February 7, 2017

Mr. Chris Veinot, EIT
Development Engineer
Natural Forces
1801 Hollis Street Suite 1205
Halifax, NS B3J 3N4

Dear Andy MacCallum

Re: Summary of 2016 Monitoring at Hillside-Boularderie Wind Farm

At the request of Natural Forces, Amec Foster Wheeler staff conducted the required post construction mortality monitoring for birds and bats as well as acoustic surveying for bats at the Hillside-Boularderie Wind Farm in Cape Breton County during the 2016 season. This letter provides a summary of the surveying activities.

Each monitoring component is discussed below.

Mortality Searches

Bird and bat mortality surveys involve regular searches around the base of turbines for any dead or injured birds or bats; such surveys identify the number of bats or birds killed per turbine over a known period of time. This value represents a minimum estimate of bat and bird mortality adjusted for carcass removal rates, the percent area surveyed, and searcher efficiency. In addition to these mortality searches, periodic scavenger trials are performed so that a correction factor may be calculated to account for underestimates in the mortality search results due to carcasses being taken by scavengers. Similarly, searcher efficiency trials are conducted so that a correction factor may be calculated to account for underestimates due to carcasses not being detected by the searcher(s). This report discusses the methodology and results of the mortality searches and scavenger trials that were conducted at the Hillside-Boularderie wind farm in 2016. The results of the searcher efficiency trials conducted in 2015 were used for the 2016 season. This was feasible since there was no change in survey location or survey team.

Amec Foster Wheeler conducted carcass surveys over the duration of the peak periods that bird and bat presence may be detected (May to October). The surveys were weighted to times to peak bird and bat migration periods, and spring breeding season for birds.

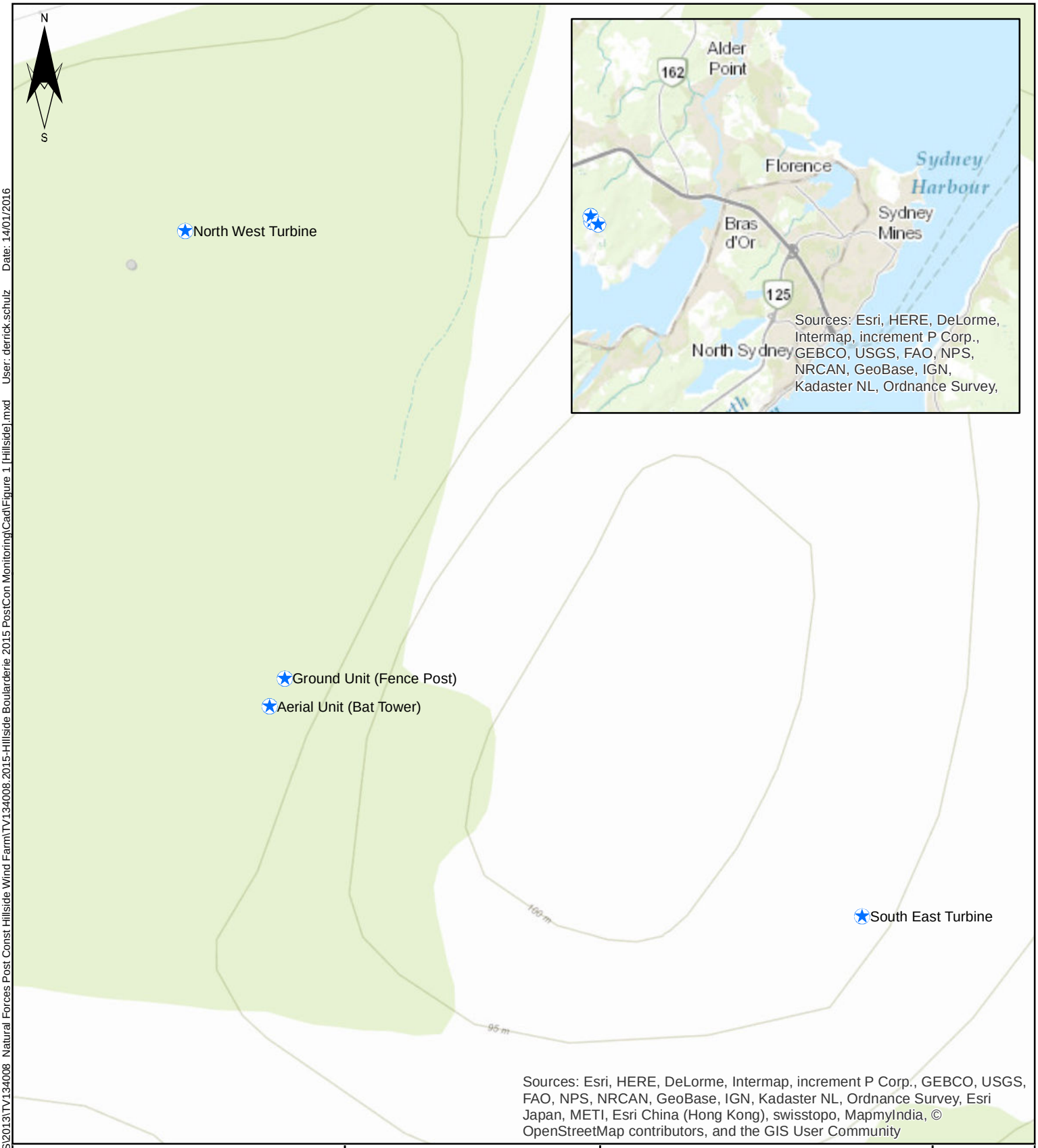
Weighting of field surveys was placed on the months of May, June, August, and September. Selection of survey dates was weather-dependent. Days with lower wind and favourable weather were chosen over those with high winds and rain.

