EXHIBIT K

Bat Acoustic Studies for the Colebrook Wind Resource Area Litchfield County, Connecticut

Interim Report

June 25 – August 31, 2010

Prepared for:

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NATURAL RESOURCES ◆ SCIENTIFIC SOLUTIONS

EXECUTIVE SUMMARY

Western EcoSystems Technology, Inc. initiated surveys in June 2010 on behalf of BNE Energy Inc. (BNE) designed to assess bat activity within the proposed Colebrook Wind Resource Area (CWRA) in Litchfield County, Connecticut. The CWRA is being permitted in two phases as Colebrook North and Colebrook South. The phases are located adjacent to one another and are comprised of similar vegetation composition and physiographic characteristics. All surveys reported herein were completed within Colebrook South. Due to the similarities of habitat, landuse and landcover, results of acoustic bat surveys for Colebrook South are likely indicative of species composition and relative abundance for Colebrook North.

Bat activity was surveyed using Anabat™ SD1, Anabat™ SD2, and Wildlife Acoustic™ Song Meter SM2Bat™ ultrasonic detectors during the summer of 2010. The study is scheduled to continue through October 31, 2010. The purpose of this interim report is to to characterize seasonal and spatial activity by bats within the CWRA during the maternity season. This report presents only the results of data collected by the Anabat SD1 and SD2 detectors between June 25 – August 31, 2010. The final report, which will be prepared at the completion of the fall 2010 study period, will include the analysis of summer and fall data collected by the Song Meter SM2Bat detector, in addition to the analysis of the data collected by the Wildlife Acoustics SM2 detector. Additional work completed during the summer of 2010 at the CWRA included breeding bird surveys, the results of which are presented in a separate report.

The objective of the acoustic bat surveys was to estimate the seasonal and spatial use of the CWRA by bats during the maternity season. Bat activity was monitored at two fixed stations from June 25 to August 31, 2010. A total of two Anabat detectors recorded 3,645 bat passes during 125 detector-nights. Substantial differences in bat detection rates between stations were apparent during the study period, with station CA1 recording 3603 bat calls compared to only 42 at station CA2. While habitat differences may partially explain detection rates, further investigation of detector functionality is needed and will be carried out prior to completion of the final annual report to ensure differences are not the result of equipment malfunction, which may have artificially biased the number of detections recorded. Fatality estimates from post-construction monitoring at wind-energy facilities in eastern North America range from 0.45 to 39.7 bats/MW/year. Activity between June 25 – August 31 within the CWRA was 28.07±3.93 bat passes/detector-night; a value within the range of the five facilities in the eastern US where pre- and post-construction data is available (range: 0.3-38.3; mean: 19.58). Bat activity at individual detectors was 55.43 passes/detector-night at station CA1 and 0.70 at station CA2.

Passes by mid-frequency bats (82.4% of all passes) exceeded passes by low-frequency (13.7%), and high-frequency bats (4.0%). Species identification was possible for hoary bat and eastern red bat. Eight species of bat have the potential to occur within the CWRA (Table 1), all of which have been recorded as casualties at wind-energy facilities. The number of passes attributable to these species compared to overall passes during the survey period was < 1 % (eight passes by these species). Passes by hoary bat comprised less than 0.1% of overall

activity (three passes), while passes by eastern red bats comprised 0.1% of overall activity (five passes). The relatively small detection rate for eastern red bats (five calls) suggests the majority of mid-frequency activity during the study period was comprised of little brown bats.

The overall number of bat calls detected per night at the CWRA was highest during mid-July and likely corresponds to the time when pups are being weaned and have joined the adult population in foraging. Comparing peak bat activity between frequency groups within any given 7-day period during the maternity season, high and mid-frequency bat activity peaked in mid-July, while low-frequency activity peaked during the last week of August. The increase in activity at the end of August may represent movement of migrating bats through the area, which may explain the greater number of low-frequency bat passes during this period. Further analysis of migration patterns and temporal trends will be discussed in the final annual study report.

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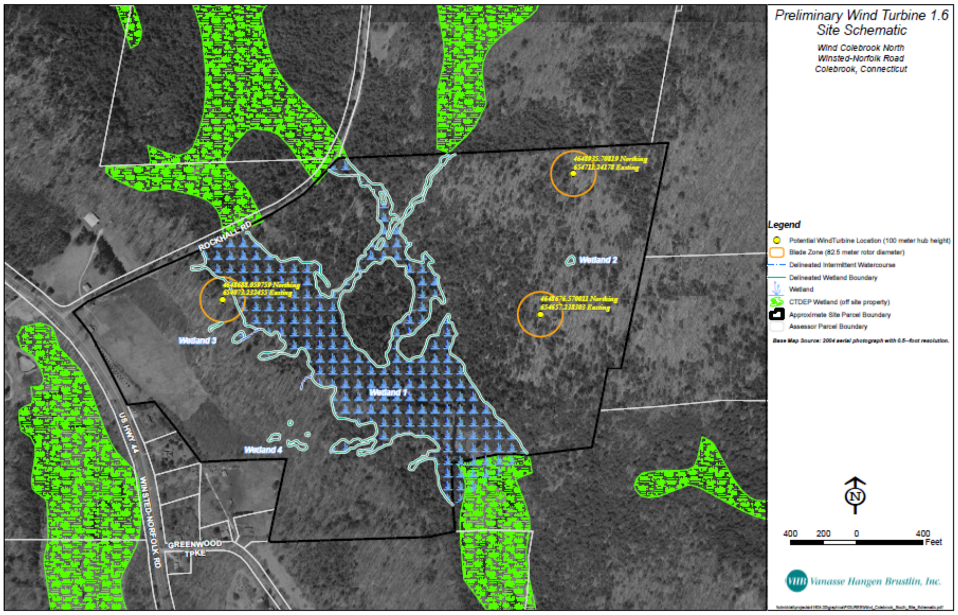
INTRODUCTION

BNE Energy, Inc (BNE) is proposing to develop a wind energy facility in Litchfield County, Connecticut. BNE contracted Western EcoSystems Technology, Inc. (WEST) to develop and implement a standardized protocol for a baseline study of bat activity within the Colebrook Wind Resource Area (CWRA) for the purpose of estimating the impacts of the wind energy facility on bats, and to assist with siting turbines to minimize impacts to bats. The protocol for this baseline study is similar to protocols used at other wind energy facilities across the United States. The protocol has been developed based on WEST's experience studying wildlife and wind turbines at wind energy facilities throughout the US and included passive acoustic sampling using Anabat™ and Song Meter SM2Bat™ ultrasonic bat detectors to quantify bat activity in the study area.

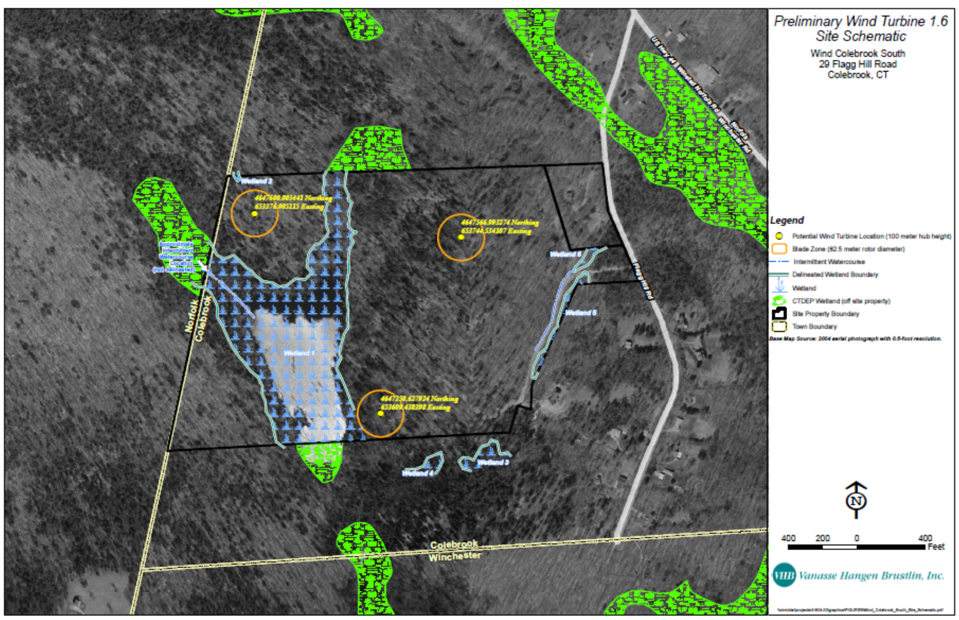
The following is an interim report describing the results of Anabat surveys conducted at the CWRA during the summer of 2010. The purpose of the report is to bring items of biological interest to the attention of BNE, such as bat activity during the maternity season. This report presents only the results of data collected by the Anabat detectors. The final report, which will be prepared at the completion of the fall study period, will include the analysis of summer and fall data collected by the Song Meter SM2Bat detector, in addition to the Song Meter SM2Bat™. Additional work completed during the summer of 2010 at the CWRA included breeding bird surveys, the results of which are presented in a separate report.

STUDY AREA

The proposed CWRA is located near the town of Colebrook, Connecticut, in northeastern Litchfield County (VHB 2010a; Figure 1). The CWRA is being permitted in two phases as Colebrook North and Colebrook South. The phases are located adjacent to one another and are comprised of similar vegetation composition and physiographic characteristics. All surveys reported herein were completed within Colebrook South. Due to the similarities of habitat, landuse and landcover, results of acoustic bat surveys for Colebrook South are likely indicative of species composition and relative abundance for Colebrook North. The CWRA lies within the Northwest Highlands region (Bell 1985), which is characterized by hard, metamorphic bedrock that has shaped the landscape into high, steeply sided plateaus, broad valleys, and rolling foothills. The Appalachian Mountains extend through Connecticut west of the study area. The CWRA is situated primarily along the top and side slopes of an unnamed hill capped with glacial till. It also includes a small part of the eastern slope of Flagg Hill, as well as a valley between the two hills. The Colebrook South property, where the studies were conducted, is approximately 80 acres (0.13 square miles [mi^2]) in size and elevation ranges from approximately 433 to 457 m (1,420 to 1,500 ft) above sea level. The region is primarily deciduous and coniferous forest, with pockets of residential development and agriculture occurring throughout the landscape. The majority of the study area is covered by secondary-growth upland forest, but also includes forested wetland associated with a manmade impoundment located on the western side of the property, and a larger forested wetland that primarily occurs off-site in the northwest corner of the property. Two intermittent watercourses also occur on-site. The forested portion of Colebrook South is dominated by deciduous pole timber. The upland forest understory is relatively open, but where vegetated, is dominated by mountain laurel (*Kalmia angustifolia*). Saplings and shrubs of American beech (*Fagus grandifolia*) and *Rubus* species occur as well. Rotting logs, old forest tracks, woody debris, and slash are abundant throughout Colebrook South (VHB 2010a). The city of Winsted is less than eight km (five mi) to the southeast. Residential development occurs to the east of Colebrook South on both sides of Flagg Hill Road.



North Colebrook



South Colebrook

Figure 1. Maps of the Colebrook Wind Resource Area.

METHODS

Bat Acoustic Surveys

The objective of the bat use surveys was to characterize seasonal and spatial bat activity within the CWRA during the majority of the maternity season. Ultrasonic detectors are a recommended method to index and compare habitat use by bats, and the use of such detectors for calculating an index to bat impacts is a primary bat risk assessment tool for baseline wind development surveys (Arnett 2007, Kunz et al. 2007). For the purpose of this report, bat activity was surveyed using ultrasonic detectors from June 25 to August 31, 2010; a period corresponding to the maternity season at this site. From June 25 to August 10, bat activity was surveyed using two Anabat™ SD1 bat detectors (Titley Scientific™, Australia). On August 11, Anabat SD1 detectors were exchanged for Anabat™ SD2 detectors (Titley Scientific™, Australia), which were used for the remainder of the study period. Bat activity at the CWRA was also surveyed using a Song Meter SM2Bat Unit (Wildlife Acoustics™, Maryland), utilizing full-spectrum recording technology, compatible with zero crossing analysis; however, results from that detector are not presented in this report. Rather, the results will be presented in the final bat report to be prepared at the completion of the fall study period.

The Anabat detectors were placed near the ground at two fixed stations (Figure 2). The first detector (CA1) was established along an abandoned forest track within deciduous forest at one of the proposed turbine locations within the central portion of the CWRA (Appendix A). A narrow woodland shelterbelt was located between station CA1 and a forest clearing in which the meteorological (met) tower was located. The second detector (CA2) was established along an abandoned forest track at a proposed turbine location within deciduous forest in the northwest corner of the CWRA (Appendix B).

Anabat detectors record bat echolocation calls with a broadband microphone. Calls were recorded to a compact high-capacity flash memory card, which was subsequently transferred onto a computer for analysis. The echolocation sounds were then translated into frequencies audible to humans by dividing the frequencies by a predetermined ratio. A division ratio of 16 was used for the study. Bat echolocation detectors also detect other ultrasonic sounds, such as those sounds made by insects, raindrops hitting vegetation, and other sources, therefore to try and reduce this type of interference a sensitivity level of six was used on the detectors during recording. The detection range of Anabat detectors depends on a number of factors, such as echolocation call characteristics, microphone sensitivity, habitat, the orientation of the bat, and atmospheric conditions (Limpens and McCracken 2004). Generally the effective range is less than 30 m (98 ft) due to atmospheric absorption on echolocation pulses (Fenton 1991). To ensure similar detection ranges among anabat units, microphone sensitivities were calibrated using a BatChirp ultrasonic emitter (Tony Messina, Las Vegas, Nevada) as described in Larson and Hayes (2000). Anabat detectors were placed inside plastic weather-tight containers with a hole cut in the side of the container for the microphone to extend through. To minimize the potential for water damage due to rain, microphones were encased in PVC tubing that curved

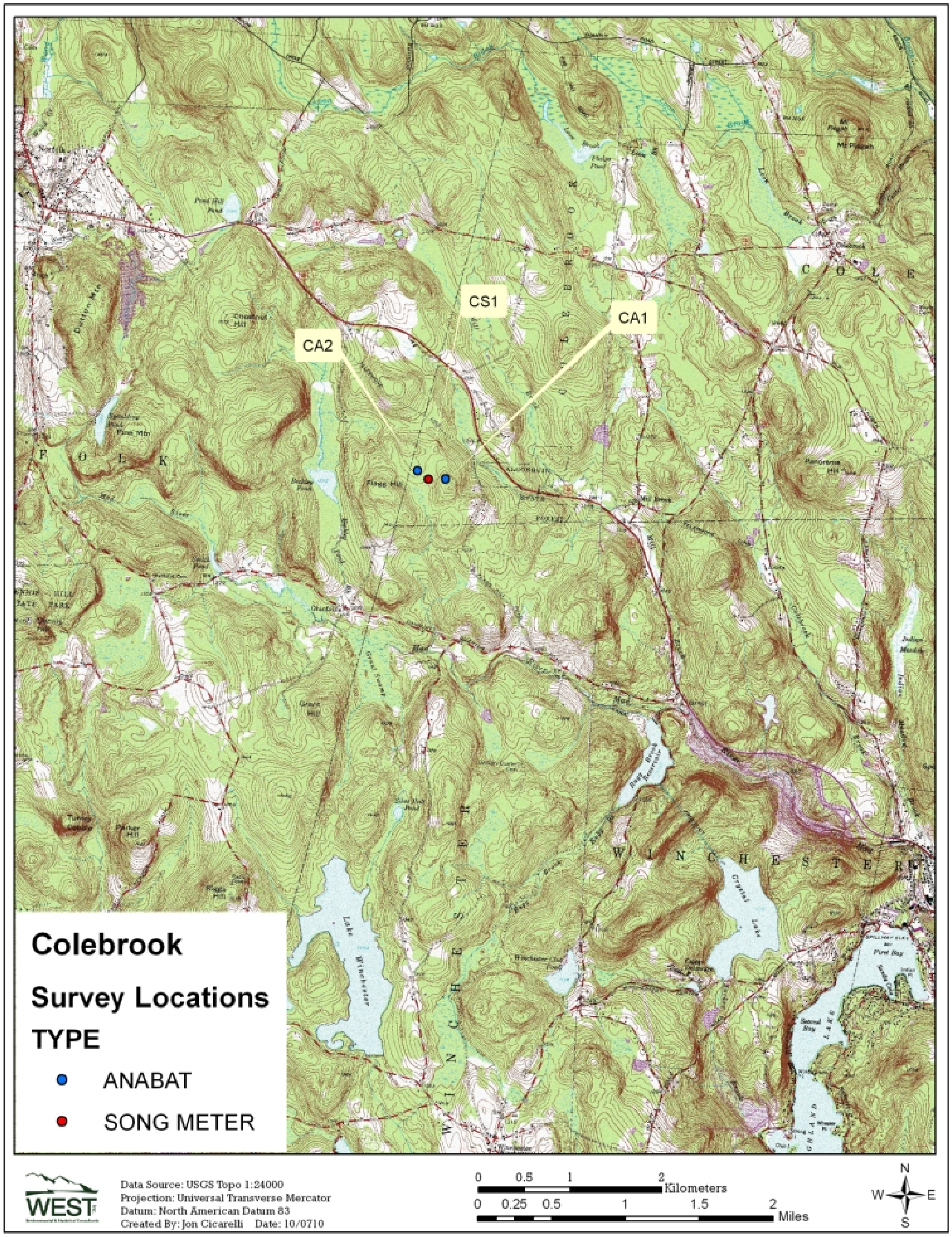


Figure 2. Map of acoustic bat sampling locations at the CWRA.

skyward at 45 degrees outside the container to minimize the potential for water damage due to rain and that had drain holes at the bottom of the curve. Containers were raised approximately two m (6.6 ft) off the ground to minimize echo interference and lift the unit above vegetation. All units were programmed to turn on each night an approximate half-hour before sunset and turn off an approximate half-hour after sunrise.

Statistical Analysis

The unit of bat activity used for analysis was the number of bat passes (Hayes 1997). A bat pass is defined as a continuous series of two or more call notes produced by an individual bat with no pauses between call notes of more than one second (White and Gehrt 2001, Gannon et al. 2003). In this report, the terms bat pass and bat call are used interchangeably. Data files were analyzed using Analook W v3.5r (2008, Chris Corben) and Analook DOS v4.9j (2004, Chris Corben) software. The Analook software displays bat calls (and extraneous noise) as a series of pixels on a time over frequency display. Analook provides a framework to build filters that constrain the values of certain call parameters. Pixels that fall outside the specified range of the filter parameters are ignored (e.g. pixels not following a smooth line, pixels below or above a specified frequency, etc.). In addition, a series of filters developed by WEST were used to quickly and effectively separate out files that contained only noise, and to sort remaining files containing bat calls into frequency groups. Filtered files were visually examined by an analyst to ensure accuracy. The total number of bat calls was then corrected for effort by dividing the number of calls by the number of detector-nights.

Depending on the species of bats that are expected to occur in an area, Anabat units can have limited use in identifying the bat species that produced the recorded call. Some bat species produce a call that has a very distinctive sonogram (shape on a frequency-time graph). However, there is much overlap between some species. For this reason, a conservative approach to species identification was used. For each station, bat passes were sorted into three groups, based on their minimum frequency, that correspond roughly to species groups of interest. For example, most species of *Myotis* bats echolocate at frequencies above 40 kilohertz (kHz), whereas species such as the eastern red bat (*Lasiurus borealis*) typically have echolocation calls that fall between 30 and 40 kHz, and species such as big brown (*Eptesicus fuscus*), silver-haired (*Lasionycteris noctivagans*), and hoary bat (*Lasiurus cinereus*), have echolocation frequencies that fall at or below 25 kHz. Therefore, passes were classified as high-frequency (HF; more than 40 kHz), mid-frequency (MF; 30 to 40 kHz), or low-frequency (LF; less than 30 kHz). To establish which species may have produced passes in each category, a list of species expected to occur in the study area was compiled from range maps (Table 1; Harvey et al. 1999, CDEF 1999). Data determined to be noise (produced by a source other than a bat) or call notes that did not meet the pre-specified criteria to be termed a pass were removed from the analysis.

Table 1. Bat species with the potential to occur within Colebrook Wind Resource Area Data from Harvey et al. (1999) and the Connecticut Department of Environmental Protection (CDEP 1999).

Common Name	Scientific Name
High-Frequency (> 40 kHz)	
tri-colored bat[2]	*Perimyotis subflavus*
Indiana bat[2]	*Myotis sodalist*
northern long-eared bat[2]	*Myotis septentrionalis*
Mid-Frequency (30-40 kHz)	
eastern red bat[1,2]	*Lasiurus borealis*
little brown bat[2]	*Myotis lucifugus*
Low-Frequency (< 30 kHz)	
big brown bat[2]	*Eptesicus fuscus*
silver-haired bat[1,2]	*Lasionycteris noctivagans*
hoary bat[1,2]	*Lasiurus cinereus*

[1]long-distance migrant; [2]species known to have been killed at wind energy facilities

Within these categories, an attempt was made to identify passes made by two *Lasiurus* species: hoary and eastern red bats. Passes that had a distinct U-shape and that exhibited variability in the minimum frequency across the call sequence were identified as belonging to the *Lasiurus* genus (C. Corben, pers comm.). Hoary and eastern red bats were distinguished based on minimum frequency; hoary bats typically produce calls with minimum frequencies between 18 and 24 kHz, whereas eastern red bats typically emit calls with minimum frequencies between 30 and 43 kHz (J. Szewczak, pers comm.). Only sequences containing three or more calls were used for species identification. These are conservative parameters. Given the high intraspecific variability of *Lasiurus* calls and the number of call files that were too fragmented for proper identification, it is likely that more hoary and eastern red bat calls were recorded than were positively identified.

Bat activity for this report is defined as the total number of bat passes per detector-night, and was used as an index representing bat use in the CWRA. Bat pass data represented levels of bat activity rather than the numbers of individuals present because individuals could not be differentiated by their calls.

RESULTS

Bat Acoustic Surveys

Bat activity was monitored within the CWRA at two sampling locations on a total of 68 nights during the period June 25 to August 31, 2010. Anabat units recorded data for the entire nightly survey period (from 1700 to 0900 EDT) during 96.2% of the sampling period (Figure 3). The number of noise files in a given week ranged from 1.79 to 194.80 files. With the exception of one week during the study, the number of noise files was significantly less than the number of bat passes recorded, ranging between 1.79 to 11.86 noise files/detector-night, and was unlikely to have interfered with overall data collection (Figure 4). The highest level of noise was recorded during the week of August 20-28, 2010 (Figure 4).

