conducted if significant concentrations of birds are present (such as migrating raptors or large flocks of waterbirds).

With specific respect to waterfowl, efforts will be made on site when these migrations are known to be occurring, based on past observations or on current information. Surveys will determine what flight paths, if any, become routine for staging waterfowl as they move about the study area. Number and height of migrating flocks in relation to proposed blade height will be recorded.

For migrants in transit such as raptors, surveys will be focused during weather conditions that promote migration. The heights of migrants, such as raptors, will be recorded.

Sampling will represent each major habitat type. If present, special habitats such as wetlands or shorelines for species that use these habitats in particular will be surveyed.

3.2 Schedule and Frequency

The following survey periods are proposed to obtain information on migrant and staging bird species in the area:

- For stopover migrants, the migration period will be separated into three components including a "core" period and shoulder periods on each side.
- For spring migration in the Maritimes, the core period is first three weeks of May and shoulder periods begin 15 April and end early June. For the fall migration the core period is the first three weeks of September, and shoulder periods begin mid-August and end late October.
- Within the core periods, surveys will be conducted twice a week (approximately once every three days), and for the shoulder periods, surveys will be conducted once a week.
- By having more frequent surveys within the core periods the possibility of missing a migrant "wave" is reduced.

4.0 OVERWINTERING

4.1 Sampling Methods

Counts during the winter (e.g., November to March) will be carried out using standardized area searches. Observations will note height of flights and specific areas of feeding, relative to proposed location of turbines.

As with migration stopover studies, if significant numbers of birds are present, searches will be complemented with behavioural studies to determine whether birds flying through areas will be within the future blade-swept area.

Sampling will represent each major habitat type.

4.2 Schedule and Frequency

The following survey periods are proposed to obtain information on use of the area by overwintering birds (e.g., songbirds, raptors, waterfowl):

- One survey every two to three weeks from November to April.

5.0 SUMMARY OF MONITORING EFFORT

A total of **126 to 140** hours will be spent monitoring bird use, during the pre-construction phase in 2008 as shown in Table 1.

TABLE 1 Summary of Monitoring Protocol

| Season | Dates | Number of survey weeks | Monitoring Behaviour | Survey Methods | Frequency | Total Survey Hours |
|-------------------------------------|---|--|------------------------------------|---|---|------------------------------|
| Winter | November 1- April 15 | 22 weeks | Overwintering | Standardized area searches Behavioural studies if required | One 4-hour survey every two to three weeks. | Approximately 30 to 44 hours |
| Spring | April 15-April 30 and last week of May | 3 weeks | Spring Migration (shoulder period) | Passage migration counts Stopover count Behavioural studies if required | One 4-hour survey per week | 12 hours |
| Spring | First three weeks of May | 3 weeks | Spring Migration (core period) | Passage migration counts Stopover count Behavioural studies if required | One 4-hour survey twice a week (approximately every three days) | 24 hours |
| Summer | June 1- August 15 | 10 weeks | Breeding | Area searches Standardized area searches Point counts Playback methods if required | Two 4-hour surveys over the breeding season | 8 hours |
| Summer- Early Fall/ Late Fall | August 15- August 30, and last week of September to October 31. | 2 weeks (Summer- Early Fall) and 5 weeks (Late Fall). | Fall Migration (shoulder period) | Passage migration counts Stopover count Behavioural studies if required | One 4-hour survey per week | 28 hours |
| Fall | First three weeks of September | 3 weeks | Fall Migration (core period) | Passage migration counts Stopover count Behavioural studies if required | One 4-hour survey twice a week (approximately every three days) | 24 hours |

6.0 REPORTING

Results of these surveys will be included in the environmental assessment reports for the proposed wind farm developments. Data will be collected and presented in such a manner to allow comparison of baseline data with post-construction survey and monitoring results that will be required as follow-up.

A seasonal species list will be developed. Observations for each species sighting will be recorded that will include the date (season), number of individuals, flight height, direction and location on the study area. Summaries will be presented for five bird groups: waterfowl, waterbirds, raptors, shorebirds and land birds.

7.0 CLOSURE

This document presents the proposed baseline survey protocol for monitoring birds at proposed wind farm development sites near Digby, Nova Scotia in order to gather data to support environmental assessment approvals. Specific methodologies will follow Environment Canada guidelines and will be conducted by a qualified birder.

8.0 REFERENCES

Environment Canada. 2007a. Wind Turbines and Birds: A Guidance Document for Environmental Assessment. Canadian Wildlife Service. April 2007.

Environment Canada. 2007b. Recommended Protocol for Monitoring Impacts of Wind Turbines on Birds. Canadian Wildlife Service. April 2007.

P:\envsci\102xxxx\1029448 Skypower NB EAs\Bird Monitoring Protocol-Sept 27-Beaver Mountain, NS.doc

Table E1 - Rare and Sensitive Bird Species Potentially Present in the Project Area (Previously Recorded within 100 km of the Project Area)

| Scientific Name | Common Name | Preferred Habitat | ACCDC Rank | NSDNR Rank | COSEWIC Rank | NS Endangered Species Act | SARA Status |
|----------------------------------|-------------------------------------|--|-------------------|-------------------|---------------------|----------------------------------|------------------------------|
| <i>Falco peregrinus anatum</i> | Peregrine Falcon | Almost any habitat type that provides hunting opportunities. For nesting, prefer habitats with cliffs. | S1B | RED | Special Concern | Vulnerable | Threatened |
| <i>Accipiter gentilis</i> | Northern Goshawk | Mature coniferous and mixedwood forest generally remote from human habitation. | S3B | YELLOW | Not At Risk | - | - |
| <i>Asio otus</i> | Long-eared Owl | Various woodland habitats as well as open habitats. | S1S2 | YELLOW | - | - | - |
| <i>Histrionicus histrionicus</i> | Harlequin Duck - Eastern population | Swift-moving streams in summer; and rocky, wave-lashed coasts and jetties in winter. | S1B,S1N | YELLOW | Special Concern | Endangered | Special Concern (Schedule 1) |

