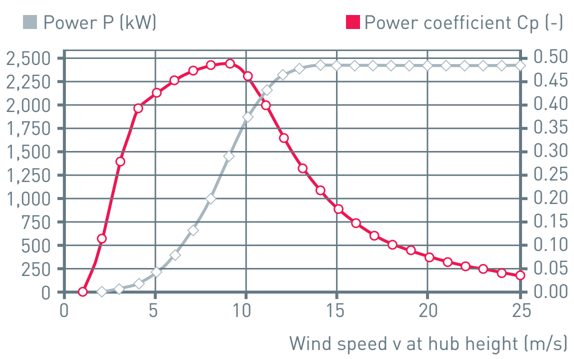
Appendix

Appendix A:

Turbine Specifications

Calculated power curve



Wind (m/s)	Power P (kW)	Power-coefficient Cp (-)
1	0.0	0.00
2	3.6	0.11
3	29.9	0.27
4	98.2	0.38
5	208.3	0.41
6	384.3	0.44
7	637.0	0.46
8	975.8	0.47
9	1,403.6	0.47
10	1,817.8	0.45
11	2,088.7	0.39
12	2,237.0	0.32
13	2,300.0	0.26
14	2,350.0	0.21
15	2,350.0	0.17
16	2,350.0	0.14
17	2,350.0	0.12
18	2,350.0	0.10
19	2,350.0	0.08
20	2,350.0	0.07
21	2,350.0	0.06
22	2,350.0	0.05
23	2,350.0	0.05
24	2,350.0	0.04
25	2,350.0	0.04

$\rho = 1.225\ kg/m^3$

Technical specifications E-92

Rated power:	**2,350 kW**
Rotor diameter:	**92 m**
Hub height in meter:	**84 / 85 / 98 / 104 / 108 / 138**
Wind zone (DIBt):	**WZ III**
Wind class (IEC):	**IEC/EN IIA**
WEC concept:	Gearless, variable speed, single blade adjustment

Rotor

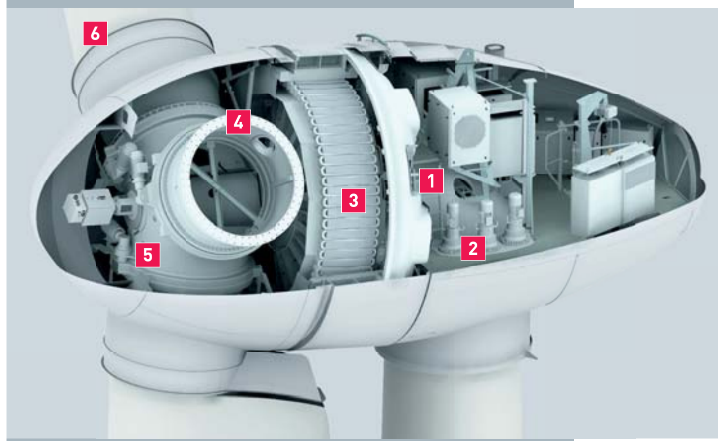
Type:	Upwind rotor with active pitch control
Rotational direction:	Clockwise
No. of blades:	3
Swept area:	6,648 m²
Blade material:	GRP (epoxy resin); Built-in lightning protection
Rotational speed:	Variable, 5 - 16 rpm
Pitch control:	ENERCON single blade pitch system; one independent pitch system per rotor blade with allocated emergency supply

Drive train with generator

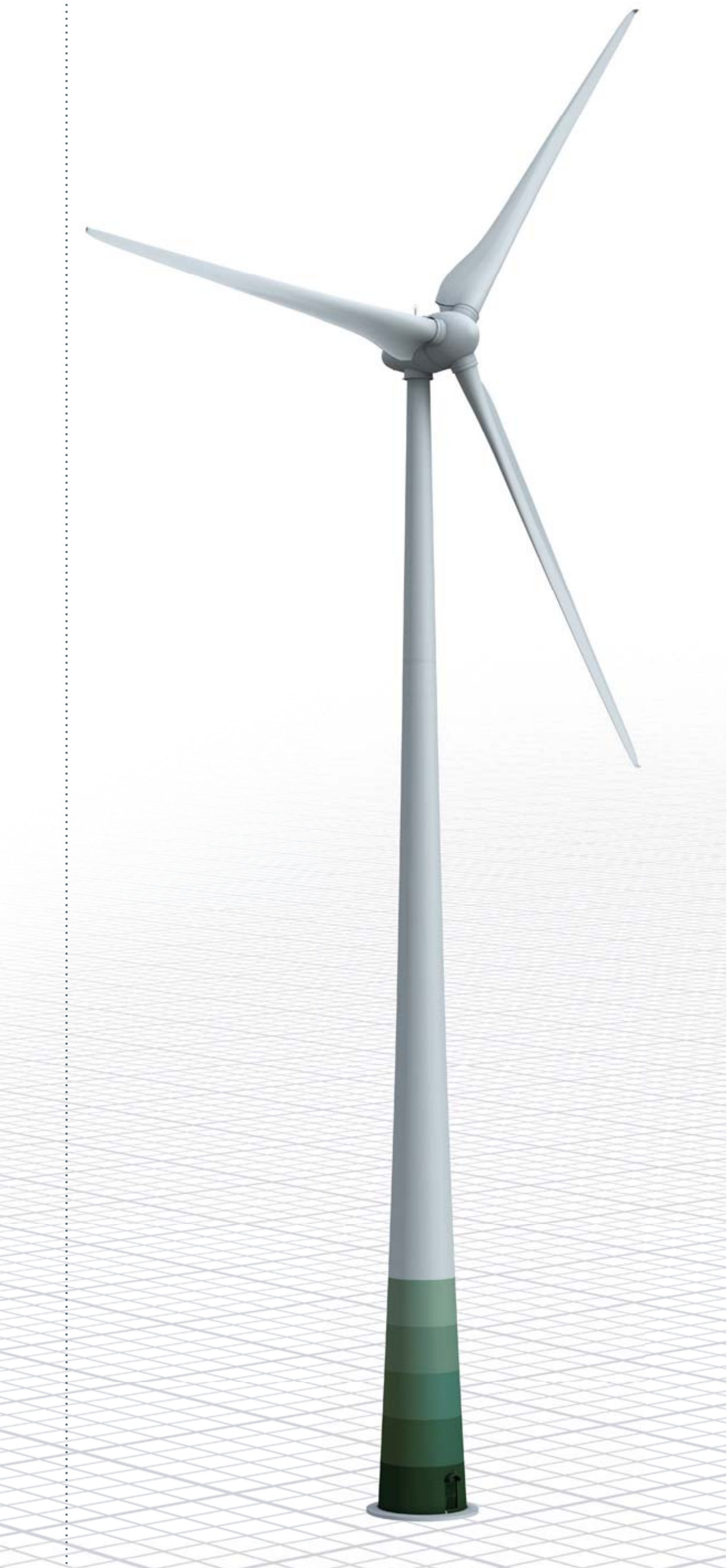
Main bearing:	Double row tapered/cylindrical roller bearings
Generator:	ENERCON direct-drive annular generator
Grid feed:	ENERCON inverter
Brake systems:	– 3 independent pitch control systems with emergency power supply – Rotor brake – Rotor lock
Yaw system:	Active via yaw gear, load-dependent damping
Cut-out wind speed:	28 - 34 m/s (with ENERCON storm control*)
Remote monitoring:	ENERCON SCADA

* For more information on the ENERCON storm control feature, please see the last page.

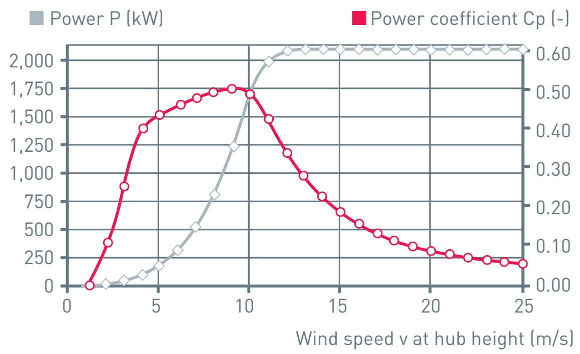
E-92
2,350 kW



1 Main carrier
2 Yaw drive
3 Annular generator
4 Blade adapter
5 Rotor hub
6 Rotor blade



Calculated power curve



Wind (m/s)	Power P (kW)	Power-coefficient Cp (-)
1	0.0	0.00
2	3.0	0.12
3	25.0	0.29
4	82.0	0.40
5	174.0	0.43
6	321.0	0.46
7	532.0	0.48
8	815.0	0.49
9	1,180.0	0.50
10	1,580.0	0.49
11	1,810.0	0.42
12	1,980.0	0.35
13	2,050.0	0.29
14	2,050.0	0.23
15	2,050.0	0.19
16	2,050.0	0.15
17	2,050.0	0.13
18	2,050.0	0.11
19	2,050.0	0.09
20	2,050.0	0.08
21	2,050.0	0.07
22	2,050.0	0.06
23	2,050.0	0.05
24	2,050.0	0.05
25	2,050.0	0.04

ρ = 1.225 kg/m³

Technical specifications E-82 E2

Rated power:	**2,000 kW**
Rotor diameter:	**82 m**
Hub height in meter:	**78 / 85 / 98 / 108 / 138**
Wind zone (DIBt):	**WZ III**
Wind class (IEC):	**IEC/EN IIA**
WEC concept:	Gearless, variable speed, single blade adjustment

Rotor

Type:	Upwind rotor with active pitch control
Rotational direction:	Clockwise
No. of blades:	3
Swept area:	5,281 m²
Blade material:	GRP (epoxy resin); Built-in lightning protection
Rotational speed:	Variable, 6 - 18 rpm
Pitch control:	ENERCON single blade pitch system; one independent pitch system per rotor blade with allocated emergency supply

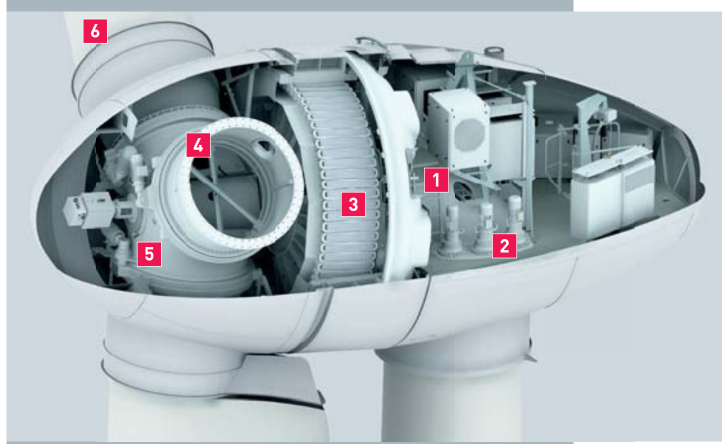
Drive train with generator

Main bearing:	Double row tapered/cylindrical roller bearings
Generator:	ENERCON direct-drive annular generator
Grid feed:	ENERCON inverter
Brake systems:	– 3 independent pitch control systems with emergency power supply – Rotor brake – Rotor lock
Yaw system:	Active via yaw gear, load-dependent damping
Cut-out wind speed:	28 - 34 m/s (with ENERCON storm control*)
Remote monitoring:	ENERCON SCADA

* For more information on the ENERCON storm control feature, please see the last page.

E-82

2,000 kW



1 Main carrier
2 Yaw drive
3 Annular generator
4 Blade adapter
5 Rotor hub
6 Rotor blade

Appendix B:

Avian Survey

May 29, 2012

DILLON
CONSULTING

137
Chain Lake Drive
Suite 100
Halifax
Nova Scotia
Canada
B3S 1B3
Telephone
(902) 450-4000
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(902) 450-2008

WIND PROSPECT INC.
1791 Barrington Street, Suite 1030
Halifax, Nova Scotia
B3J 3L1

ATTENTION: Mr. Andy MacCallum
Development Manager

Summary of Avian Surveys Completed in April 2012 at Groves Point, Hillside Boulardrie, Cape Breton Regional Municipality

INTRODUCTION

The following report summarizes the species encountered during the early breeding, migratory and nocturnal bird surveys conducted at Wind Prospect's proposed wind farm location near Groves Point, Hillside Boulardrie, Cape Breton Regional Municipality (CBRM), Nova Scotia

METHODOLOGY

The study area boundaries for the avian surveys were located on two parcels of land north of the Hillside Boulardrie Road and south of the Trans Canada Highway (Highway 105), CBRM, Nova Scotia (Property Identification Designation 15684392 and 15315161). In order to determine site selection for point count locations, Dillon conducted a brief scoping exercise prior to the avian surveys, in order to focus assessments to areas that would provide the best representative coverage of the project footprint and the highest potential for habitat suitability. Dillon established 12 point count locations during this exercise including two background locations located off-site. These site locations are provided on Figure 1.

The survey was completed by an experienced birder, Mr. Fulton Lavender, with assistance from biologists and technical support from Mr. Paul Koke. The design of the avian survey program was determined based on professional experience, knowledge of the project area and migratory bird activity in that area of Nova Scotia, and review of guidance documents including the following Environment Canada publications: *Wind Turbines and Birds – A Guidance Document for Environmental Assessment* (2007), and *Recommended Protocols for Monitoring Impacts of Wind Turbines on Birds* (2007).

Dillon conducted a brief site reconnaissance exercise during the afternoon of April 20, followed by an afternoon migratory avian survey. The migratory survey focused on raptor movements, and was completed with the use of a mounted viewing scope set at the highest point of elevation (103 m above sea level) at the site, allowing for a 360° area view.


Wind Prospect
Groves Point Comfit project
Figure 1
Avian Survey Locations
Proposed Turbine Locations (Wind Prospect April 2012)
Survey Locations (April 2012)
Building
Contour 5M
Watercourse
Transmission Line
Roads
Highway
Collector
Local / Street
Resource / Recreation
Wetland
NSDNR Mapped wetland
Open Water
Subject Property Parcels
0 75 150 300 450
Metres
1:12,500
N
Site #1
Site #2
Site #3
Site #4
Site # 5
Site #6
Site #7
Site #8
Site #9
Site #10
Site #11
Site #12
Key Map
Project Location
Sydney
Antigonish
Port Hawkesbury
NTS

A nocturnal survey, focusing on owls and woodcocks was completed during the pre-dawn period on April 21. Surveys followed the Guidelines for Nocturnal Owl Monitoring in North America published by Bird Studies Canada. Survey stations were established along a route (with appropriate distances between points), and involved listening and callback/playback procedures.

Early breeding and migratory surveys were completed at twelve (12) survey locations during the morning of April 21. Two survey locations were located off the proposed site and were selected because of their potential as migration corridors and landing locations. As per Canadian Wildlife Service protocol, these surveys were completed as 10 minute point counts and were located in relation to the turbine locations and the various habitat types at the proposed site. Survey timing reflected the early morning period (prior to sunrise to no more than four hours after sunrise) method for quantitative estimates in the breeding season.