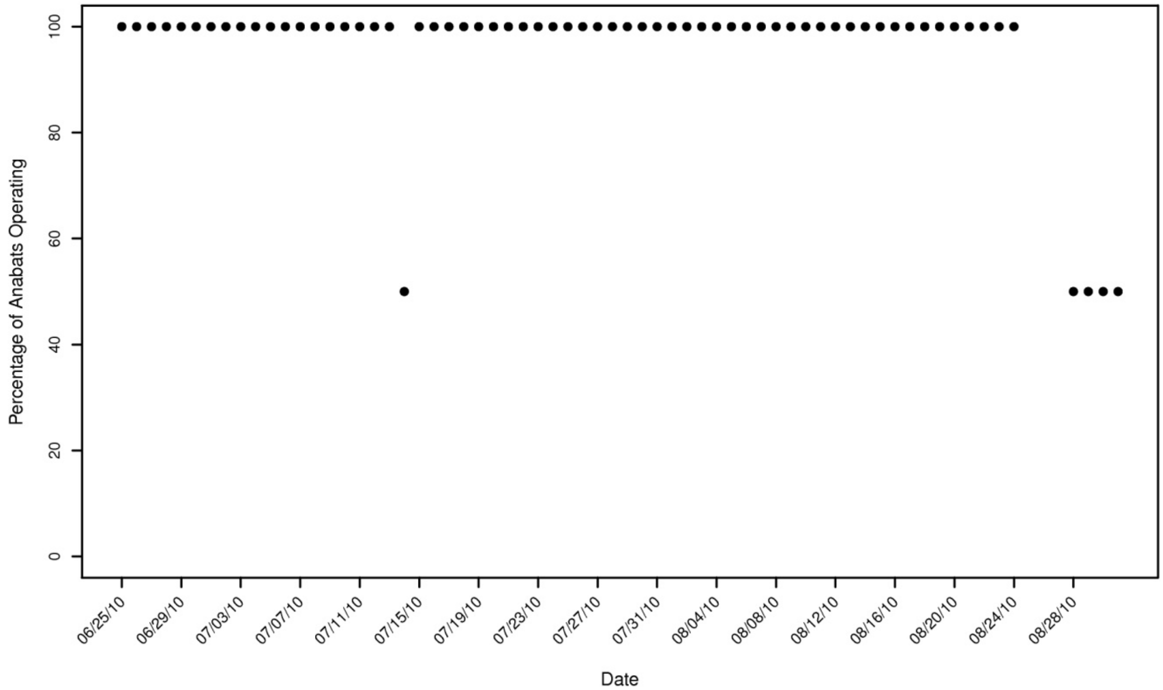


Figure 3. Proportion of Anabat detectors (n = 2) operating during each night of the study within the Colebrook Wind Resource Area, June 25 – August 31, 2010.

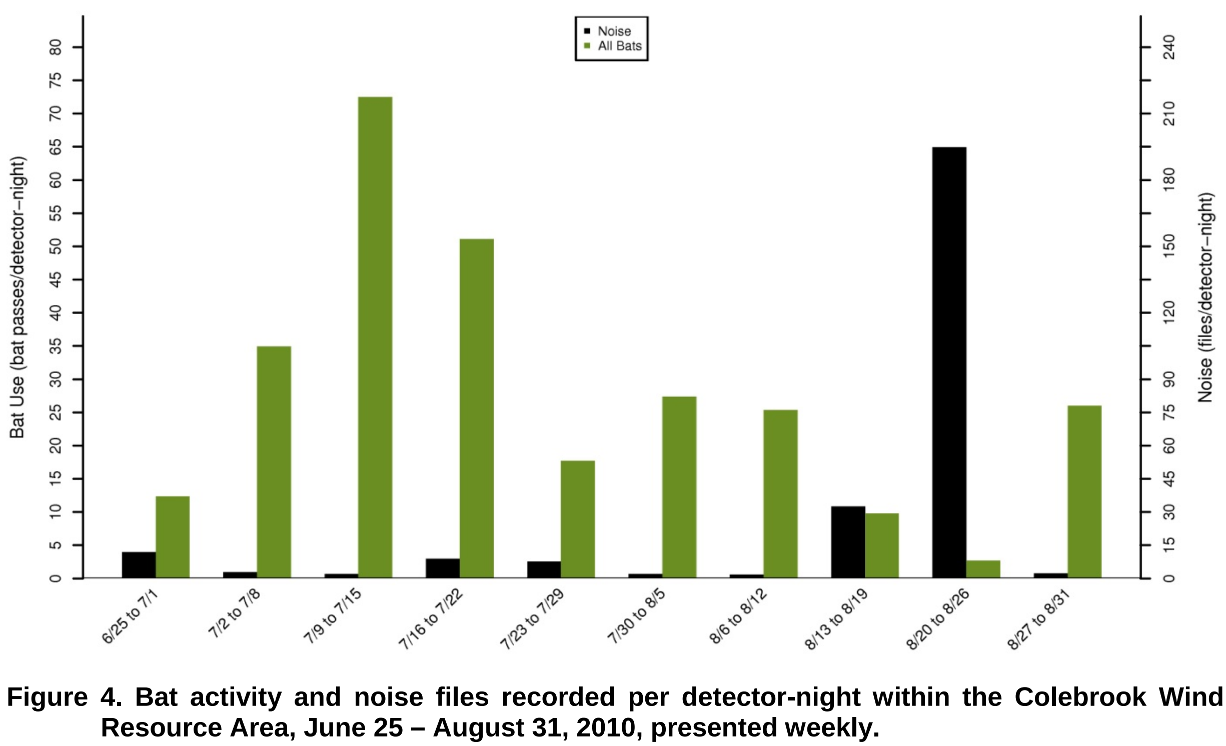


Figure 4. Bat activity and noise files recorded per detector-night within the Colebrook Wind Resource Area, June 25 – August 31, 2010, presented weekly.

A total of 3,645 bat passes were recorded at the two Anabat stations on 125 detector-nights (Table 2). CA1 accounted for approximately 99% of the total calls recorded during the study period. Averaging bat passes per detector-night across stations, a mean of 28.07 passes/detector-night was recorded. At individual stations, bat activity was 55.43 passes/detector-night at station CA1 and 0.70 at station CA2.

Table 2. Results of acoustic bat surveys conducted at the Colebrook Wind Resource Area, June 25 – August 31, 2010, separated by call frequency (high-frequency [HF], mid-frequency [MF], and low-frequency [LF]).

Station	HF-Calls	MF-Calls	LF-Calls	Eastern Red Bat Calls[a]	Hoary Bat Calls[b]	Total Bat Passes	Detector-Nights	Bat Passes / Detector-Night*
CA1	136	2,971	496	5	2	3,603	65	55.43±8.60
CA2	9	31	2	0	1	42	60	0.70±0.16
Total	**145**	**3,002**	**498**	**5**	**3**	**3,645**	**125**	**28.07±3.93**

[a]Passes by eastern red bats are included in mid-frequency (MF) numbers; [b]Passes by hoary bats included in low-frequency (LF) numbers. *± bootstrapped standard error.

Overall, passes by MF bats (82.4% of all passes) outnumbered passes by LF bats (LF; 13.7%) and HF bats (HF; 4.0%; Table 2; Figure 5). At station CA1, MF passes comprised 82.5% of the total activity (2,971 MF passes), while LF calls comprised 13.8% of activity (496) and HF calls comprised 3.8% of activity (136; Table 2; Figure 5). At station CA2, MF calls also comprised the majority of activity (73.8%; 31 MF passes). However, a greater proportion of HF calls (21.4%; nine passes) were recorded compared to LF calls (4.8%; two passes; Table 2; Figure 5).

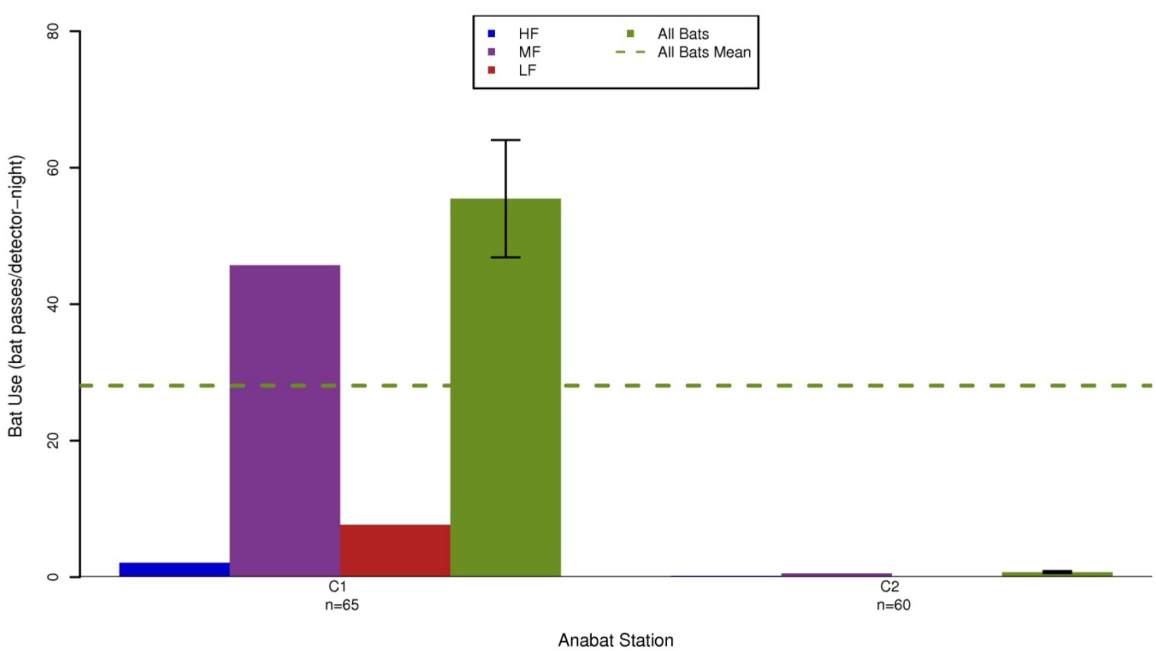


Figure 5. Bat activity (bat passes/detector-night) by frequency group recorded at Anabat stations within the Colebrook Wind Resource Area from June 25 – August 31, 2010. Error bars represent standard errors.

Comparing temporal patterns between frequency groups over the course of the survey period, MF activity generally followed a bell-shaped distribution, with the exception of the last week of the study period (Figure 6). During the first week of the study period in late June, MF activity averaged 8.3 bat passes/detector-night. Activity increased through early July, peaking in mid-July with 68.0 bat passes/detector-night. After mid-July, MF activity generally decreased throughout the summer, reaching a low of 0.7 bat passes/detector-night during the third week of August before rising again to 10.75 during the last week of August (Figure 6). Activity by LF bats during the survey period remained fairly constant, ranging from 0.7 to 6.86 bat passes/detector-night per week until the last week of August, when it peaked at 12.25 bat passes/detector-night (Figure 5). High-frequency activity was relatively low throughout the study period, with slight increases in activity during mid-July and late-August..

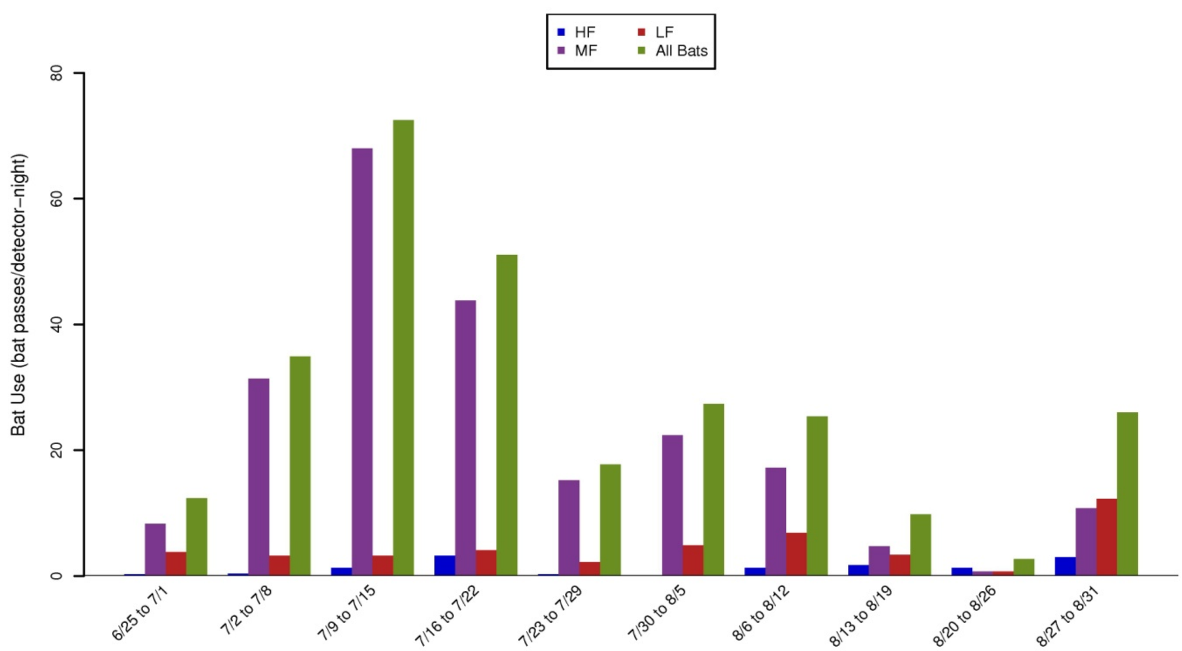


Figure 6. Weekly activity of high-frequency (HF), mid-frequency (MF), and low-frequency (LF) bats within the Colebrook Wind Resource Area, based on 52 weeks during the calendar year beginning January 1, and corresponding to the start and end dates of the study period; June 25 – August 31, 2010.

Comparing peak bat activity between frequency groups within any given 7-day period during the maternity season, HF and MF bat activity peaked almost simultaneously, while LF activity peaked over a month later (Table 3; Figure 6). High-frequency bat activity peaked during July 11-July 17, with a mean of 3.93 bat passes/detector-night, while MF activity peaked during July 14-July 20, with 72.48 bat passes/detector-night recorded. Low-frequency activity peaked during the week of August 25-August 31, with a mean rate of 12.25 bat passes/detector-night. Overall bat activity, influenced primarily by MF bat activity, peaked during July 11-July 17, with 80.20 bat passes/detector-night (Table 3).

Table 3. Highest activity rates recorded during a seven day (week) period during the maternity season within Colebrook Wind Resource Area; June 25-August 31, 2010; separated by call frequency (high frequency [HF], mid frequency [MF], low frequency [LF], and by species.

Frequency Group/Species	7-Day Period of Highest Bat Activity	Bat Passes/ Detector-Night
All Bats	07/14/10 to 07/20/10	80.20
HF Bats	07/11/10 to 07/17/10	3.93
MF Bats	07/14/10 to 07/20/10	72.48
LF Bats	08/25/10 to 08/31/10	12.25
Eastern Red Bat	08/11/10 to 08/17/10	0.29
Hoary Bat	08/25/10 to 08/31/10	0.25

Two species with distinctive call sonograms are the hoary bat and the eastern red bat (Kunz et al. 2007), and species identification was attempted for these two species. However, given the high intraspecific variability of *Lasiurus* calls, and the number of call files that were too fragmented for proper identification, it is likely that more hoary and eastern red bat calls were recorded than were positively identified.

The number of passes attributable to these species compared to overall passes during the 2010 maternity season was extremely low (eight passes for the two species combined; Table 2). Passes by hoary bats (three passes) comprised less than 0.1% of total passes detected within the study area and 0.6% of all LF passes. Hoary bat calls were recorded at both stations; Station CA1 recorded two calls and CA2 recorded a single call (Table 2; Figure 7). All recognizable hoary bat activity occurred between August 27 and August 3 (63.6%; Figure 8), corresponding to a peak seven day activity period of August 25 to August 31, with 0.25 bat passes/detector-night recorded (Table 3).

Passes attributable to eastern red bats was also very low (five passes) accounting for only 0.1% of total passes and only 0.2% of all MF calls (Table 2). All (100%) eastern red bat activity was recorded at Station CA1 (Figure 7). The majority of recognizable eastern red bat activity occurred during two weeks of the study period, from August 6 - 12 (40.0%) and August 27 - 31 (46.7%; Figure 8). The peak activity within a 7-day period for eastern red bats occurred during August 11 – 17, with 0.29 bat passes/detector-night recorded (Table 3).

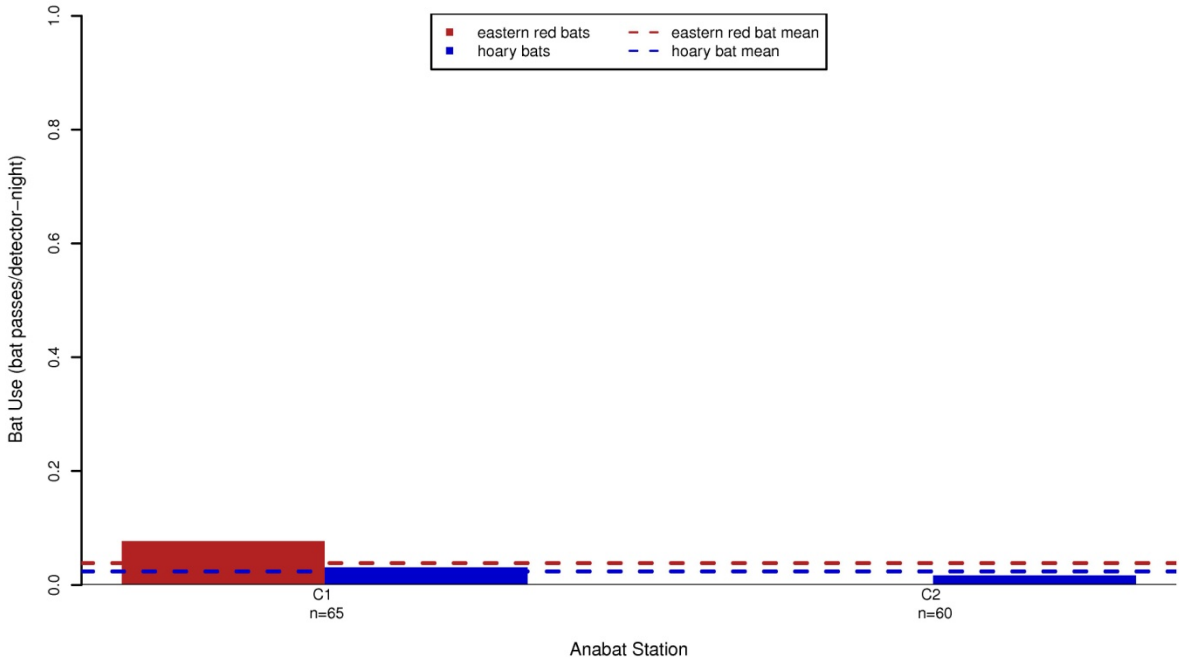


Figure 7. Hoary and eastern red bat activity (bat passes/detector-night) recorded within the Colebrook Wind Resource Area, June 25 – August 31, 2010.

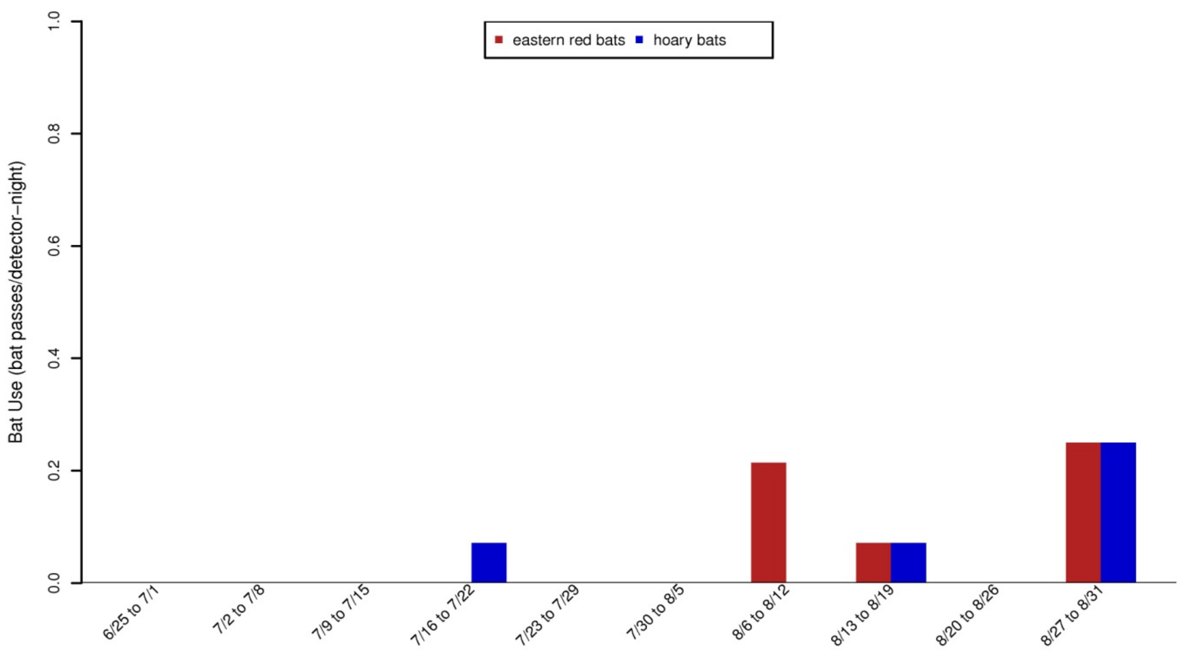


Figure 8. Weekly activity by hoary and eastern red bats recorded within the Colebrook Wind Resource Area, June 25 – August 31, 2010.

DISCUSSION

Interim Findings

This interim report reviewed results from the period July 25 – August 31, 2010, a period encapsulating the majority of the bat maternity season in central Connecticut. The annual study report will include data for the June 25 – October 31, 2010 study period, and will include analysis of overall passage rates for the CWRA relative to observed patterns at other wind-energy facilities. The results reported here are subject to change based on further analysis included in the annual study report.