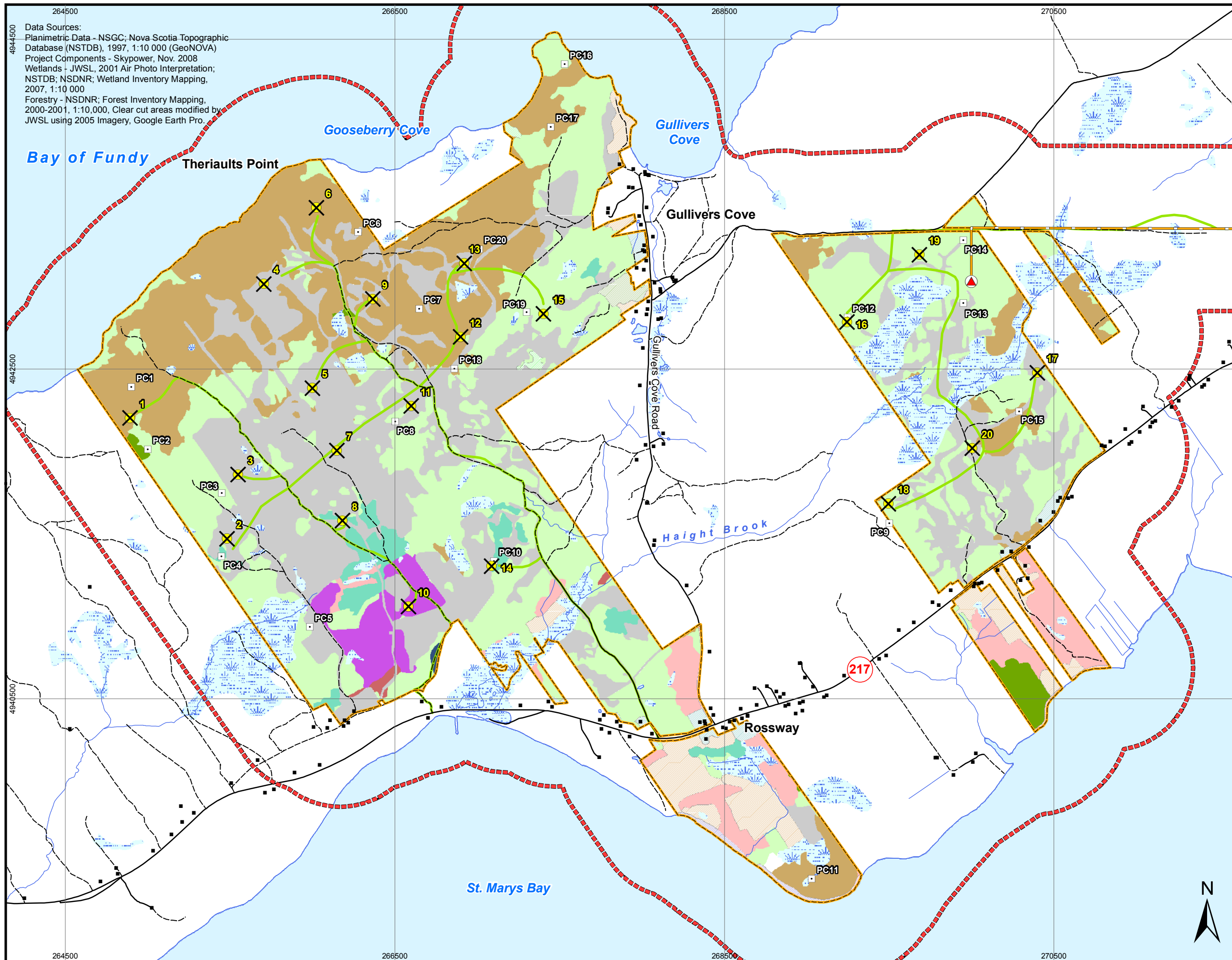
Table E2 Summary of Bird Survey Site Visits

| Monitoring Period | Survey Date | Primary Survey Method | Weather | Temperature (°C)* | Wind Speed and Direction** |
|------------------------------------|--------------------|-----------------------|-------------------|-------------------|----------------------------|
| Overwintering | November 14, 2007 | Area Searches | - | 9 | 13 km/h – S |
| Overwintering | December 14, 2007 | Area Searches | - | -4 | 15 km/h - E |
| Overwintering | January 8, 2008 | Area Searches | - | 7 | 20 km/h – S |
| Overwintering | February 16, 2008 | Area Searches | - | -8 | 34 km/h - WNW |
| Overwintering | March 9, 2008 | Area Searches | - | 4 | 34 km/h – SW |
| Overwintering | April 6, 2008 | Area Searches | - | 5 | 22 km/h – ENE |
| Spring Migration (shoulder period) | April 19, 2008 | Area Searches | - | 7 | 23 km/h – N |
| Spring Migration (shoulder period) | April 26, 2008 | Area Searches | - | 6 | 36 km/h – N |
| Spring Migration (core period) | May 4, 2008 | Area Searches | Overcast, showers | 10 | 15 km/h – S |
| Spring Migration (core period) | May 10, 2008 | Area Searches | Showers | 6 | 15 km/h – SE |
| Spring Migration (core period) | May 11, 2008 | Area Searches | Overcast | 9 | 28 km/h – NE |
| Spring Migration (core period) | May 15, 2008 | Area Searches | Clear, sunny | 10 | 15 km/h – NE |
| Spring Migration (core period) | May 19, 2008 | Area Searches | Overcast, foggy | 13 | 28 km/h – SW |
| Spring Migration (core period) | May 20, 2008 | Area Searches | Clear, sunny | 12 | 35 km/h – SW |
| Spring Migration (core period) | May 24, 2008 | Area Searches | Partly cloudy | 9 | 15 km/h – NW |
| Spring Migration (shoulder period) | May 27, 2008 | Area Searches | Clear, sunny | 13 | 15 km/h – SW |
| Breeding | June 1, 2008 | Point Counts *** | Overcast, drizzle | 12 | 14 km/h – SSW |
| Breeding | June 5, 2008 | Point Counts | Clear, sunny | 11 | 31 km/h – N |
| Breeding | June 7, 2008 | Point Counts | Cloudy, foggy | 12 | 12 km/h – S |
| Breeding | June 13, 2008 | Point Counts | Sunny | 14 | 19 km/h – WNW |
| Breeding | June 19, 2008 | Point Counts | Clear, sunny | 14 | 13 km/h – SE |
| Breeding | July 2, 2008 | Point Counts | Overcast | 15 | 23 km/h – SSE |
| Breeding | July 6, 2008 | Point Counts | Clear, sunny | 16 | 19 km/h – SSE |
| Breeding | July 29, 2008 | Point Counts | Clear | 16 | 16 km/h – SSE |
| Breeding | August 14, 2008 | Point Counts | - | 16 | 12 km/h - ENE |
| Fall Migration (shoulder period) | August 21, 2008 | Area Searches | Sunny | 15 | 15 km/h – NW |
| Fall Migration (core period) | September 5, 2008 | Area Searches | Clear | 18 | 15 km/h – SE |
| Fall Migration (core period) | September 8, 2008 | Area Searches | Overcast, foggy | 16 | 15 km/h – NW |
| Fall Migration (core period) | September 12, 2008 | Area Searches | Cloudy | 18 | 15 km/h – S |
| Fall Migration (core period) | September 15, 2008 | Area Searches | Clear | 20 | 40 km/h – S |
| Fall Migration (core period) | September 19, 2008 | Area Searches | Sunny | 13 | 8 km/h – NW |
| Fall Migration (shoulder period) | October 6, 2008 | Area Searches | Overcast, misty | 12 | 10 km/h – NW |
| Fall Migration (shoulder period) | October 14, 2008 | Area Searches | Cloudy | 15 | <1 km/h – S |
| Fall Migration (shoulder period) | October 20, 2008 | Area Searches | Cloudy | 10 | 15 km/h – NW |
| Fall Migration (shoulder period) | October 27, 2008 | Area Searches | Light rain | 11 | 8 km/h – SE |