RESULTS

Based on the survey results from each activity period, a total of 51 bird species and 579 individual birds were noted within the avian study area for the Proposed Wind Farm; no species of conservation concern were identified as a result of this survey. Refer to the attachments for the complete list of bird species observed.

CLOSING

We trust the information in this letter report meets your requirements at this time.

If you have any questions, please do not hesitate to contact Darren Parker at (902) 450-4000, or via email at dparker@dillon.ca.

Yours truly,

DILLON CONSULTING LIMITED

Darren Parker, B.D.Env.Plan., LEED AP
Project Manager

DSP: jep
Our File: 12-6260-1000

Afternoon Migratory, Spring 2012 - Bird Surveys, Hillside, NS
20-Apr-12

Location: 4
UTM: 0704331, 5124714
Time: 3:15 pm - 5:00 pm

Note: Within ~500 m of survey location (in each direction)

BIRD	#
Red Tailed Hawk	1
Pine Siskin	1
American Goldfinch	5
Common Raven	8
American Crow	4
American Robin	32
Dark Eyed Junco	1
Purple Finch	1
Northern Flicker	4
Merlin	1
Herring Gull	3
American Kestrel	2
Tree Swallow	1
Iceland Gull	1
Northern Harrier	2
Purple Finch	1
Great Black Backed Gull	1
Palm Warbler	1
Red Breasted Nuthatch	1
	71

*Note: Located beyond ~500 m (in each direction)

BIRD	#
Bald Eagle	1
Double Crested Cormorant	2
Ring Billed Gull	1
American Robin	2
Common Raven	4
Red Tailed Hawk	1
Herring Gull	27
American Kestrel	1
	39

* Migratory focus on raptors. Mounted viewing scope was set up at highest point of elevation (103 m ASL) at the site, allowing 360° area view for survey.

Location (hill) is a migratory corridor
Groves Point has traditionally/historically been used as a birding location for Spring Migration.
For years, Groves Pt. has been the location for annual NS Bird Society Spring field trips (Late April to early May)

Nocturnal, Spring 2012 - Avian Surveys, Hillside, NS
21-Apr-11

Location:	1
UTM:	0704666, 5123211
Habitat:	At Groves Pt. park entrance gate.
Time:	3:55
Weather:	3°C, Wind: <10 km/h, clear

BIRD	#	
Ruffed Grouse	1	
Song Sparrow	1	
		2

Location:	2
UTM:	0704232, 5123909
Habitat:	Open field, mixed woods, Wetland, Pond
Time:	4:12
Weather:	3°C, Wind: <10 km/h, clear

BIRD	#	
Ring Billed Gull	1	
		1

Location:	3
UTM:	0704248, 5124389
Habitat:	Open field, within range of mixed forest to east
Time:	4:28
Weather:	3°C, Wind: <10 km/h, clear

BIRD	
	0

Location:	4
UTM:	0704331, 5124714
Habitat:	Open field (highest elevation at property)
Time:	4:41
Weather:	3°C, Wind: <10 km/h, clear

BIRD	#	
Barred Owl	1	(~1 km to the east)
		1

Location:	5
UTM:	0704540, 5125140
Habitat:	At powerlines, north of proposed turbine (furthest east). Mixed forest - hardwood dominant
Time:	4:54
Weather:	3°C, Wind: <10 km/h, clear

BIRD	#	
Great Horned Owl	8	(2 over 1.5 km to east; 1 ~1 km to south)
Ruffed Grouse	1	
American Woodcock	10	
Common Snipe	2	
		21

Early Breeding Period 2012 - Avian Surveys, Hillside, NS
21-Apr-12

Location: 5
UTM: 0704540, 5125140
Habitat: At powerlines, north of proposed turbine (furthest east). Mixed forest - hardwood dominant
Time: 5:35
Weather: 3°C, Wind: <10 km/h, clear

BIRD	#
Song Sparrow	10
American Robin	30
Hermit Thrush	15
White Throated Sparrow	10
Black Capped Chickadee	5
Mourning Dove	2
American Crow	1
Common Raven	3
Common Loon	1
Great Horned Owl	1
Dark Eyed Junco	5
Ruffed Grouse	2
	85

Location: 6
UTM: 0704837, 5125236
Habitat: At transmission line, hardwood dominant (97% +)
Time: 5:56
Weather: 3°C, Wind: <10 km/h, clear

BIRD	#
American Robin	15
Dark Eyed Junco	1
White Throated Sparrow	1
Black Capped Chickadee	1
Hermit Thrush	5
Yellow Bellied Sapsucker	1
Song Sparrow	1
Brown Creeper	2
	27

Location: 7
UTM: 0704368, 5125073 (immediately north of middle turbine location)
Habitat: At powerline, cutover, mixed - hardwood dominant
Time: 6:14
Weather: 3°C, Wind: <10 km/h, clear

BIRD	#
American Robin	15
White Throated Sparrow	5
Song Sparrow	8
Winter Wren	1
Ruby Crowned Kinglet	1
Swamp Sparrow	2
Purple Finch	3
Dark Eyed Junco	1
American Goldfinch	4
Northern Flicker	5
Hairy Woodpecker	1
Pine Siskin	2
Common Raven	2
American Crow	1
Black Capped Chickadee	1
Bald Eagle	2
Mourning Dove	1
	55

Location: 4
UTM: 0704331, 5124714
Habitat: Open field, agricultural
Time: 6:31
Weather: 4°C, Wind: 15 km/h, clear

BIRD	#
American Robin	15
White Throated Sparrow	2
Common Raven	2
American Crow	1
Black Capped Chickadee	1
Pine Siskin	1
Herring Gull	5
Song Sparrow	1
Yellow Rumped Warbler	1
	29

Location: 8
UTM: 0704086, 5124638
Habitat: Sedge meadow, young softwoods, agricultural/open
Time: 6:50 AM
Weather: 4°C, Wind: 15 km/h, clear

BIRD	#
Hairy Woodpecker	1
Downy Woodpecker	1
Northern Flicker	2
American Robin	15
American Goldfinch	2
Purple Finch	2
Dark Eyed Junco	1
Black Capped Chickadee	5
Song Sparrow	1
Blue Jay	1
Savannah Sparrow	2
Redwinged Blackbird	1
Common Raven	2
	36

Location: 9
UTM: 0704054, 5124983
Habitat: Small cattail marsh (poorly drained), at powerlines, young conifers/dogwood
Time: 7:10
Weather: 5°C, Wind: 15 km/h, clear

BIRD	#
American Robin	10
Purple Finch	2
American Goldfinch	10
Downy Woodpecker	1
Song Sparrow	3
American Crow	2
Common Raven	2
Herring Gull	2
Pine Siskin	1
Swamp Sparrow	1
Northern Flicker	2
	36

Location: 3
UTM: 0704331, 5124714
Habitat: Open field, agricultural, mixed forest
Time: 7:32
Weather: 5°C, Wind: 10 km/h, clear

BIRD	#
Northern Flicker	2
American Robin	15
American Crow	2
Hermit Thrush	1
Blue Jay	2
Herring Gull	4
Ring Billed Gull	1
Hairy Woodpecker	1
Belted Kingfisher	1
Purple Finch	2
White Throated Sparrow	2
Song Sparrow	2
Common Raven	1
	36

Location: 10
UTM: 0704019, 5124356
Habitat: Cultivated and mowed field, small wetland, some hardwood
Time: 7:55
Weather: 6°C, Wind: 10 km/h, clear

BIRD	#	
American Robin	10	
Song Sparrow	2	
White Throated Sparrow	1	
Northern Harrier	1	
Hairy Woodpecker	1	
Herring Gull	2	
Common Raven	2	
Ruffed Grouse	1	
American Goldfinch	2	
Black Capped Chickadee	1	
American Crow	1	
Purple Finch	1	
American Black Duck		Fly over
	25	

Location: 2
UTM: 0704232, 5123909
Habitat: Open field, some uncultivated, mixed forest - HW dominant
Time: 8:15
Weather: 6°C, Wind: 10 km/h, clear

BIRD	#
American Robin	12
Blue Jay	4
Dark Eyed Junco	1
Purple Finch	1
Song Sparrow	4
Yellow Rumped Warbler	2
Herring Gull	6
Hairy Woodpecker	2
American Crow	8
Red Tailed Hawk	1
Savannah Sparrow	1
Northern Flicker	2
Common Loon	1
Ruffed Grouse	1
Ring Billed Gull	1
Common Grackle	4
	51

Location: 11
UTM: 0704371, 5123932
Habitat: Wetland (large), pond and riparian area
Time: 8:35
Weather: 7°C, Wind: 10 km/h, clear

BIRD	#
American Robin	10
Common Grackle	6
Herring Gull	5
American Crow	2
Song Sparrow	4
Swamp Sparrow	1
Dark Eyed Junco	2
Ruby Crowned Kinglet	2
Yellow Rumped Warbler	2
American Black Duck	2
Mallard	1
Wood Duck	1
Blue Jay	2
	40

Location: 1
UTM: 0704666, 5123211
Habitat: At Groves Pt., developed area, mixed forest on lake
Time: 9:15
Weather: 8°C, Wind: 15 km/h, clear

BIRD	#
American Robin	5
Song Sparrow	5
American Goldfinch	4
American Crow	2
Hairy Woodpecker	2
Great Black-backed Gull	1
Herring Gull	3
Black Capped Chickadee	1
Northern Flicker	2
Dark Eyed Junco	1
Northern Harrier	1
	27

Location: 12 (Background site, migratory passage)
UTM: 0703322, 5124119
Habitat: Large pond area, ~1.5 km west of development area, some residential, lake
Time: 9:40
Weather: 8°C, Wind: 15 km/h, clear

BIRD	#
American Crow	6
Common Merganser	2
American Robin	1
American Goldfinch	1
Song Sparrow	2
Red Winged Blackbird	1
Great Blue Heron	1
American Kestrel	2
Northern Harrier	1
Common Raven	1
Herring Gull	2
Rock Pigeon	1
Belted Kingfisher	1
	22

Species Summary April 20/212 2012

American Black Duck
American Crow
American Goldfinch
American Kestrel
American Robin
American Woodcock
Bald Eagle
Barred Owl
Belted Kingfisher
Black Capped Chickadee
Blue Jay
Brown Creeper
Common Grackle
Common Loon
Common Merganser
Common Raven
Common Snipe
Dark-Eyed Junco
Double Crested Cormorant
Downy Woodpecker
Great Black-backed Gull
Great Blue Heron
Great Horned Owl
Hairy Woodpecker
Hermit Thrush
Herring Gull
Herring Gull
Mallard
Merlin
Mourning Dove
Northern Flicker
Northern Harrier
Palm Warbler
Pine Siskin
Purple Finch
Red Breasted Nuthatch
Red Tailed Hawk
Red Winged Blackbird
Ring Billed Gull
Rock Pigeon
Ruby Crowned Kinglet
Ruffed Grouse
Savannah Sparrow
Song Sparrow
Swamp Sparrow
Tree Swallow
White Throated Sparrow
Winter Wren
Wood Duck
Yellow Bellied Sapsucker
Yellow Rumped Warbler

**PRE-CONSTRUCTION AVIAN SURVEYS FOR
PROPOSED WIND FARM AT HILLSIDE BOULARDERIE
CAPE BRETON COUNTY, NOVA SCOTIA**

Submitted to:

Natural Forces, Inc.
1791 Barrington Street Suite 1030
Halifax, Nova Scotia
Canada B3J 3L1

Submitted by:

AMEC Environment & Infrastructure
a Division of AMEC Americas Limited
50 Troop Avenue, Unit #300
Dartmouth, Nova Scotia
Canada B3B 1Z1

February 2013

Project No.: TV121030.1000

Executive Summary

This report summarizes pre-construction baseline avian surveys at the proposed Hillside Boularderie wind farm. Beginning in June of 2012, surveys were completed during breeding season and the fall migration period. Winter bird surveys with a focus on raptors were initiated in January 2013, and will continue until April, and 2013 spring migration surveys may be conducted to supplement spring surveys conducted in 2012. Breeding birds were surveyed using point counts distributed around the proposed turbine locations, while migration and winter surveys were conducted along a walked transect route passing through the site.

A total of 46 species were observed during the surveys, of which 43 are confirmed or likely to be breeding on or near the project site. All of the species observed during the fall migration surveys are known to breed in the region; therefore, it is not believed that the area serves as a significant migration stopover. Breeding status was inferred based on observed behavior the June and July breeding bird surveys. Three species were confirmed to be breeding in the area 20 species are considered “probable” breeders, and another 20 species were considered “possible” breeders. One federally listed species at risk, the Bobolink, was observed during the summer breeding and fall migration surveys. Additionally, three regionally rare species according to ACCDC were observed: Eastern Wood-pewee, Yellow-bellied Flycatcher and Boreal Chickadee.

Winter resident surveys are in progress and will be summarized at a later date. Preliminary results from the first winter survey conducted in January showed nine species in the Project Area, all of which are typical overwintering species for the region.

Based on observed species use of the site to date, there appears to be relatively little risk of bird mortality due to collisions with the wind turbines at the Project Area, since the site does not appear to be part of a major migration corridor. Species that engage in aerial displays which would put them at greater risk of collision were not observed at the site. Raptors were present in moderate numbers (Bald Eagle, Red-tailed Hawk, Northern Harrier and, less frequently, American Kestrel). Disturbance through displacement and habitat loss are considered to be of minor concern at this site; the habitat types found in the Project Area are not unique to the region, and the proposed wind farm consists of just two to three turbines.

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1.0 INTRODUCTION

Natural Forces Inc. is proposing to develop a two to three turbine wind farm in Hillside Boularderie, Nova Scotia, and has engaged the services of AMEC Environment & Infrastructure, a Division of AMEC Americas Limited (AMEC), to provide an assessment of the potential effects of the proposed project on local bird populations. In order to provide a complete assessment, AMEC has conducted a desktop data review for bird species and rare fauna reports in the region, and has designed and implemented a survey plan for pre-construction baseline avian surveys. This report summarizes the results of the data review and surveys conducted to date at the proposed wind farm site.

The objectives of this study were to determine: 1) what species make use of the habitat at the proposed wind farm site at different times of year; 2) of the species present at the site, which may be most susceptible to collision with turbines based on flight height and behaviour; 3) the peak spring and fall migration periods at the site, based on bird abundance and species diversity; and 4) whether any species at risk or species of conservation concern make use of the proposed site during migration or for breeding. Avian surveys were initiated in June of 2012, and encompassed the breeding season and fall migration periods. Winter resident surveys are in progress, and 2013 spring migration surveys may be conducted to supplement spring surveys conducted in 2012. All avian surveys were conducted by Maureen Cameron-MacMillan, a biologist based in Sydney, NS who has more than ten years of experience conducting avian surveys in eastern Canada.