The bird and bat mortality surveys involved regular searches around the base of turbines for dead or injured birds or bats. Such surveys identify the number of bats or birds killed per turbine over a known period of time (expressed as bats or birds/turbine/time). This value represents a minimum estimate of bat/bird mortality adjusted for bat/bird carcass removal rates, and searcher efficiency. Larger wind farms may also incorporate the percent area searched, however, the Hillside-Boularderie wind farm is small enough that the entire study area should be searched.

Based on previous work by the Ontario Ministry of Natural Resources (OMNR), the following recommendations were followed:

- Surveys were initiated in the morning at first light, prior to sunrise, to minimize losses due to scavengers.
- All carcasses found were photographed and recorded/labeled with species, sex, date, time, location (UTM coordinates), carcass condition, searcher name, injuries, distance to nearest turbine, ground cover and distance to plot centre. A data sheet sample should be provided in the mortality report.
- The condition of each carcass collected was recorded in one of the following categories:
    - **Intact** – a carcass that is not badly decomposed and shows no sign of having been fed upon by a predator or scavenger, although it may show signs of traumatic injury such as amputation from a turbine collision.
    - **Scavenged** – an entire carcass that shows signs of having been fed upon by a predator or scavenger or a partial carcass that has been scavenged, with portions of it (for example, wings, skeletal remains, legs, pieces of skin) found in more than one location.

No bat carcasses were found within either of the Hillside-Boularderie turbine footprints during the 2016 carcass search period (April 29 to October 15).



Path: \\hfx1-fs1\projects$\53300 PROJECTS\2013\TV134008 Natural Forces Post Const Hillside Wind Farm\TV134008.2015-HIllside Boularderie 2015 PostCon Monitoring\Cad\Figure 1 [Hillside].mxd User: derrick.schulz Date: 14/01/2016

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

SCALE:
20 10 0 20 40 60
Meters

PROJECT:
HIllside Boularderie
Wind Farm

DWN BY: DS
CHK'D BY: BC
DATE: January 2016
REV. NO: .
FIGURE NO: 1

amec foster wheeler
50 Troop Avenue, Unit 300
Dartmouth, N.S., B3B 1Z1
(P) 902-468-2848 (F) 902-468-1314
www.amec.com