The CWRA is not in the vicinity of any known bat colonies or features likely to attract large numbers of bats. Substantial differences in bat detection rates between stations were apparent during the study period, with station CA1 recording 3603 bat calls compared to only 42 at station CA2. While habitat differences may partially explain detection rates, further investigation of detector functionality is needed and will be carried out prior to completion of the final annual report to ensure differences are not the result of equipment malfunction, which may have artificially biased the number of detections recorded[1].

Eight species of bat have the potential to occur within the CWRA (Table 1), all of which have been recorded as casualties at wind-energy facilities. Acoustic bat passes recorded by AnaBat detectors were classified to frequency groups. Overall, passes by MF-bats (82.4% of all passes) outnumbered passes by LF-bats (13.7%), and HF-bats (4.0%). This suggests a higher relative abundance of MF species, little brown and eastern red bats, during the survey period. The relatively small detection rate for eastern red bats (five calls) suggests the majority of MF activity during the study period was comprised of little brown bats.

Based on the information available concerning the ecology and habitat use of these species in New England (DeGraaf and Yamasaki 2001), it is likely that the majority of HF-bats recorded at were northern long-eared myotis, a species with the anatomy and ability to forage within forested areas (Lacki et al. 2007). Some of the calls within the HF group may also have been produced by little brown bats. Bats active at low altitudes within the forest cover dominating the site are likely to be species such as northern long-eared myotis or little brown bat which have the size and anatomy to able to maneuver between the trees and are known to forage in intact forest habitats (Lacki et al. 2007). Very few northern long-eared myotis have been recorded as casualties at wind-energy facilities (Kunz et al. 2007b). Eastern red bat is a long-distance migratory tree roosting bat and is one of the three species found most often as casualties at wind-energy facilities (Kunz et al. 2007b).

LF-bats with the potential to occur within the study area include hoary, silver-haired, and big-brown bat. This group of bats tends to be larger in size and wing-span, and as such require uncluttered air space for foraging and maneuverability (Norberg and Rayner 1987, Lacki et al. 2007). Hoary bats comprised 0.60% of all LF passes with only three calls identified between

[1]QA/QC of the detector will be performed by the manufacturer (Tetley Electronics), which is located in Australia.

both stations. The very small number of recognizable hoary bat calls recorded within the study area is likely due to the conservative approach taken to determine species identification. Little is known about summer populations of silver-haired bats in Connecticut. Silver-haired bats use forest clear-cuts for foraging while big brown bats utilize less forest-dominated areas. Both are likely to forage along forest edges, with silver-haired bats using air-space closer to the ground than big brown bats (DeGraaf and Yamasaki 2001).

The overall number of bat calls detected per night at the CWRA was highest during mid-July and likely corresponds to the time when pups are being weaned and have joined the adult population in foraging. During lactation energy requirements are at their highest for female mammals and as such foraging is increased (Kurta et al. 1989, Lacki et al. 2007); in addition, juvenile bats begin to fly prior to weaning increasing the number of calls recorded. In New England, young of hoary bats, silver-haired bats, and big brown bats are typically born in late-May-early June, June-July, and June, respectively; and it is likely that weaning occurs at approximately 5-6 weeks (DeGraff and Yamasaki 2001; Barclay and Harder 2005). Overall detection rates during the week of August 20-26 may have been obscured by relatively high levels of noise interference, however, the preceding weeks showed a decreasing trend of activity. The increase in recorded activity at the end of August may represent movement of migrating bats through the area, which may explain the greater number of LF bat passes during this period. Further analysis of migration patterns and temporal trends will be discussed in the final annual study report.

Potential Impacts

Assessing the potential impacts of wind-energy development to bats is confounded due the proximate and ultimate causes of bat fatalities at turbines being poorly understood (Kunz et al. 2007b, Baerwald et al. 2008, Cryan 2008, Cryan and Barclay 2009). In addition, the monitoring of elusive, night-flying animals is inherently difficult (O'Shea et al. 2003) and although installed wind-energy capacity has increased rapidly in recent years, the availability of results from well-designed studies from these projects has lagged (Kunz et al. 2007b). Nonetheless, monitoring studies at constructed wind-energy facilities suggest that:

a) bat mortality shows a rough correlation with bat activity (Table 4);
b) the majority of fatalities occur during the post-breeding or fall migration season (roughly August and September);
c) migratory tree-roosting species (eastern red, hoary, and silver-haired bats) comprise almost 75 % of reported bat casualties, and;
d) some of the highest reported fatalities occur at wind-energy facilities located along forested ridge tops in the eastern and northeastern US .

Based on these patterns, current guidance on estimating potential mortality levels of a proposed wind-energy development involves the evaluation of on-site bat acoustic data including activity levels, seasonal variation, and species composition (Kunz et al. 2007b), as well as comparing overall results with regional data.

Table 4. Summary of publically available bat activity and bat fatality data from wind-energy facilities in eastern North America.

Wind Energy Facility	Bat Use Estimate[A]	Fatality Estimate[B]	No. of Turbines	Total MW
Colebrook, CT	*28.07*	*n/a*	*6*	*9.6*
Buffalo Mountain, TN (2006)		39.70	18	29
Mountaineer, WV	38.3	31.69	44	66
Buffalo Mountain, TN (2000-2003)	23.7	31.54	3	2
Meyersdale, PA		18.00	20	30
Cohocton/Dutch Hill, NY		16.02	50	125
Casselman, PA		15.66	23	34.5
Maple Ridge, NY (2006)		15.00	120	198
Noble Bliss, NY (2008)		14.66	67	100
Mount Storm, WV (2008)	35.2	12.11	82	164
Maple Ridge, NY (2007)		9.42	195	321.75
Noble Clinton, NY (2009)		6.48	67	100
Wolfe Island, Ont.		6.42	86	197.8
Noble Bliss, NY (2009)		5.50	67	100
Noble Ellenburg, NY (2008)		5.45	54	80
Noble Ellenburg, NY (2009)		5.34	54	80
Ripley, Ont.		4.67	38	76
Noble Clinton, NY (2008)		3.63	67	100
Lempster, NH (2009)	0.4	3.08	12	24
Mars Hill, ME (2007)		2.91	28	42
Stetson Mountain, ME	0.30	1.40	38	57
Munnsville, NY		0.46	23	34.5
Mars Hill, ME (2008)		0.45	28	42

A=bat passes per detector night
B=number of bat fatalities/MW/study period
C=averaged across phases and/or study years, and may not be directly related to mortality estimates
D=bat activity not measured concurrently with bat mortality studies
Data from the following sources:

Facility	Use Estimate	Mortality Estimate	Facility	Use Estimate	Mortality Estimate
Buffalo Mountain, TN (2006)		Fiedler et al. 2007			
Mount Storm, WV (2008)	Young et. al 2009	Young et. al 2009	Lempster, NH	Stantec 2006	Tidhar et al 2010
Cohocton/Dutch Hill, NY		Stantec 2010	Noble Ellenburg, NY (2009)		Jain et. al 2010
Munnsville, NY		Stantec 2009	Ripley, Ont.		Stantec 2009
Buffalo Ridge, MN (Phases II&III; 2001)	Johnson et al. 2004	Johnson et al. 2004	Wolfe Island, Ont.		Stantec 2010
Biglow Canyon I, OR (2009)		Enk et al. 2010	Mars Hill (2008)		Stantec 2009

There are few instances where both bat activity and bat mortality have been recorded at wind-energy facilities and where results are comparable. For this reason, a definitive relationship between pre-construction bat activity and post-construction bat mortality has not been established empirically. From the data available, there appears to be a positive correlation between the two variables and there is the expectation amongst the scientific and resource management communities that when more data become available this relationship will hold (Kunz et al. 2007a). Datasets such as that provided by the current study will further contribute to our understanding of this relationship. Table 4 summarizes the results of publically-available activity and fatality data from wind-energy facilities in the eastern US and Canada. To our knowledge, activity data were collected using ground-based Anabat™ detectors.

Fatality estimates from post-construction monitoring at wind-energy facilities in eastern North America range from 0.45 to 39.7 bats/MW/year (Table 4). Activity between June 25 – August 31 within the CWRA was 28.07±3.93 bat passes/detector-night; a value within the range of the five facilities in the eastern US where pre- and post-construction data is available (range: 0.3-38.3; mean: 19.58). There appears to be some latitudinal variation in the eastern US, such that higher numbers of fatalities are estimated for more southerly sites compared to those further north. This requires more data but may possibly reflect the migratory patterns of bats on a broad-scale in this region. Bat fatality patterns observed at facilities within the region in similar forest-dominated landscapes (e.g Noble Ellenberg NY, Noble Clinton NY, Maple Ridge NY, Lempster NH, Stetson Mountain ME and Mars Hill ME) have been low to moderate based on regional study results. If latitudinal, landscape and patterns of bat activity rates relative to fatality rates are consistent for the CWRA with regional study results then fatality rates for bats may be moderate.

The vast majority of formal post-construction mortality studies completed in the Unites States have been completed at facilities with substantially larger numbers of turbines and MW capacity. For example, the mean project size for studies included in Table 4 is 53.8 turbines (range: 3-195). Impacts from small wind facilities such as the CWRA may be lower in terms of the number of bats killed per year compared to these facilities given the low (six) number of turbines proposed for the site.

Post-construction monitoring at wind-energy facilities throughout North America show the highest number of bat casualties during fall migration (approximately mid-August through mid-September) with lower numbers in general in the summer and spring (Johnson 2005; Arnett et al. 2008). The final annual report will include analysis of fall migration data and temporal comparison between summer and fall seasons. In addition, this report will include analysis of data collected by the full spectrum Wildlife Acoustics SM2 unit and additional analysis of acoustic data collected by Anabats for species identification.

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Appendix A. Photographs of Anabat Station CA1 Placement and Surrounding Habitat within the Colebrook Wind Resource Area for the Period of June 25 – August 31, 2010.

Appendix A. Photographs of Anabat station CA1 placement and surrounding habitat within the Colebrook Wind Resource Area for the period of June 25 – August 31, 2010.

Pictures taken in clockwise direction with the top picture at the front of the station.

Appendix B. Photographs of Anabat Station CA2 Placement and Surrounding Habitat within the Colebrook Wind Resource Area for the Period of June 25 – August 31, 2010.

Appendix B. Photographs of Anabat station CA2 placement and surrounding habitat within the Colebrook Wind Resource Area for the period of June 25 – August 31, 2010.

Pictures taken in clockwise direction with the top picture at the front of the station.

EXHIBIT L

Breeding Bird Surveys for the Colebrook Wind Resource Area Litchfield County, Connecticut

Final Report
June 29 –July 15, 2010

Prepared for:

BNE Energy, Inc.

Town Center, Suite 200
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West Hartford, Connecticut 06107

Prepared by:

David Tidhar and Kimberly Bay

Western EcoSystems Technology, Inc.
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November 17, 2010

WEST Inc. Environmental & Statistical Consultants

NATURAL RESOURCES ◆ SCIENTIFIC SOLUTIONS

EXECUTIVE SUMMARY

Western EcoSystems Technology, Inc. initiated surveys in June 2010 on behalf of BNE Energy Inc. (BNE) designed to assess breeding bird activity within the proposed Colebrook Wind Resource Area (CWRA) in Litchfield County, Connecticut. The following report contains results for summer breeding bird surveys and incidental wildlife observations. The CWRA is being permitted in two phases as Colebrook North and Colebrook South. The phases are located adjacent to one another and are comprised of similar vegetation composition and physiographic characteristics. All surveys reported herein were completed within Colebrook South. Due to the similarities of habitat, landuse and landcover, results of field surveys for Colebrook South are likely indicative of breeding bird species composition and relative abundance for Colebrook North.

The principal objectives of the study were to: 1) provide site-specific bird resource and use data that would be useful in evaluating potential impacts from the proposed wind energy facility, 2) provide information that could be used in project planning and design of the facility to minimize impacts to birds, and 3) recommend further studies or potential mitigation measures, if warranted.

Breeding bird use point surveys were conducted at 12 points located within the CWRA during three rounds: June 29, July 6, and July 15, 2010. A total of 36 five-minute breeding bird surveys were completed, with 461 individual bird observations within 443 separate groups recorded representing 39 unique bird species. Cumulatively, three species (7.7% of all species) composed 26.5% of the individual observations: unidentified passerine (46 observations), red-eyed vireo (*Vireo olivaceus*; 39 observations), and ovenbird (*Seiurus aurocapilla*; 37 observations. No other species made up more than 10% of the observations, individually. No federally-protected or sensitive species were recorded during the breeding bird surveys.

Incidental wildlife observations provide record of wildlife seen outside of the standardized surveys. Thirty-one bird species, totaling 86 individuals in 53 groups, were recorded incidentally within the project area. Two mammal species and seven amphibian species were also recorded incidentally. No sensitive or protected species were observed incidentally.

The results of the breeding bird surveys were characteristic of forested and open grassland areas of central Connecticut. Common species such as red-eyed vireo and ovenbird comprised the majority of identified species observed during breeding bird surveys. The most probable direct impact to birds from wind energy facilities is direct mortality or injury due to collisions with turbines or guy wires of met towers. Currently there is no evidence that observed impacts to individuals resulting from collisions with wind turbines have an effect on populations. Wind energy development has the potential to cause direct loss of habitat where infrastructure is located and indirect loss of habitat through behavioral avoidance and habitat fragmentation. Breeding bird habitats at the CWRA are regionally common. Findings studies completed at grassland or wetland habitats suggest that indirect impacts of wind turbines on birds are small

scale spatial effects, with the largest spatial scale for significant reduction in abundance noted at distances up to 400 m for a non-raptor species and 250 m for a raptor species (Pearce-Higgins 2009). Some research has also shown that the displacement effects may be temporary with birds becoming habituated to the turbines or facility cause disturbance over time, or not significantly changing their behavior in the presence of turbines (see Johnson et al 2000, Young et al. 2005b, Pearce-Higgins 2009).

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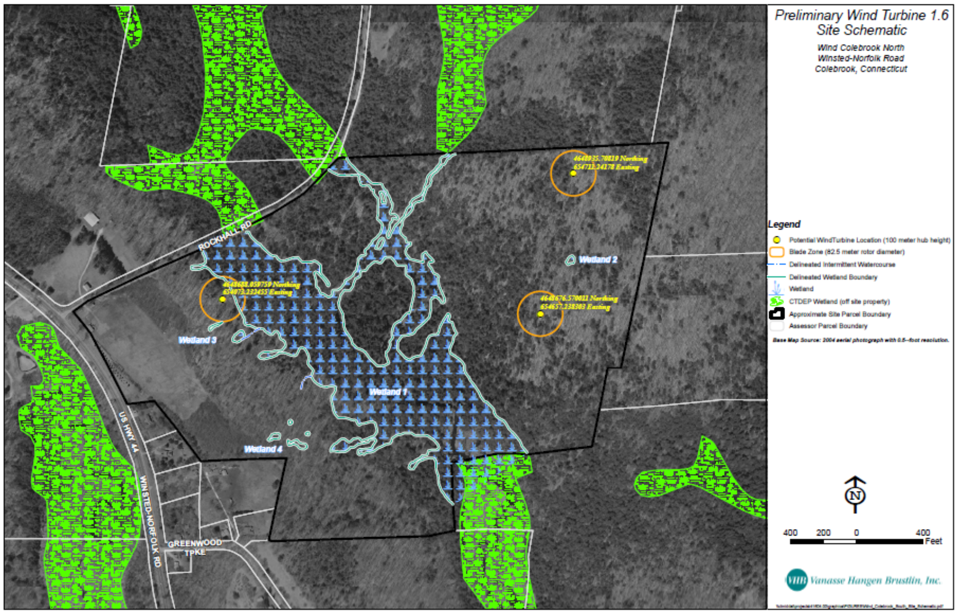
INTRODUCTION

Western EcoSystems Technology, Inc. initiated surveys in June 2010 on behalf of BNE Energy Inc. (BNE) designed to assess breeding bird activity within the proposed Colebrook Wind Resource Area (CWRA) in Litchfield County, Connecticut. The aim of the breeding bird study is to record information about the relative abundance and species composition of breeding songbirds throughout representative habitats in the study area. .The principal objectives of the study were to: 1) provide site-specific breeding bird use and distribution data that would be useful in evaluating potential impacts from the proposed CWRA, 2) provide information that could be used in project planning and design of the facility to minimize impacts to birds, and 3) recommend further studies or potential mitigation measures, if warranted. The protocols for the breeding bird studies are similar to those used at other wind energy facilities across the nation, and follow the guidance of the National Wind Coordinating Collaborative (Anderson et al. 1999). Other wildlife surveys completed included acoustic bat monitoring; the results of which are reported elsewhere. The protocols have been developed based on WEST's experience studying wildlife at proposed wind energy facilities throughout the US and were designed to help predict potential impacts to bird species.

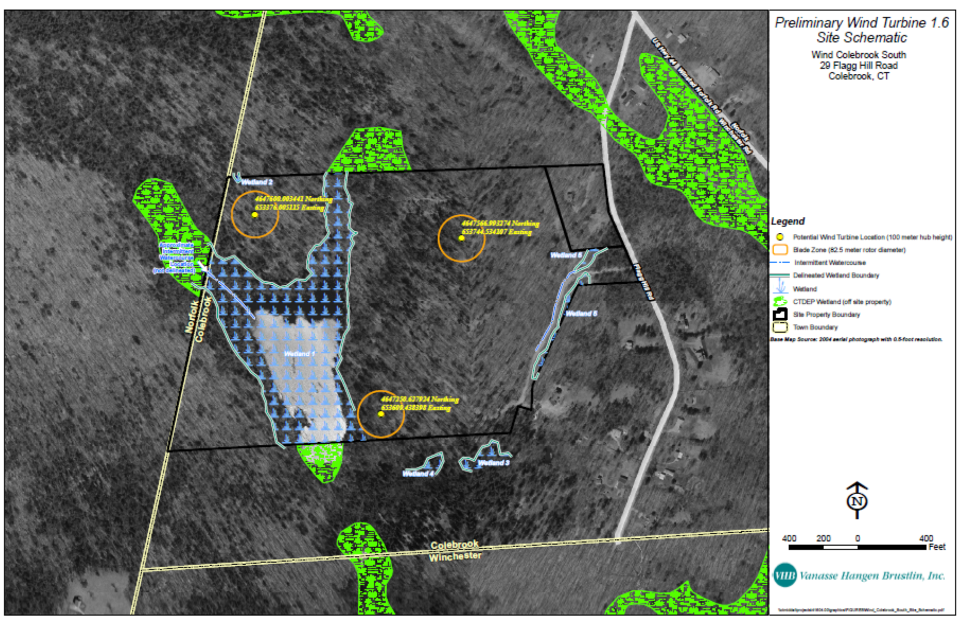
Summer breeding bird surveys and incidental wildlife observations were conducted from June 29 through July 15, 2010. In addition to site-specific data, this report presents existing information and results of studies conducted at other wind energy facilities.

STUDY AREA

The proposed CWRA is located near the town of Colebrook, Connecticut, in northeastern Litchfield County (VHB 2010a; Figure 1). The CWRA is being permitted in two phases as Colebrook North and Colebrook South. The phases are located adjacent to one another and are comprised of similar vegetation composition and physiographic characteristics. All surveys reported herein were completed within Colebrook South. Due to the similarities of habitat, landuse and landcover, results of field surveys for Colebrook South are likely indicative of breeding bird species composition and relative abundance for Colebrook North. The CWRA lies within the Northwest Highlands region (Bell 1985), which is characterized by hard, metamorphic bedrock that has shaped the landscape into high, steeply sided plateaus, broad valleys, and rolling foothills. The Appalachian Mountains extend through Connecticut west of the study area. The CWRA is situated primarily along the top and side slopes of an unnamed hill capped with glacial till. It also includes a small part of the eastern slope of Flagg Hill, as well as a valley between the two hills. The CWRA is approximately 80 acres (0.13 square miles [mi^2]) in size and elevation ranges from approximately 433 to 457 m (1,420 to 1,500 ft) above sea level. The region is primarily deciduous and coniferous forest, with pockets of residential development and agriculture occurring throughout the landscape. The majority of the study area is covered by secondary-growth upland forest, but also includes forested wetland associated with a manmade impoundment located on the western side of the property, and a larger forested wetland that primarily occurs off-site in the northwest corner of the property. Two intermittent watercourses also occur on-site. The forested portion of the CWRA is dominated by deciduous pole timber. The upland forest understory is relatively open, but where vegetated, is dominated by mountain laurel (*Kalmia angustifolia*). Saplings and shrubs of American beech (*Fagus grandifolia*) and *Rubus* species occur as well. Rotting logs, old forest tracks, woody debris, and slash are abundant throughout the CWRA (VHB 2010a). The city of Winsted is less than eight km (five mi) to the southeast. Residential development occurs to the east of the CWRA, on both sides of Flagg Hill Road.



North Colebrook



South Colebrook

Figure 1. Maps of the Colebrook Wind Resource Area.

METHODS

Baseline studies at the CWRA consisted of breeding bird surveys and incidental observations.

Breeding Bird Surveys

The objective of the breeding bird surveys was to identify songbird use and distribution in the CWRA.

Survey Plots

Twelve survey points were established within potential breeding bird habitat within the CWRA (Figure 2). Points were established approximately 100 m (328 ft) apart along a survey transect along a roughly east-west oriented transect through the proposed turbine development area. Habitat characteristics are summarized in Table 1. The majority of the points were located in deciduous forest dominated areas with the exceptions of point four and twelve, which were located in grassland and shrub/scub dominated areas, and point eleven, which was situated in a conifer dominated area. Survey points were microsited to facilitate seeing and hearing birds, while avoiding potential disturbance to habitat or nests. Coordinates for each survey point was recorded with a global positioning system (GPS) unit.

Survey Methods

A five-minute survey was conducted at 12 survey points by a qualified biologist between dawn and 10:00 am EDT during three survey rounds between June 28 – July 12, 2010. Surveys were not conducted during periods of excessive or abnormal heat, cold, wind (greater than 2 on Beaufort scale), or rain that may reduce the surveyor's ability to detect bird species. All birds seen or heard were recorded on a standardized data form, though only observations within 50-m (164 ft) of the survey point were included in analyses (see Statistical Analysis).