2.0 METHODS

2.1 DESKTOP REVIEW

Prior to conducting field surveys, aerial photographs of the site were reviewed so that survey sites would be selected to ensure that all representative habitat types within the proposed project footprint were surveyed. A data request from the Atlantic Canada Conservation Data Center (ACCDC) was conducted to obtain a record of species at risk and species of conservation concern previously reported in the area or having the potential to occur within the area based on known species range maps, and to obtain information on biologically significant areas in the vicinity of the proposed project. The Important Bird Area (IBA) database was consulted to determine whether known areas with significant attributes for birds exist near the project site. Finally, a list of bird species known or suspected to be breeding in the area was obtained through the Maritimes Breeding Bird Atlas (MBBA), and the Christmas Bird Count (CBC) database was consulted to obtain records of wintering bird species in the region.

2.2 FIELD SURVEYS

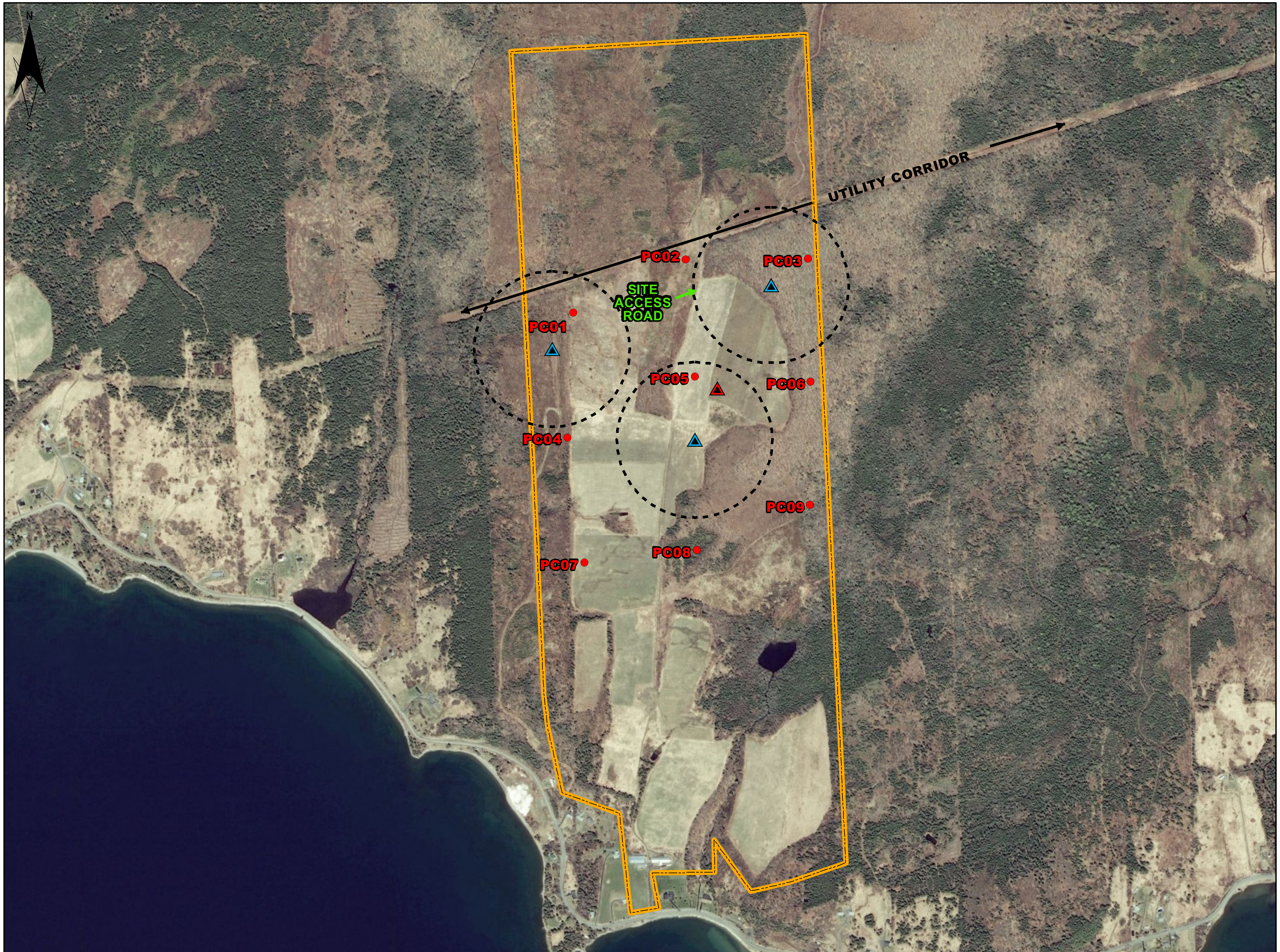
2.2.1 Survey Methodology

For the breeding bird surveys, a “point count” survey consisting of ten minutes of silent listening was conducted at nine locations on the subject property, spaced approximately 300 m apart. Figure 2.1 shows the point count locations with respect to the proposed turbine locations. The point count surveys were conducted on two occasions during the breeding season. Species were identified visually or by their characteristic songs and call notes, and the observer recorded numbers and breeding evidence (using Bird Studies Canada and Maritimes Breeding Bird Atlas criteria), as well as weather conditions and habitat type.

For migration surveys and winter resident surveys, a transect route was established along the site access road (Figure 2.1). Surveys for winter resident species incorporated a particular focus on raptors. Fall and winter counts took place in the morning or early afternoon, and the route was traversed on foot with frequent listening stops, and all birds seen or heard were recorded. Weather conditions, bird species and numbers, and behaviour (in particular, the height of birds in flight around the proposed turbine locations) were noted.

2.2.2 Survey Timing

At each of the nine point count locations, two 10-minute surveys for breeding birds were conducted during the 2012 breeding season, the first on June 28th and the second on July 8th. A total of seven surveys were completed during the 2012 fall migration period: August 23rd, September 1st, September 7th, September 8th, September 19th, October 3rd and October 12th. The first winter bird survey was conducted on January 10th, 2013; these will be repeated at an approximately monthly frequency until April. Spring migration surveys may be conducted in April to early June of 2013 to supplement spring surveys conducted in 2012



The map shown here has been created with all due and reasonable care and is strictly for use with AMEC Project Number: TV121030.2000.
This map has not been certified by a licensed land surveyor, and any third party use of this map comes without warranties of any kind.
AMEC assumes no liability, direct or indirect, whatsoever for any such third party or unintended use.

Path: F:\TV121030\MXD\20130125_BirdMonitorLocation_Fig2_1.mxd User: tanya.morehouse, Date: 28/01/2013 SOURCE: BING Aerial Maps

TITLE:
FIGURE 2.1
BIRD SURVEY LOCATIONS

PROJECT:
PROPOSED HILLSIDE BOULARDERIE WIND FARM

CLIENT:
Natural Forces, Inc.

1791 Barrington Street Suite 1030
Halifax, Nova Scotia
Canada B3J 3L1

LOCATION:
HILLSIDE BOULARDERIE, NOVA SCOTIA

AMEC PROJECT NO: **TV121030.1000**

DATE: **January 25, 2013**

DATUM: **NAD 1983**

PROJECTION: **UTM Zone 20 North**

LEGEND:
- Bird Monitoring Locations
- Hillside Met Mast Location
- Proposed Turbine Sites (June 2012)
- Turbine 200m Buffer
- Property Boundary

200 100 0 200
Meters
1:10,000

AMEC Environment & Infrastructure
50 Troop Avenue, Unit 300
Dartmouth, N.S., B3B 1Z1
(P) 902-468-2848 (F) 902-468-1314

3.0 RESULTS

3.1 DESKTOP REVIEW

Four major habitat types were identified on the site; these are described in greater detail in the vegetation survey report (AMEC 2012). Grass-dominated farm fields and deciduous forest (primarily beech, sugar maple and yellow birch) make up most of the project area. Disturbed habitat consists of a dirt road which provides access to the site from the Hillside Boularderie road, and runs through the middle of the project area; roadside vegetation is dominated by red maple and balsam fir, with raspberry and blackberry. A utility corridor runs along the northern border of the site, which is periodically cleared and contains a number of disturbance species such as alder, fireweed, coltsfoot and goldenrod, as well as some species typical of bogs and fens (e.g. cranberry and cattail).

No biologically significant areas were identified within 5 km of the project site (ACCDC 2012). A search of the IBA database revealed that the nearest IBA, Central Cape Breton Highlands (NS061) is situated approximately 15 km northwest of the Site (IBA 2013). This IBA is home to a globally significant number of Bicknell's Thrush (*NSESA*: Vulnerable; *SARA* and COSEWIC: Threatened). The Bicknell's Thrush favours coniferous forest, and so is unlikely to occur on the project site.

Results of the 2nd MBBA were accessed for the 10 km atlas square in which the site is located (20QS02). A total of 80 species were recorded for the square (MBBA 2013); these are listed in Table A.1 (Appendix A). Of these species, 21 were confirmed to be breeding in the square based on observed breeding evidence, and a further 29 were considered probable breeders. One species, the Herring Gull, was observed within the square but is not considered likely to be breeding there based on available habitat.

Count results were obtained for all 28 CBCs conducted between 1966 and 2012 in the Sydneys count area, a 24 km diameter circle which is centered near North Sydney and encompasses the project location (CBC 2013). Over the 28 CBCs, a total of 135 species have been observed wintering in the Sydneys count area (Table A.2 in Appendix A).

Results of an ACCDC search for rare species observations within a 100km buffer around the study area, encompassing almost all of Cape Breton Island, show 2910 records of 103 vertebrate species and 166 records of 41 invertebrate species (Table A.3 in Appendix A). Records of rare flora (1600 records of 258 vascular species and 40 records of 16 nonvascular species) are discussed in a separate report (AMEC 2012).

3.2 FIELD SURVEYS

A list of species observed during the summer and fall surveys is provided in Appendix A, and the results of all surveys conducted to date (including preliminary results of the winter surveys) are discussed below. Representative photographs of the habitat types found in the survey area are shown in Appendix B.

3.2.1 Summer Breeding Surveys

Over the course of two breeding bird surveys, conducted on June 28th and July 11th, a total of 354 birds were counted and breeding evidence for 43 species was recorded (Table A.4 in Appendix A), including 20 probable breeders, 20 possible breeders and three confirmed breeders according to the categories used by the MBBA. One additional species, Herring Gull, was observed flying over the site outside of suitable breeding habitat. The most commonly detected species were Song Sparrow and American Robin, each with 32 observations, followed by Red-eyed Vireo, Hermit Thrush, American Goldfinch, Ovenbird and Cedar Waxwing, each with more than 20 occurrences throughout the survey period.

3.2.2 Fall Migration Surveys

A total of 158 bird observations were recorded, with 15 species detected during the fall migration surveys (Table A.5 in Appendix A). A fairly large number of American Crows (a non-migratory species) were seen on the site on a few occasions, as many as 50 on one survey. Savannah Sparrow, Black-capped Chickadee, Bald Eagle and American Goldfinch were all observed with some regularity. Species abundance and diversity was relatively low at the site, and all of the species observed are known to breed in the region, with no northern migrant species detected; therefore, it is not believed that the area serves as a significant stopover for fall migrants.

3.2.3 Winter Resident Surveys

The first winter resident survey was completed on January 10th. Eighty individuals of nine species were detected: 1 American Crow, 3 Bald Eagles (2 adults and one immature), 4 Black-capped Chickadees, 2 Boreal Chickadees, 1 Blue Jay, 2 Common Ravens, a flock of 65 Common Redpolls, a Herring Gull and a Red-tailed Hawk.

The remaining winter resident surveys will be summarized at a later date, along with the results of the spring migration surveys.

3.3 OBSERVED HEIGHT OF BIRDS

During the surveys, the height at which birds in flight were observed was estimated. Of the 199 recorded observations of birds in flight, 182 were below 20 m (91%), 13 were between 20 and 50 m (7%), and 4 birds were observed at heights above 50 m (2%). Bald Eagle was the only species observed above 50 m, and raptors also made up most of the observations between 20 and 50 m: Bald Eagle, Red-tailed Hawk and Northern Harrier, along with Herring Gull and Common Raven. On one occasion during the breeding bird surveys, a Herring Gull was observed circling around the met tower on the site, maneuvering through the guy wires.

3.4 AVIAN SPECIES AT RISK AND SPECIES OF CONSERVATION CONCERN

One federally listed species at risk was observed during the field surveys, the Bobolink (*SARA* and COSEWIC: Threatened). Four species considered to be of conservation concern by ACCDC were observed: Eastern Wood-pewee (S3S4B), Yellow-bellied Flycatcher (S3S4B), Boreal Chickadee (S3) and Bobolink (S3S4B). A number of additional species at risk and species of conservation concern may occur in the project area, based on information obtained from the MBBA, CBC and ACCDC (Appendix A). Of those, the following are considered to have potential to occur on the site based on the available habitat:

- Common Nighthawk (*SARA* and *NSESA*: Threatened; ACCDC: S3B)
- Killdeer (ACCDC: S3S4B)
- Wilson's Snipe (ACCDC: S3S4B)
- Barn Swallow (COSEWIC: Threatened; ACCDC: S3B)
- Pine Grosbeak (ACCDC: S3?B,S5N)
- Pine Siskin (ACCDC: S3S4B,S5N)

Certain species, including raptors and the aforementioned Wilson's Snipe, are considered to be at potentially greater risk of negative interactions with wind turbines due to aerial behavior such as hunting and mating displays; Bobolink also perform aerial displays, but their displays are generally too low to create a high collision rate with turbines (Kingsley and Whittam 2007). Because of this concern, presence of raptors is of particular interest. The following raptor species have been observed at various times of year during the field surveys:

- Bald Eagle, observed during summer, fall and winter surveys. Likely breeding near site, as two adults and one immature (presumably a family group) were observed together on one occasion.
- Northern Harrier, observed during the summer and fall surveys. Most often seen engaging in hunting behaviour, flying low (1 m to 20 m above ground surface) over the field.
- Red-tailed Hawk, a single individual observed during summer, fall and winter surveys. On most occasions, the hawk was seen along the access road to the south of the proposed turbine locations.
- American Kestrel, seen on just one occasion during the fall surveys.

In addition to the above species, Broad-winged Hawk, Merlin and Osprey were all observed during the breeding season within the 10 km square in which the site is located (MBBA 2012).

3.5 OTHER FAUNA

Incidental observations of non-avian fauna noted during the surveys included red squirrel (*Tamiasciurus hudsonicus*), snowshoe hare (*Lepus americanus*), white-tailed deer (*Odocoileus virginianus*), and red fox (*Vulpes vulpes*). Tracks of a second canid species were observed in the winter survey, which may have been either coyote (*Canis latrans*) or domestic dog. Three common butterfly species were noted: Canadian tiger swallowtail (*Papilio canadensis*), red admiral (*Vanessa atalanta*), clouded sulphur (*Colias philodice*). A woolly bear caterpillar, larva of the Isabella tiger moth (*Pyrrharctia isabella*), was also observed in the study area.

4.0 DISCUSSION

A total of 46 species were observed during the surveys, of which 43 are confirmed or believed to be breeding on or near the project site. All of the species observed during the fall migration surveys are known to breed in the region; therefore, it is not believed that the area serves as a significant migration stopover.