DATUM: NAD83 CSRS
PROJECTION: UTM Zone 20 North
PROJECT NO: TV134008

TITLE:
General Site Location

Scavenger Trials

Scavenger efficiency trials were conducted at Hillside-Boularderie in late August, and late September. In the early morning, a total of 14 small animal carcasses (10 quail and 4 small brown mammals) were randomly placed around the two turbines by Amec Foster Wheeler staff who were conducting the mortality searches, and the location of the carcasses was recorded. Following carcass placement, daily early-morning searches were conducted by another Amec Foster Wheeler employee until all of the carcasses were gone or two weeks had passed. The presence or absence of each of the placed carcasses was confirmed, and if present, the condition of the carcass (e.g., intact, partially scavenged) was recorded.

Japanese Quail (*Coturnix japonica*) carcasses were obtained from a commercial quail producer in Moncton, NB. Although OMNR (2010) recommends that bat carcasses should be used for scavenger trials, neither of the two most common bat species in Nova Scotia, the Little Brown Bat (*Myotis lucifugus*) and Northern Long-eared Bat (*M. septentrionalis*), could be used due to concerns about white-nose syndrome contamination risks, so mice were used as a surrogate. Mouse carcasses were obtained from a pet supply store.

A Scavenger Efficiency Correction Factor was calculated for each trial, which allows for incorporation of losses due to scavenging into the carcass survey results. Proportions of carcasses remaining after each search interval are pooled to calculate the overall scavenger correction (S_c) factor (OMNR 2010), which is calculated as follows:

$$S_c = \frac{n_{visit1} + n_{visit2} + n_{visit3...}}{n_{visit0} + n_{visit1} + n_{visit2...}}$$

Where:
S_c is the proportion of carcasses not removed by scavengers over the search period
n_{visit0} is the total number of carcasses placed
n_{visit1} – n_{visit3} are the numbers of carcasses remaining on visits 1 through 3

Carcass persistence was very low during the initial scavenger efficiency trial in June, indicating high scavenging rates at the site. In the June/August and September trials, carcass persistence increased somewhat, but few carcasses remained after three visits. The scavenger efficiency correction factor at the Hillside-Boularderie site ranged from 0 to 0.46 (Table 1), while the mean for the site was 0.27.

Table 1. Scavenger efficiency at Hillside-Boularderie in 2016

Month	Number of Carcasses Placed	Sc
June	13	0.00
July/Aug	13	0.46

September	14	0.36
Sc Overall	14	0.27

Searcher Efficiency Trials

The results of the 2015 searcher efficiency trial were used for the 2016 season, since the same team conducted the mortality searches in both years, and the Project site remained the same. The 2015 trial took place on 21 September 2015. A total of 14 small animal carcasses (10 quail and 4 bat surrogates) were randomly placed by an Amec Foster Wheeler personnel around the turbines in locations unknown to the Amec Foster Wheeler employee conducting the mortality searches.

In order to minimize the risk of scavenging, carcasses were placed in the early morning, and searchers began surveying shortly after. When a carcass was found, the searcher recorded the species, turbine number and coordinates, and left the carcass in place for other searchers to find. Following the searcher efficiency trial, the person who placed the carcasses returned to the site to check whether the carcasses were still present and had not been scavenged during the searcher trial.