*Average temperature during 4-hour survey

**Average wind speed and direction during 4-hour survey

***Refer to Figure E1 for Point Count survey locations; area searches were conducted throughout the Project Area.

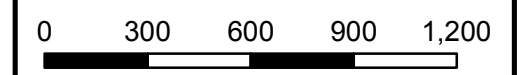


Data Sources:
 Planimetric Data - NSGC; Nova Scotia Topographic Database (NSTDB), 1997, 1:10 000 (GeoNOVA)
 Project Components - Skypower, Nov. 2008
 Wetlands - JWSL, 2001 Air Photo Interpretation; NSTDB; NSDNR; Wetland Inventory Mapping, 2007, 1:10 000
 Forestry - NSDNR; Forest Inventory Mapping, 2000-2001, 1:10,000, Clear cut areas modified by JWSL using 2005 Imagery, Google Earth Pro.



Figure E-1
 DIGBY WIND POWER PROJECT
Bird Survey Locations

- Project Components**
- Point Count Location
 - ✕ Proposed Turbine Location
 - ▲ Proposed 69 kV Substation
 - Proposed Turbine Access Road
 - Proposed Transmission Route Nov. 28-08
 - ⬢ Study Area
 - ⬢ Proposed Site Development Area
 - Watercourse
 - Wetland
 - Waterbody
- Main Forested Land Cover**
- Softwood - 75% softwood species
 - Mixedwood - 74-26% softwood species
 - Hardwood - < 25% softwood species
- Other Forested Land Cover**
- Natural Stand
 - Treated
 - Old Field
 - Dead
 - Tall Shrub Thicket
 - Clear Cut
- Non-Forested Land Use**
- Cliff, Dunes, Coastal Rock
 - Barren
 - Agriculture
 - Urban
 - Beach
 - Gravel Pit
 - Road Corridor



Meters

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



Table E3 Bird Species Observed During Breeding Point Counts, 2008

| Highest Confirmed Breeding Status | Common Name | Latin Name | NSDNR Rank | ACCDC Rank | Number Observed |
|-----------------------------------|--|--------------------------------|--------------|------------|-----------------|
| Possible | Sharp-shinned Hawk ¹ | <i>Accipiter striatus</i> | Green | S4B | 1 |
| Possible | Red-winged Blackbird ¹ | <i>Agelaius phoeniceus</i> | Green | S5B | 4 |
| Possible | Ruby-throated Hummingbird ¹ | <i>Archilochus colubris</i> | Green | S5B | 1 |
| Observed | Great Blue Heron ¹ | <i>Ardea herodias</i> | Green | S5B | 1 |
| Possible | Cedar Waxwing | <i>Bombycilla cedrorum</i> | Green | S5B | 49 |
| Confirmed | Ruffed Grouse | <i>Bonasa umbellus</i> | Green | S5 | 5 |
| Possible | Red-tailed Hawk ¹ | <i>Buteo jamaicensis</i> | Green | S5B | 5 |
| Observed | Red-shouldered Hawk ^{1,2} | <i>Buteo lineatus</i> | Accidental | SAN | 1 |
| Possible | Broad-winged Hawk ¹ | <i>Buteo platypterus</i> | Green | S4B | 2 |
| Observed | Rough-legged Hawk ¹ | <i>Buteo lagopus</i> | Green | S3N | 1 |
| Possible | American Goldfinch ¹ | <i>Carduelis tristis</i> | Green | S5 | 17 |
| Possible | Purple Finch | <i>Carpodacus purpureus</i> | Green | S5B | 12 |
| Observed | Turkey Vulture ¹ | <i>Cathartes aura</i> | Accidental | SAB, SZN | 10 |
| Possible | Hermit Thrush | <i>Catharus guttatus</i> | Green | S5B | 35 |
| Possible | Northern Flicker | <i>Colaptes auratus</i> | Green | S5B | 15 |
| Possible | Eastern Wood Pewee | <i>Contopus virens</i> | Green | S4B | 1 |
| Possible | American Crow ¹ | <i>Corvus brachyrhynchos</i> | Green | S5 | 52 |
| Possible | Common Raven ¹ | <i>Corvus corax</i> | Green | S5 | 17 |
| Possible | Blue Jay ¹ | <i>Cyanocitta cristata</i> | Green | S5 | 8 |
| Confirmed | Magnolia Warbler | <i>Dendroica magnolia</i> | Green | S5B | 21 |
| Confirmed | Yellow Warbler | <i>Dendroica petechia</i> | Green | S5B | 34 |
| Possible | Pine Warbler | <i>Dendroica pinus</i> | Accidental | SAN | 1 |
| Confirmed | Black-throated Green Warbler | <i>Dendroica virens</i> | Green | S5B | 140 |
| Possible | Yellow-rumped Warbler | <i>Dendroica coronata</i> | Green | S5B | 51 |
| Possible | Pileated Woodpecker ¹ | <i>Dryocopus pileatus</i> | Green | S5 | 2 |
| Probable | Peregrine Falcon ^{1,3} | <i>Falco peregrinus anatum</i> | Red | S1B | 1 |
| Possible | Merlin ¹ | <i>Falco columbarius</i> | Green | S4B | 1 |
| Observed | American Coot | <i>Fulica americana</i> | Green | S2B | 5 |
| Confirmed | Common Yellowthroat ¹ | <i>Geothlypis trichas</i> | Green | S5B | 103 |
| Confirmed | Dark-eyed Junco | <i>Junco hyemalis</i> | Green | S5 | 98 |
| Observed | Herring Gull | <i>Larus argentatus</i> | Green | S4 | 67 |
| Possible | White-winged Crossbill ¹ | <i>Loxia leucoptera</i> | Undetermined | S5 | 21 |