Breeding status was inferred based on observed behavior the June and July breeding bird surveys. Three species were confirmed to be breeding in the area based on presence of fledged young or on observations of adults carrying food, while 20 species are considered "probable" breeders based on territorial behaviour (observed in suitable habitat on two or more occasions over the breeding season), agitated behaviour of adults, and/or presence of a breeding pair in suitable habitat. Another 20 species were considered "possible" breeders, heard or observed only once in a particular location in suitable breeding habitat. One federally listed species at risk, the Bobolink, was observed during the summer breeding and fall migration surveys. Additionally, three regionally rare species according to ACCDC were observed: Eastern Wood-pewee, Yellow-bellied Flycatcher and Boreal Chickadee.

Winter resident surveys are in progress and will be summarized at a later date. Preliminary results from the first winter survey conducted in January showed nine species in the Project Area, all of which are typical overwintering species for the region.

The potential negative effects of wind farms on birds can be classified into four main categories: collision, displacement due to disturbance, barrier effects and habitat loss (Drewitt and Langston 2006).

Collision

Collision rates can be affected by a number of factors. For example, certain species, due to size or behaviour, are at greater risk of collision (for example, large-bodied birds such as geese are less maneuverable, and species such as raptors and snipe engage in aerial hunting or displays (Kingsley and Whittam 2007; Environment Canada 2006). Nocturnal migrants (including many passerines) tend to fly well above turbine heights; however, they may be at risk of collision near stopover locations at dawn and dusk. In adverse weather conditions, poor visibility and impaired flight due to strong headwinds can increase collision risk.

Collision risk can be mitigated by proper siting and alignment of turbines, avoiding large concentrations of sensitive species, as well as migration corridors and important nesting areas. The Hillside Boularderie site does not appear to support a large number of fall migrants (spring migration surveys are planned for 2013), and is situated more than 10 km from the nearest IBA. Three raptor species, Bald Eagle, Northern Harrier and Red-tailed Hawk, are seen frequently at the site.

Turbine size, rotor speed and lighting can also influence collision risk; for example, intermittent flashing white lights of the lowest effective intensity will be less disorienting to birds than a constant bright point source (Drewitt and Langston 2006).

Displacement Due to Disturbance

Displacement of birds can occur during both the construction and operations phases of wind farms, through visual, noise and vibration impacts. Displacement may also occur as a result of repeated movements of maintenance vehicles (Drewitt and Langston 2006). The pattern and scale of disturbance depends on the species, life cycle stage, availability of alternate habitats, and siting of the wind turbines with respect to important habitat areas. Little is known about the effects of displacement on breeding birds, particularly short-lived passerines, and in long-term recruitment rates of longer-lived species around wind turbines; however, for wintering waterfowl, reduced density and abundance has been reliably recorded as far as 600 m from wind turbines.

It is difficult to determine the potential scale of disturbance caused by a wind farm, as effects can only reliably be determined following turbine installation through comparison of abundances before and after. Therefore, post-construction follow-up monitoring of the site will be required to assess displacement effects.

Barrier Effect

In addition to the habitat displacement described above, birds may also alter their migration flyways and/or local flight paths to avoid wind turbines (Drewitt and Langston 2006; Environment Canada 2006). This may lead to the birds having to fly further, resulting in a costly increase in energy expenditure, and may even disrupt routes between feeding, roosting, moulting and/or breeding areas far from the wind farm. This barrier effect is more pronounced with larger wind farms, or those that are sited close to other wind farms creating a cumulative barrier effect. The Hillside Boularderie project is considered a small wind farm, with three turbines proposed, and is situated more than 20 km from any other wind farm.

Habitat Loss

Actual habitat loss resulting from wind farm construction is quite small on a per-turbine basis, generally amounting to no more than 5% of the total development area (Drewitt and Langston 2006). The proposed Hillside Boularderie wind farm consists of three turbines, and the habitat types found in the project footprint are common for the area; therefore, habitat loss is not expected to have an appreciable negative impact on species in the Project Area.

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Appendix C:

Bat Impact Study

HILLSIDE BOULARDERIE WIND FARM
BAT MONITORING PROTOCOL
AND SURVEY REPORT

Prepared for
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February 2013

Project No.: TV121030.2000

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1.0 INTRODUCTION

Natural Forces Wind Inc. is proposing to develop a 2 to 3 turbine wind farm in Hillside Boularderie, Nova Scotia, and has engaged the services of AMEC Environment & Infrastructure, a Division of AMEC Americas Limited (AMEC), to provide an assessment of the potential effects of the proposed project on local and migratory bat populations. In order to provide a complete assessment, AMEC has compiled relevant information on bats in the region, reviewed existing monitoring protocols, and developed a cost efficient and effective monitoring protocol to meet the specific needs of Natural Forces Wind Inc. Finally, AMEC collected and analyzed data on the occurrence of bats in the project area in accordance with the protocol.

1.1 LEGISLATION/REGULATORY ENVIRONMENT

An environmental assessment (EA) is an assessment of the possible positive or negative impact that a proposed project may have on the environment, together consisting of the environmental, social and economic aspects. This is a planning tool that provides managers and decision-makers with information on whether a proposed project may undermine sustainable development.

There are two levels of environmental assessment legislation that govern the environmental assessment process. At the provincial level, the *Nova Scotia Environment Act* and the ensuing regulations provide the mandate to the NS Department of Environment to review and assess environmental assessment documents prior to the approval of projects that meets certain "trigger" conditions. Similarly, the *Canadian Environmental Protection Act* (CEPA) and the *Canadian Environmental Assessment Act* (CEAA) perform a similar function at the federal level, providing the mandates and authorities to various government departments including the Canadian Environmental Assessment Agency, Environment Canada, and the Department of Fisheries and Oceans Canada. Depending upon the location of the wind farm (private land, federal or provincial crown land), the source of funding (e.g., private investment vs. federal government) and the size of the wind farm, an environmental assessment will need to be completed for review and approval by either the NS Department of Environment, or the relevant federal department or agency.

One area of concern addressed in an EA is the potential effect that a project may have on local wildlife, and the habitats upon which these species depend. As a result, the federal *Species at Risk Act* (SARA) and the *Nova Scotia Endangered Species Act* (NSESA) must be considered in the EA process. Under the terms of the Acts, no project can have or potentially have a negative effect on a species listed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as endangered, threatened or of concern, under a list within the NS General Status of Wild Species as species of conservation concern.

Several federal and provincial government departments and agencies have legislative and regulatory responsibility of wildlife species and habitats in Nova Scotia, including bats. Bats are a matter of special interest in the EA process; since little is known about most species, there is a lack of understanding of the long term effects that past developments have had upon their well-being. In 2012, emergence of a devastating fungal infection affecting bat populations in eastern

North America (see Section 2.0) led COSEWIC to designate three bat species, all known residents of Nova Scotia, as “Endangered” (COSEWIC 2012).

Federally, the Canadian Wildlife Service of Environment Canada is responsible for all migratory birds and for all wildlife on federally owned land. Within the Provincial government the Department of Natural Resources, Wildlife Division is responsible for all wildlife, other than that managed by federal government. Furthermore, several other government Departments and Agencies have an interest in wildlife resources, and while they do not have regulatory responsibility, they may provide useful and important information on bats suitable for inclusion in an EA. Examples include the Wildlife Division of the Nova Scotia Department of Natural Resources and the Heritage Division of Nova Scotia Tourism, Culture & Heritage. Local universities and non-profit organizations such as the Atlantic Canada Conservation Data Centre and local naturalist groups can also provide valuable information.

Since wind energy development activities have commenced in Nova Scotia, the Nova Scotia Department of Environment has regularly issued consistent approval conditions for environmental assessments of wind farm projects in the province, namely:

a) The Proponent must develop and implement a program to monitor for birds and bats to the standards as defined by the Nova Scotia Department of Natural Resources (NSDNR) and Canadian Wildlife Service (CWS). Based on the results of monitoring programs, the Proponent must make necessary modifications to mitigation plans and/or wind farm operations to prevent any unacceptable environmental effects to the satisfaction of NSE, based on consultation with NSDNR and CWS.

b) The Proponent must document accidental mortalities of bats and birds and submit an annual report to the Director of Wildlife, NSDNR, and CWS. The report shall be submitted in January of each operating year unless otherwise approved by NSE.

2.0 INTRODUCTION TO BATS

Bats are one of the most diverse groups of mammals, with over 1100 known species (Tudge 2000). The only mammals which truly fly, all bats species have wings consisting of webbing stretched between their elongated fingers. Worldwide, bats play vital roles in insect control and the life cycles of fruiting plants. However, despite their diversity and important ecological function, bats generally remain poorly understood and are often unfairly reviled by the public.

Members of the Order Chiroptera, bat species are divided into two main families, the Microchiroptera (insectivorous bats) and the Megachiroptera (fruit bats); the latter is found in tropical regions, and is not discussed further here. Microchiropterans typically have small eyes, sharp pointed teeth, and distinctly-shaped ears. This group is also unique in that it utilizes ultrasonic noise, inaudible to humans, to navigate by echolocation. Echolocating bats produce high-pitched calls which bounce off objects in their path. The bat then uses its highly sensitive ears to detect the resulting echo, and interprets it to provide information on size, shape and direction of travel of objects in its path. These calls are usually fairly species-specific, and scientists can use the characteristics of these calls to identify bat species in an area. This ability to navigate by sound results in bats being able to fly and hunt in complete darkness, and in fact most bat species are primarily nocturnal.

In temperate climes such as Nova Scotia, bat species deal with the inhospitable conditions of winter by either hibernating or migrating to warmer areas until spring. Larger, fast-flying species tend to migrate, while smaller species, which tend to be weaker fliers, usually hibernate. Some bat species may fly up to several hundred kilometers to a suitable hibernating site, known as a hibernaculum. Many species begin gathering at their chosen hibernaculum several weeks before hibernation actually begins, and often mate at this time.

The colonial hibernation behavior of many species results in a high level of vulnerability during the winter months. While bats may arouse naturally and move around within their hibernaculum (Tuttle 1991), unintentional arousals during hibernation such as disturbance by humans entering their hibernaculum can cause bats to rapidly deplete their stored fat reserves, eventually leading to starvation (Thomas 1995). A small number of visits to a winter hibernaculum of colonial species can have serious effects on the bat population utilizing that hibernaculum.

Another dramatic example of this winter vulnerability is seen in the current epidemic of white-nose syndrome (WNS) in bats of northeastern North America. The condition, named for a distinctive fungal growth around the muzzles and on the wings of affected bats, was first identified in a cave in New York, USA, in February 2006 (Blehert *et al.* 2008). It has since spread over much of eastern North America and in 2011 was confirmed Nova Scotia. The fungus responsible has been identified *Geomyces destructans,* a newly discovered cold-loving fungus that can grow at temperatures below 20 °C (68 °F), and grows on the bats when they are hibernating in caves and mines during winter (Blehert *et al.* 2008). The fungus appears to disrupt the normal patterns of hibernation, causing bats to arouse too frequently from their winter torpor and starve to death. The symptoms associated with WNS include loss of body fat, unusual winter behavior (including flying outside of the hibernaculum), and death. The mortality rate from WNS in some caves has exceeded 90% (Frick *et al.* 2010). To date, seven hibernating bat species have been confirmed with WNS and an additional two with infection of *Geomyces destructans* in the Northeast USA, and several of these species have suffered major mortality (Frick *et al*., 2010). Some of these species, like the Indiana bat (*Myotis sodalis*), were already considered endangered. The U.S Fish and Wildlife Service maintains a website documenting the current status and the spread of WNS in North America (http://whitenosesyndrome.org/).

Each of the three bat species known to have significant populations in Nova Scotia have been reported to exhibit WNS in parts of their ranges. In the northeastern United States, the once common little brown bat (*Myotis lucifugus*), has suffered a major population collapse and may be at risk of rapid extirpation in the Northeast within 20 years, due to mortality associated with WNS (Frick *et al*. 2010). Dzal *et al.* (2010) reported a 78 per cent decline in the summer activity of the little brown bat in an area affected by WNS, as evidenced by echolocation surveys. The long-term impact of the reduction in bat populations may be an increase in insect populations as they become subject to decreased bat predation, possibly leading to crop damage or increased pesticide requirements.

2.1 BATS IN NOVA SCOTIA

All the bat species known to occur in Nova Scotia belong to the Vespertilionidae, a family of bats variously known as the vesper bats, evening bats or common bats. It is the largest and best-known family of bats, and part of the suborder Microchiroptera (microbats). Seven species have been reliably reported to occur in Nova Scotia (Hebda 2011, NSDNR General Status website, ACCDC website). Two of these belong to the genus *Myotis,* known as the mouse-eared bats: the little brown bat (*M. lucifugus*), and northern long-eared bat (*M. septentrionalis*). Two *Lasuirus* species, red bat (*L. borealis*), and hoary bat (*L. cinereus*) are also known to occur. Three other species are the only representatives of their genera known to occur in NS: tri-coloured bat (*Perimyotis subflavus)* (formerly known as the eastern pipistrelle (*Pipistrellus subflavus*)), silver-haired bat (*Lasionycteris noctivagans*), and big brown bat (*Eptesicus fuscus*).

Of these species, only little brown bat, northern long-eared bat and tri-coloured bat are thought to have significant populations in Nova Scotia; the other four species are considered likely to be at the northern edge of their ranges (Broders *et al.* 2003). Four species have been recorded in Cape Breton: the little brown bat, northern long-eared bat, hoary bat and red bat; the latter two are thought to be transients to the area (Broders, personal communication). Brief life history overviews of the bats known to occur in Nova Scotia are provided in the following subsections.

2.1.1 Little Brown Bat

The little brown bat is a small species and believed the most common bat species in North America, ranging from Alaska to California (Barbour and Davis 1969). While individuals migrate from summering to wintering areas, they are not considered long-distance migrants. They are considered the most abundant and widespread bat species in Nova Scotia (Scott and Hebda 2004). It is one of three bat species considered to have significant populations in Nova Scotia (Broders *et al.* 2003). Because of the impacts of WNS, COSEWIC lists the little brown bat as Endangered, and in Nova Scotia, the Atlantic Canada Conservation Data Centre (ACCDC) lists them as S1, or extremely rare. The Nova Scotia Department of Natural Resources (NSDNR) lists the little brown bat as Yellow, meaning they are sensitive to human or natural impacts. In the case of little brown bats, this sensitivity is due to their vulnerability at winter hibernacula, when large numbers congregate in caves or mines to hibernate. This species has been shown to be seriously affected by white-nose syndrome, and may be at risk of rapid extirpation in the Northeast USA within 20 years due to WNS mortality (Frick *et al*. 2010).