Data recorded included: date, start and end time of observation period, point number, species or best possible identification, sex, age, number of individuals, distance from point, behavior, first altitude above ground, flight direction, habitat and auditory-only observations. Recognized behavior categories were:

- NA – nesting activity (visually identified – e.g. nesting/food material delivery)
- CO – courtship display (visually identified – e.g. copulation, flight display)
- AC – alarm/warning call (auditory detection)
- SI – singing (auditory detection)
- OC – other call (auditory detection – e.g. chirp, non-breeding call)
- PE - perched
- FL – flight including flapping, soaring, gliding, hovering
- OT – other

Climate information, such as temperature, wind speed, wind direction, precipitation, and cloud cover also were also recorded for each point survey.

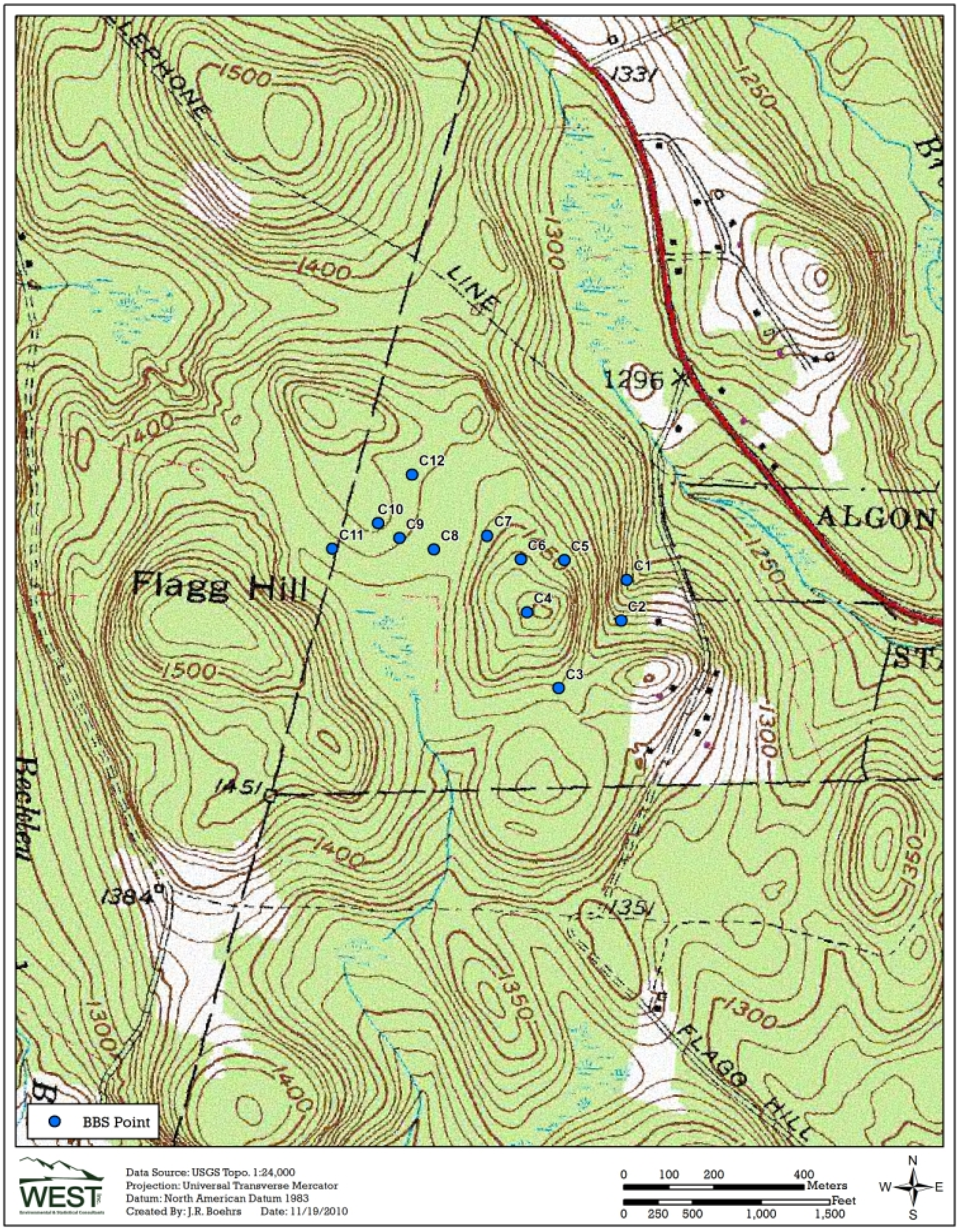


Figure 2. Breeding bird points at the Colebrook Wind Resource Area.

Statistical Analysis

Bird Diversity and Species Richness

Bird diversity was illustrated by the total number of unique species observed. Species lists (with the number of observations and the number of groups) were generated by season and included all observations of birds detected, regardless of their distance from the observer. Species richness was calculated as the mean number of species observed per plot per survey (number of species/50-m plot/5-min survey). Species diversity and richness were compared between seasons for breeding bird surveys.

Bird Use, Composition, and Frequency of Occurrence

For the standardized breeding bird use estimates, only observations within a 50 m radius were used in the analysis. Estimates of mean bird use (i.e., number of birds/plot/5-min survey) were used to compare and contrast among bird types, seasons, survey points, and other wind energy facilities. Mean use is calculated by determining the number of birds seen within each 50-m plot for each given visit and then averaging by the number of plots surveyed during that visit. A visit is defined as the required length of time to survey all of the plots once within the study area.

Percent composition was calculated as the proportion of the overall mean use for a particular bird type or species, and the frequency of occurrence was calculated as the percent of surveys in which a particular bird type or species is observed. Frequency of occurrence and percent composition provide relative estimates of species exposure to the wind energy facility. For example, a species may have high use estimates for the study area based on just a few observations of large groups; however, the frequency of occurrence will indicate that the species occurs during very few of the surveys and therefore may be less likely to be affected by the proposed wind energy facility.

Spatial Use

Data were analyzed by comparing mean use among plots.

Incidental Wildlife Observations

The objective of incidental wildlife observations was to provide record of wildlife seen outside the standardized surveys. All large birds, unusual or unique birds, sensitive species, mammals, reptiles, and amphibians were recorded in a similar fashion to standardized surveys. The observation number, date, time, species, number of individuals, sex/age class, distance from observer, activity, height above ground (for bird species), habitat, and, in the case of sensitive species, the location was recorded by Universal Transverse Mercator (UTM) or Global Positioning System (GPS) coordinates.

Quality Assurance and Quality Control

Quality assurance and quality control (QA/QC) measures were implemented at all stages of the study, including in the field, during data entry and analysis, and report writing. Following field surveys, observers were responsible for inspecting data forms for completeness, accuracy, and legibility. A sample of records from an electronic database was compared to the raw data forms and detected errors were corrected. Irregular codes or data suspected as questionable were discussed with the observer or project manager. Errors, omissions, or problems identified in later stages of analysis were traced back to the raw data forms, and appropriate changes in all steps were made.

A Microsoft® ACCESS database was developed for storing, organizing, and retrieving survey data. Data were keyed into the electronic database using a pre-defined format to facilitate subsequent QA/QC and data analysis. All data forms, field notebooks, and electronic data files were retained for reference.

RESULTS

Breeding Bird Surveys

Breeding bird use point surveys were conducted at the CWRA during three rounds: June 29, July 6, and July 15, 2010. A total of 36 five-minute breeding bird surveys were conducted (Table 1).

Table 1. Summary of overall bird use (number of birds/plot/5-min survey), species richness (species/plot/5-min survey), and sample size during the breeding bird surveys in the Colebrook Wind Resource Area, June 29 to July 15, 2010.

Survey	# of Visits	Mean Use	Species Richness	# Species	# Surveys Conducted
6/29/2010	1	13.58	9.25	27	12
7/6/2010	1	12.5	8.25	30	12
7/15/2010	1	12.33	7.92	24	12
	3	**12.78**	**8.44**	**39**	**36**

Bird Diversity and Species Richness

For all surveys combined, 39 unique species were identified during the breeding bird surveys and species richness (the mean number of species observed per plot per survey) was 8.44 (Table 1). Mean use (13.58 birds/plot/5-min survey) and species richness (9.25 species/plot/5-min survey) were highest during the June 29, 2010 survey. Overall, a total of 461 individual bird observations within 443 separate groups were recorded (Table 2). Cumulatively, three species (7.7% of all species) comprised 26.5% of the individual observations: unidentified passerine (46 observations), red-eyed vireo (*Vireo olivaceus*; 39 observations), and ovenbird (*Seiurus aurocapilla*; 37 observations). All other species composed no more than ten percent of the observations individually. No sensitive or protected species were recorded during regularly scheduled breeding bird surveys.

Table 2. Total number of groups and individuals for each bird type and species during the summer breeding bird surveys in the Colebrook Wind Resource Area, June 29 to July 15, 2010.

Species/Type	Scientific Name	# Grps	# Obs
Waterfowl		**3**	**3**
unidentified waterfowl		1	1
wood duck	*Aix sponsa*	2	2
Doves/Pigeons		**7**	**8**
mourning dove	*Zenaida macroura*	7	8
Passerines		**416**	**433**
Passerines		*45*	*46*
unidentified passerine		45	46
Blackbirds/Orioles		*18*	*20*
red-winged blackbird	*Agelaius phoeniceus*	18	20
Creepers/Nuthatches		*1*	*2*
white-breasted nuthatch	*Sitta carolinensis*	1	2
Finches		*4*	*4*
American goldfinch	*Carduelis tristis*	4	4
Flycatchers		*7*	*7*
eastern phoebe	*Sayornis phoebe*	2	2
eastern wood-pewee	*Contopus virens*	3	3
great crested flycatcher	*Myiarchus crinitus*	2	2
Gnatcatchers/Kinglet		*2*	*2*
black-tailed gnatcatcher	*Polioptila melanura*	2	2
Grassland/Sparrows		*41*	*41*
chipping sparrow	*Spizella passerina*	3	3
eastern towhee	*Pipilo erythrophthalmus*	34	34
indigo bunting	*Passerina cyanea*	2	2
swamp sparrow	*Melospiza georgiana*	2	2
Mimids		*4*	*4*
gray catbird	*Dumetella carolinensis*	4	4
Tanagers/Grosbeaks/Crossbills		*12*	*12*
scarlet tanager	*Piranga olivacea*	12	12
Thrushes		*52*	*52*
American robin	*Turdus migratorius*	10	10
eastern bluebird	*Sialia sialis*	1	1
hermit thrush	*Catharus guttatus*	25	25
Veery	*Catharus fuscescens*	13	13
wood thrush	*Hylocichla mustelina*	3	3
Titmice/Chickadees		*14*	*19*
black-capped chickadee	*Poecile atricapillus*	7	11
tufted titmouse	*Baeolophus bicolor*	7	8
Vireos		*39*	*39*
red-eyed vireo	*Vireo olivaceus*	39	39
Warblers		*143*	*144*
black-and-white warbler	*Mniotilta varia*	5	5
black-throated blue warbler	*Dendroica caerulescens*	28	28
black-throated green warbler	*Dendroica virens*	10	10
chestnut-sided warbler	*Dendroica pensylvanica*	30	31

Table 2. Total number of groups and individuals for each bird type and species during the summer breeding bird surveys in the Colebrook Wind Resource Area, June 29 to July 15, 2010.

Species/Type	Scientific Name	# Grps	# Obs
common yellowthroat	*Geothlypis trichas*	18	18
myrtle warbler	*Dendroica coronata coronata*	14	14
Ovenbird	*Seiurus aurocapilla*	37	37
pine warbler	*Dendroica pinus*	1	1
Waxwings		*2*	*3*
cedar waxwing	*Bombycilla cedrorum*	2	3
Wrens		*2*	*2*
winter wren	*Troglodytes troglodytes*	2	2
Corvids		*30*	*36*
American crow	*Corvus brachyrhynchos*	23	27
blue jay	*Cyanocitta cristata*	7	9
Woodpeckers		**16**	**16**
hairy woodpecker	*Picoides villosus*	3	3
northern flicker	*Colaptes auratus*	3	3
pileated woodpecker	*Dryocopus pileatus*	1	1
yellow-bellied sapsucker	*Sphyrapicus varius*	9	9
Unidentified Birds		**1**	**1**
unidentified bird		1	1
Overall		**443**	**461**

Bird Use, Composition, and Frequency of Occurrence

Mean bird use estimates, percent composition, and frequency of occurrence for all species and bird types are shown in Table 3. Mean use for passerines (12.03 birds/plot/5-min survey) was the highest of all major bird types; the passerine subtypes warblers and thrushes had the highest use of all passerine subtypes (4.00 and 1.44 birds/plot/5-min survey, respectively). Waterfowl comprised less than 1% of overall bird use, and were recorded during 5.6% of surveys. Woodpeckers comprised 3.5% of overall bird use within the project area and were recorded during 36.1% of all surveys.

Table 3. Mean bird use (number of birds/plot/5-min survey), percent of total composition, and frequency of occurrence (%) for each bird type and species during the summer breeding bird use surveys in the Colebrook Wind Resource Area, June 29 to July 15, 2010.

Species	Use	% Composition	% Frequency
Waterfowl	**0.08**	**0.7**	**5.6**
unidentified waterfowl	0.03	0.2	2.8
wood duck	0.06	0.4	2.8
Doves/Pigeons	**0.22**	**1.7**	**19.4**
mourning dove	0.22	1.7	19.4
Passerines	**12.03**	**94.1**	**100**
Passerines	*1.28*	*10.0*	*66.7*
unidentified passerine	1.28	10.0	66.7
Blackbirds/Orioles	*0.56*	*4.3*	*25.0*

Table 3. Mean bird use (number of birds/plot/5-min survey), percent of total composition, and frequency of occurrence (%) for each bird type and species during the summer breeding bird use surveys in the Colebrook Wind Resource Area, June 29 to July 15, 2010.

Species	Use	% Composition	% Frequency
red-winged blackbird	0.56	4.3	25.0
Creepers/Nuthatches	*0.06*	*0.4*	*2.8*
white-breasted nuthatch	0.06	0.4	2.8
Finches	*0.11*	*0.9*	*5.6*
American goldfinch	0.11	0.9	5.6
Flycatchers	*0.19*	*1.5*	*19.4*
eastern phoebe	0.06	0.4	5.6
eastern wood-pewee	0.08	0.7	8.3
great crested flycatcher	0.06	0.4	5.6
Gnatcatchers/Kinglet	*0.06*	*0.4*	*5.6*
black-tailed gnatcatcher	0.06	0.4	5.6
Grassland/Sparrows	*1.14*	*8.9*	*63.9*
chipping sparrow	0.08	0.7	5.6
eastern towhee	0.94	7.4	61.1
indigo bunting	0.06	0.4	5.6
swamp sparrow	0.06	0.4	2.8
Mimids	*0.11*	*0.9*	*11.1*
gray catbird	0.11	0.9	11.1
Tanagers/Grosbeaks/Crossbills	*0.33*	*2.6*	*30.6*
scarlet tanager	0.33	2.6	30.6
Thrushes	*1.44*	*11.3*	*61.1*
American robin	0.28	2.2	22.2
eastern bluebird	0.03	0.2	2.8
hermit thrush	0.69	5.4	50.0
Veery	0.36	2.8	22.2
wood thrush	0.08	0.7	5.6
Titmice/Chickadees	*0.53*	*4.1*	*22.2*
black-capped chickadee	0.31	2.4	8.3
tufted titmouse	0.22	1.7	13.9
Vireos	*1.08*	*8.5*	*72.2*
red-eyed vireo	1.08	8.5	72.2
Warblers	*4.00*	*31.3*	*91.7*
black-and-white warbler	0.14	1.1	11.1
black-throated blue warbler	0.78	6.1	52.8
black-throated green warbler	0.28	2.2	22.2
chestnut-sided warbler	0.86	6.7	52.8
common yellowthroat	0.50	3.9	27.8
myrtle warbler	0.39	3.0	33.3
Ovenbird	1.03	8.0	58.3
pine warbler	0.03	0.2	2.8
Waxwings	*0.08*	*0.7*	*5.6*
cedar waxwing	0.08	0.7	5.6
Wrens	*0.06*	*0.4*	*5.6*
winter wren	0.06	0.4	5.6

Table 3. Mean bird use (number of birds/plot/5-min survey), percent of total composition, and frequency of occurrence (%) for each bird type and species during the summer breeding bird use surveys in the Colebrook Wind Resource Area, June 29 to July 15, 2010.

Species	Use	% Composition	% Frequency
Corvids	*1.00*	*7.8*	*55.6*
American crow	0.75	5.9	52.8
blue jay	0.25	2.0	13.9
Woodpeckers	**0.44**	**3.5**	**36.1**
hairy woodpecker	0.08	0.7	8.3
northern flicker	0.08	0.7	8.3
pileated woodpecker	0.03	0.2	2.8
yellow-bellied sapsucker	0.25	2.0	22.2
Overall	**12.78**	**100**	

Spatial Use

For all bird species combined, mean use was highest at points 10 and 12 (17.0 and 16.3 birds/5-min survey, respectively), and ranged from 8.33 to 15.0 at other points (Figure 3). For all passerines combined (Figure 3) and for passerine subtypes (Figure 4), use does not appear to correlate with habitat type (forested vs. grassland/shrub/scrub). Waterfowl use was only recorded at points 8 (0.67 birds/5-min survey) and 10 (0.33), where woody and shrub/scrub wetlands were present within 50 m of survey points (Figure 4).

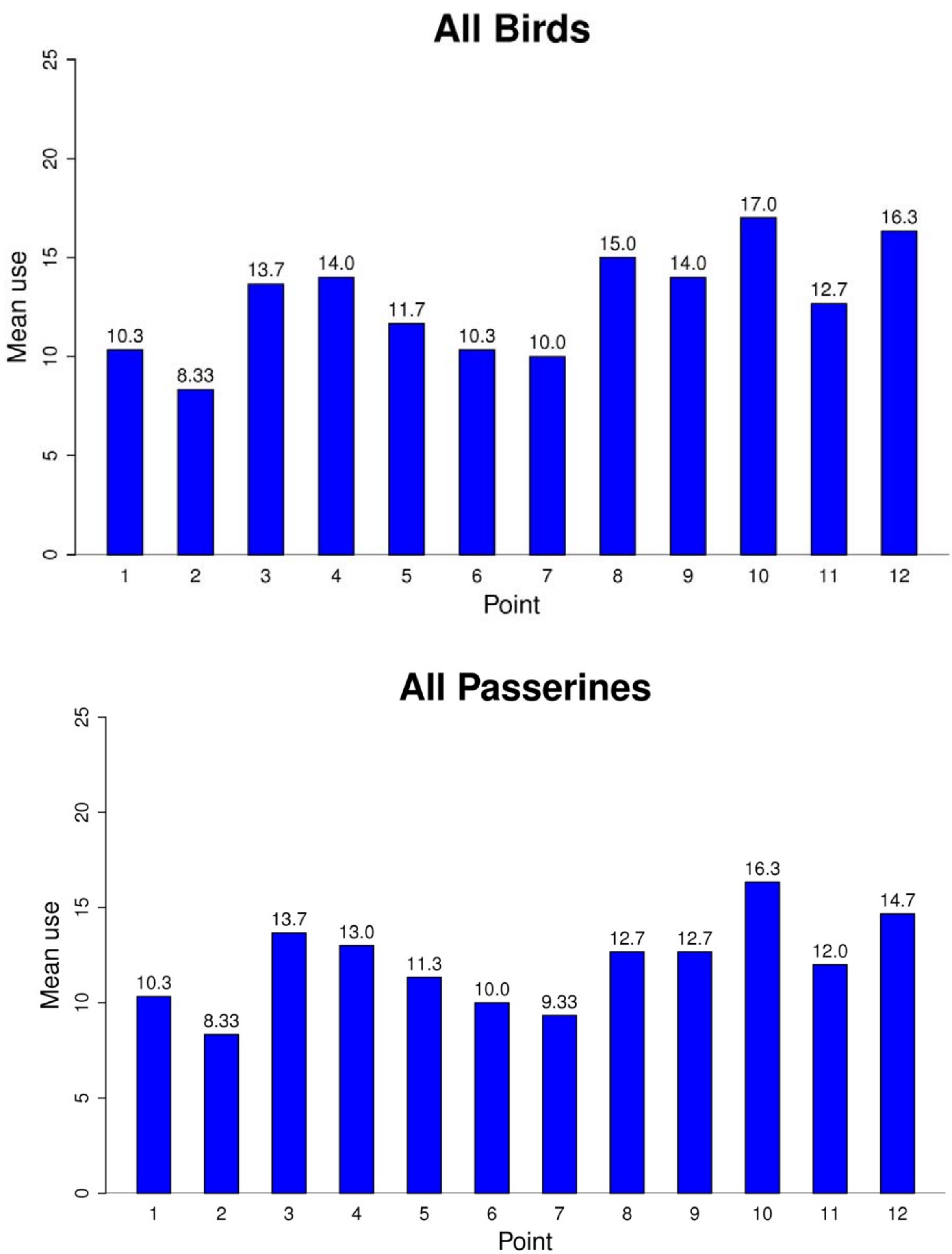


Figure 3. Mean use (number of birds/5-min survey) at each breeding bird point for all birds and all passerines at the Colebrook Wind Resource Area.

Incidental Wildlife Observations

Thirty-two bird species, totaling 86 individuals in 53 groups, were recorded incidentally within the CWRA (Table 4). Two mammal species and seven amphibian species were also recorded incidentally. No sensitive or protected species were recorded incidentally.

Table 4. Summary of Incidental Wildlife Observations by Groups (grps) and as Individuals (obs) within the Colebrook Wind Resource Area, from June 29 to July 15, 2010.