Table E3 Bird Species Observed During Breeding Point Counts, 2008

| Highest Confirmed Breeding Status | Common Name | Latin Name | NSDNR Rank | ACCDC Rank | Number Observed |
|-----------------------------------|-------------------------------|--------------------------------|------------|------------|-----------------|
| Confirmed | Song Sparrow ¹ | <i>Melospiza melodia</i> | Green | S5B | 90 |
| Confirmed | Black and White Warbler | <i>Mniotilta varia</i> | Green | S5B | 20 |
| Possible | Black-capped Chickadee | <i>Parus atricapillus</i> | Green | S5 | 1 |
| Possible | Boreal Chickadee | <i>Parus hudsonicus</i> | Yellow | S4 | 3 |
| Observed | Double-crested Cormorant | <i>Phalacrocorax auritus</i> | Green | S5B | 69 |
| Possible | Downy Woodpecker ¹ | <i>Picoides pubescens</i> | Green | S5 | 2 |
| Confirmed | Common Grackle | <i>Quiscalus quiscula</i> | Green | S5B | 28 |
| Possible | Golden-crowned Kinglet | <i>Regulus satrapa</i> | Green | S5B | 7 |
| Possible | Ruby-crowned Kinglet | <i>Regulus calendula</i> | Green | S5B | 17 |
| Possible | Eastern Phoebe ¹ | <i>Sayornis phoebe</i> | Green | S2S3B | 8 |
| Probable | Ovenbird ¹ | <i>Seiurus aurocapillus</i> | Green | S5B | 5 |
| Confirmed | American Redstart | <i>Setophaga ruticilla</i> | Green | S5B | 19 |
| Possible | Red-breasted Nuthatch | <i>Sitta canadensis</i> | Green | S3B | 1 |
| Possible | Chipping Sparrow | <i>Spizella passerina</i> | Green | S5B | 1 |
| Possible | American Tree Sparrow | <i>Spizella arborea</i> | Green | S5N | 1 |
| Possible | Tree Swallow ¹ | <i>Tachycineta bicolor</i> | Green | S5B | 8 |
| Possible | Winter Wren | <i>Troglodytes troglodytes</i> | Green | S5B | 12 |
| Confirmed | American Robin | <i>Turdus migratorius</i> | Green | S5B | 106 |
| Possible | Orange-crowned Warbler | <i>Vermivora celata</i> | Accidental | SZN | 1 |
| Possible | Blue-headed Vireo | <i>Vireo solitarius</i> | Green | S5B | 2 |
| Possible | Canada Warbler ⁴ | <i>Wilsonia canadensis</i> | Yellow | S4B | 1 |
| Possible | Mourning Dove ¹ | <i>Zenaidura macroura</i> | Green | S5B | 3 |
| Confirmed | White-throated Sparrow | <i>Zonotrichia albicollis</i> | Green | S5B, SZN | 132 |

¹Species give s aerial flight display

²Red-shouldered Hawk is also listed as Threatened under Schedule 3 of SARA

³Peregrine Falcon is also listed as Threatened under Schedule 1 of SARA

⁴Canada Warbler is also listed as Threatened by COSEWIC

Table E4 Bird Species Observed During Overwintering Period, 2007 - 2008

| Bird Group | Bird Code | Common Name | Latin Name | Total Observed | NSDNR Rank | ACCDC Rank |
|------------|-----------|---------------------------|----------------------------------|----------------|--------------|--------------|
| Waterfowl | LTDU | Long-tailed Duck | <i>Clangula hyemalis</i> | 6 | n/a | S4N |
| Waterfowl | BLSC | Black Scoter | <i>Melanitta nigra</i> | 2 | Green | S5M |
| Waterfowl | HARD | Harlequin Duck* | <i>Histrionicus histrionicus</i> | 2 | Yellow | S2N |
| Waterfowl | COEI | Common Eider | <i>Somateria mollissima</i> | 52 | Green | S5B, S5M, S4 |
| Gamebird | RUGR | Ruffed Grouse | <i>Bonasa umbellus</i> | 6 | Green | S5 |
| Waterbird | GBHE | Great Blue Heron | <i>Ardea herodias</i> | 2 | Green | S5B |
| Waterbird | BUFF | Bufflehead | <i>Bucephala albeola</i> | 4 | Green | S4N |
| Waterbird | HERG | Herring Gull | <i>Larus argentatus</i> | 57 | Green | S4 |
| Waterbird | GBBG | Greater Black-backed Gull | <i>Larus marinus</i> | 22 | Green | S5B |
| Raptor | RTHA | Red-tailed Hawk | <i>Buteo jamaicensis</i> | 3 | Green | S5B |
| Raptor | RLHA | Rough-legged Hawk | <i>Buteo lagopus</i> | 1 | Green | S3N |
| Raptor | TUVU | Turkey Vulture | <i>Cathartes aura</i> | 2 | Accidental | SAB, SZN |
| Raptor | BAEA | Bald Eagle | <i>Haliaeetus leucocephalus</i> | 1 | Green | S5B, S4N |
| Landbird | RWBL | Red-winged Blackbird | <i>Agelaius phoeniceus</i> | 4 | Green | S5B |
| Landbird | CEDW | Cedar Waxwing | <i>Bombycilla cedrorum</i> | 50 | Green | S5B |
| Landbird | BOWX | Bohemian Waxwing | <i>Bombycilla garrulus</i> | 16 | Green | S5N |
| Landbird | CORE | Common Redpoll | <i>Carduelis flammea</i> | 122 | Green | S5N |
| Landbird | HORE | Hoary Redpoll | <i>Carduelis hornemanni</i> | 1 | Accidental | SAN |
| Landbird | AMCR | American Crow | <i>Corvus brachyrhynchos</i> | 22 | Green | S5 |
| Landbird | CORA | Common Raven | <i>Corvus corax</i> | 10 | Green | S5 |
| Landbird | BLJA | Blue Jay | <i>Cyanocitta cristata</i> | 4 | Green | S5 |
| Landbird | DEJU | Dark-eyed Junco | <i>Junco hyemalis</i> | 18 | Green | S5 |
| Landbird | NSHR | Northern Shrike | <i>Lanius excubitor</i> | 1 | Green | SZN |
| Landbird | WWCR | White-winged Crossbill | <i>Loxia leucoptera</i> | 34 | Undetermined | S5 |
| Landbird | BCCH | Black-capped Chickadee | <i>Parus atricapillus</i> | 58 | Green | S5 |
| Landbird | BOCH | Boreal Chickadee | <i>Parus hudsonicus</i> | 10 | Yellow | S4 |
| Landbird | GCKI | Golden-crowned Kinglet | <i>Regulus satrapa</i> | 2 | Green | S5B |
| Landbird | RCKI | Ruby-crowned Kinglet | <i>Regulus calendula</i> | 4 | Green | S5B |
| Landbird | EUST | European Starling | <i>Sturnus vulgaris</i> | 8 | Exotic | SE |
| Landbird | AMRO | American Robin | <i>Turdus migratorius</i> | 3 | Green | S5B |