Throughout their range, little brown bats are usually abundant in forested areas, and are often associated with human settlement. In summer, reproductive females may form nursery colonies containing hundreds, sometimes thousands of individuals in buildings, attics, and other man-made structures. Females generally give birth to single young. Males and non-reproductive females roost alone or in smaller groups and may be found in buildings, caves, trees, under rocks, behind shutters, in crevices, and under tree bark (Barbour and Davis 1969, Fenton and Barclay 1980). Broders and Forbes (2004) noted that in New Brunswick, roost selection by male little brown bats appears highly dependent on the number of snags (dead trees) in the area.

Little brown bats often forage over water (Fenton and Bell 1979), as well as in woodlands and developed areas (van Zyll de Jong 1985). They eat a wide variety of insects, including Diptera (flies),Coleoptera (beetles), Lepidoptera (butterflies and moths), Trichoptera (caddis flies), Hemiptera (cicadas,leafhoppers, aphids, scales), and Hymenoptera (ants, bees, and wasps) (Whitaker 1972, Anthony and Kunz 1977, Whitaker 2004). A single little brown bat can catch up to 1,200 insects in just one hour during peak feeding activity (BatCon, 2006).

While many bat species mainly hunt flying insects (a behavior known as hawking), little brown bats and northern long-eared bats can also take prey off foliage, other surfaces or the ground, a behavior known as gleaning (Ratcliffe and Dawson 2003). Their large ears, characteristically short, high frequency, soft echolocation call (Faure *et al*. 1993), and ability to hover in flight make this gleaning behavior possible (Ratcliffe and Dawson 2003).

In late summer, little brown bats may travel hundreds of kilometers to swarm around caves and abandoned mines (Fenton and Barclay 1980). Their hibernation sites tend to be extremely humid (>90%) and to maintain temperatures above-freezing (i.e., 1-5°C) (Fenton and Barclay 1980). In Nova Scotia, this species is known to hibernate in several caves or abandoned mine openings (Moseley 2007b). Tuttle (1991) has reported that this species may arouse at intervals during hibernation to move about in response to temperature fluctuations. This behavior has been observed among hibernating bats in a cave in Hants County, NS (Moseley 2007b). Little brown bats have also been observed to use underground sites as summer roosts in Nova Scotia (Moseley 2007b).

2.1.2 Northern Long-eared Bat

The Northern long-eared bat is a small, non-migratory species which is widely distributed across North America, with a range from Newfoundland and the eastern United States to coastal British Columbia (Barbour and Davis 1969). Because of the impacts of WNS, COSEWIC lists the Northern long-eared bat as Endangered, and in Nova Scotia, the ACCDC lists them as an S1 species in Nova Scotia, meaning they are considered extremely rare in the province. Though considered uncommon in Nova Scotia, it is one of three bat species considered to have significant populations in the province (Broders *et al.* 2003). DNR lists them as Yellow, meaning they are sensitive to human or natural impacts, In the case of northern long-eared bats, this is due to their vulnerability at winter hibernacula, when large numbers congregate to hibernate.

The Northern long-eared bat is considered a forest-interior species (Broders *et al*. 2006, Caceres and Barclay 2000) and occurs in both hardwood and softwood forests (Foster and Kurta 1999). Northern long-eared bats have been observed foraging along forest edges, over forest clearings, at tree-top level, and occasionally over ponds (BatCon 2006). Similar to little brown bats, northern long-eared bats eat a variety of insects, including Coleoptera (beetles), Diptera (true flies), Lepidoptera (butterflies and moths) and Trichoptera (caddis flies) (Brack and Whitaker 2001, Carter *et al*. 2003, Whitaker 2004). They also exhibit hawking behavior in addition to gleaning (Ratcliffe and Dawson 2003).

Little is known about the population dynamics and reproductive biology of this species. In New Brunswick, maternity colonies appear to occur most often in mature, shade tolerant deciduous tree stands (Broders and Forbes 2004) where females generally give birth to single young. Males and non-reproductive females typically roost in tree cavities and beneath peeling bark. Such individuals may switch roosts every two days and have roosts up to two kilometers apart (Foster and Kurta 1999, Jung *et al*. 2004). Henderson *et al.* (2008) documented differences in variables influencing the distribution of male and female northern long-eared bats in forest fragments in a forest-agricultural landscape of Prince Edward Island. This species is generally more solitary than the little brown bat and is most often found singly or in very small groups. Unlike the little brown bat, the northern long-eared bat has not yet been observed to use underground sites as summer roosts in NS, though it is possible (Moseley 2007b).

They swarm in mines and caves in the fall, and hibernate in many of these same spaces, although not in large numbers. Northern long-eared bats are said to prefer cooler hibernation temperatures than little brown bats (van Zyll de Jong 1985). In Nova Scotia, they are known to hibernate at most caves used by little brown bats (Scott and Hebda 2004), where they often squeeze into small crevices within the cave. They often hibernate solitarily or in small clusters. They may be overlooked in hibernation caves due to their physical similarity to little brown bats and their tendency to squeeze into small crevices. Recent harp trapping studies at several hibernacula in NS have shown that this species often makes up a substantial proportion of bats trapped (Garroway 2004). It is currently felt that this species may be more common than previously believed.

2.1.3 Tricoloured Bat (Eastern Pipistrelle)

This species was formerly known as the eastern pipistrelle (*Pipistrellus subflavus*); however, recent genetic analysis indicates that the tricoloured bat is only distantly related to the true pipistrelles, and it has been placed in its own genus, *Perimyotis* (Hoofer and Van Den Bussche 2003). The tricoloured bat is a widespread species, and southeast Canada is considered the northern limit of their range (van Zyll de Jong 1985; Broders *et al*. 2001, 2003). Because of the impacts of WNS, COSEWIC lists the tricoloured bat as Endangered, and in Nova Scotia, the ACCDC lists them as S1, meaning their status in the province is extremely rare. NSDNR lists them as Yellow, meaning they are sensitive to human or natural impacts. Tricoloured bat is one of three bat species considered to have significant populations in Nova Scotia (Broders *et al.* 2003), and is thought to be restricted to the southern end of the province (Rockwell 2005).

Tri-coloured bats usually forage over watercourses and open spaces such as clearings and fields (Davis and Mumford 1962). Little is known about their diet, although they appear to feed mostly on moths (Barbour and Davis 1969). Females usually have two pups each year (Barbour and Davis 1969). They are known to roost in summer in rock crevices, caves and mines. In some parts of their range, tri-coloured bats are known to roost in buildings, and Hoying and Kunz (1998) reported a maternity roost of about 20 adult females with young in a barn. In Nova Scotia, maternity colonies primarily utilize clumps of *Usnea* spp. lichen for roosting, typically in mature spruce trees (Poissant *et al.* 2010). Tricoloured bats will also occasionally roost in woodpecker holes and the hollows of old trees, but most often they roost in foliage (Findley 1954, Davis and Mumford 1962, Veilleux *et al*. 2004). Farrow and Broders (in press) stated that this forest-associated bat species appears to be negatively impacted by landscape practices that remove forest cover.

Tri-coloured bats are weak fliers (sometimes called 'butterfly bats') and have longer hibernation periods, which may result in them not dispersing from winter hibernacula as far as other hibernating species (OMNR 2006). They hibernate in caves and abandoned mines, which are also used as swarming sites during the autumn mating season (Barbour and Davis 1969). They hibernate at higher temperatures than most bats, and though this means they metabolize fat reserves more rapidly, they apparently compensate for the loss by reducing the frequency of arousal episodes (Tuttle 1991). The ability to hibernate at higher temperatures than other bat species enables them to use a wider variety of caves as hibernacula. Tri-coloured bats also tend to hibernate singly, and have been shown in NS to show fidelity to small roost areas both within and between years (Poissant 2009).

2.1.4 Hoary Bat

The hoary bat is a migratory tree bat, which ranges throughout North America from Alaska south into Brazil and Guatemala (Barbour and Davis 1969). It is said to be the most widespread bat species in North America (Shump and Shump 1982). The ACCDC lists the hoary bat as S1 in NS, meaning its status in the province is extremely rare. DNR lists this species as Undetermined, meaning the status of the population in Nova Scotia has not been fully studied. Broders *et al.* (2003) determined that Nova Scotia is at this species is at, or beyond, the northern edge of this species' usual range.

These large solitary bats are high, strong and fast fliers (Larrison and Johnson 1981), reaching an average speed of 7.7 m/s while foraging (Salcedo *et al.* 1995). Banfield (1974) and van Zyll de Jong (1985) reported that hoary bats often forage in open spaces over glades or lakes in forested areas. They also appear to be more active above the forest canopy than within or below it (Menzel *et al*. 2005), and some authors state they are positively associated with edge habitats (Furlonger *et al*. 1987). Barclay (1984) reported that hoary bats forage on nightly round-trip flights of up to 40 km. Hoary bats are thought to feed primarily on Lepidoptera (butterflies and moths) (Black 1974, Whitaker 1972, Carter *et al*. 2003), although they may consume a wide variety of insects. They are said to be an obligate tree-roosting species, roosting in elm, plum, and cherry trees throughput their range (Shump and Shump 1982).

During the summer, some segregation based on sex has been observed, with females concentrated in eastern North America and males concentrated in the western North America (Findley and Jones 1964, Cryan 2003). Females give birth in spring (i.e., mid-May to late June); usually litters of two, but may have up to four pups (Bogan 1972, Koehler and Barclay 2000). Adult females roost alone or with their dependent young, usually 3-12 m above the ground (van Zyll de Jong 1985). Mating occurs in late summer and autumn (Bouchard *et al.* 2001).

As a migratory species (Barclay 1984), hoary bats do not overwinter in Nova Scotia. Bats from eastern North America are thought to winter primarily in southeastern USA, Mexico, and Guatemala (Barbour and Davis 1969, Cryan 2003) although individuals have been found in Michigan, New York and Ontario during the winter (Shump and Shump 1982, Bouchard *et al*. 2001). Migrants often travel in groups while moving south in the fall (Shump and Shump 1982). In the spring, a northern migration occurs, with females preceding males by about a month (Valdez and Cryan 2009, Findley and Jones 1964).

Garroway (2004) reported a single echolocation sequence attributable to this species from near the entrance to a Nova Scotia cave (Hayes Cave). Broders *et al.* (2003) reported fewer than five echolocation sequences attributable to hoary bats in 2001 acoustic surveys conducted in Kejimikujik Park, Brier Island, and Bon Portage Island. Just eight specimens or reliable sight records exist for hoary bats in Nova Scotia (Nova Scotia Museum Collections, cited in Broders *et al*. 2003).

2.1.5 Silver-haired Bat

The silver-haired bat is a migratory tree bat species (Barclay 1984, Griffin 1970). This species is thought to be widespread in Canada in summer (van Zyll de Jong 1985), though other sources consider them scarce through most of their range (Barbour and Davis 1969). The ACCDC lists this species as S1 in Nova Scotia, meaning their status in the province is extremely rare. DNR lists them as Undetermined, meaning the status of their population in Nova Scotia is unknown. Broders *et al*. (2003) determined that this species is at, or beyond, the northern edge of its range in Nova Scotia. They are irregular visitors, primarily during migration season.

Throughout their range, silver-haired bats are usually found in forested areas. During the day they roost under loose bark (Barbour and Davis 1969). There is some evidence that males and females segregate during the summer and mate in the fall, but little is known about the reproductive behaviour of this species (Barbour and Davis 1969). Females form small maternity colonies (~10 adult females) in hollows in rotting trees (Parsons *et al*. 1986, Crampton and Barclay 1998).

As a migratory species (Barclay 1984), silver-haired bats do not overwinter in Nova Scotia. Little is known about their migration behaviour. Populations in Ontario are thought to overwinter in the Ohio River Valley (Barbour and Davis 1969, Cryan 2003). Barbour and Davis (1969) stated that bird banders have captured groups of silver-haired bats on the east coast of Canada, suggesting they migrate in groups.

Little is known about the diet of this species. Studies have shown they feed on Trichoptera (caddisflies) and Lepidoptera (butterflies and moths) (Whitaker 1972, Black 1974). Carter *et al*. (2003) also found they feed on Diptera (flies) and some Homoptera (cicadas, leafhoppers, aphids, scales); however these observations were based on very small sample sizes.

Broders *et al.* (2003) recorded less than 5 echolocation sequences attributable to this species during their survey of bat species of southwestern Nova Scotia, reinforcing the idea that the silver-haired bat is at the northern limit of its range in Nova Scotia. Two specimen or reliable sight records exist for this species in Nova Scotia: A sight record of a silver haired bat in a manmade cave in Nova Scotia (Peddler's Tunnel) in February 1996 is considered likely to be a storm-blown individual (Hebda 2006, cited in Moseley 2007a), and a silver-haired bat was also photographed on Brier Island in September 2004 (H. Broders, pers. comm.).

2.1.6 Eastern Red Bat

The eastern red bat is a migratory tree bat species (Barclay 1984, Griffin 1970), ranging from southern Canada south to Argentina and Chile (Shump and Shump 1982). The ACCDC lists them as S1 in Nova Scotia, meaning their status in the province is extremely rare. DNR lists them as Undetermined, meaning their population status in Nova Scotia is unknown.

As a migratory species, eastern red bats are high, fast fliers, reaching average speeds of 6.7 m/s while foraging (LaVal and LaVal 1979, Salcedo *et al*. 1995). They often forage around streams, ponds, forest ridges, and streetlamps (Hickey and Fenton 1990, Hickey *et al*. 1996, Acharya and Fenton 1999, Reddy and Fenton 2003). They are well camouflaged while roosting and tend to be seen more frequently seen in flight than at rest. Eastern red bats feed primarily on Lepidoptera (butterflies and moths), but have also been shown to feed on Coleoptera (beetles), Diptera (true flies), and other insects (Hickey *et al*. 1996, Whitaker *et al*. 1997, Carter *et al*. 2003).

Female eastern red bats typically roost alone in the foliage of trees and vines during summer. Mating takes place in late summer/early fall and may occur in flight (Barbour and Davis 1969). They give birth to 1-5 young in early summer and have average litter sizes of 3.2 (Barbour and Davis 1969). It has been suggested eastern red bats have large litters to compensate for the high predation risk of tree-roosting (van Zyll de Jong 1985). Eastern red bats tend to be faithful to roost areas, but not to specific roosts (Mager and Nelson 2000). Menzel *et al*. (1998) recorded eastern red bats spending an average of 1-2 nights in an individual tree before moving to another location in the surrounding area. Roosts are usually more than 5 metres above the ground (Mager and Nelson 2000).

This migratory species is rarely found in caves. A study in Missouri found that eastern red bats found in caves usually die (Myers 1960). Red bats have never been observed swarming with other species at cave entrances in autumn in Nova Scotia (Moseley 2007b). Individuals in some areas of the United States hibernate in leaf litter and emerge to forage during warmer periods

(Moorman *et al*. 1999, Mormann *et al*. 2004). In warmer areas, eastern red bats may fly regularly throughout the winter and forage at locations where insects are present (Whitaker *et al*. 1997), such as in North Carolina and southeastern Virginia. In Ontario, there are recent winter records of these bats roosting in leaf litter and under the shingles of houses (Mager and Nelson 2000).