		Total	
Common Name	**Scientific Name**	**#grps**	**#obs**
wood duck	*Aix sponsa*	2	15
common yellowthroat	*Geothlypis trichas*	4	14
red-winged blackbird	*Agelaius phoeniceus*	4	8
eastern kingbird	*Tyrannus tyrannus*	3	4
ruffed grouse	*Bonasa umbellus*	1	3
scarlet tanager	*Piranga olivacea*	3	3
American goldfinch	*Carduelis tristis*	2	2
black-billed cuckoo	*Coccyzus erythropthalmus*	2	2
black-capped chickadee	*Poecile atricapillus*	1	2
broad-winged hawk	*Buteo platypterus*	2	2
cedar waxwing	*Bombycilla cedrorum*	2	2
eastern phoebe	*Sayornis phoebe*	2	2
hermit thrush	*Catharus guttatus*	2	2
indigo bunting	*Passerina cyanea*	2	2
red-breasted nuthatch	*Sitta Canadensis*	1	2
red-shouldered hawk	*Buteo lineatus*	2	2
white-breasted nuthatch	*Sitta carolinensis*	1	2
wild turkey	*Meleagris gallopavo*	2	2
Baltimore oriole	*Icterus galbula*	1	1
black-and-white warbler	*Mniotilta varia*	1	1
blue-headed vireo	*Vireo salitarius*	1	1
Canada goose	*Branta Canadensis*	1	1
chipping sparrow	*Spizella passerine*	1	1
common raven	*Corvus corax*	1	1
gray catbird	*Dumetella carolinensis*	1	1
great blue heron	*Ardea Herodias*	1	1
mourning dove	*Zenaida macroura*	1	1
Ovenbird	*Seiurus aurocapilla*	1	1
pileated woodpecker	*Dryocopus pileatus*	1	1
red-bellied woodpecker	*Melanerpes carolinus*	1	1
red-eyed vireo	*Vireo olivaceus*	1	1
unidentified owl		1	1
yellow-bellied sapsucker	*Sphyrapicus varius*	1	1
Bird Subtotal	**33 Species**	**53**	**86**
white-tailed deer	*Odocoileus virginianus*	2	2
Coyote	*Canis latrans*	1	1
Mammal Subtotal	**2 Species**	**3**	**3**
green frog	*Rana clamitans*	5	11
American bullfrog	*Rana catasbeiana*	1	4

Table 4. Summary of Incidental Wildlife Observations by Groups (grps) and as Individuals (obs) within the Colebrook Wind Resource Area, from June 29 to July 15, 2010.

eastern newt	*Notophthalmus viridescens*	3	3
gray treefrog	*Hyla versicolor*	1	1
northern leopard frog	*Rana pipiens*	1	1
spring peeper	*Pseudacris crucifer*	1	1
wood frog	*Rana sylvatica*	1	1
Amphibian Subtotal	**6 Species**	**13**	**22**
Total	**41 Species**	**69**	**111**

DISCUSSION AND IMPACT ASSESSMENT

The results of the breeding bird surveys were characteristic of forested and open grassland areas of central Connecticut. Breeding bird habitats at the CWRA are regionally common. No state- or federal-listed species were recorded during breeding bird surveys or incidentally within the CWRA.

The most probable direct impact to birds from wind energy facilities is direct mortality or injury due to collisions with turbines or guy wires of met towers. Collisions may occur with residents foraging and flying within the project area or with migrants seasonally moving through the project area. Common species such as red-eyed vireo and ovenbird comprised the majority of identified species observed during breeding bird surveys. Direct impacts to individuals may result from operation of the CWRA. Currently there is no evidence that observed impacts to individuals resulting from collisions with wind turbines have an effect on populations. Post construction mortality studies conducted at 12 wind facilities throughout the nation indicate a national avian mortality rate of 2.3 birds per turbine per year (birds/turbine/year) (NWCC 2004). Two thirds of fatalities documented during post-construction mortality monitoring studies were assumed to be migrants (NRC 2007).

Wind energy development has the potential to cause direct loss of habitat where infrastructure is located and indirect loss of habitat through behavioral avoidance and habitat fragmentation. Some research studies have shown that small scale displacement of grassland passerines from wind turbines is likely due to birds avoiding habitat disturbed by construction, turbine noise, and/or maintenance activities. Studies concerning displacement of avian species have largely concentrated on grassland passerines, raptors, and waterfowl/waterbirds (see Usgaard et al. 1997, Osborn et al. 1998, Winkelman 1990, Larsen and Madsen 2000, Johnson et al. 2000, Erickson et al. 2004, Young et al. 2005a, Young et al 2005b, Mabey and Paul 2007). The greatest concern with displacement impacts for wind projects in the U.S. has been where these facilities have been constructed in grassland or other native habitats where tall structures such as turbines do not normally occur (Leddy et al. 1999, Mabey and Paul 2007). Data on the effect of wind-energy on birds within largely forested landscapes is not currently available for analysis. Study findings from grassland or wetland habitats (see above references), suggest that indirect impacts of wind turbines on birds are small scale spatial effects, with the largest spatial scale for significant reduction in abundance noted at distances up to 400 m for a non-raptor species and

250 m for a raptor species (Pearce-Higgins 2009). Some research has also shown that the displacement effects may be temporary with birds becoming habituated to the turbines or facility cause disturbance over time, or not significantly changing their behavior in the presence of turbines (see Johnson et al 2000, Young et al. 2005b, Pearce-Higgins 2009).

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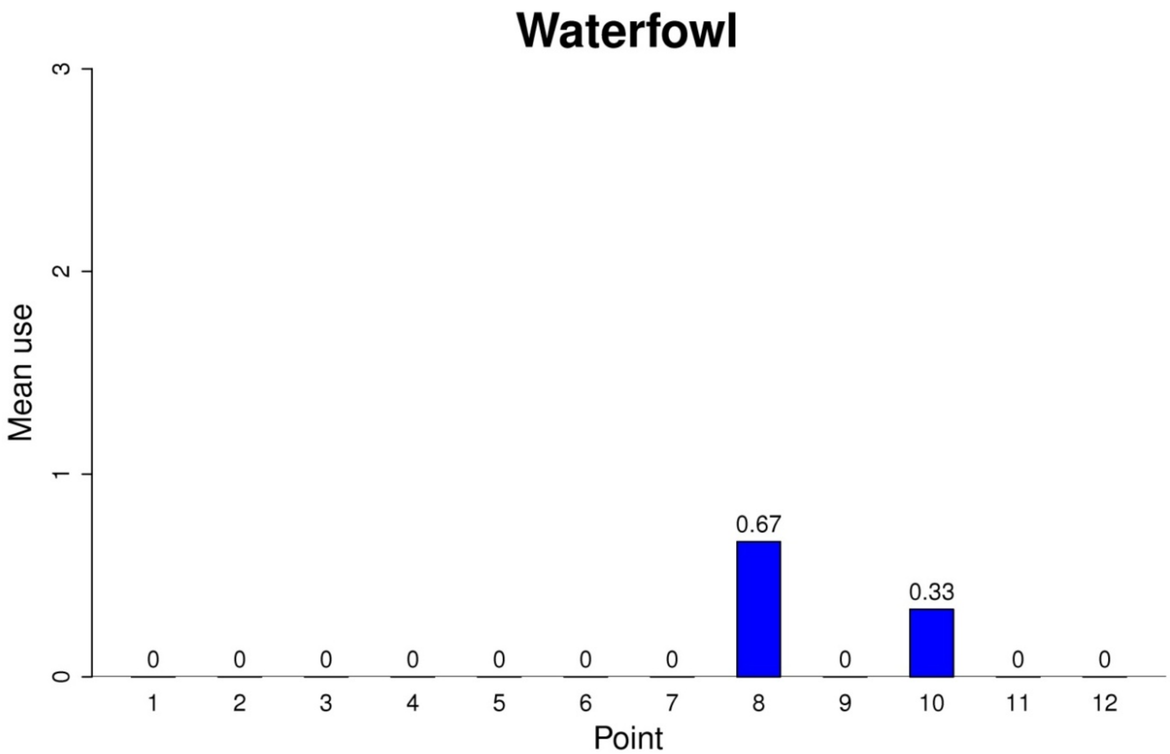


Figure 4. Mean use (number of birds/5-min survey) at each breeding bird point for all birds major bird types at the Colebrook Wind Resource Area.

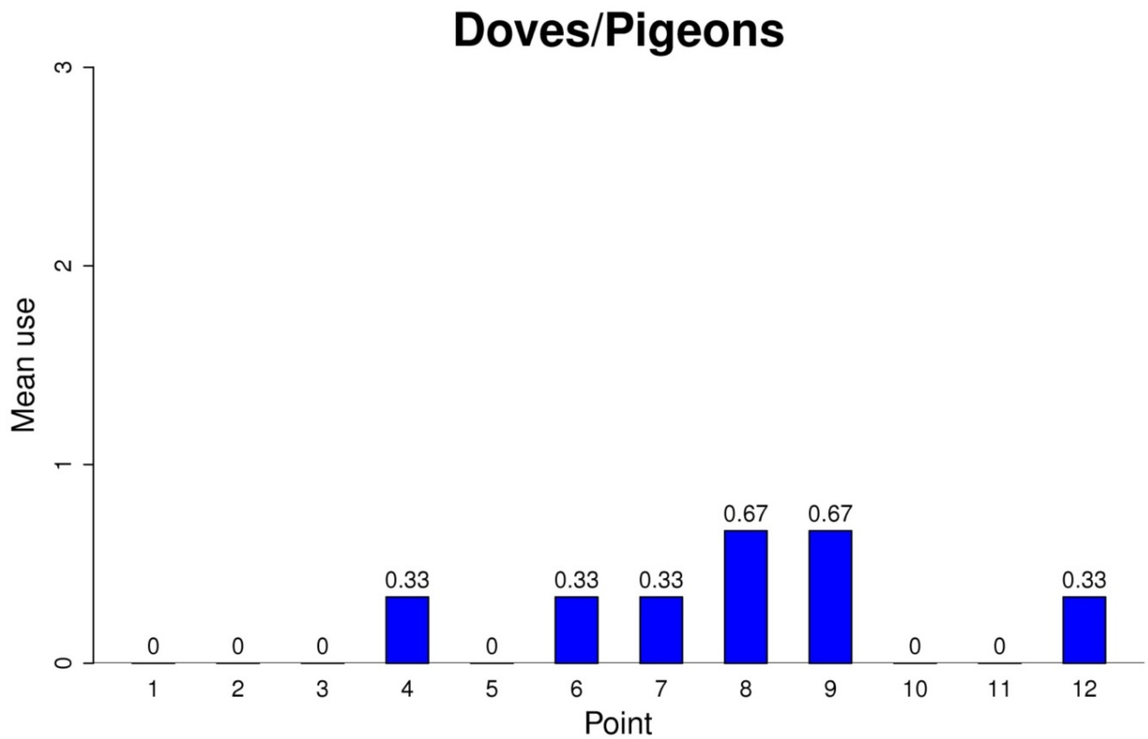
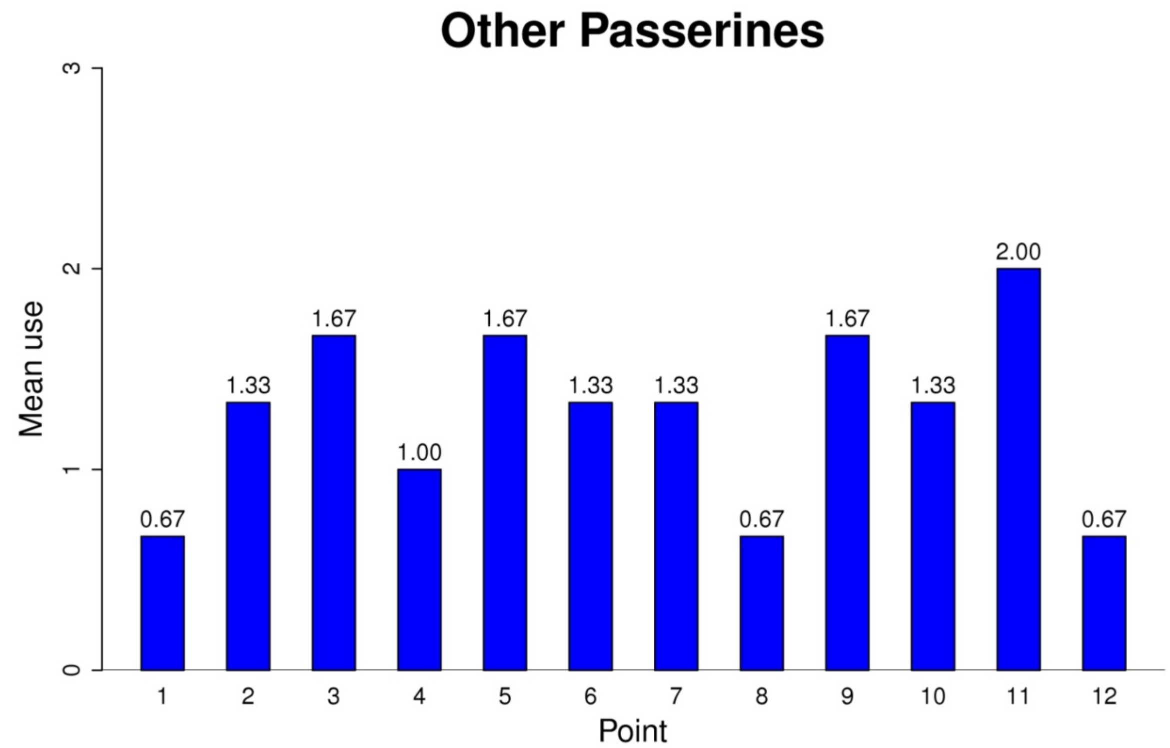
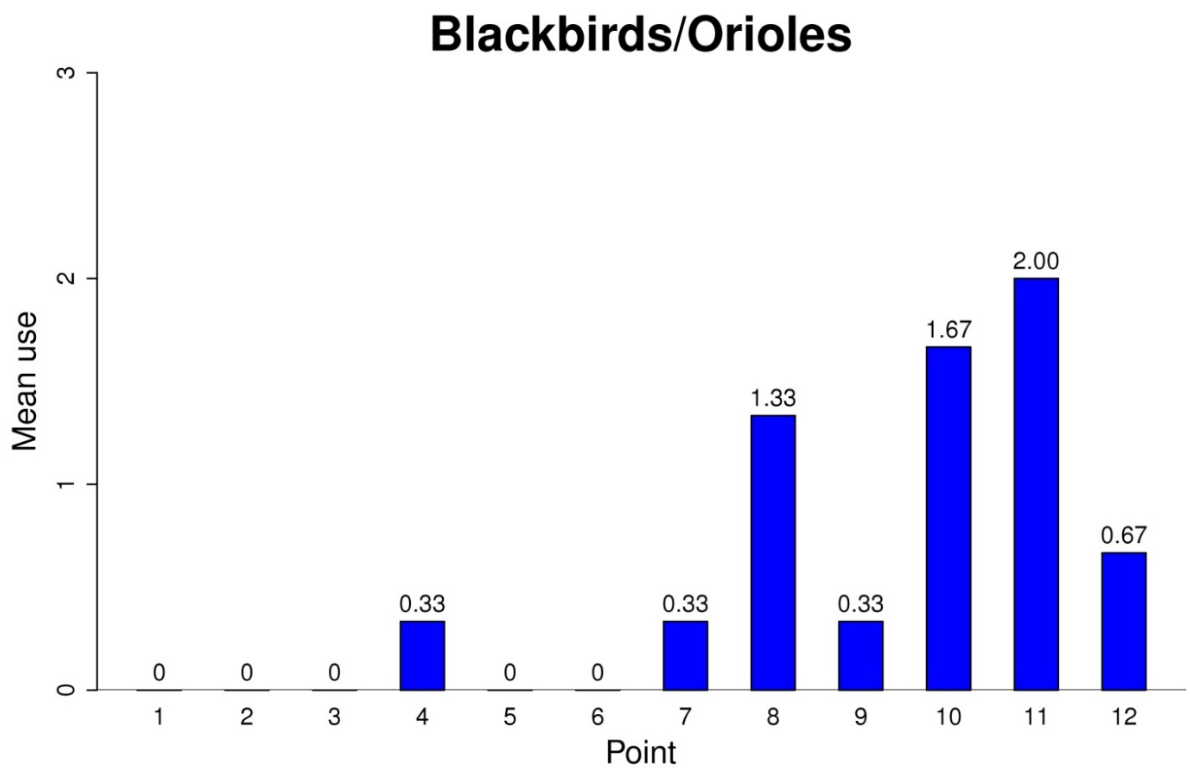


Figure 4 (*continued*). Mean use (number of birds/5-min survey) at each breeding bird point for all birds and major bird types at the Colebrook Wind Resource Area.





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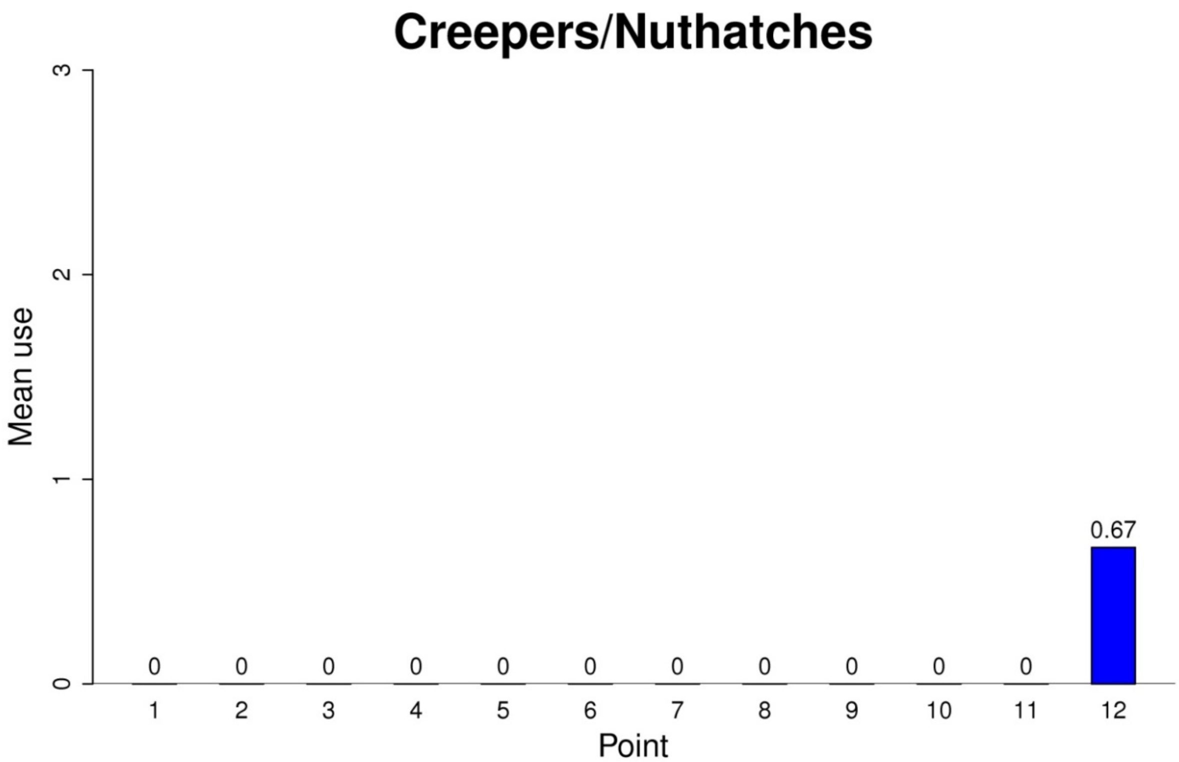

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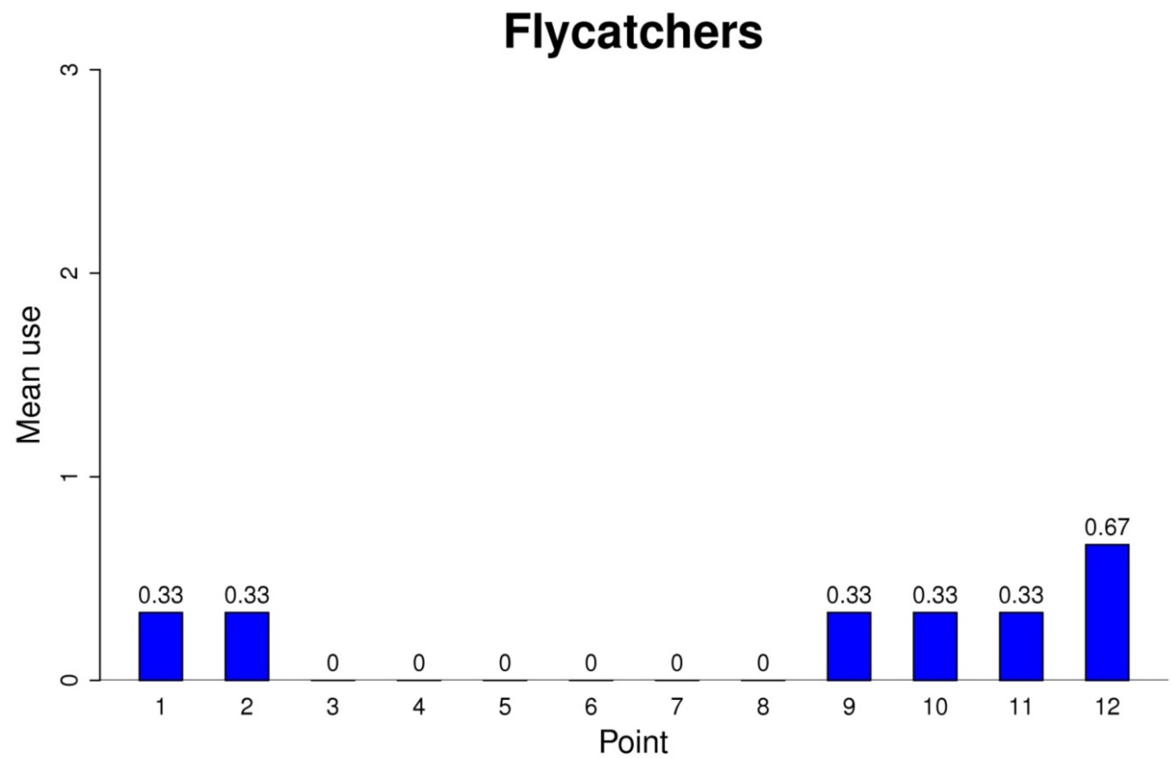