*Harlequin Duck is also listed as a species of Special Concern under Schedule 1 of SARA and by COSEWIC

Table E5 Bird Species Observed During Spring Migration, 2008

| Bird Group | Bird Code | Common Name | Latin Name | Number Observed | NSDNR Rank | ACCDC Rank |
|-------------------|------------------|------------------------------|-------------------------------|------------------------|-------------------|-------------------|
| Waterfowl | ABDU | American Black Duck | <i>Anas rubripes</i> | 13 | Green | S5B |
| Gamebird | RUGR | Ruffed Grouse | <i>Bonasa umbellus</i> | 2 | Green | S5 |
| Gamebird | RIPH | Ring-necked Pheasant | <i>Phasianus colchicus</i> | 2 | Exotic | SEB |
| Waterbird | GBHE | Great Blue Heron | <i>Ardea herodias</i> | 1 | Green | S5B |
| Waterbird | AMBI | American Bittern | <i>Botaurus lentiginosus</i> | 1 | Green | S4B |
| Waterbird | COLO | Common Loon | <i>Gavia immer</i> | 24 | Yellow | S4B, S4N |
| Waterbird | HERG | Herring Gull | <i>Larus argentatus</i> | 27 | Green | S4 |
| Waterbird | DCCO | Double-crested Cormorant | <i>Phalacrocorax auritus</i> | 6 | Green | S5B |
| Raptor | RTHA | Red-tailed Hawk | <i>Buteo jamaicensis</i> | 6 | Green | S5B |
| Raptor | TUVU | Turkey Vulture | <i>Cathartes aura</i> | 12 | Accidental | SAB, SZN |
| Raptor | MERL | Merlin | <i>Falco columbarius</i> | 1 | Green | S4B |
| Landbird | RWBL | Red-winged Blackbird | <i>Agelaius phoeniceus</i> | 11 | Green | S5B |
| Landbird | RTHU | Ruby-throated Hummingbird | <i>Archilochus colubris</i> | 2 | Green | S5B |
| Landbird | CEDW | Cedar Waxwing | <i>Bombycilla cedrorum</i> | 24 | Green | S5B |
| Landbird | AMGO | American Goldfinch | <i>Carduelis tristis</i> | 5 | Green | S5 |
| Landbird | PUFI | Purple Finch | <i>Carpodacus purpureus</i> | 13 | Green | S5B |
| Landbird | HETH | Hermit Thrush | <i>Catharus guttatus</i> | 3 | Green | S5B |
| Landbird | BEKI | Belted Kingfisher | <i>Ceryle alcyon</i> | 1 | Green | S5B |
| Landbird | NOFL | Northern Flicker | <i>Colaptes auratus</i> | 7 | Green | S5B |
| Landbird | AMCR | American Crow | <i>Corvus brachyrhynchos</i> | 67 | Green | S5 |
| Landbird | CORA | Common Raven | <i>Corvus corax</i> | 28 | Green | S5 |
| Landbird | BLJA | Blue Jay | <i>Cyanocitta cristata</i> | 4 | Green | S5 |
| Landbird | BTBW | Black-throated Blue Warbler | <i>Dendroica caerulescens</i> | 1 | Green | S4B |
| Landbird | YRWA | Yellow-rumped Warbler | <i>Dendroica coronate</i> | 101 | Green | S5B |
| Landbird | MAWA | Magnolia Warbler | <i>Dendroica magnolia</i> | 7 | Green | S5B |
| Landbird | YWAR | Yellow Warbler | <i>Dendroica petechia</i> | 52 | Green | S5B |
| Landbird | CMWA | Cape May Warbler | <i>Dendroica tigrina</i> | 1 | Green | S4B |
| Landbird | BTNW | Black-throated Green Warbler | <i>Dendroica virens</i> | 154 | Green | S5B |
| Landbird | PIWO | Pileated Woodpecker | <i>Dryocopus pileatus</i> | 2 | Green | S5 |
| Landbird | GRCA | Gray Catbird | <i>Dumetella carolinensis</i> | 2 | Green | S5B |
| Landbird | SOSP | Song Sparrow | <i>Melospiza melodia</i> | 57 | Green | S5B |