Eight specimens or reliable sight records exist for eastern red bat in Nova Scotia (Nova Scotia Museum of Natural History Collections). While documenting the first breeding record of this species in Nova Scotia, Broders *et al.* (2003) also determined that the eastern red bat is likely at, or beyond, the northern edge of its range in Nova Scotia.

2.1.7 Big Brown Bat

The big brown bat is a non-migratory species (Davis *et al*. 1968, Mills *et al*. 1975), which is common across southern Canada (van Zyll de Jong 1985). This species is listed on the ACCDC website as SNA, meaning its status is not applicable, as it is not definitively known to occur in the province. NSDNR lists the big brown bat as Undetermined in Nova Scotia. It is considered to be at the northern limit of its range in southern New Brunswick (van Zyll de Jong 1985) and Nova Scotia (Broders *et al.* 2003). A single provincial sight record of a big brown bat in Nova Scotia exists (Hebda 2006, cited in Moseley 2007a), but this species has recently been shown to overwinter and breed in New Brunswick (MacAlpine *et al.* 2002).

Big brown bats appear to be habitat generalists when foraging (Furlonger *et al*. 1987, Krusic and Neefus 1996) and are often seen foraging around streetlights (Geggie and Fenton 1985, Furlonger *et al*. 1987). They eat a wide variety of insects. Some reports say they specialize on Coleoptera (beetles) (Hamilton 1933, Phillips 1966, Whitaker 1972, Black 1974, Griffith and Gates 1975, Brigham and Saunders 1990, Whitaker 1994, Hamilton and Barclay 1998), while others have found they also feed on Diptera (true flies) and Hemiptera (true bugs). Moths are less often eaten by big brown bats (Whitaker *et al*. 1977, Whitaker *et al*. 1981, Warner 1985, Hamilton and Barclay 1998). Menzel *et al*. (2005) reported this species as being more active above the forest canopy rather than within or below it, suggesting this species prefers to forage in more open areas.

This species appears to use a wide range of habitats for rearing young. Throughout their range, big brown bats have been reported to form maternity roosts in natural habitats such as hollow trees (Barbour and Davis 1969, Brigham 1991, Vonhof 1996, Vonhof and Barclay 1996, Kalcounis and Brigham 1998) and rock crevices (Brigham 1988, cited in Kurta and Baker, 1990), to unnatural ones such as buildings (Rysgaard 1942, Davis *et al*. 1968, Brigham and Fenton 1986), storm sewers (Goehring 1972) and specially-made bat houses (Brittingham and Williams 2000). Females in eastern North America usually give birth to two young (Barbour and Davis, 1969). Little is known about the summer roost preferences of males and non-reproductive females (Agosta 2002).

Big brown bats do not appear to make seasonal migrations (Davis *et al*. 1968, Mills *et al*. 1975). In winter, they may hibernate in buildings, rock crevices, caves or mines (Fenton 1972, Lausen and Barclay 2006), and will select areas with good air circulation (Raesly and Gates 1987).

However, Whitaker and Gummer (2000) have suggested that this species originally hibernated in hollow trees trunks, and that this preference has been transferred to attics of heated buildings. They also suggest that this species may be spreading northward due to the increased prevalence of this relatively new type of hibernaculum.

2.2 RESEARCH STUDIES ON BATS IN NOVA SCOTIA AND THE MARITIMES

Then majority of recent research on bats in Nova Scotia and the rest of the Maritimes has been conducted by the research lab of Dr. Hugh Broders at St. Mary's University, in Halifax. Distribution studies have provided valuable information on species status, and the spatial and temporal patterns of activity of bats in southwest Nova Scotia (Broders *et al.* 2003) and the summer distribution and status of the bats of Prince Edward Island (Henderson *et al.* 2009). Broders has also published research on various aspects of using ultrasonic bat detecting equipment (Broders *et al.* 2004, Broders 2003).

Dr. Broders and his students have also published research on topics such as social networks of female northern long-eared bats (Patriquin *et al.* 2010), roost behavior and selection of northern long-eared bats (Garroway and Broders 2007, 2008) and little brown bats (Broders and Forbes, 2004), and studies on ectoparasites of bat species (Poissant and Broders 2008). Other projects have examined the effects of forest loss on bats species distribution (Henderson *et al.* 2008) and movements and resource selection of the northern long-eared bat in forest-agriculture landscapes (Henderson and Broders 2008).

Max Moseley, a research associate at the Nova Scotia Museum of Natural History, has also published various articles on caves and cave fauna of the Maritimes, including some relevant to bats (*i.e.* Moseley 2007a). He has also recently prepared a summary of bat records at cave and mines in Nova Scotia (Moseley, 2007b).

3.0 POTENTIAL INTERACTIONS BETWEEN WIND FARMS AND BATS

Bats are vulnerable wind turbine impacts similar to birds, for which the potential impacts of wind turbines have long been recognized and studied (Johnson *et al.* 2002, Erickson *et al.* 2002, Anderson *et al.* 2004). In recent years, however, impacts unique to bats have been recognized, and the issue of wind power and bat impacts has been receiving considerable attention (Arnett *et al*. 2008, Kunz *et al.* 2007a and 2007b, Johnson *et al*. 2003, Barclay *et al* 2007, Baerwald *et al*. 2008, Baerwald and Barclay 2009, Horn *et al.* 2008). It has lately been recognized that, in general, mortality at wind turbines is much more an issue for bat compared to birds (Barclay *et al*. 2007). Since bats tend to be nocturnal, their presence near wind turbines is not as easily noticed as birds which fly only during the day. Furthermore, they may have been less of a concern, from a conservation standpoint, due to the commonly held negative perception of them. At least 11 species have been found dead at U.S wind turbines (Illinois Department of Natural Resources 2007), including all seven species reported to occur in Nova Scotia.

3.1 TYPES OF IMPACTS

Potential impacts on bat species include both direct effects (such as death of individuals related to project infrastructure and activities), and indirect impacts (i.e., loss and/or alteration of habitat). The significance of an impact depends on the degree of impact to individuals, the number of bats impacted, and the vulnerability of the species. While many of the impacts to birds can be extrapolated to bats, recent evidence has suggested that bats may also be impacted via different mechanisms than birds. Three main types of potential impacts to bats are discussed in the following subsections.

3.1.1 Collisions

Like birds, there is a potential risk to bats from collisions with operating wind turbines. Bats have been shown to be killed by the collision with the turning rotor blades of turbines (Horn *et al.* 2004). The reasons for these collisions remain unclear. As bats are thought to detect moving objects better than stationary ones (Jen and McCarty 1978), their relatively high fatality rate is poorly understood. While bats have been shown to fly and feed in close proximity to the wind turbines (Ahlen 2003, Horn *et al.* 2008) via radar, echolocation is relatively ineffective at distances greater than 10m for most bats species, so bats foraging around turbines may fail to predict rotor velocity or to detect the large rapidly moving turbine blades (Ahlen 2003). There is nothing in a bat’s natural habitat which is comparable to a turbine, so they may not recognize it as a threat.

Results of different studies have suggested that turbines may attract bats in one way or another, leading to increased risk of collision. For example, it has been postulated that land clearing for construction of access roads, turbine foundations, and power transmission lines might attract bats by mimicking natural linear landscape features, such as natural forest edges, along which foraging and commuting bats may regularly travel (Kunz *et al*. 2007b). Several authors have suggested that tree-roosting bats may mistake the turbine monopoles for roost trees and fly into the rotor blades (Ahlen 2003, von Hensen 2004, cited in Baerwald *et al.* 2008). Cryan (2008) suggested that tree bats collide with turbines while engaging in mating behaviors that center on the tallest "trees" in the landscape, or in this case, the turbines.

Many other hypotheses involve the attraction of insects. Turbines are often situated at the highest points in the landscape, where some flying insects tend to gather (''hilltopping'', see Thornhill and Alcock 1983), potentially attracting foraging bats. Published studies in North America reveal a surprising lack of correlation between local landscape features and fatalities at wind energy sites (Arnett *et al*. 2008). An example is the relatively high fatality rates of bats reported from sites in open, treeless, relatively unmodified landscapes, such as Alberta (Baerwald *et al*. 2008). Other authors have suggested that insects may be attracted to aviation lights or the warmth (Ahlen 2003, von Hensen 2004 cited in Baerwald *et al.* 2008) or color of turbines, in turn drawing in hungry bats (Kunz *et al*. 2007b). It has also been suggested that the clearing of treed areas around turbine sites creates habitat conducive to the aerial insects which most bats feed upon (Grindal and Brigham 1998, von Hensen 2004 cited in Baerwald *et al.* 2008), thereby indirectly attracting foraging bats (Limpens and Kaptyen 1991, Verboom and Spoelstra 1999, Menzel *et al.* 2005).

3.1.2 Barotrauma

Recent evidence has come to light which indicates a threat to bats not considered significant to birds. It has long been recognized that spinning turbine blades create vortices at the turbine blade tips, causing rapid changes in atmospheric pressure as the rotor blades rotate downward. The decompression hypothesis suggests that bats are killed by lung injuries (barotrauma) due to the rapid reductions in air pressure near the moving turbine blades (Dürr and Bach 2004, von Hensen 2004, both cited in Baerwald *et al.* 2008). This rapid change in air pressure causes damage to bat lungs, resulting in death. Evidence for this effect, known as barotrauma, comes from the fact that some bats killed at wind turbines show no sign of external injury, but necropsies have shown signs of internal organ damage consistent with decompression (Baerwald *et al*. 2008). Baerwald *et al.* (2009) provided the first evidence that barotrauma is the cause of death in a high proportion of bat deaths around a wind turbine. Their study found that 90% of all bat fatalities (nearly half of which showed no external injury) at a wind turbine in Alberta involved internal hemorrhaging consistent with barotrauma, and that direct collision with turbine blades only accounted for 50% of fatalities. The faster a turbine blade is spinning, the greater the pressure drop in the vortex. Modern turbines blades reach speeds of 55-80 m/s, resulting in pressure drops of 5-10 kPa, sufficient to cause serious damage in small mammals (Dreyfuss *et al*. 1985). It appears that birds, with their unique respiratory systems of compact, rigid lungs, are less susceptible to barotrauma than mammals, which have larger, more pliant lungs (Baerwald *et al.* 2009).

3.1.3 Disturbance/ Noise Impacts

During the construction and operational phases of wind projects, bats may also be impacted by a variety of disturbances, such as noise emitted by the turbines. It is possible that turbine noise could affect bat foraging. As bats use ultrasound (20 kHz and up) for echolocation of prey, there could potentially be interference with foraging activities, if the sounds from the turbine cover the frequencies that bats use for echolocation. The frequencies and volume of sound in the 20 – 60 kHz range are of particular interest. Sounds emanating from wind farms could potentially result in bats avoiding the area; conversely, though, they may attract bats to the turbines (Keeley *et al*., 2001, Schmidt and Joermann 1986), potentially increasing the risk of collisions. Since bats have been found to forage at distances as close as 1 m from a moving turbine blade (Bach *et al*., 1999, in Keeley *et al*., 2001), it appears unlikely that bats would avoid a wind farm because of noise. They have been shown via thermal imaging to fly and feed in close proximity to the wind turbines (Ahlen 2003, Horn *et al*. 2004). Erickson *et al*. (2002) stated there is no impact of turbine noise on echolocation of bats.

Increased human presence in a formerly undisturbed area on a regular basis could potentially affect bats. Since bats are nocturnal, it is not likely that foraging would be negatively affected by the infrequent presence of humans during the day. Construction, turbine inspections, maintenance and general visits to the wind farm would only occur during the day. However, such daytime disturbance near roosting sites could have an effect on roosting bats (Garcia *et al*., 1995) and could lead to abandonment of summer roosts. Disturbance of bats from roosting areas is discussed further in the Habitat Loss and Modification section.

3.1.4 Habitat Loss and Modification

Worldwide, habitat loss has been identified a main cause of declines in bat populations (Mickleburgh *et al*. 2002). Bats need several types of habitat to survive. These are 1) foraging areas, 2) summer roosting areas, and 3) hibernation areas. Loss or alteration of any of these habitats types can have impacts on bats. Wind power developments can potentially impact these crucial habitats in a variety of ways.

Tree clearing activities remove or alter foraging and roosting sites, and detrimental to local bat populations (Waldien *et al*. 2000a and 2000b, Hayes 2003, Humphrey 1982). This can also affect bat species which hibernate in hollow trees or on the ground. In particular, removal of large diameter snags and/or hollow trees can be detrimental to maternity colonies and local populations (Brigham *et al.* 1997; Waldien *et al*. 2000*a*, 2000*b*). Alteration or degradation of riparian areas could also affect foraging habitats. Replacement of mature forest areas with younger regenerating forest can also affect bats. Broders and Forbes (2004) noted that in New Brunswick, roost selection by male little brown bats appeared highly dependent on the number of snags (dead trees) in the area.

Other impacts to foraging areas are less direct. Pesticide use, intended to kill insects, results in fewer insects or bats to feed on (Clark 1981, cited in Miller *et al.* 2005) and may poison bats (Henny *et al*. 1982) and cause declines in bat populations (Cockrum 1970, Geluso and Altenbach 1976, Clark and Kroll 1977).

3.2 IMPACT VARIABLES

Environmental and behavioural factors that may influence the nature and severity of potential impacts of wind turbines on bat populations include season, species behaviour and meteorological conditions.

3.2.1 Season

It has been observed that few fatalities of bats occur at wind turbines during spring, when long-distance migrant bats species are likely migrating to summering areas. Instead, most are documented during late summer and autumn, during migration (Arnett *et al*. 2008, Bach and Rahmel 2004, Cryan and Brown 2007, Johnson 2005). Reviews of bat fatality data (Arnett *et al*. 2008, Erickson *et al*. 2002) have found that bat fatalities, although highly variable and periodic, consistently peak in late summer and fall, coinciding with migration of lasiurines and other species. A few exceptions have been observed, such as documented fatalities of pregnant female Brazilian freetailed bats (*Tadarida brasiliensis*) in May and June at a facility in Oklahoma, USA (Piorkowski, 2006, cited in Arnett *et al.* 2008) and female silver-haired bats during spring in Tennessee, USA (Fiedler 2004, cited in Arnett *et al.* 2008), and Alberta (Brown and Hamilton 2002, 2006a, 2006b)

Fall also corresponds with the mating season of bats. This is discussed further in the following section on behaviour.

3.2.2 Behaviour

Bat species exhibit a wide range of behaviors, including differences in winter behaviour, roost selection (tree vs. cave vs. buildings) and prey preferences. They also forage at different heights, and may migrate at different heights, though specific behaviors of migrating bats are very poorly known. Differences in behavior patterns of bat species appear to strongly affect their risk of wind turbine impacts. Many studies have shown that turbine risk for migratory bats is greater than for resident non-migratory bats (Keeley *et al.* 2001; Erickson *et al.* 2002). Bat species most affected by turbines also tend to undertake long-distance, latitudinal migrations (Cryan 2003). These species also tend to be tree bats, which rely heavily on trees for roosting (Griffin 1970) and are the species most consistently affected by wind turbines, both in terms of overall numbers and geographic distribution. In North America, migratory tree bats have been shown to account for 75% of documented fatalities to date, of which about half are hoary bats (Arnett *et al*. 2008). Examination of some fatality data also suggests biases between sexes, with adult males dominating samples for several affected species in North America (Arnett *et al*. 2008).