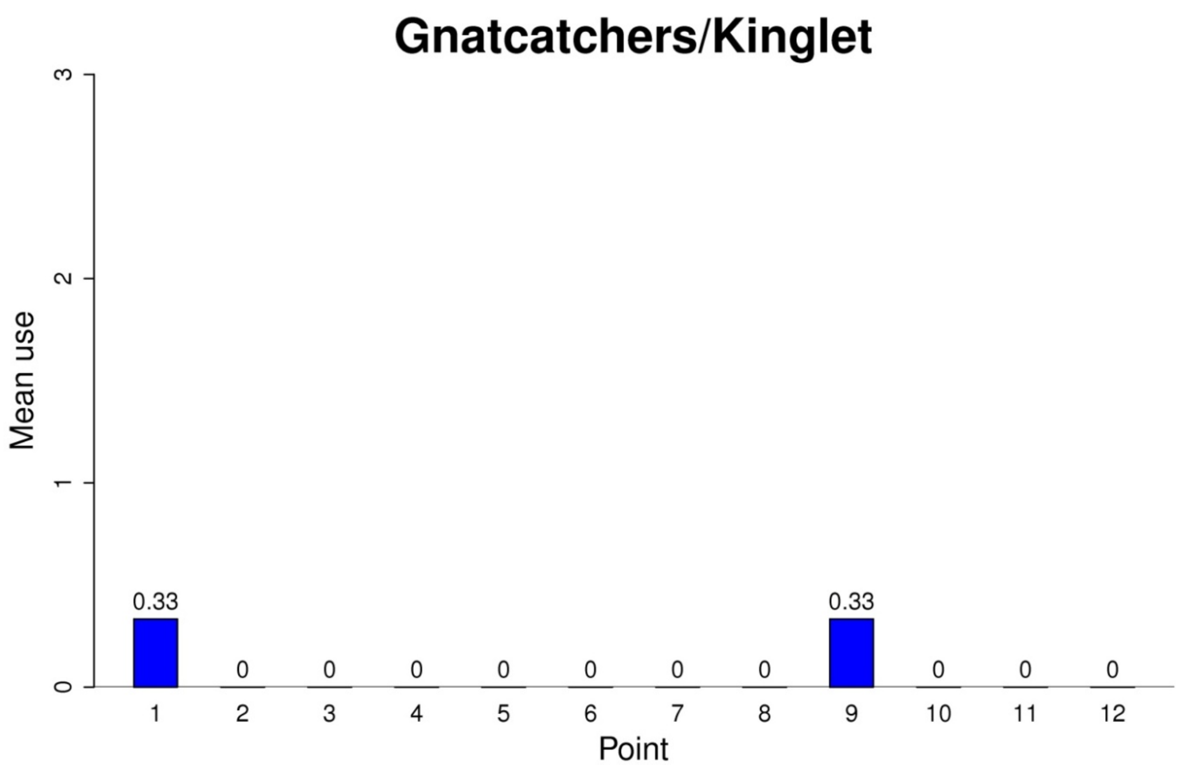

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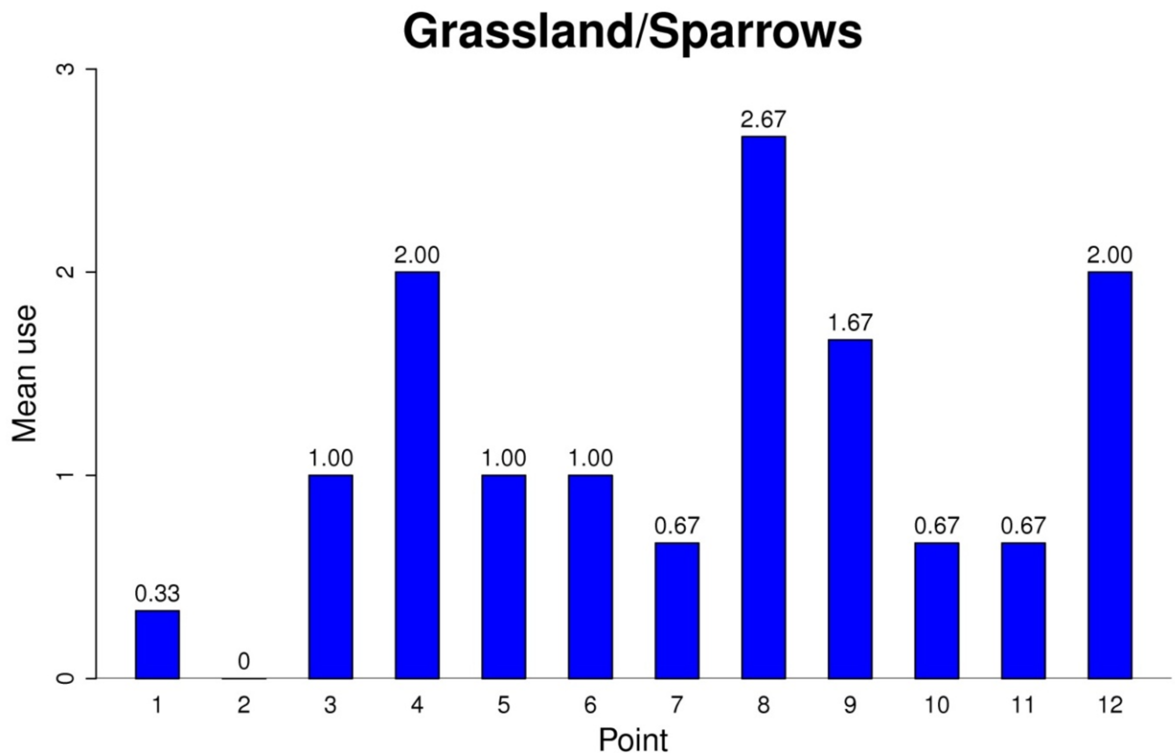

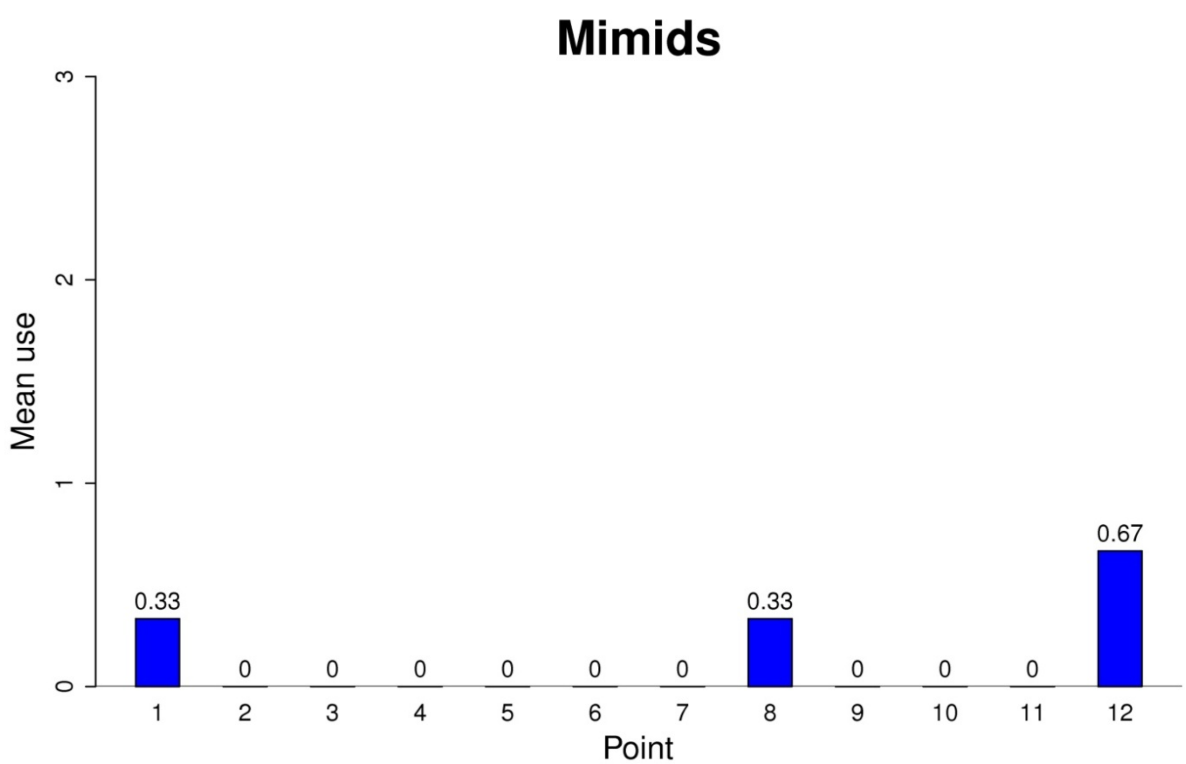

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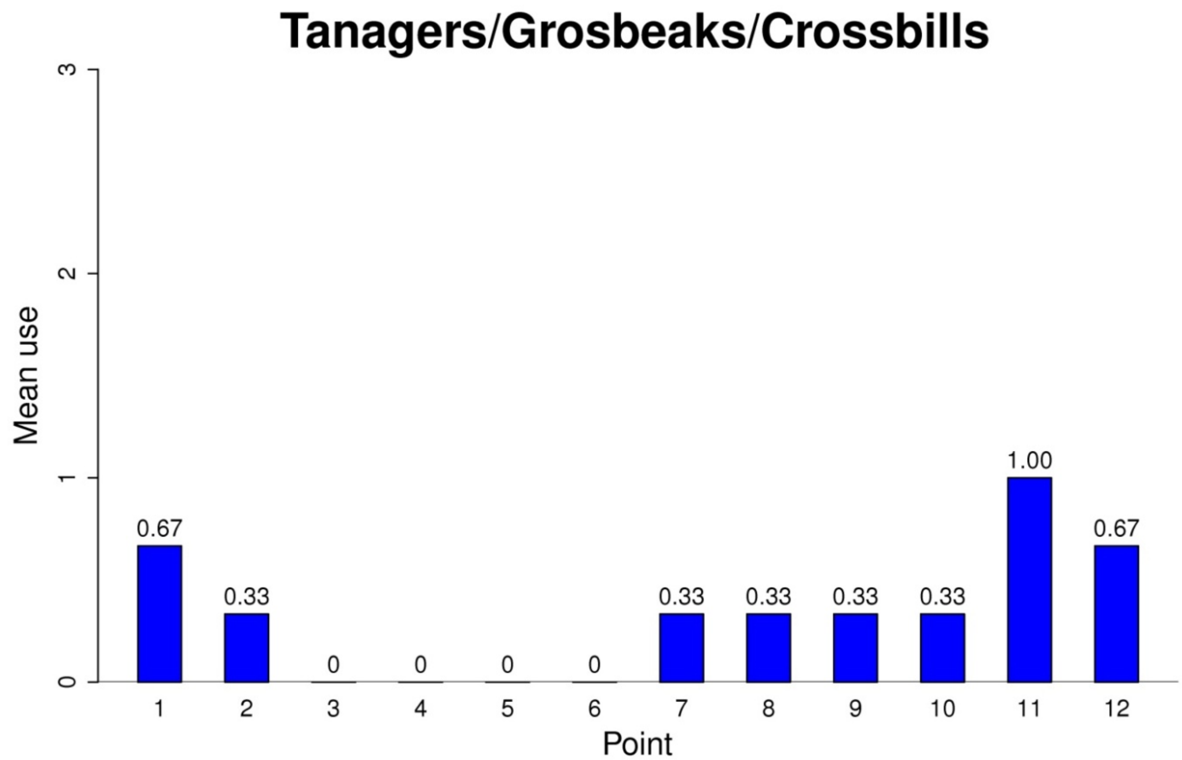

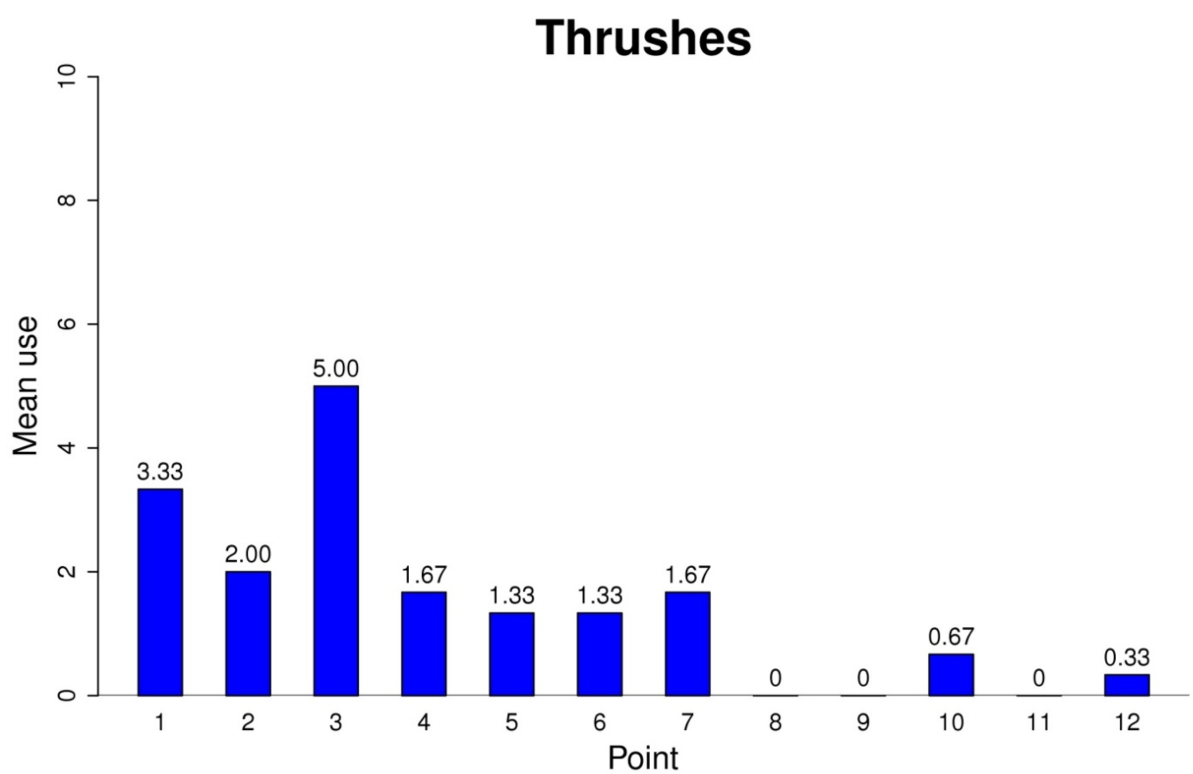

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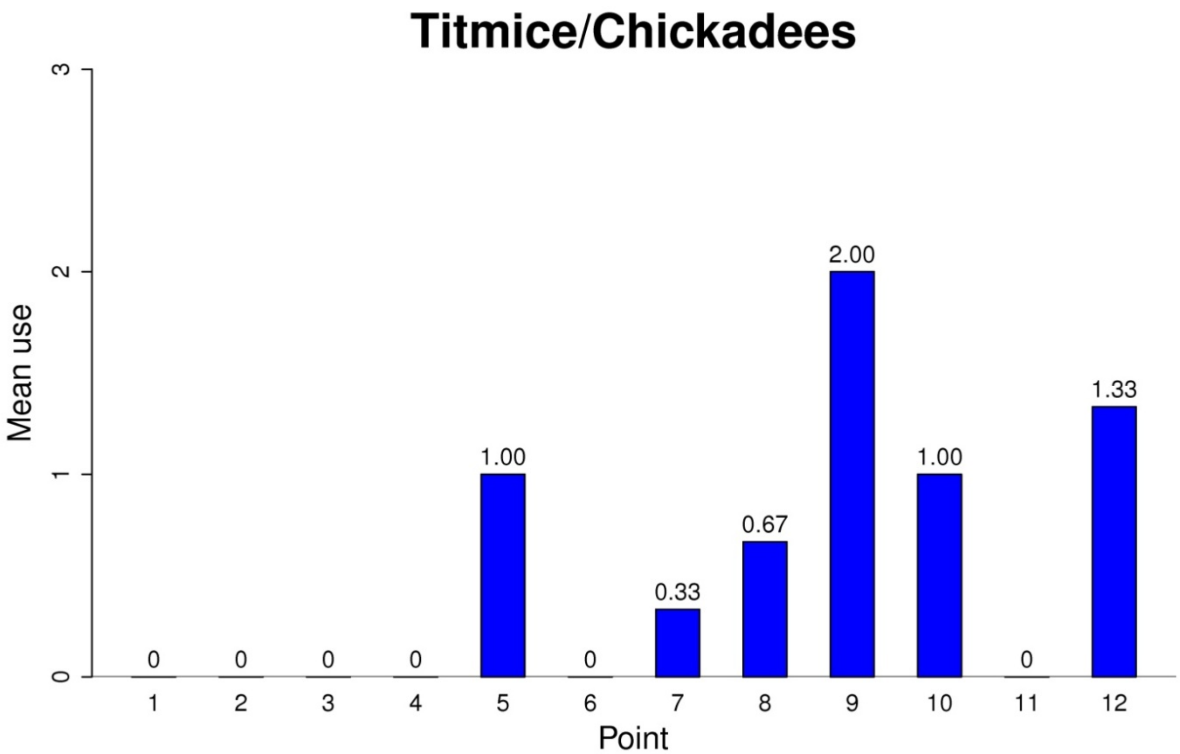

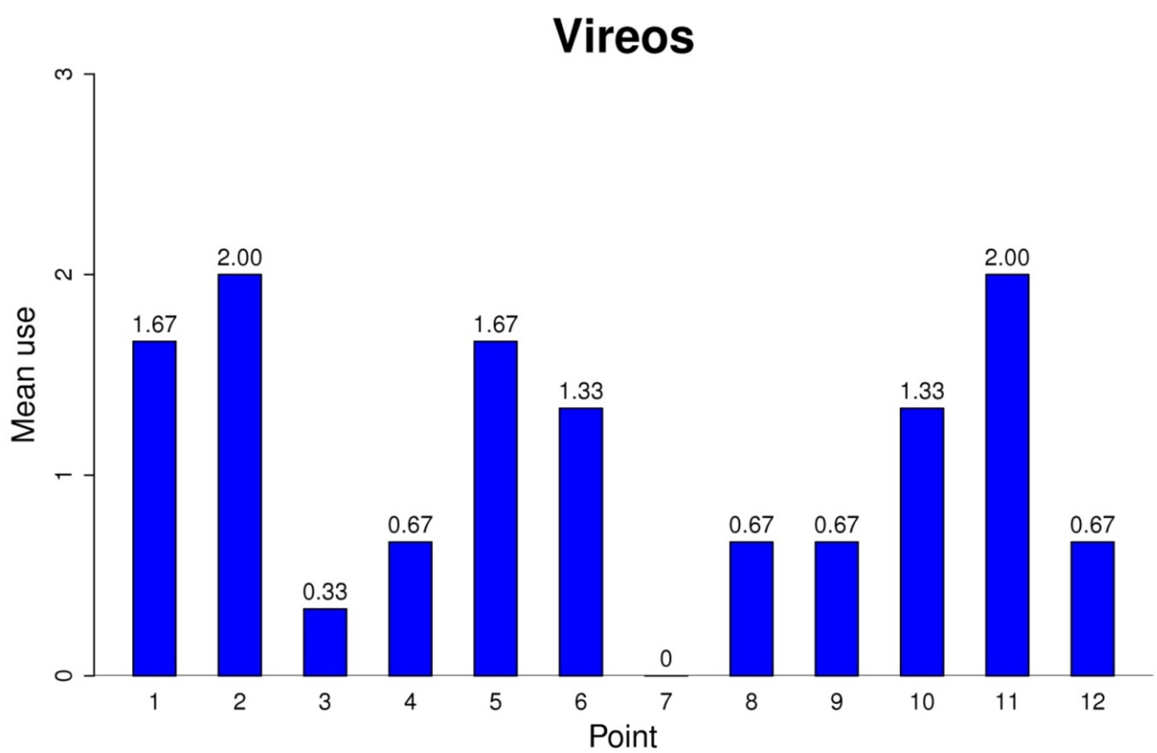

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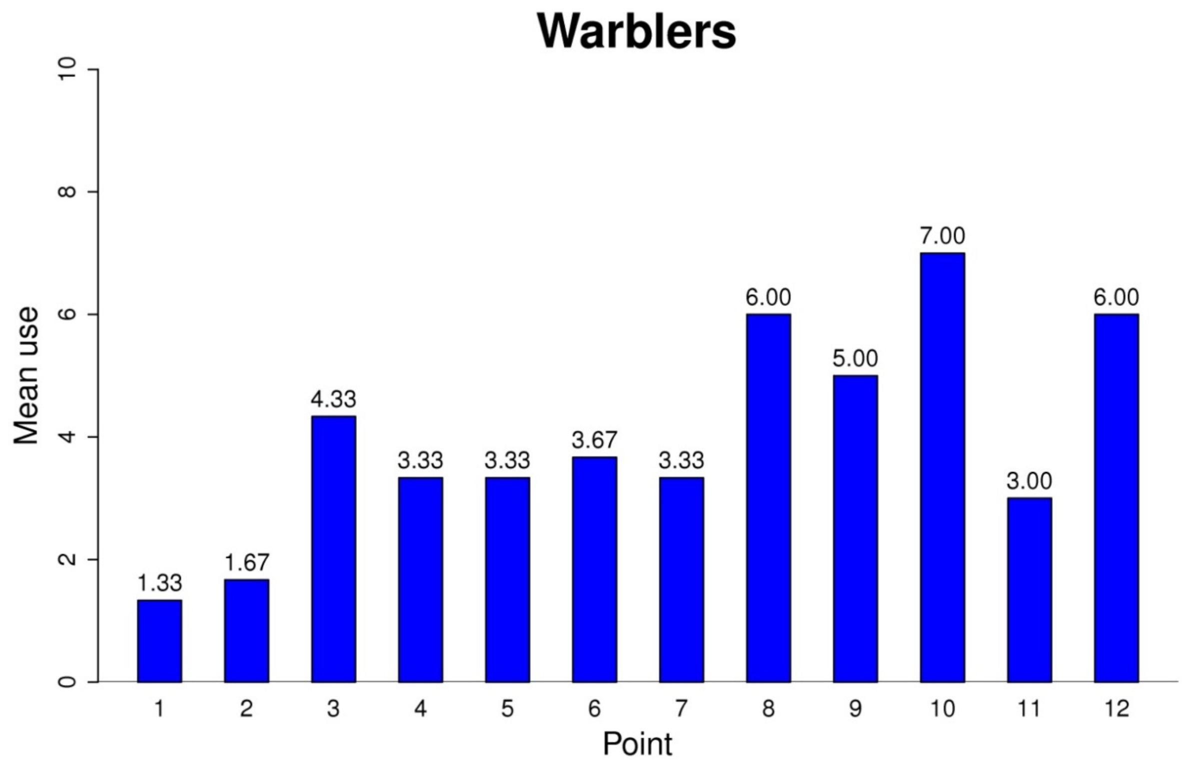