Table E5 Bird Species Observed During Spring Migration, 2008

| Bird Group | Bird Code | Common Name | Latin Name | Number Observed | NSDNR Rank | ACCDC Rank |
|-------------------|------------------|-------------------------|----------------------------------|------------------------|-------------------|-------------------|
| Landbird | BAWW | Black and White Warbler | <i>Mniotilta varia</i> | 12 | Green | S5B |
| Landbird | COYE | Common Yellowthroat | <i>Geothlypis trichas</i> | 15 | Green | S5B |
| Landbird | DEJU | Dark-eyed Junco | <i>Junco hyemalis</i> | 70 | Green | S5 |
| Landbird | NOPA | Northern Parula | <i>Parula americana</i> | 4 | Green | S5B |
| Landbird | BCCH | Black-capped Chickadee | <i>Parus atricapillus</i> | 76 | Green | S5 |
| Landbird | BOCH | Boreal Chickadee | <i>Parus hudsonicus</i> | 1 | Yellow | S4 |
| Landbird | SAVS | Savannah Sparrow | <i>Passerculus sandwichensis</i> | 18 | Green | S5B |
| Landbird | GRJA | Gray Jay | <i>Perisoreus Canadensis</i> | 5 | Yellow | S4 |
| Landbird | COGR | Common Grackle | <i>Quiscalus quiscula</i> | 31 | Green | S5B |
| Landbird | RCKI | Ruby-crowned Kinglet | <i>Regulus calendula</i> | 54 | Green | S5B |
| Landbird | NOWA | Northern Waterthrush | <i>Seiurus noveboracensis</i> | 1 | Green | S5B |
| Landbird | AMRE | American Redstart | <i>Setophaga ruticilla</i> | 5 | Green | S5B |
| Landbird | CHSP | Chipping Sparrow | <i>Spizella passerine</i> | 4 | Green | S5B |
| Landbird | EUST | European Starling | <i>Sturnus vulgaris</i> | 30 | Exotic | SE |
| Landbird | TRES | Tree Swallow | <i>Tachycineta bicolor</i> | 15 | Green | S5B |
| Landbird | WIWR | Winter Wren | <i>Troglodytes troglodytes</i> | 1 | Green | S5B |
| Landbird | AMRO | American Robin | <i>Turdus migratorius</i> | 52 | Green | S5B |
| Landbird | REVI | Red-eyed Vireo | <i>Vireo olivaceus</i> | 1 | Green | S5B |
| Landbird | BHVI | Blue-headed Vireo | <i>Vireo solitarius</i> | 2 | Green | S5B |
| Landbird | MODO | Mourning Dove | <i>Zenaida macroura</i> | 17 | Green | S5B |
| Landbird | WTSP | White-throated Sparrow | <i>Zonotrichia albicollis</i> | 173 | Green | S5B, SZN |
| Landbird | WCSP | White-crowned Sparrow | <i>Zonotrichia leucophrys</i> | 11 | Green | SZN |

Table E6 Bird Species Observed During Fall Migration, 2008

| Bird Group | Bird Code | Common Name | Latin Name | Number Observed | NSDNR Rank | ACCDC Rank |
|------------|-----------|---------------------------|---------------------------------|-----------------|------------|--------------|
| Gamebird | SPGR | Spruce Grouse | <i>Falcipennis canadensis</i> | 1 | Green | S5 |
| Gamebird | RIPH | Ring-necked Pheasant | <i>Phasianus colchicus</i> | 3 | Exotic | SEB |
| Waterbird | CAEG | Cattle Egret | <i>Bubulcus ibis</i> | 1 | Accidental | SAN |
| Waterbird | COLO | Common Loon | <i>Gavia immer</i> | 4 | Yellow | S4B, S4N |
| Waterbird | HERG | Herring Gull | <i>Larus argentatus</i> | 80 | Green | S4 |
| Waterbird | GBBG | Greater Black-backed Gull | <i>Larus marinus</i> | 16 | Green | S5B |
| Waterbird | NOGA | Northern Gannet | <i>Morus bassanus</i> | 1 | Green | S5M |
| Waterbird | DCCO | Double-crested Cormorant | <i>Phalacrocorax auritus</i> | 36 | Green | S5B |
| Waterbird | COEI | Common Eider | <i>Somateria mollissima</i> | 14 | Green | S5B, S5M, S4 |
| Raptor | SSHA | Sharp-shinned Hawk | <i>Accipiter striatus</i> | 4 | Green | S4B |
| Raptor | RTHA | Red-tailed Hawk | <i>Buteo jamaicensis</i> | 6 | Green | S5B |
| Raptor | BWHA | Broad-winged Hawk | <i>Buteo platypterus</i> | 5 | Green | S4B |
| Raptor | TUVU | Turkey Vulture | <i>Cathartes aura</i> | 5 | Accidental | SAB, SZN |
| Raptor | MERL | Merlin | <i>Falco columbarius</i> | 1 | Green | S4B |
| Raptor | BAEA | Bald Eagle | <i>Haliaeetus leucocephalus</i> | 6 | Green | S5B, S4N |
| Landbird | RWBL | Red-winged Blackbird | <i>Agelaius phoeniceus</i> | 8 | Green | S5B |
| Landbird | RTHU | Ruby-throated Hummingbird | <i>Archilochus colubris</i> | 2 | Green | S5B |
| Landbird | CEDW | Cedar Waxwing | <i>Bombycilla cedrorum</i> | 44 | Green | S5B |
| Landbird | BOWX | Bohemian Waxwing | <i>Bombycilla garrulous</i> | 1 | Green | S5N |
| Landbird | PISI | Pine Siskin | <i>Carduelis pinus</i> | 20 | Green | S5 |
| Landbird | AMGO | American Goldfinch | <i>Carduelis tristis</i> | 23 | Green | S5 |
| Landbird | PUFI | Purple Finch | <i>Carpodacus purpureus</i> | 146 | Green | S5B |
| Landbird | HETH | Hermit Thrush | <i>Catharus guttatus</i> | 1 | Green | S5B |
| Landbird | NOFL | Northern Flicker | <i>Colaptes auratus</i> | 6 | Green | S5B |
| Landbird | AMCR | American Crow | <i>Corvus brachyrhynchos</i> | 48 | Green | S5 |
| Landbird | CORA | Common Raven | <i>Corvus corax</i> | 4 | Green | S5 |
| Landbird | BLJA | Blue Jay | <i>Cyanocitta cristata</i> | 65 | Green | S5 |
| Landbird | YRWA | Yellow-rumped Warbler | <i>Dendroica coronate</i> | 22 | Green | S5B |
| Landbird | YTWA | Yellow-throated Warbler | <i>Dendroica dominica</i> | 12 | Accidental | SAN |
| Landbird | MAWA | Magnolia Warbler | <i>Dendroica magnolia</i> | 3 | Green | S5B |