Searcher efficiency (S_e) for birds and bats for each searcher was calculated as follows:

$$S_e = \frac{\text{number of test carcasses found}}{\text{(Number of test carcasses placed - number of carcasses scavenged)}}$$

Since the number of turbines searched by each individual over the season will vary, it is necessary to calculate a weighted average that reflects the proportion of turbines each searcher searched. The weighted average or overall searcher efficiency is calculated as follows:

$$S_{eo} = S_{e1}(n_1/T) + S_{e2}(n_2/T) + S_{e3}(n_3/T)\ldots$$

Where:
S_{eo} is the overall searcher efficiency
S_{e1} and $_2$ and $_3$… are individual searcher efficiency ratings
n_1 and $_2$ and $_3$… are number of turbines searched by each searcher
T is the total number of turbines searched by all searchers

No test carcasses were scavenged during the trial, so searcher efficiency was simply the number of test carcasses found divided by the number placed. The percentage of birds (quail) found ranged from 60% to 80%, while for mice (surrogate for bats), the searcher efficiency varied considerably, reaching a high of 75% while one searcher did not succeed

in finding any of the mouse carcasses (Table 2). Overall, the searcher efficiency ranged from 43% to 79%, and the overall weighted average searcher efficiency (S_{eo}) was 61%.

Table 2. Searcher efficiency for birds and bats at Natural Forces sites

Searcher Name	Number of Searches	S_e for Birds	S_e for Bats	Total S_e	Overall S_{eo}
Beth Cameron	3	0.6	0	0.43	0.61
Jason Marsh	6	0.8	0.75	0.79	
John Krilow	2	0.6	0.25	0.50	
Maureen Cameron-MacMillan	6	0.6	0.5	0.57	

Acoustic Monitoring

Aerial System

On April 30, a dedicated 10 m bat survey tower was erected on the Hillside-Boularderie site, at the same location as in 2015. Coordinates were 704181 5124726 (UTM NAD 83) (Photo 3). The microphone assembly pointed parallel to the tree line to allow sampling of the forest edge. A high-sensitivity Anabat microphone was mounted on an extension cable and placed within a tubular waterproof plastic housing, which was then strapped to the top of the tower. The microphone faced downwards within the housing, and a plate angled at 45° from horizontal reflected incoming sounds upward into the waterproof housing. This allowed sampling of a horizontal section of the sky at approximate 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 Anabat SD2 bat detector unit, which was placed in a waterproof housing at the base of the pole, along with the power supply.

The Anabat SD2 was programmed to record all ultrasonic sounds between 7 pm and 7 am. This system was frequently checked (approximately weekly) to download data, check batteries, and verify that the system was intact and functioning properly.

This system remained in operation until October 29. On November 21, the Anabat SD2 body and power supply were removed, as was the tower.

Photo 3: Pole erected on site for aerial Anabat system in 2015, showing detail of cleared area and forest edge. (Same location and setup used in 2016).

Ground System

In 2016 an Anabat SD2 acoustic bat detector was deployed at the Hillside-Boularderie site from 30 April to 29 October, at the same location as in 2015. Coordinates were 704187 5124737 (UTM NAD 83) and the location is depicted on Figure 1. The detector was mounted, along with its power supply, on a galvanized fence post installed for this purpose. The microphone was mounted in a waterproof housing identical to the 'bat hat' described for the aerial system, mounted on the fence post approximately 1 m above ground. This allowed sampling of a section of the sky approximately 45 degrees from horizontal. The detector was programmed to record all ultrasonic sounds between 7 pm and 7 am. This setup was placed within 5m of the tree line on the site, with the microphone tube pointing parallel to the tree line to allow sampling of the forest edge (Photo 2).

Photo 4: Ground-based Anabat system in 2015. (Same location and setup used in 2016).

ANABAT Data Format and Analysis

While deployed at the site, the ANABAT detectors recorded all ultrasonic frequencies detected onto a compact flash card. This data was then interpreted via AnalookW software (version 3.8s) 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* present within Nova Scotia (little brown bat and northern long-eared bat) generally cannot be distinguished reliably using these acoustic survey methods.

Analysis of the acoustic bat data for the Hillside-Boularderie site indicates that *Myotis* bats occur on the site at very low levels throughout the season. Levels of *Myotis* activity are

plotted on Figure 1 for both the aerial and ground Anabat units. These data are summarized in Table 3. The data indicate that low numbers of little brown bats (*Myotis lucifugus*) and/or northern long eared bats (*M. setpentrionalis*) continue to occur infrequebt on the site. It appears that the local bat population has decreased dramatically from previous years. This is not unexpected, since WNS has been known to occur in the local area since 2013, and losses at hibernacula are often over 95% by the third year of local infection (USDA 2015).