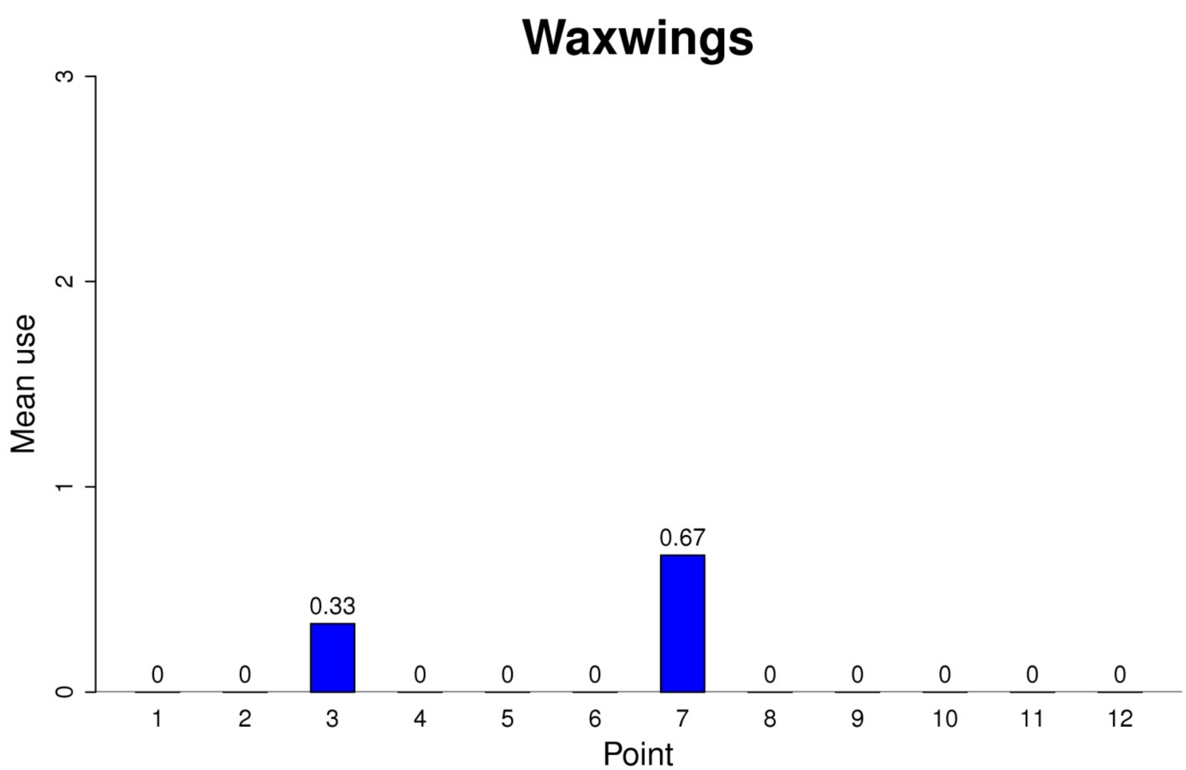
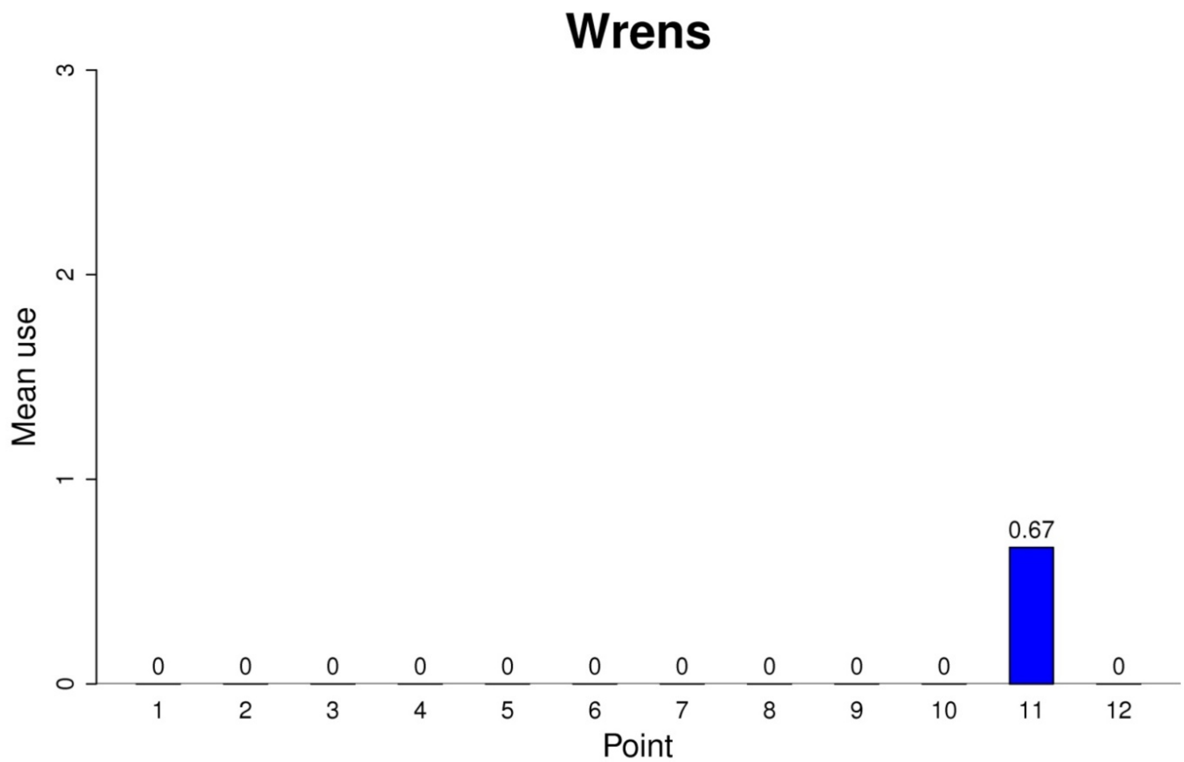


Figure 4 (*continued*). Mean use (number of birds/5-min survey) at each breeding bird point for all birds and major bird types at the Colebrook Wind Resource Area.



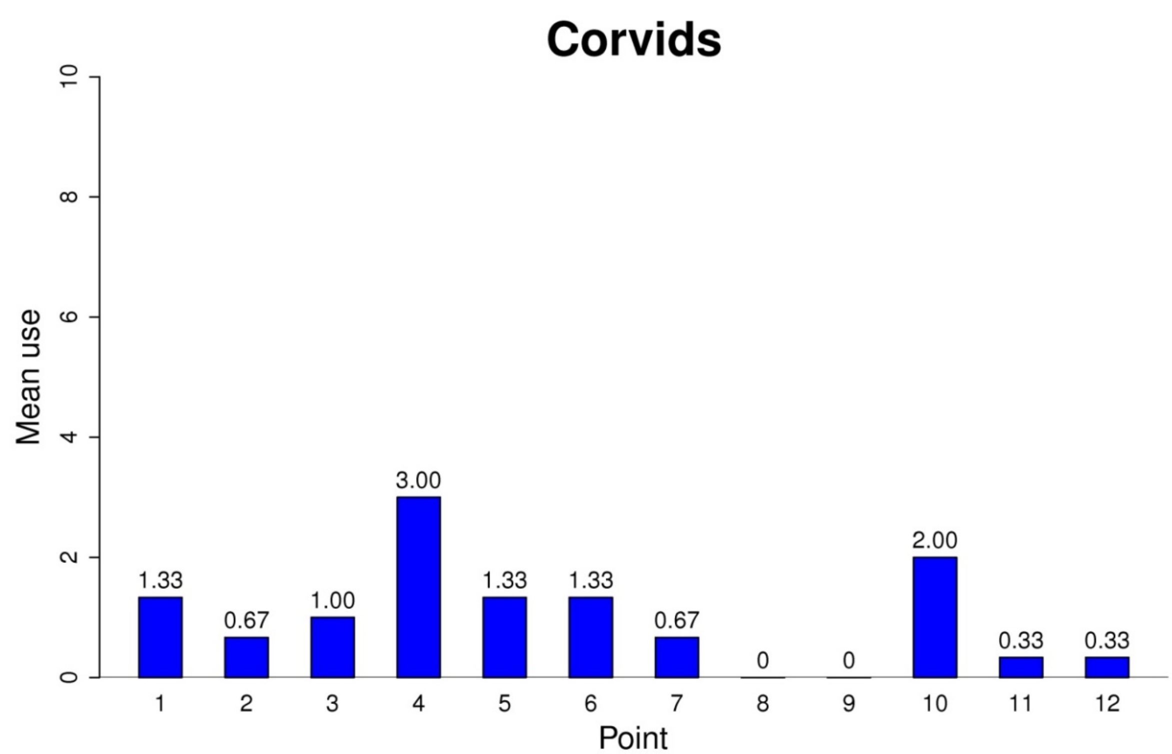


Figure 3 (*continued*). Mean use (number of birds/5-min survey) at each breeding bird point for all birds and major bird types at the Colebrook Wind Resource Area.

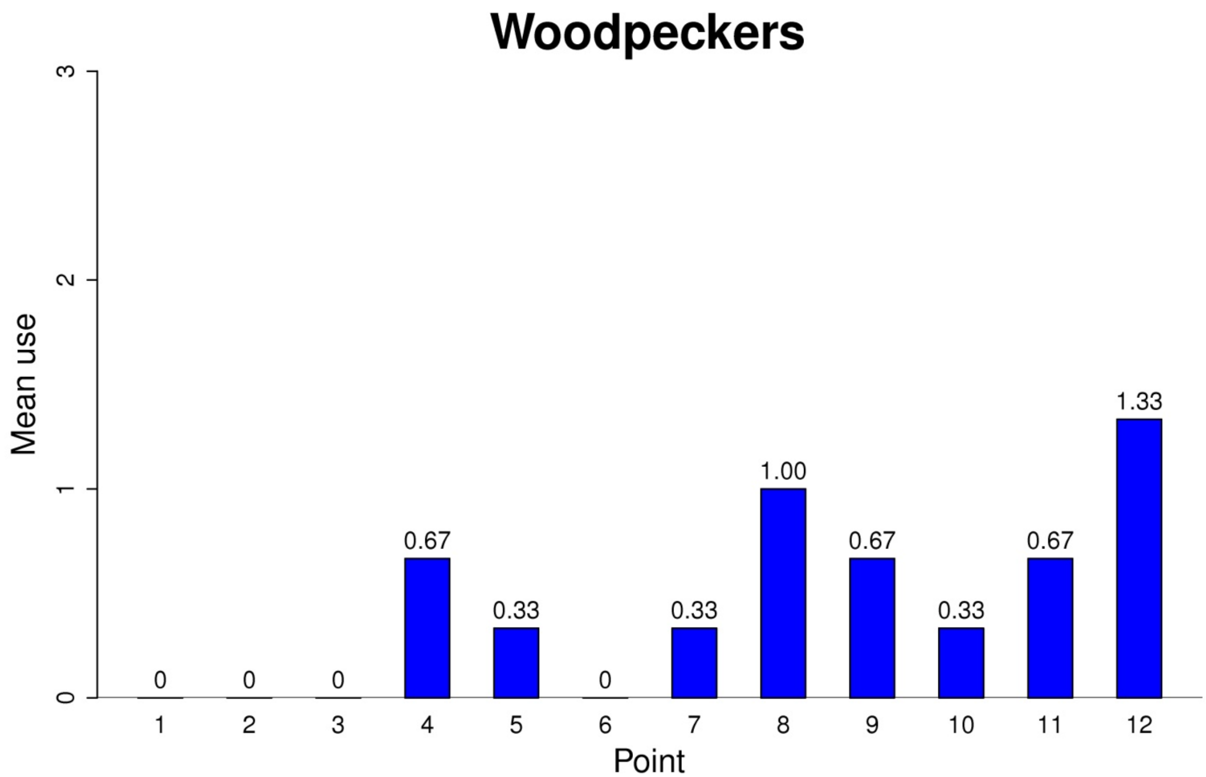


Figure 4 (*continued*). Mean use (number of birds/5-min survey) at each breeding bird point for all birds and major bird types at the Colebrook Wind Resource Area. Small bird observations were focused within 100-m viewsheds.

EXHIBIT M

Noise Evaluation

Wind Colebrook North

Winsted-Norfolk Road and
Rock Hall Road
Colebrook, Connecticut

Prepared for BNE Energy Inc.
Producer of green clean energy

Prepared by ***VHB***/**Vanasse Hangen Brustlin, Inc.**
Middletown, Connecticut

November 2010

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Executive Summary

The purpose of the noise analysis was to evaluate the potential noise impacts associated with the proposed construction of up to three 1.6-megawatt wind turbines on property northeast of the intersection of Winsted-Norfolk Road (Route 44) and Rock Hall Road in Colebrook, Connecticut. This noise analysis evaluated the existing and future build sound levels. Existing condition sound levels were determined by a noise monitoring program. The project-generated sound levels were calculated using manufacturer's sound data for the wind turbines and the principles of acoustical propagation of sound over distance.

The sound levels were projected to nearby residential noise receptor locations. These receptor locations were selected based on land use considerations, and represent the most sensitive locations (i.e., the residential areas) that may experience changes in sound levels resulting from the operation of three turbines. The results of this analysis demonstrate that the operation of three turbines will meet the Connecticut Department of Environmental Protection's noise impact criteria.

Noise Impact Analysis

Introduction

The purpose of this noise analysis was to evaluate the potential noise impacts associated with construction of up to three (3) 1.6-megawatt ("MW") wind turbines ("Wind Colebrook North" or the "Project") proposed for installation by BNE Energy, Inc. ("BNE") on property located at the intersection of Winsted-Norfolk Road (Route 44) and Rock Hall Road in Colebrook, Connecticut (the "Property" or "Site"). This noise analysis evaluated the existing condition and build condition sound levels. The sound levels were compared to the noise control regulations (Regulations of Connecticut State Agencies (RCSA), Title 22a, Section 22a-69-1 to 22a-69-7) established by the Connecticut Department of Environmental Protection ("CTDEP").

Noise Background

Noise is defined as unwanted or excessive sound. Sound becomes unwanted when it interferes with normal activities such as sleep, work, or recreation. How people perceive sound depends on several measurable physical characteristics. These factors include:

- Intensity - Sound intensity is often equated to loudness.
- Frequency - Sounds are comprised of acoustic energy distributed over a variety of frequencies. Acoustic frequencies, commonly referred to as tone or pitch, are typically measured in Hertz. Pure tones have all their energy concentrated in a narrow frequency range.

Sound levels are most often measured on a logarithmic scale of decibels (dB). The decibel scale compresses the audible acoustic pressure levels which can vary from the threshold of hearing (0 dB) to the threshold of pain (120 dB). Because sound levels are measured in dB, the addition of two sound levels is not linear. Adding two equal sound levels creates a 3 dB increase in the overall level. Research indicates the following general relationships between sound level and human perception:

- A 3 dB increase is a doubling of acoustic energy and is the threshold of perceptibility to the average person.
- A 10 dB increase is a tenfold increase in acoustic energy but is perceived as a doubling in loudness to the average person.

The human ear does not perceive sound levels from each frequency as equally loud. To compensate for this phenomenon in perception, a frequency filter known as A-weighted (dBA) is used to evaluate environmental noise levels.
A variety of sound level indicators can be used for environmental noise analysis. These indicators describe the variations in intensity and temporal pattern of the sound levels. The indicators used in this analysis are defined as follows:

- Lmax is the maximum A-weighted sound level measured during the time period.
- L_{10} is the A-weighted sound level, which is exceeded for 10 percent of the time during the time period.
- L_{90} is the A-weighted sound level, which is exceeded for 90 percent of the time during the time period. The L_{90} is generally considered to be the background sound level. It should be noted that the L_{90} eliminates the highest 10 percent of the sound levels that occur in the study area.

It should be noted that CTDEP requires that the noise analysis use the L_{90} A-weighted sound levels. Table 1 presents a list of common indoor and outdoor sound levels.

Table 1
Indoor and Outdoor Sound Levels

Outdoor Sound Levels	Sound Pressure (μPa)		Sound Level (dBA)	Indoor Sound Levels
	6,324,555	-	110	Rock Band at 5 m
Jet Over-Flight at 300 m		-	105	
	2,000,000	-	100	Inside New York Subway Train
Gas Lawn Mower at 1 m		-	95	
	632,456	-	90	Food Blender at 1 m
Diesel Truck at 15 m		-	85	
Noisy Urban Area—Daytime	200,000	-	80	Garbage Disposal at 1 m
		-	75	Shouting at 1 m
Gas Lawn Mower at 30 m	63,246	-	70	Vacuum Cleaner at 3 m
Suburban Commercial Area		-	65	Normal Speech at 1 m
	20,000	-	60	
Quiet Urban Area—Daytime		-	55	Quiet Conversation at 1 m
	6,325	-	50	Dishwasher Next Room
Quiet Urban Area—Nighttime		-	45	
	2,000	-	40	Empty Theater or Library
Quiet Suburb—Nighttime		-	35	
	632	-	30	Quiet Bedroom at Night
Quiet Rural Area—Nighttime		-	25	Empty Concert Hall
Rustling Leaves	200	-	20	
		-	15	Broadcast and Recording Studios
	63	-	10	
		-	5	
Reference Pressure Level	20	-	0	Threshold of Hearing

μPA MicroPascals describe pressure. The pressure level is what sound level monitors measure.
dBA A-weighted decibels describe pressure logarithmically with respect to 20 μPa (the reference pressure level).
Source: Highway Noise Fundamentals, Federal Highway Administration, September 1980.

Impact Criteria

The CTDEP has developed noise impact criteria that establish noise thresholds deemed to result in adverse impacts. The noise analysis for Wind Colebrook North used these criteria to evaluate whether the proposed Project will generate sound levels that result in adverse impacts.

Connecticut DEP Criteria

The CTDEP's noise control regulations identify the limits of sound that can be emitted from specific premises and what activities are exempt. The noise control regulations (Title 22a, §§ 22a-69-1 to 22a-69-7) are contained in the Regulations of Connecticut State Agencies (RCSA). This policy states that a source located in a "Class C Noise Zone" shall not emit noise exceeding the levels stated in Table 2 at the adjacent noise zones.

Table 2
Noise Zone Standards, L_{90} (dBA)

	Receptor Noise Zone			
Emitter Zone	Class A (Daytime)	Class A (Nighttime)	Class B	Class C
Class A (Residential)	55	45	55	62
Class B (Commercial)	55	45	62	62
Class C (Industrial)	61	51	66	70

Source: Control of Noise (Title 22a, Section 22a-69-1 to 22a-69-7.4), Regulations of Connecticut State Agencies, June 1978.

A Class C land use is defined as generally industrial where protection against damage to hearing is essential, and the necessity for conversation is limited. The land use for Class B is defined as generally commercial in nature, where human beings converse and such conversations are essential to the intended use of the land. The land use in Class A is defined as generally residential where human beings sleep or areas where serenity and tranquility are essential to the intended use of the land.

The noise analysis assumed that the Emitter Zone for the proposed wind turbines is Class C (Industrial) and that the Receptor Noise Zone for the receptor locations is Class A (Residential).

Methodology

This noise analysis evaluated the sound levels of Wind Colebrook North. The noise analysis consists of two components: existing ambient sound levels and Project contributions. The existing condition sound levels were determined by conducting noise measurements at sensitive receptor locations surrounding the Project Site. The Project-generated sound levels were calculated using manufacturer's sound data and the principles of acoustical propagation of sound over distance.

Noise monitoring was conducted to determine the existing sound levels in the vicinity of the Project Site following procedures established in Section 22a-69-4 of the CTDEP noise control regulations. Noise monitoring was conducted at two locations that are representative of the receptor locations during the weekday daytime and nighttime periods. The noise monitoring data was used to establish existing conditions in areas that may experience changes in sound levels associated with Wind Colebrook North.

Noise associated with wind turbines consists of two sources: the aerodynamic sound produced by air flow over the rotor blades and sound from the mechanical components that drive the blades. The Project-generated sound levels were calculated for each receptor location based on manufacturer reference sound level data of the 1.6-MW wind turbines. The noise analysis assumed that the proposed wind turbines would be operating at the maximum wind speed during the daytime period and at the mean wind speed for the nighttime period. The wind speed was based upon wind data collected from the region by BNE to determine the feasibility of the Project. The manufacturer's sound level data for these operating conditions were projected to the receptor locations using the acoustical properties of sound propagation over terrain.

The calculations of the sound level projections to the receptor locations follow the methodology outlined by the International Organization of Standardization (ISO). The following equation, from the publication *ISO 9613-2: Attenuation of sound during propagation outdoors – Part2: General method of calculation*, was used to calculate the sound levels at the receptor locations.

Lft(DW) = Lw + Dc – A, where…

- Lw is the sound power level produced by the sound source.
- Dc is the directivity correction to account for deviation of the sound power level in a specified direction. For an omni-directional sound source radiating into open space, Dc = 0.
- A is the attenuation occurring during propagation from sound source to receptor location. Attenuation may include geometrical divergences (or spherical spreading), atmospheric absorption, ground effect, barrier, and other miscellaneous effects, such density of vegetation and buildings.

The calculation of the proposed Project's sound levels took into consideration geometric divergences and atmospheric absorption due to the surrounding environment.

Receptor Locations

Eight noise receptor locations were identified in the vicinity of Wind Colebrook North. The receptor locations were selected based on their proximity to the Site and their land use. These receptor locations represent the most sensitive locations in the immediate area that may experience changes in sound levels once Wind Colebrook North is in operation. These receptor locations represent the residential parcels that surround the Project Site. They include:

- Receptor Location 1 (R1) – Residence on Rock Hall Road,
- Receptor Location 2 (R2) – Residence on Rock Hall Road,
- Receptor Location 3 (R3) – Residence on Greenwoods Turnpike,
- Receptor Location 4 (R4) – Residence on Greenwoods Turnpike,
- Receptor Location 5 (R5) – Residence on Greenwoods Turnpike,
- Receptor Location 6 (R6) – Residence on Greenwoods Turnpike,
- Receptor Location 7 (R7) – Residence on Winsted Norfolk Road (Route 44)
- Receptor Location 8 (R8) – Residence on Pinney Street,
- Receptor Location 9 (R9) – Residence on Pinney Street,
- Receptor Location 10 (R10) – Residence on Pinney Street,
- Receptor Location 11 (R11) – Residence on Stillman Hill Road (Route 182)
- Receptor Location 12 (R12) – Residence on Rock Hall Road, and
- Receptor Location 13 (R13) – Residence on Rock Hall Road.