Table E6 Bird Species Observed During Fall Migration, 2008

| Bird Group | Bird Code | Common Name | Latin Name | Number Observed | NSDNR Rank | ACCDC Rank |
|-------------------|------------------|------------------------------|----------------------------------|------------------------|-------------------|-------------------|
| Landbird | PAWA | Palm Warbler | <i>Dendroica palmarum</i> | 3 | Green | S5B |
| Landbird | PIWA | Pine Warbler | <i>Dendroica pinus</i> | 1 | Accidental | SAN |
| Landbird | BTNW | Black-throated Green Warbler | <i>Dendroica virens</i> | 24 | Green | S5B |
| Landbird | PIWO | Pileated Woodpecker | <i>Dryocopus pileatus</i> | 2 | Green | S5 |
| Landbird | COYE | Common Yellowthroat | <i>Geothlypis trichas</i> | 3 | Green | S5B |
| Landbird | DEJU | Dark-eyed Junco | <i>Junco hyemalis</i> | 94 | Green | S5 |
| Landbird | WWCR | White-winged Crossbill | <i>Loxia leucoptera</i> | 103 | Undetermined | S5 |
| Landbird | RBWO | Red-bellied Woodpecker | <i>Melanerpes carolinus</i> | 1 | Accidental | SAN |
| Landbird | SOSP | Song Sparrow | <i>Melospiza melodia</i> | 61 | Green | S5B |
| Landbird | BCCH | Black-capped Chickadee | <i>Parus atricapillus</i> | 35 | Green | S5 |
| Landbird | SAVS | Savannah Sparrow | <i>Passerculus sandwichensis</i> | 16 | Green | S5B |
| Landbird | GRJA | Gray Jay | <i>Perisoreus Canadensis</i> | 2 | Yellow | S4 |
| Landbird | DOWO | Downy Woodpecker | <i>Picoides pubescens</i> | 2 | Green | S5 |
| Landbird | COGR | Common Grackle | <i>Quiscalus quiscula</i> | 23 | Green | S5B |
| Landbird | RCKI | Ruby-crowned Kinglet | <i>Regulus calendula</i> | 10 | Green | S5B |
| Landbird | GCKI | Golden-crowned Kinglet | <i>Regulus satrapa</i> | 6 | Green | S5B |
| Landbird | AMRE | American Redstart | <i>Setophaga ruticilla</i> | 1 | Green | S5B |
| Landbird | RBNU | Red-breasted Nuthatch | <i>Sitta canadensis</i> | 5 | Green | S3B |
| Landbird | ATSP | American Tree Sparrow | <i>Spizella arborea</i> | 1 | Green | S5N |
| Landbird | EUST | European Starling | <i>Sturnus vulgaris</i> | 42 | Exotic | SE |
| Landbird | TRES | Tree Swallow | <i>Tachycineta bicolor</i> | 6 | Green | S5B |
| Landbird | AMRO | American Robin | <i>Turdus migratorius</i> | 117 | Green | S5B |
| Landbird | REVI | Red-eyed Vireo | <i>Vireo olivaceus</i> | 1 | Green | S5B |
| Landbird | MODO | Mourning Dove | <i>Zenaidra macroura</i> | 28 | Green | S5B |
| Landbird | WTSP | White-throated Sparrow | <i>Zonotrichia albicollis</i> | 24 | Green | S5B, SZN |

ANALYSIS OF BIRD DATA, GULLIVERS COVE WINDPOWER SITE

STATISTICAL ANALYSES

The raw data consist of counts of birds made during roughly 4-h observation periods on 10 days in spring and 10 days in fall, 2008. These are minimal data sets for producing any statistically robust results, but can be treated to modest data exploration.

To maximize power of the analysis, it was best to combine the passerines (excluding crows) and near passerines (i.e., doves, woodpeckers, hummingbirds) as a single count, plausibly representing waves of transient or stopover migrants in the area. Because migration counts are unlikely to show linear changes through the season (i.e., more likely to show a peak or peaks), dates were grouped into 10-day categories in spring and 15-day categories in fall. Wind direction and speed are the most likely factors affecting the intensity of migration and stopover in the region. These were logged on-site (as nearest cardinal and point categories: N, NW, W, etc.) and are also available for Yarmouth, Halifax and Saint John at <http://www.climate.weatheroffice.ec.gc.ca/>. Yarmouth and Saint John in spring can plausibly be used to account respectively for migration from the south and drift from the west, and Halifax and Saint John in fall to account respectively for migration from the northeast and drift from the west. The wind variables from the weather stations were taken as mean values of direction and speed during the 6 h period around the previous midnight, possibly capturing prior conditions for overnight migration. They were also converted to compass categories. The somewhat variable estimates (3.8-4.5 h) of survey times were incomplete, so could not be used as an explanatory variable.

The combination of categorical and ordinal data can be used in General Linear Models (GLMs). While more powerful techniques are available (e.g. Bayesian techniques to take advantage of expectations in migration, etc.), General Additive Models for fitting nonlinear functions to seasonal and compass data, etc., these approaches are unlikely to reveal any patterns in small data sets that are not suggested by simple GLMs.

Spring Migration

There were no significant variables in GLMs using wind data from on-site, Yarmouth and Saint John. The best results (highest R^2) used the on-site wind data:

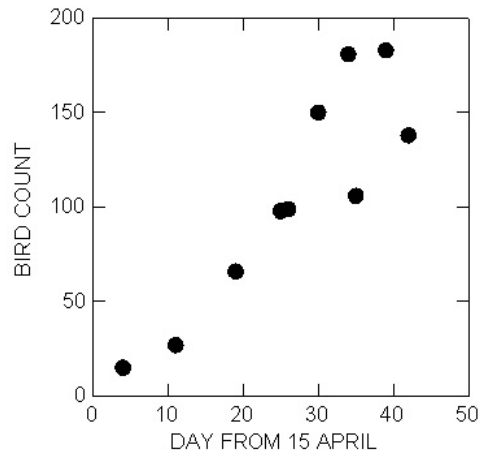
| Source | Sum-of-Squares | df | Mean-Square | F-ratio | P |
|----------------------------|----------------|----|-------------|---------|-------|
| Wind speed | 1376.000 | 1 | 1376.000. | 0.255 | 0.427 |
| Wind Dir. (category) | 17895.402 | 4 | 4473.851. | 0.220 | 0.253 |
| 10-day interval (category) | 1075.667 | 2 | 537.834. | 0.000 | 0.723 |
| Error | 2809.000 | 2 | 1404.500 | | |

The model is ill-behaved, with outliers and low tolerances. Also apparent is a correlation between season and wind direction, with N, and NE winds prevailing early in the season, and SW and NW winds later.