No evidence of any other bat species was detected at the Hillside-Boularderie site during the 2016 season.

Figure 1. Myotis Activity Levels Recorded by Ground and Aerial Acoustic Detectors at Barrachois Wind Farm in 2016.

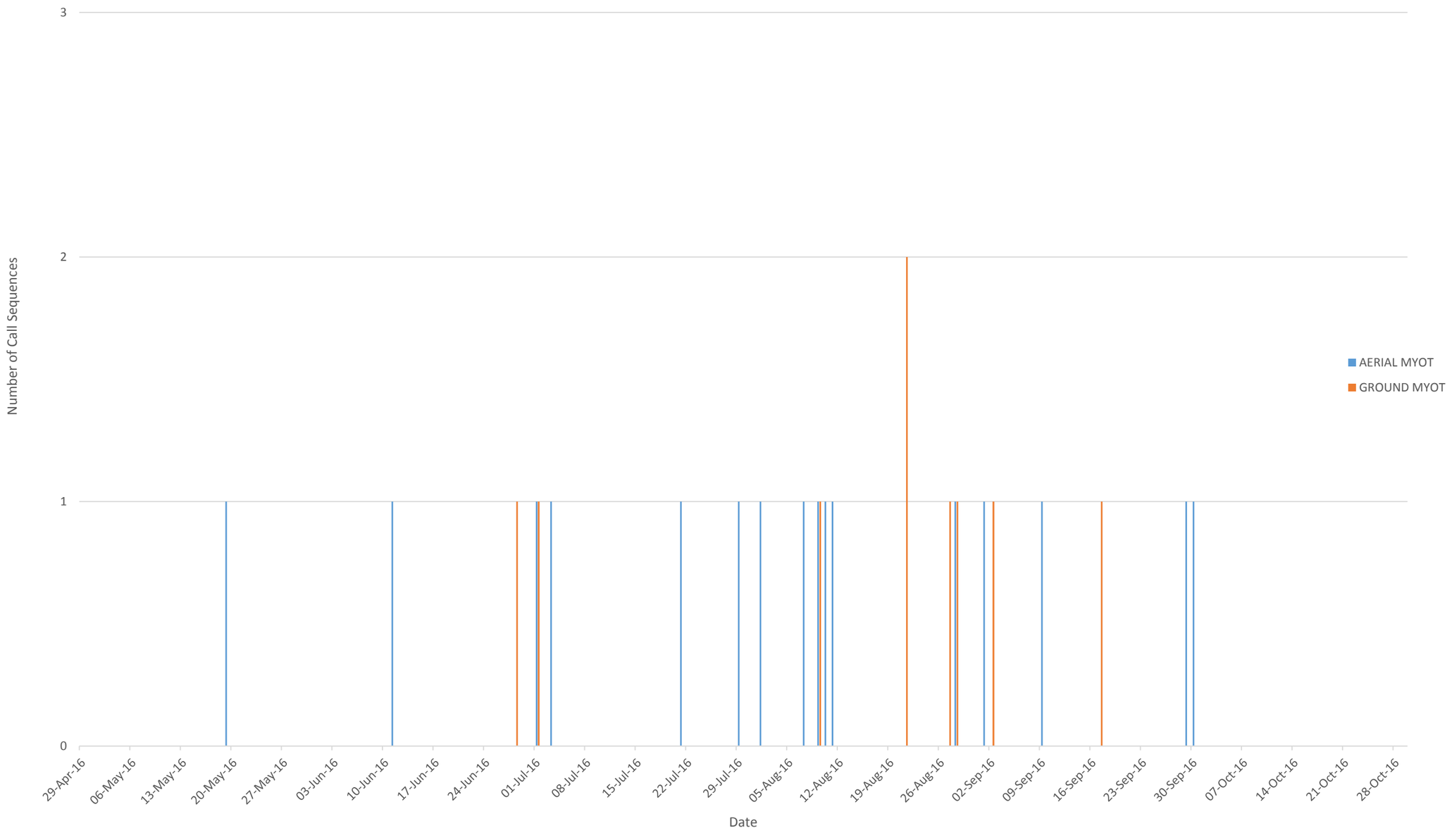


Table 3. Summary of Acoustic Monitoring Data from Aerial and Ground Anabat units at Hillside-Boularderie Wind Farm, 2016

DATE	GROUND UNIT			AERIAL UNIT		
	MYLU	MYOT	NOISE	MYLU	MYOT	NOISE
April-29-16	0	0	1	0	0	25
April-30-16	0	0	2	0	0	67
May-01-16	0	0	3	0	0	167
May-02-16	no data	no data	no data	0	0	219
May-03-16	no data	no data	no data	0	0	563
May-04-16	0	1	2	0	0	319
May-05-16	0	0	151	0	0	1525
May-06-16	0	0	0	0	0	0
May-07-16	0	0	4	0	0	708
May-08-16	0	0	10	0	0	754
May-09-16	0	0	79	0	0	598
May-10-16	0	0	0	0	0	408
May-11-16	0	0	2	0	0	33450
May-12-16	0	0	0	0	0	34402
May-13-16	0	0	3	0	0	32481
May-14-16	0	0	43	0	0	18005
May-15-16	0	0	14	no data	no data	no data
May-16-16	0	0	6	no data	no data	no data
May-17-16	0	0	14	no data	no data	no data
May-18-16	0	0	0	no data	no data	no data
May-19-16	0	0	0	no data	no data	no data
May-20-16	0	0	3	no data	no data	no data
May-21-16	0	0	3	no data	no data	no data
May-22-16	0	0	13	no data	no data	no data
May-23-16			4	no data	no data	no data
May-24-16	no data	no data	no data	0	0	4591
May-25-16	0	0	8	0	0	4655
May-26-16	0	0	9	0	0	4504
May-27-16	0	0	50	0	0	5027
May-28-16	0	0	14	0	0	5379