It has been suggested that the increased risk to migratory bats may be because they rely on sight more than echolocation while migrating (Curry and Kerlinger 2005, Van Gelder 1956 in Keeley *et al.* 2001). Long distance migrants such as hoary or red bats (*Lasiurus* spp.) may be more likely to fly through open areas, and to fly at heights that would bring them into contact with turbine blades or cables used for anchoring turbines or communication towers, than short distance migrants such as *Myotis* spp. (Keeley *et al.* 2001). Very little is known about the specific behaviors of bats during migration (Cryan and Diehl 2009).

It has also been suggested that migratory tree bats may migrate by following landscape features such as windy places such as mountain ridges, passes, coastal areas, and river valleys (Cryan and Diehl 2009, Furmankiewicz and Kucharska 2009), all places where wind turbines tend to be built. Baerwald and Barclay (2009) found that autumn activity and fatality of migrating species in Alberta is concentrated near the foothills of the Rocky Mountains, suggesting that migrating bats follow particular routes on their way south. However, other studies in North America reveal a surprising lack of correlation between local landscape features and fatalities at wind energy sites (Arnett *et al*. 2008). In addition, reports of relatively high fatality rates of bats at sites in open, treeless, scarcely modified landscapes such as in Alberta (Baerwald *et al*. 2008) suggest that this does not explain all patterns, if any.

Many of the species affected by wind turbines engage in mating activity during the same period when their carcasses are found in the greatest numbers beneath turbines (Cryan 2008). Little is known of the specifics of bat mating; most bat species mate in fall during swarming events at hibernacula.

Cryan and Brown (2007) have suggested that the dominance of migratory tree bats among summer and fall turbine fatalities is related to flocking and mating behaviors exhibited by tree bats, which may be attracted to, and use, tall prominent landscape features as meeting locations. This is supported by the idea that flocking behavior in migratory bats during migration increases the chance of finding mates (Cryan 2008, Fleming and Eby 2003). Male and female adult hoary bats have been shown exhibit different geographical distributions during spring and summer (Findley and Jones 1964, Cryan 2003), but they reunite during fall migration to wintering grounds (Cryan 2003). The mating hypothesis also explains why adult bats dominate fatalities, not juveniles as would be expected if fatalities were due to juvenile inexperience.

Though there is a risk of fatal collisions with turbines when any bats are present, most published reports show that mortality of resident bats is generally low, though numbers may vary with the location of the wind farm. Many studies have shown that resident species tend to be killed at wind turbines less frequently than migratory species, even in areas where the resident species are common throughout the summer (Arnett *et al*. 2008, Johnson *et al*. 2003, Kunz *et al*. 2007b). Erickson *et al.* (2002) stated that the collision risk for resident breeding bats is virtually nil, resulting in no apparent impact on resident breeding bats. Collision risk is low because bats generally forage below 25 m height (Erickson *et al.* 2002), below the height of most turbine blades, however bats will occasionally fly to the height of the blades. A review by OMNR (2006) stated that general observations to date indicate that bats do not typically collide with the stationary turbine towers, transmission structures, guy wires, or meteorological towers (i.e., stationary structures) associated with wind turbines.

3.2.3 Meteorological conditions

Fatality rates of bats at turbines often increase with the passage of storm fronts (Arnett *et al*. 2008). These observations, combined with the fact that most fatalities occur during a few weeks in late summer and autumn, suggest that migrating bats may utilize certain weather conditions during late summer and autumn that put them at risk (Cryan and Barclay 2009). Almost nothing is known about the effects of weather on the behavior of most migrating bat species (Cryan and Brown 2007).

Cryan and Brown (2007) found evidence to suggest that hoary bats may be more likely to arrive on remote islands with passing storm fronts in autumn. They also found that relatively low wind speeds, low moon illumination, and relatively high degrees of cloud cover were important predictors of bat arrivals and departures. Low barometric pressure also aided in predicting arrivals.

There is also considerable evidence that bat fatality rates at turbines are affected by wind speed. More bats appear to be killed on nights exhibiting low wind speeds, perhaps due to increased food insect availability on calmer nights (Fiedler 2004, and von Hensen 2004, both cited in Baerwald *et al.* 2009; Arnett *et al*. 2008, Horn *et al*. 2008). Arnett *et al*. (2008) suggest that at facilities where collision fatalities are prevalent, curtailing operations on calm nights (wind speeds below 6 m/sec), particularly in the late summer and fall migration period, could substantially decrease mortality.

4.0 BAT SURVEY METHODOLOGY

4.1 REVIEW OF AVAILABLE DATA

The baseline bat monitoring survey began with a detailed desktop review of existing data. As the Nova Scotia Department of Environment (NSE) regards wind farm sites within 25 km of a known bat hibernaculum as having ‘very high’ site sensitivity (NSE 2009), it is imperative to determine whether the bat hibernacula are known to occur within this radius.

A review of geological mapping of the area was conducted to determine the likelihood of possible bat hibernacula, in the form of natural caves. NSDNR’s Mine Openings database was also consulted to determine if there are abandoned mines in the area which could also serve as hibernacula. As many parts of Nova Scotia including eastern Cape Breton have historically supported various types of mining activities, a review of the geology and mining history of the site can be beneficial in determining the likely presence of natural caves and/ or abandoned mines.

Bat species occurring in Cape Breton were discussed with NSDNR Regional Biologist Terry Power based in Coxheath. Discussions were also held with Dr. Hugh Broders of Saint Mary’s University.

4.2 ACOUSTIC SURVEYS

Electronic detection of bats has advanced considerably in recent years, enabling researchers to detect and monitor bats without capturing bats with mist nets. The Anabat SD2 detector, manufactured by Titley Scientific, is a well known monitoring system used throughout North America to identify and survey bats by detecting and analyzing their echolocation calls (Photo 4.1). The Anabat system is a passive detection system that monitors bat activity without human presence and intervention. It consists of a bat detector, a ZCAIM (Zero-Crossings Analysis Interface Module) and software. The Anabat detector unit contains an ultrasonic microphone, an electronic amplifier, and a digital signal divider. The bat detector will produce an audible output from the inaudible ultrasonic echolocation signals produced by the bats. The ZCAIM is an interface that is used to read the Anabat recorded data on a computer, and the software is used to present the data in a useable format. In the Anabat SD2 system used in the present study, the ZCAIM records data directly onto a compact flash card, which is then used to transfer data to a computer.

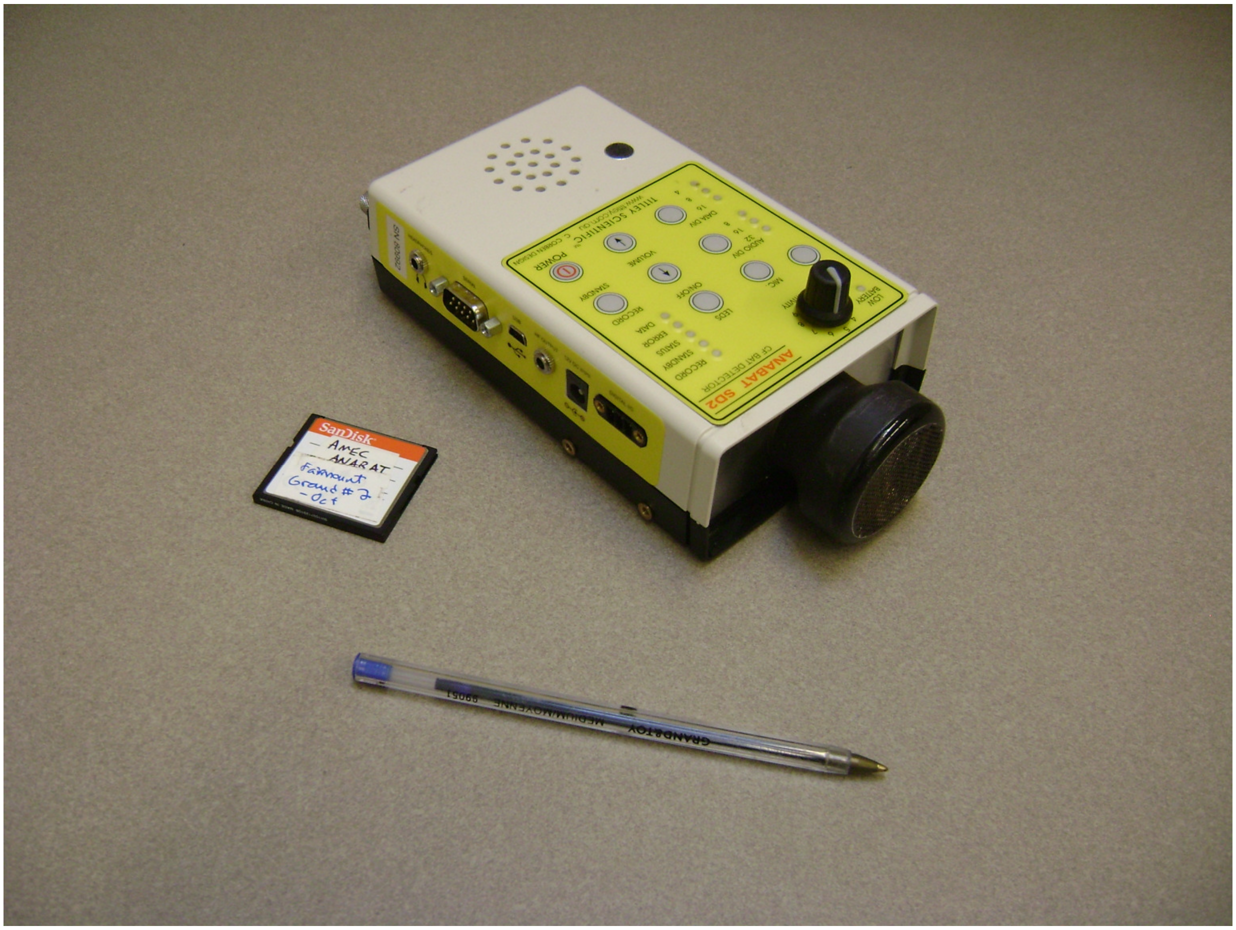


Photo 4.1. Anabat SD2 acoustic bat detector and compact flash card.

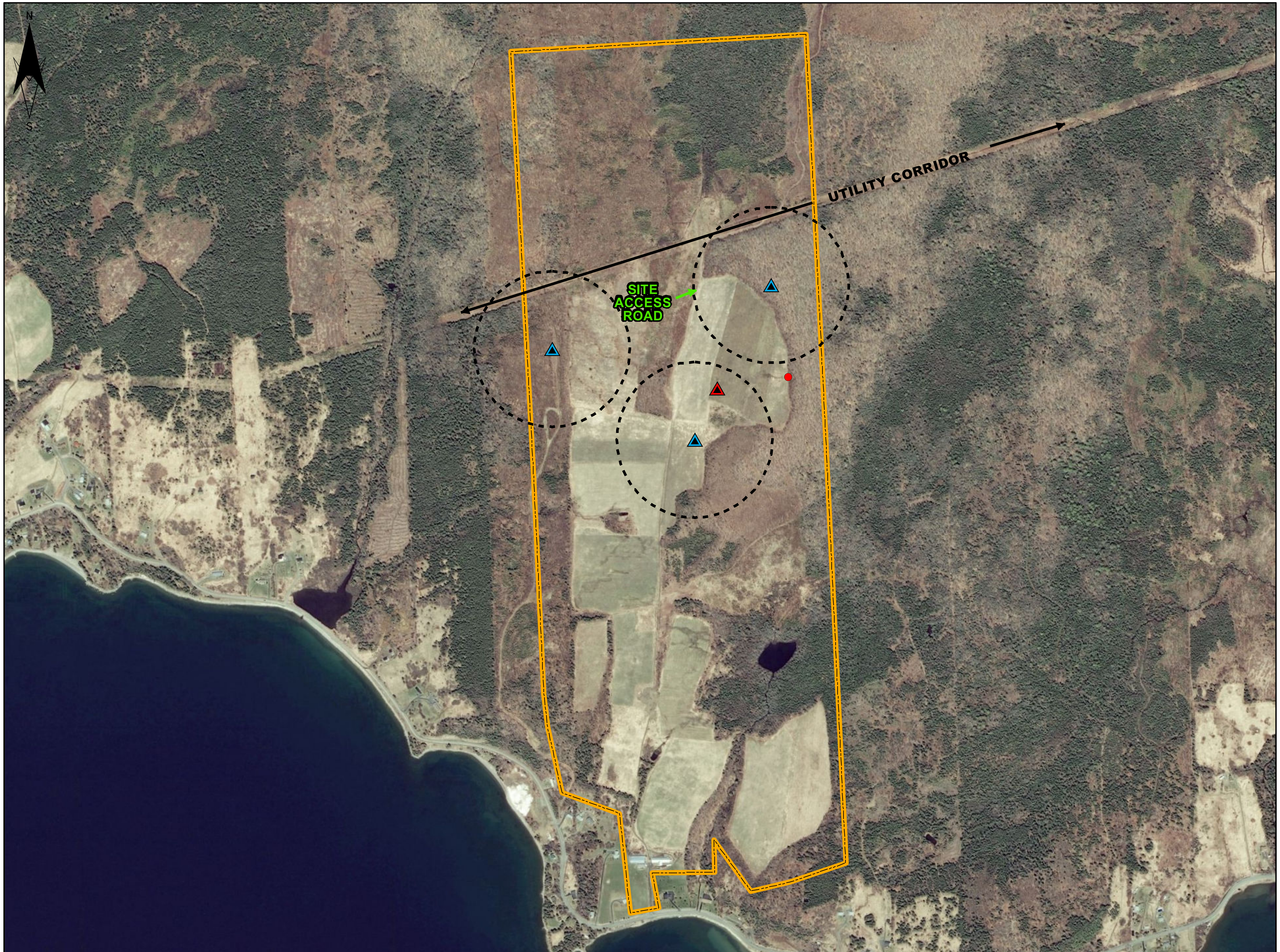
Weller (2002) noted that there is a considerable variability in signals recorded by Anabat detectors depending upon their orientation. Based on Weller's research, it was determined that multiple bat detectors should be deployed; although two detectors may record the same individuals, the redundancy will enable continued detection in the event one system fails due to battery depletion, weather events, or animal disturbance. Efforts must be made to ensure continuous detection for a complete picture of potential bat activity.

Based on previous acoustic bat surveys conducted by AMEC, it was decided that an aerial detector elevated 10 m above ground surface would be set to detect bats along the tree line at the edge of the cleared site, to permit detection of bats foraging near the tree canopy at the edge of the clearing and detect bats that may be migrating above the canopy. A second ground-based system was set to detect bats that forage on low flying insects in cleared areas. Use of the dual acoustic systems with a combination of ground and aerial orientation would provide effective cross coverage and ensure redundancy in the event one system failed due to battery failure or disturbance.