Day from 15 Apr. [4 11 19 25 26 30 34 35 39 42]
 Wind Direction [N N S SE NE NE SW SW NW NW]

With stepwise elimination of wind speed, both (categorical) wind direction (at $P = 0.071$) and 10-day interval (at $p = 0.045$) may separately affect the spring bird counts, but are impossible to disentangle in such a small data set.

With effects of wind eliminated, the highly significant increase ($P < 0.001$) of numbers counted during the season is manifest ($p < 0.001$).

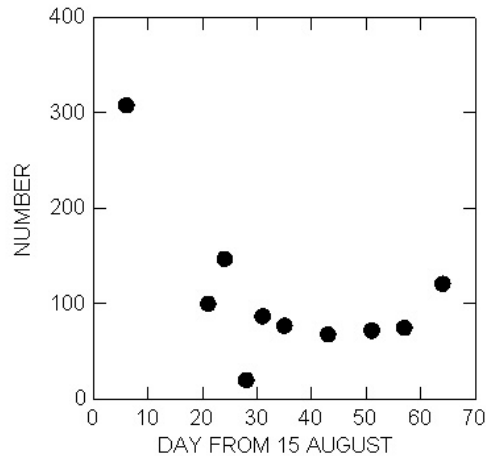


Fall Migration

Again, the best GLM again used on-site wind data, but revealed no significant effects of season (here in categorical 15-day intervals), or wind directions and speeds, and the model is badly behaved, with outliers and predicted counts ranging below zero.

| Source | Sum-of-Squares | df | Mean-Square | F-ratio | P |
|-----------------|----------------|----|-------------|---------|-------|
| Wind Speed | 1200.462 | 1 | 1200.462 | 0.170 | 0.751 |
| Wind Direction | 1260.822 | 3 | 420.274 | 0.060 | 0.974 |
| 15-day Interval | 38126.556 | 4 | 9531.639 | 1.353 | 0.562 |
| Error | 7045.538 | 1 | 7045.538 | | |

Again, in a stepwise GLM, only season (expressed as 15-day intervals) is by itself significant (at $P = 0.037$). This is evidently driven by a large count at the beginning of the season, followed by greatly reduced, but irregular ones thereafter.



DISCUSSION AND CONCLUSIONS

Further statistical analysis of the limited available data does not seem worthwhile. In both spring and fall, the strongest influence on overall numbers seems to be seasonal, with possibly some influence of winds in spring. But, in neither instance does the seasonal pattern appear to reflect an expected migration peak of overall numbers in, say, mid-to-late May in spring and late September and early October in fall. Thus scrutiny of the species involved is probably more revealing than statistical analysis of the combined counts.

In spring, the initial passerines present on the site were largely early migrants or year-round residents. Thereafter there were buildups of several short- and long-distance migrants, for example:

| | 4 May | 10-11 May (av.) | 15 May | 19-20 May (av.) | 24 May | 27 May |
|-----------------|-------|--------------------|--------|--------------------|--------|--------|
| Am Robin | 8 | 4 | 0 | 6 | 8 | 14 |
| B.-c. Chickadee | 6 | 12 | 4 | 11 | 0 | 0 |
| Sparrows, junco | 22 | 38 | 64 | 48 | 33 | 34 |
| Warblers | 6 | 17.5 | 58 | 69.5 | 76 | 45 |

This pattern suggests that by May, American Robin and sparrows were fully settled in the area, that in late May chickadees had either moved out or were (typically) quietly incubating in available nest holes, and that most warblers largely arrived and settled, as expected, by mid-May. There is no evidence of a migratory peak of passage in any of the species or groups.

In fall, the large initial total count (308 on 21 August) was driven by high counts of several sparrows (Junco, White-throated, Song), and by a very large count of Purple Finch. The sparrows do not normally migrate in numbers at this season, and were more probably resident and regional adults and young in this environmentally degraded area, with much edge habitat and presumably shrubby cover. The Purple Finch is certainly not

as much migratory as nomadic – certainly at this season. Thereafter counts varied between 20 and 147 birds. Most sparrows had disappeared, but there were periodic large counts of European Starling, Cedar Waxwing, Purple Finch (smaller than those of 21 August) and White-winged Crossbills, which are all more nomadic than migratory. There was an initial peak count of 43 wood warblers, mostly Black-throated Green, and too early for major migratory movements. Thereafter there were very few long-distance nighttime migrants like vireos (total 1 Red-eyed), wood warblers (17), and *Catharus* thrushes (1 Hermit Thrush). Not until October were there good counts of short-distance day-migrants, such as Blue Jay (32), American Robin (92), and Dark-eyed Junco (43).

The general conclusion from these data and observations is that the area is not a major “corridor” or stopover site for waves of migrants arriving or leaving the province. The counts generally show no evidence of major peaks of arrival or departure of the sort observed every spring and autumn on Brier I., where on some days many hundreds of sparrows, warblers, and other species can be observed near North Point light station. Neither were major raptor flights – hundreds of Broad-winged Hawks in on Brier Island in fall, for example - in evidence over the site. It may be that the degraded upland habitat, while suitable for nesting species like seed-eating sparrows and attractive to cone-feeding species (good counts of Purple Finches, White-crossbills, Purple Finches) is not very suitable for insect-fueled night-migrants like flycatchers, vireos, warblers, *Catharus* thrushes. It is noteworthy that the large numbers of migrants spring and fall have been noted (pers. obs.) in the lowland areas at the head of St. Marys Bay immediately to the northeast of the site. Those richer habitats may tend to deflect local migration from the highland areas.

Thus the area’s importance may be of greater importance as breeding habitat for species that can use its degraded habitats. Perhaps any development of the area should pay more heed to “footprint” effects on remaining “natural” habitat than to possible threats of tower collisions by large numbers of passage migrants.

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22 February 2009