May-29-16	0	0	6	0	0	4812
May-30-16	0	0	1	0	0	4860
May-31-16	0	0	237	0	0	5752
June-01-16	0	0	5	0	0	4947
June-02-16	0	0	1	0	0	5413
June-03-16	no data	no data	no data	0	0	3183
June-04-16	no data	no data	no data	0	0	3394
June-05-16	no data	no data	no data	0	0	3512

DATE	GROUND UNIT			AERIAL UNIT		
	MYLU	MYOT	NOISE	MYLU	MYOT	NOISE
June-06-16	0	0	28			8508
June-07-16	0	0	5			8311
June-08-16	0	0	21			6522
June-09-16	0	0	30			9759
June-10-16	0	0	7			7771
June-11-16	0	0	31	no data	no data	no data
June-12-16	0	0	720	no data	no data	no data
June-13-16	0	0	59	no data	no data	no data
June-14-16	0	0	77	no data	no data	no data
June-15-16	0	0	54	no data	no data	no data
June-16-16	0	0	51	0	0	3348
June-17-16	0	0	51	0	0	3896
June-18-16	0	0	3	0	0	2495
June-19-16	0	0	31	0	0	890
June-20-16	0	0	289	0	0	240
June-21-16	0	0	412	0	0	2647
June-22-16	0	1	1	0	0	2188
June-23-16	0	0	11	0	0	1275
June-24-16	0	0	17	0	0	736
June-25-16	0	0	2	0	0	834
June-26-16	0	0	6	0	0	1187
June-27-16	0	0	126	0	0	1727
June-28-16	0	0	155	0	0	1297
June-29-16	0	0	207	0	0	1441
June-30-16	0	0	0	0	0	1392
July-01-16	0	0	3	0	0	1057
July-02-16	0	0	147	0	0	1126
July-03-16	0	0	21	0	0	790
July-04-16	0	1	1	2	0	538
July-05-16	0	0	45	0	0	0
July-06-16	0	0	4	0	0	0
July-07-16	0	0	134	0	0	0
July-08-16	0	0	18	0	0	0
July-09-16	0	0	0	0	0	0
July-10-16	0	0	1331	0	0	0
July-11-16	0	0	30	0	0	0
July-12-16	no data	no data	no data	0	0	0