For the aerial detector, AMEC erected a pole at the edge of the cleared site adjacent to the treeline (see Figure 4.1, Photo 4.2). The microphone assembly pointed northward, and parallel to the tree line to allow sampling of the forest edge. A high-sensitivity Anabat microphone was mounted on an extension cable and secured to a 10 m length of 1.25 inch diameter galvanized steel pipe, within a tubular waterproof plastic housing which was sealed around the cable at the base. The microphone faced downwards within the housing, and a plate angled at 45° from horizontal reflected incoming sounds into the waterproof housing. This allowed sampling of a horizontal section of the sky at treetop height. The tower was constructed with a cantilevered base, allowing it to be raised and lowered as needed. A microphone extension cable ran down the pole to the main body of the detector, which was placed in a waterproof housing at the base of the pole, along with the power supply. The waterproof housing was covered in green plastic to minimize visibility and potential vandalism.

The ground-based detector was elevated slightly off the ground by placing it on top of the housing for the aerial unit, and its waterproof housing was fitted with a microphone tube which allowed sampling of a section of the sky approximately 45° upwards from horizontal. The ground-based detector was situated at right angles to the aerial system to maximize detection area.

The two systems were deployed on August 23, 2012 and remained in operation until October 11, and the detectors were programmed to record all ultrasonic sounds between 7 pm and 7 am. The units were frequently checked (approximately weekly) to download data, check batteries, and verify that the system was intact and functioning properly. Coordinates (UTM NAD83) were 704571 E, 5124726 N. The location of the bat monitoring systems is shown on Figure 4.1.



The map shown here has been created with all due and reasonable care and is strictly for use with AMEC Project Number: TV121030.2000.
This map has not been certified by a licensed land surveyor, and any third party use of this map comes without warranties of any kind.
AMEC assumes no liability, direct or indirect, whatsoever for any such third party or unintended use.

Path: F:\TV121030\MXD\20130125_BatMonitorLocation_Fig5_1.mxd User: tanya.morehouse, Date: 28/01/2013 SOURCE: BING Aerial Maps

TITLE:

FIGURE 4.1
BAT MONITORING LOCATION

PROJECT:

PROPOSED HILLSIDE BOULARDERIE WIND FARM

CLIENT:

Natural Forces Wind Inc.

1791 Barrington Street Suite 1030
Halifax, Nova Scotia
Canada B3J 3L1

LOCATION:

HILLSIDE BOULARDERIE, NOVA SCOTIA

AMEC PROJECT NO: **TV121030.2000**

DATE: **January 25, 2013**

DATUM: **NAD 1983**

PROJECTION: **UTM Zone 20 North**

LEGEND:

- Bat Monitoring Location
- Hillside Met Mast Location
- Proposed Turbine Sites (June 2012)
- Turbine 200m Buffer
- Property Boundary

200 100 0 200
Meters
1:10,000

AMEC Environment & Infrastructure
50 Troop Avenue, Unit 300
Dartmouth, N.S., B3B 1Z1
(P) 902-468-2848 (F) 902-468-1314

Photo 4.2. Pole erected on site for aerial Anabat system, showing detail of cleared area and forest edge.

4.2.1 Anabat Data Format and Analysis

While deployed at the site, the Anabat SD2 detectors recorded all ultrasonic frequencies detected onto a compact flash card. These data were then interpreted via AnalookW software (version 3.7w) using zero-crossing analysis. All ultrasonic frequencies recorded were then displayed graphically as sonograms, and bat echolocation sequences were identified based on the minimum, maximum, and characteristic frequencies, in addition to the slope of the calls (O'Farrell *et al.* 1999). Sequences were identified to species using the Analook W software and published information on the calls of bat species native to eastern North America (Barclay 1989, Barclay *et al.* 1999, Betts 1998, Broders *et al.* 2001, Fenton and Bell 1981, Fenton *et al.* 1983, MacDonald *et al.* 1994). It should be noted that bats of the genus *Myotis* (including little brown bat and northern long-eared bat) cannot reliably be distinguished using these acoustic survey methods.

5.0 SURVEY RESULTS

5.1 REVIEW OF AVAILABLE DATA

Within 25 km of the Project site, there are more than 600 known mine openings according to the Nova Scotia Abandoned Mine Openings (AMO) Database (NSDNR, 2013). None of these mine openings correspond to caves known to support bats in Nova Scotia, as summarized by Moseley (2007a and 2007b). Total measured depths of most of the mine openings are not provided; however, two of the openings have a measured depth of ten metres or more. The original depths of some of these openings were much greater, but according to the records, the majority have been filled or sealed for public safety (NSDNR, 2013).

Discussions with Dr. Hugh Broders and NSDNR Regional Biologist Terry Power indicate that there are no known bat hibernacula in the immediate area of Hillside Boularderie. According to Terry Power, there is a small hibernaculum in an abandoned mine located approximately 13 km south of the project site; in a winter 2012 survey, fewer than 20 individuals were counted. Dr. Broders states that observations of significant swarming activity suggest a possible hibernaculum near Donkin, approximately 35 km east of the project site, and there have been reports of at least two other minor hibernacula (10 - 100 bats) in Cape Breton: the one in Coxheath described above, and another near Louisbourg, more than 40 km to the southeast of the project site.

Bats are also known to hibernate in natural caves or caverns associated with Karst topography. Karst, a unique landscape feature caused by dissolution of calcareous sedimentary rock, has the potential to develop caverns and sinkholes suitable for bat hibernation. Karst-prone bedrock types (gypsum, limestone, sandstone and shale) are common around Cape Breton Island (Moseley 1996), with gypsum cliffs occurring around parts of the Bras d'Or Lakes, and natural caves near Cape Dauphin, approximately 15 km to the northwest of the project site.

5.2 ANABAT DATA

The two Anabat units were deployed for a total of 50 nights, from August 23 to October 11. Due to battery failure, the units did not record for a full 12 hours (7:00 pm to 7:00 am) on all nights; the total monitoring time for each unit was 255 hours and 42 minutes. Heavy wind and rainfall hampered data collection by causing interference in the acoustic files on some nights; in particular, September 5, 9, 10, 22 and 23.

For the aerial unit, a total of 879 bat echolocation sequences were recorded (Table 5.1), for an average of approximately 3.4 sequences per hour of monitoring. The number of bat echolocation sequences recorded per night ranged from 0 to 171, and based on analysis, all were made by *Myotis* species.

Similar results were seen for the ground-based unit. Bat activity was recorded on most nights, and a total of 1135 *Myotis* sequences were recorded for an average of 4.4 sequences per hour, with up to 175 sequences recorded in a single night. The number of calls each night was similar for the two detectors, which suggests that the same bats were frequently being detected by both units.

Table 5.1: Number of bat echolocation sequences detected per night by Anabat systems deployed at proposed Natural Forces wind turbine site in Hillside Boularderie

Evening Of	Time Recording (h:mm)	Number of *Myotis* spp. Sequences	
		Aerial Unit	Ground Unit
23-Aug-12	12:00	171	175
24-Aug-12	12:00	62	73
25-Aug-12	12:00	54	59
26-Aug-12	12:00	22	28
27-Aug-12	12:00	49	83
28-Aug-12	12:00	36	81
29-Aug-12	12:00	24	26
30-Aug-12	12:00	53	53
31-Aug-12	10:38	42	54
1-Sep-12	3:15	6	2
2-Sep-12	4:33	30	24
3-Sep-12	3:58	7	11
4-Sep-12	3:59	22	16
5-Sep-12	1:32	0	0
6-Sep-12	2:21	25	21
7-Sep-12	2:09	11	12
8-Sep-12	12:00	33	57
9-Sep-12	12:00	19	43
10-Sep-12	12:00	34	64
11-Sep-12	12:00	26	30
12-Sep-12	12:00	25	26
13-Sep-12	12:00	20	16
14-Sep-12	12:00	17	37
15-Sep-12	9:33	41	70
16-Sep-12	6:03	3	5
17-Sep-12	3:59	5	10
18-Sep-12	4:10	1	2
19-Sep-12	2:27	3	4
20-Sep-12	2:04	5	9
21-Sep-12	2:29	11	20
22-Sep-12	2:10	4	6
23-Sep-12	2:01	3	3
24-Sep-12	1:43	9	8
25-Sep-12	1:11	0	0
26-Sep-12	0:54	0	0
27-Sep-12	0:40	0	0
28-Sep-12	0:38	0	0
29-Sep-12	0:27	1	2
30-Sep-12	0:17	2	2
1-Oct-12	0:40	3	3
2-Oct-12	0:12	0	0
3-Oct-12	0:27	0	0
4-Oct-12	0:10	0	0
5-Oct-12	0:18	0	0
6-Oct-12	0:08	0	0

7-Oct-12	0:25	0	0
8-Oct-12	0:02	0	0
9-Oct-12	0:02	0	0
10-Oct-12	0:05	0	0
11-Oct-12	0:02	0	0

The ACCDC database has records for just one bat species in Cape Breton, the little brown bat (ACCDC, 2012). However, the Dr. Hugh Broders-led research team has capture records of three additional species; the northern long-eared bat is believed to be a year round resident (along with the little brown bat), and hoary and eastern red bats are likely transient, at the northern extent of their range. The habitat of the site is suitable for northern long-eared bats, and could potentially support maternal colonies (Broders, personal communication).

A decrease in bat echolocation sequences as the fall season progresses is typical of the seasonal behaviour of *Myotis* species in Nova Scotia, and although the recording time in the last nights of the survey was very short, it is unlikely that many bats were missed on those dates. Overall, the data suggest a moderate to high level of *Myotis* bat activity on the Natural Forces site.

6.0 ANALYSIS

6.1 POTENTIAL IMPACTS

Both migratory and resident bat species are known to occur in Nova Scotia. Migratory tree bat species present in Nova Scotia include hoary bats, eastern red bats, and silver-haired bats. Resident bat species in Nova Scotia include the little brown bat and northern long-eared bats; though these species may travel a few hundred kilometers to hibernacula (Davis and Hitchcock 1965) they are not considered long-distance migrants. The tricoloured bat, while it may be characterized as a tree bat (Findley 1954, Veilleux *et al*. 2004), is considered a resident species in Nova Scotia as it hibernates in the province (Broders, unpublished). According to the results of an ACCDC search for rare species observations within 100 km of the project area, which encompasses almost all of Cape Breton Island, only little brown bats are known to occur in the area (ACCDC 2012); however, there has been little research in the area compared with mainland Nova Scotia.

All of the bat echolocation sequences recorded with the ground and aerial detectors at the proposed Natural Forces wind farm site are attributable to one of the two *Myotis* species widespread in Nova Scotia (little brown bat and northern long-eared bat). While the habitat on the site is more typical of that preferred by the northern long-eared bat, little brown bats are more common in the region, so it is likely that both species are present.

Impacts from the proposed wind turbines on the two resident *Myotis* species are expected to be low. Though there is a risk of fatal collisions with turbines when any bats are present, most published reports suggest that mortality of resident bats is generally low, though numbers may vary with the location of the wind farm. Many studies have shown that resident species tend to be killed at wind turbines less frequently than migratory species, even in areas where the resident species are common throughout the summer (Arnett *et al*. 2008, Johnson *et al*. 2003, Kunz *et al*. 2007b). Erickson *et al.* (2002) stated that the collision risk for resident breeding bats is virtually nil, resulting in no apparent impact on resident breeding bats. Collision risk is low because resident bats generally forage below 25 m height (Erickson *et al.* 2002), below the height of most turbine blades, however bats will occasionally fly to the height of the blades.

Most bat researchers agree that the potential impact of wind turbines is greater to migratory bats than resident ones. No migratory tree bats were detected in this study, and it is believed that the migratory bats that have been found in Cape Breton are irregular and transient in the area (Broders, personal communication). Therefore, it is considered unlikely that migratory tree bats will pass through the Natural Forces study site area during the fall migratory period, when risk is considered highest. As all migratory tree bats reported in the province are considered to be at the northern limit of their geographic ranges, impacts from this project on migratory tree bats are predicted to be very low.

There is a very low likelihood that this project will have an impact on bat hibernating areas, as the *Myotis* species occurring on the site hibernate underground, in habitats which the project will not affect. None of the other bats species reported to occur in the province will lose any hibernating habitat due to this project.

Depending on how much additional land will be cleared, the project may cause loss of some foraging and roosting habitat on the Project site via clearing of treed areas. It may also cause minor disturbance of bats roosting on or near the project site, via construction and maintenance activities. Clearing of vegetation will add slightly to the cumulative effect of loss of bat habitat that is occurring throughout the province.

6.2 RECOMMENDATIONS

Based on above, there are likely to be some impact on bats in the vicinity of the project site. While impacts are not expected to be significant, mitigation measures should be taken to minimize potential effects. These are outlined in the following subsection.

6.2.1 Mitigation

Two main types of mitigation are recommended for this project. These are discussed in the following paragraphs.

Minimize Habitat Disturbance

The project should aim to disturb the existing habitat as little as is reasonably possible. To protect bat roosting areas it is recommended that the removal of forested areas, tall trees and snags be limited to the areas where it is absolutely necessary for project construction.

In addition, the timing of any clearing activities must consider bats. Avoidance of clearing and grubbing activities during the late spring and summer months (May 1 to August 30) will minimize impact to breeding and roosting bats potentially on the site.

To avoid poisoning bats or reducing their food supply, no pesticides should be used on the site.

Monitor for Fatalities

In previous wind farm developments, it has been recommended that monitoring of the turbines for bat strikes be carried out for at least two years during the construction and operation phase. In the first couple of years they should consist of full season surveys. Surveys should occur throughout the migration periods in spring and in late summer to early fall (i.e., April to May and August to September). Surveys should be conducted by a person with knowledge of bat identification, early in the morning around the bases of the turbines, extending outward from the base to a 50 m radius. If dead bats are found, they should be identified to species, photographed, given an identification number, collected, and provided to the NS Museum of Natural History. Information on the location and condition of all carcasses, the season, and of weather conditions the previous night should also be recorded. All fatality data must be submitted to both Nova Scotia Department of Environment and to NSDNR's Wildlife Division.

In consideration of the increased effectiveness of acoustic monitoring systems, and the potential for bat mortalities to occur undetected due to timeliness of surveys (bats carcasses taken by scavengers) and/or lack of trained monitors, it is suggested that consideration be given to an acoustic survey program with a randomized survey of bat mortality to augment and verify acoustic data.

Prior to initiation of bat monitoring surveys, the monitoring program shall be submitted to Nova Scotia Department of Natural Resources (NSDNR) and Canadian Wildlife Service (CWS) for their comment and approval. Should bat fatalities become an issue, Natural Forces Wind Inc. will work with NSDNR and CWS to seek advice and to determine acceptable methods of minimizing and mitigating any impacts.

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