DATE	GROUND UNIT			AERIAL UNIT		
	MYLU	MYOT	NOISE	MYLU	MYOT	NOISE
July-13-16	no data	no data	no data	0	0	0
July-14-16	no data	no data	no data	0	0	0
July-15-16	no data	no data	no data	0	0	0
July-16-16	no data	no data	no data	0	0	0
July-17-16	no data	no data	no data	0	0	0
July-18-16	0	0	10	0	0	0
July-19-16	0	0	11	0	0	0
July-20-16	0	0	14	0	0	0
July-21-16	0	0	8	0	0	4
July-22-16	0	0	485	0	0	72
July-23-16	0	0	4	0	0	0
July-24-16	0	0	1	0	0	0
July-25-16	1	0	2	1	0	2
July-26-16	0	0	240	0	0	27
July-27-16	0	0	2	0	0	0
July-28-16	0	0	2	0	0	1
July-29-16	1	0	303	1	0	58
July-30-16	0	0	4	0	0	0
July-31-16	0	0	4	0	0	0
August-01-16	0	0	0	0	0	0
August-02-16	0	0	4	1	0	0
August-03-16	1	0	15	1	0	0
August-04-16	0	0	283	0	1	3
August-05-16	0	0	525	0	0	12
August-06-16	1	0	251	0	0	12
August-07-16	1	0	5	0	0	1
August-08-16	0	0	7	0	0	0
August-09-16	0	0	1	0	0	0
August-10-16	0	0	1	0	0	0
August-11-16	1	0	58	1	0	0
August-12-16	1	0	0	1	0	0
August-13-16	0	0	1	0	0	0
August-14-16	0	0	11	1	0	1
August-15-16	0	0	0	0	0	0
August-16-16	0	0	15	0	0	0
August-17-16	0	0	0	0	0	0
August-18-16	0	0	80	0	0	0

DATE	GROUND UNIT			AERIAL UNIT		
	MYLU	MYOT	NOISE	MYLU	MYOT	NOISE
August-19-16	0	0	4	0	0	0
August-20-16	0	0	0	0	0	1
August-21-16	1	0	8	1	0	0
August-22-16	0	0	83	0	0	4
August-23-16	0	0	10	0	0	0
August-24-16	1	0	27	4	0	0
August-25-16	0	0	806	0	0	3
August-26-16	0	0	5	0	0	0
August-27-16	0	0	10	0	0	1
August-28-16	1	0	21	1	0	0
August-29-16	0	0	793	0	0	120
August-30-16	0	0	2	0	0	0
August-31-16	0	0	97	0	0	7
September-01-16	0	1	62	1	0	9
September-02-16	1	0	75	1	0	131
September-03-16	0	0	1	0	0	1
September-04-16	0	0	7	0	0	0
September-05-16	0	1	11	1	0	0
September-06-16	0	0	11	0	0	1
September-07-16	0	0	29	0	0	2
September-08-16	0	0	2	0	0	0
September-09-16	0	0	12	0	0	0
September-10-16	0	0	1	1	1	3
September-11-16	0	0	1192	0	0	485
September-12-16	0	0	18	0	0	0
September-13-16	0	0	147	0	0	0
September-14-16	0	0	295	0	0	51
September-15-16	0	0	20	0	0	0
September-16-16	no data	no data	no data	0	0	6
September-17-16	no data	no data	no data	0	0	0
September-18-16	no data	no data	no data	0	0	124
September-19-16	no data	no data	no data	0	0	0
September-20-16	no data	no data	no data	1	0	3
September-21-16	no data	no data	no data	0	0	0
September-22-16	no data	no data	no data	0	0	0
September-23-16	no data	no data	no data	0	0	1
September-24-16	no data	no data	no data	0	0	1

DATE	GROUND UNIT			AERIAL UNIT		
	MYLU	MYOT	NOISE	MYLU	MYOT	NOISE
September-25-16	no data	no data	no data	0	0	0
September-26-16	0	0	0	0	0	0
September-27-16	0	0	2	0	0	996
September-28-16	0	0	0	0	0	0
September-29-16	0	0	81	0	0	705
September-30-16	1	0	2	0	0	2
October-01-16	0	0	0	1	0	0
October-02-16	0	0	0	0	0	0
October-03-16	0	0	37	0	0	6
October-04-16	0	0	0	0	0	0
October-05-16	0	0	0	1	0	0
October-06-16	0	0	1	0	0	1
October-07-16	0	0	13	0	0	0
October-08-16	0	0	12	0	0	0
October-09-16	0	0	571	0	0	351
October-10-16	0	0	4648	0	0	6534
October-11-16	0	1	0	0	0	0
October-12-16	0	0	6	0	0	0
October-13-16	0	0	0	0	0	0
October-14-16	0	0	184	0	0	75
October-15-16	0	0	0	0	0	0
October-16-16	0	0	49	0	0	1
October-17-16	0	0	25	0	0	0
October-18-16	0	0	91	0	0	29
October-19-16	0	0	13	0	0	0
October-20-16	0	0	0	0	0	0
October-21-16	0	0	44	0	0	12
October-22-16	0	0	41	0	0	31
October-23-16	0	0	3572	0	0	1205
October-24-16	0	0	25	0	0	6
October-25-16	0	0	0	0	0	0
October-26-16	0	0	13	0	0	0
October-27-16	0	0	0	0	0	0
October-28-16	0	0	1	0	0	0
October-29-16	0	0	0	0	0	2

Conclusions and Recommendations

Mortality searches are conducted to provide estimates of mortality for wind farms; however, corrected mortality estimates must be obtained in order to adjust for carcass removal (i.e. scavenging) rates, searcher efficiency, and the proportion of the survey area that is actually searched. The results of the mortality searches and associated scavenger and searcher trials conducted in 2016 indicate a low level of mortality (carcasses recovered) and low scavenging rates. Searcher efficiency at the site was average

Analysis of the acoustic bat data for the Hillside-Boularderie site indicates that *Myotis* bats occur on the site at very low levels infrequently throughout the season. The reduced numbers may be the result of widespread impact of White Nose Syndrome in the Cape Breton Regional Municipality. The winter of 2013 was the third known year of WNS infection on the island, and it has been noted in other areas that after three years of infection, WNS can decrease local bat populations by 95% (USDA 2015).

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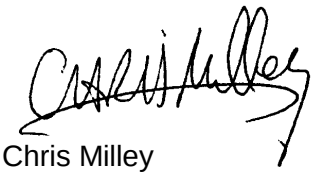
The bird and bat mortality monitoring plan for the site stated that a minimum of two years of acoustic bat monitoring and mortality searches at the site, as well as scavenger and searcher efficiency trials was required. The 2016 season concludes this period, therefore it is assumed that post-construction monitoring requirements at the Hillside-Boularderie Wind Farm have been met. Additional monitoring may, however, be required by the Nova Scotia government to further understand the relationship between wind farms and WNS on bat population in the area. Should this be required it is recommended that priority be given to acoustic monitoring.

Closing

We trust this report meets your requirements. Please contact the undersigned should have any questions or comments on any aspect of the 2016 monitoring and surveying program.

Amec Foster Wheeler Environment & Infrastructure,
a Division of Amec Foster Wheeler Americas Limited



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