The primary land use in the vicinity of the Project Site is residential. The receptor and existing conditions noise monitoring locations used in the noise analysis are presented in Figure 1.

Existing Conditions

The existing sound levels in the vicinity of the Project Site were established by conducting actual measurements of sound levels at the neighborhood of Flagg Hill Road to the south of the Project Site. The measured sound levels were used to establish a baseline for the study area.

The noise monitoring was conducted using a Larson Davis 824 Type I sound level analyzer and followed noise monitoring procedures outlined in Section 22a-69-4 of the CTDEP's noise control regulations. The sound levels were measured at each location during both the weekday daytime (7 AM. to 10 PM) on April 1, 2010 and weekday nighttime periods (10:00 PM. to 7:00 AM) on April 1, 2010 to April 2, 2010. The noise sources included local vehicular traffic and natural occurrences, such as wind, birds and other animals. The sound levels represent conservative values because the wind conditions during the measurements were calm.

The existing sound levels do not exceed the local and State criteria of 61 dBA and 51 dBA during the daytime and nighttime, respectively. The recorded hourly L_{90} sound levels are presented in Table 3.

Table 3
Existing Sound Levels, L_{90} (dBA)

Monitoring Location*	Daytime Sound Level	Nighttime Sound Level
M1 - Flagg Hill Road	37	38

* Refer to Figure 1 for location

Project-Generated Sound Levels

There are two noise sources associated with a wind turbine. These sources include aerodynamic noise associated with the blade movement through air and the mechanical noise associated with the interaction of parts that drive the blades. Aerodynamic sound from the movement of the blade through air is a function of wind speed, which can be controlled by the rotational speed of the blades. Existing background sound levels are also dependent of wind speed. Therefore louder background sound levels would be result from higher wind conditions. With increasing wind speeds, the sound from wind turbines can often be masked by increasing wind noise.

Each of the wind turbines consists of three blades with the hub located at 100 meters from the ground. Under operational conditions, the blades will rotate at speeds between 3 meters per second (m/s) to 12m/s. The maximum daytime sound levels from the proposed wind turbines will occur with the maximum wind speeds of 9 m/s. The maximum nighttime sound levels from the wind turbine will occur with the maximum wind speeds of 8 m/s. The Project-generated sound levels based upon the wind speed were projected to each receptor location based upon the properties of sound propagation over distance, terrain, and geometry. Following the methodology outlined in ISO 9613-2, the calculation of Wind Colebrook North's sound levels included attenuation due to geometric divergences and atmospheric absorption. The Project-generated hourly L_{90} sound level contribution for each receptor location is presented in Table 4.

Table 4
Project-Generated Sound Levels, L_{90} (dBA)

Receptor Location*	Daytime Noise Criteria**	Project Daytime Sound Levels	Nighttime Noise Criteria**	Project Nighttime Sound Levels
R1 – Rock Hall Road	61	45	51	43
R2 – Rock Hall Road	61	46	51	44
R3 – Greenwoods Turnpike	61	46	51	44
R4 – Greenwoods Turnpike	61	44	51	42
R5 – Greenwoods Turnpike	61	43	51	41
R6 – Greenwoods Turnpike	61	40	51	38
R7 – Winsted Norfolk Road (Rt 44)	61	34	51	32
R8 – Pinney Street	61	34	51	32
R9 – Pinney Street	61	32	51	30
R10 – Pinney Street	61	33	51	31
R11 – Stillman Hill Road (Rt 182)	61	32	51	30
R12 – Rock Hall Road	61	36	51	34
R13 – Rock Hall Road	61	38	51	36

* Refer to Figure 1 for receptor locations.

The results of the preliminary noise analysis demonstrate that Wind Colebrook North will generate sound levels that range from 30 dBA to 46 dBA. These sound levels are below the daytime or nighttime noise criteria of 61 and 51 dBA respectively.

Conclusion

The noise analysis demonstrates that the operation of up to three (3) 1.6 MW wind turbines to be located on property northeast of the intersection of Winsted-Norfolk Road (Route 44) and Rock Hall Road in Colebrook, Connecticut will meet the CTDEP's noise control regulations (Regulations of Connecticut State Agencies (RCSA), Title 22a, Section 22a-69-1 to 22a-69-7). The noise analysis evaluated the worst-case daytime and nighttime sound levels, based upon operational wind speeds, calculated sound levels for the receptor locations (residential area) adjacent to Wind Colebrook North. It should be noted that the actual sound levels for the majority of the time will be lower because the wind speeds will be lower.

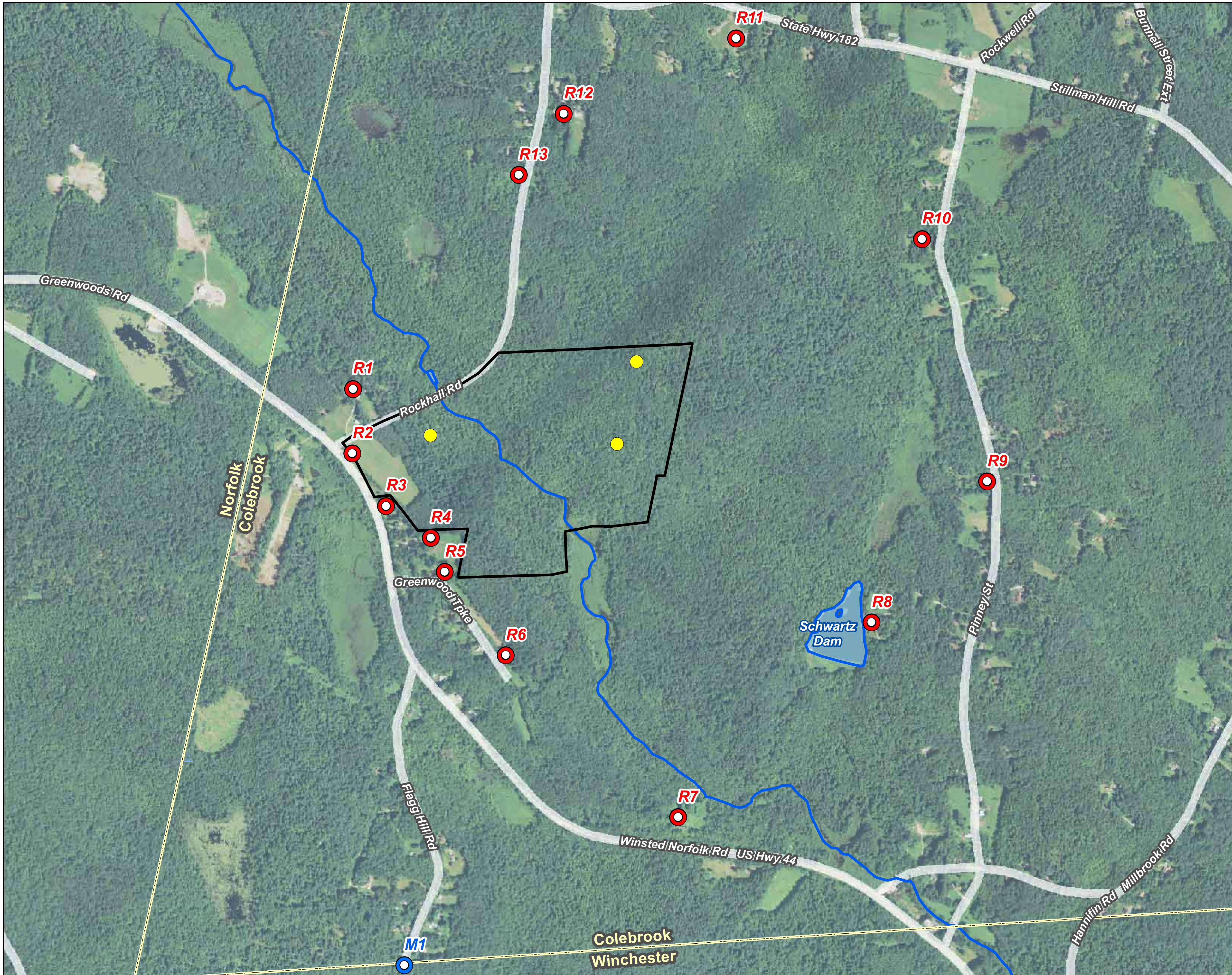

Figure 1
Wind Colebrook North
Noise Monitoring and
Receptor Locations

Winsted-Norfolk Road
Colebrook, CT

Legend

- Receptor Location
- Monitoring Location
- Proposed Wind Turbine Location
- Approximate Site Property Boundary
- Town Boundary

Base Map Source: 2008 aerial photograph with 1-meter resolution.

1,000 500 0 1,000 Feet

Vanasse Hangen Brustlin, Inc.

\\ctmiddat\projects\41604.00\graphics\FIGURES\WC_North_Receptor_Locations_Map.pdf

Appendix

- Noise Monitoring Summary
- Sound Level Calculations
- Wind Assessment

Noise Monitoring Summary

VHB
101 Walnut Street
Post Office Box 9151
Watertown, Massachusetts 02471
Phone (617) 924-1770
Fax (617) 924-2286

Noise Monitoring Data Sheet

Notes Taken By: Q. Tat

Date: April 1, 2010

Weather: Sunny, mid 60's F

Project Number: 41604.00

Location: Flagg Hill Road
Colebrook, CT

Start Time: 2:55 PM

Noise Monitor: Larson Davis 824

Duration: 20 min.

What is the name of the data run? Run#1

Measured Leq **41.0** **dBA**

Traffic Data	Volume	Speed
Automobiles		
Medium Trucks		
Heavy Trucks		

Sketch

Monitor setup at end of Flagg Hill Rd.

Notes:

What was the angle of exposure to the highway? Norfold Road (Rte 44) approximately half mile away.

Were there any objects blocking the highway noise sources? (Such as buildings or hills) Flagg Hill Rd uphill with curves.

Were there other roadway or highway noise sources nearby? N/A

Were there significant other non-highway noise sources? Wildlife (bird and critter noises), running stream, airplane, gun shots (Northwestern Connecticut Sportsman's Association Facility).

SLM & RTA Summary

Translated:	5-Apr-10	14:23:48		
File Translated:	Z:\41604.00\tech\Noise\Noise Monitoring Data\FlaggHillRd-Day.slmdl			
Model Number:	824			
Serial Number:	A0184			
Firmware Rev:	4.283			
Software Version:	3.12			
Name:	Enter Company Name			
Descr1:	Enter Address Line 1			
Descr2:	Enter Address Line 2			
Setup:	VHBGen1h.ssa			
Setup Descr:	VHB-Gen1hr-1sec			
Location:	Flagg Hill Rd			
Note 1:	Daytime			
Note 2:				

Overall Any Data

Start Time:	1-Apr-10	14:53:57		
Elapsed Time:	20:01.1			

	A Weight	C Weight	Flat
Leq:	41.0 dBA	54.1 dBC	56.7 dBF

Spectra

Start Time:	1-Apr-10	14:53:57	Run Time:	20:01.1

Freq Hz	Leq 1/1 Oct	Max 1/1 Oct	Min 1/1 Oct
16	-0.5	---	-7.5
31.5	13.2	20.2	-7.5
63	23.9	34.9	1.9
125	31.1	49	6.6
250	34.8	53.9	13.1
500	32.4	50.1	21.3
1000	33.5	42.2	27.8
2000	33.5	34.5	30
4000	30.2	30.2	28.3
8000	26.7	26.8	25.6
16000	28.7	28.7	28

L 90.00 37.1 dBA

Vanasse Hangen Brustlin, Inc.
Transportation | Land Development | Environmental Services

VHB
101 Walnut Street
Post Office Box 9151
Watertown, Massachusetts 02471
Phone (617) 924-1770
Fax (617) 924-2286

Noise Monitoring Data Sheet

Notes Taken By: Q. Tat

Date: April 2, 2010

Weather: Clear, low 40's F

Project Number: 41604.00

Location: Flagg Hill Road
Colebrook, CT

Start Time: 1:15 AM

Noise Monitor: Larson Davis 824

Duration: 15 min.

What is the name of the data run? Run#6

Measured Leq **38.4** **dBA**

Traffic Data	Volume	Speed
Automobiles		
Medium Trucks		
Heavy Trucks		

Sketch

Monitor setup at end of Flagg Hill Rd.

Notes:

What was the angle of exposure to the highway? Norfold Road (Rte 44) approximately half mile away.

Were there any objects blocking the highway noise sources? (Such as buildings or hills) Flagg Hill Rd uphill with curves.

Were there other roadway or highway noise sources nearby? N/A

Were there significant other non-highway noise sources? Wildlife (bird and critter noises), running stream

SLM & RTA Summary

Translated:	5-Apr-10	14:24:13		
File Translated:	Z:\41604.00\tech\Noise\Noise Monitoring Data\FlaggHillRd-Night.slmdl			
Model Number:	824			
Serial Number:	A0184			
Firmware Rev:	4.283			
Software Version:	3.12			
Name:	Enter Company Name			
Descr1:	Enter Address Line 1			
Descr2:	Enter Address Line 2			
Setup:	VHBGen1h.ssa			
Setup Descr:	VHB-Gen1hr-1sec			
Location:	Flagg Hill Road			
Note 1:	Nighttime			
Note 2:				

Overall Any Data

Start Time:	2-Apr-10	1:18:49		
Elapsed Time:	15:26.6			
	A Weight	C Weight	Flat	
Leq:	38.4 dBA	42.4 dBC	45.3 dBF	
Spectra				
Start Time:	2-Apr-10	1:18:49	Run Time:	15:26.6
Freq Hz	Leq 1/1 Oct	Max 1/1 Oct	Min 1/1 Oct	
16	-6.7	---	---	
31.5	-2.5	8.2	-7.5	
63	11	24	-7.5	
125	14.6	27	6	
250	21.6	28.8	16.9	
500	29.1	38	24.5	
1000	31.8	37.5	27.6	
2000	32.9	40.1	29	
4000	30.6	42.8	27.6	
8000	27.7	35.8	25.9	
16000	28.8	29.2	28.1	

L 90.00 38.1 dBA

Sound Level Calculations

Colebrook North Wind Turbine
Noise Model - Daytime Conditions (9 m/s)

hub height	h =	328	ft
sound power level	Lw =	106	db
absorption coefficent	a =	0.005	db/m

Background Levels, L90 (dBA)	RN1	RN2	RN3	RN4	RN5	RN6	RN7	RN8	RN9	RN10	RN11	RN12	RN13
Wind Turbine N1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1
Wind Turbine N2	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1
Wind Turbine N3	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1
Wind Turbine S1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1
Wind Turbine S2	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1
Wind Turbine S3	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1

Horizontal Distance to Rec.(feet)	RN1	RN2	RN3	RN4	RN5	RN6	RN7	RN8	RN9	RN10	RN11	RN12	RN13
Wind Turbine N1	929	820	853	1047	1404	2387	4664	4905	5725	5426	5136	3568	2822
Wind Turbine N2	2769	2717	2451	2136	2198	2451	3876	3180	3810	3765	4333	3426	2939
Wind Turbine N3	2924	3061	2963	2775	2916	3299	4690	3595	3796	3183	3466	2644	2265
Wind Turbine S1	3955	3303	2825	2675	2438	2268	3713	5868	7476	8261	8663	7210	6469
Wind Turbine S2	4290	3687	3388	3428	3295	3394	4934	7076	8637	9249	9372	7768	7001
Wind Turbine S3	5246	4600	4151	4008	3758	3437	4256	6758	8479	9473	9986	8543	7801

Distance to Rec., R (feet)	RN1	RN2	RN3	RN4	RN5	RN6	RN7	RN8	RN9	RN10	RN11	RN12	RN13
Wind Turbine N1	985	883	914	1097	1442	2409	4676	4916	5734	5436	5146	3583	2841
Wind Turbine N2	2788	2737	2473	2161	2222	2473	3890	3197	3824	3779	4345	3442	2957
Wind Turbine N3	2942	3079	2981	2794	2934	3315	4701	3610	3810	3200	3481	2664	2289
Wind Turbine S1	3969	3319	2844	2695	2460	2292	3727	5877	7483	8268	8669	7217	6477
Wind Turbine S2	4303	3702	3404	3444	3311	3410	4945	7084	8643	9255	9378	7775	7009
Wind Turbine S3	5256	4612	4164	4021	3772	3453	4269	6766	8485	9479	9991	8549	7808

Distance to Rec., R (meters)	300	269	279	335	440	735	1425	1499	1748	1657	1569	1092	866
	850	834	754	659	678	754	1186	975	1166	1152	1325	1049	902
	897	939	909	852	895	1011	1433	1101	1162	976	1061	812	698
	1210	1012	867	822	750	699	1136	1792	2281	2521	2643	2200	1975
	1312	1129	1038	1050	1010	1040	1508	2160	2635	2822	2859	2370	2137
	1603	1406	1269	1226	1150	1053	1301	2063	2587	2890	3046	2606	2380

Sound pressure level	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13
with atmospheric absorp.	43.9	45.1	44.7	42.8	39.9	34.0	24.8	24.0	21.4	22.3	23.2	28.8	31.9
Lp=Lw-20logR-11-ar	32.2	32.4	33.7	35.3	35.0	33.7	27.6	30.3	27.8	28.0	25.9	29.3	31.4
	31.5	30.9	31.3	32.1	31.5	29.9	24.7	28.7	27.9	30.3	29.2	32.7	34.6
	27.3	29.8	31.9	32.6	33.7	34.6	28.2	21.0	16.4	14.4	13.3	17.1	19.2
	26.1	28.3	29.5	29.3	29.9	29.5	23.9	17.5	13.4	11.9	11.6	15.7	17.7
	22.9	25.0	26.6	27.1	28.0	29.3	26.2	18.4	13.8	11.3	10.1	13.6	15.6
	44.6	**45.7**	**45.6**	**44.4**	**42.7**	**40.2**	**34.0**	**33.7**	**31.6**	**32.9**	**31.7**	**35.6**	**37.8**

Colebrook North Wind Turbine
Noise Model - Nightime Conditions (8 m/s)

hub height	h =	328	ft	
sound power level	Lw =	104	db	Average wind speed of 8 m/s
absorption coefficent	a =	0.005	db/m	

Background Levels, L90 (dBA)	RN1	RN2	RN3	RN4	RN5	RN6	RN7	RN8	RN9	RN10	RN11	RN12	RN13
Wind Turbine N1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1
Wind Turbine N2	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1
Wind Turbine N3	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1
Wind Turbine S1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1
Wind Turbine S2	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1
Wind Turbine S3	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1

Horizontal Distance to Rec.(feet)	RN1	RN2	RN3	RN4	RN5	RN6	RN7	RN8	RN9	RN10	RN11	RN12	RN13
Wind Turbine N1	929	820	853	1047	1404	2387	4664	4905	5725	5426	5136	3568	2822
Wind Turbine N2	2769	2717	2451	2136	2198	2451	3876	3180	3810	3765	4333	3426	2939
Wind Turbine N3	2924	3061	2963	2775	2916	3299	4690	3595	3796	3183	3466	2644	2265
Wind Turbine S1	3955	3303	2825	2675	2438	2268	3713	5868	7476	8261	8663	7210	6469
Wind Turbine S2	4290	3687	3388	3428	3295	3394	4934	7076	8637	9249	9372	7768	7001
Wind Turbine S3	5246	4600	4151	4008	3758	3437	4256	6758	8479	9473	9986	8543	7801

Distance to Rec., R (feet)	RN1	RN2	RN3	RN4	RN5	RN6	RN7	RN8	RN9	RN10	RN11	RN12	RN13
Wind Turbine N1	985	883	914	1097	1442	2409	4676	4916	5734	5436	5146	3583	2841
Wind Turbine N2	2788	2737	2473	2161	2222	2473	3890	3197	3824	3779	4345	3442	2957
Wind Turbine N3	2942	3079	2981	2794	2934	3315	4701	3610	3810	3200	3481	2664	2289
Wind Turbine S1	3969	3319	2844	2695	2460	2292	3727	5877	7483	8268	8669	7217	6477
Wind Turbine S2	4303	3702	3404	3444	3311	3410	4945	7084	8643	9255	9378	7775	7009
Wind Turbine S3	5256	4612	4164	4021	3772	3453	4269	6766	8485	9479	9991	8549	7808

Distance to Rec., R (meters)	300	269	279	335	440	735	1425	1499	1748	1657	1569	1092	866
	850	834	754	659	678	754	1186	975	1166	1152	1325	1049	902
	897	939	909	852	895	1011	1433	1101	1162	976	1061	812	698
	1210	1012	867	822	750	699	1136	1792	2281	2521	2643	2200	1975
	1312	1129	1038	1050	1010	1040	1508	2160	2635	2822	2859	2370	2137
	1603	1406	1269	1226	1150	1053	1301	2063	2587	2890	3046	2606	2380

Sound pressure level	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13
with atmospheric absorp.	41.9	43.1	42.7	40.8	37.9	32.0	22.8	22.0	19.4	20.3	21.2	26.8	29.9
Lp=Lw-20logR-11-ar	30.2	30.4	31.7	33.3	33.0	31.7	25.6	28.3	25.8	26.0	23.9	27.3	29.4
	29.5	28.9	29.3	30.1	29.5	27.9	22.7	26.7	25.9	28.3	27.2	30.7	32.6
	25.3	27.8	29.9	30.6	31.7	32.6	26.2	19.0	14.4	12.4	11.3	15.1	17.2
	24.1	26.3	27.5	27.3	27.9	27.5	21.9	15.5	11.4	9.9	9.6	13.7	15.7
	20.9	23.0	24.6	25.1	26.0	27.3	24.2	16.4	11.8	9.3	8.1	11.6	13.6
	42.6	**43.7**	**43.6**	**42.4**	**40.7**	**38.2**	**32.0**	**31.7**	**29.6**	**30.9**	**29.7**	**33.6**	**35.8**

Wind Assessment

BNE ENERGY

COLEBROOK, CT
WIND ASSESSMENT

The seal on this document
Authorized by
Hala Ballouz, P.E.
On April 12, 2010

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Executive Summary

Electric Power Engineers, Inc. (EPE) completed the following wind assessment for BNE Energy's (BNE) Colebrook CT proposed wind project that is located in Litchfield County, Connecticut. The site is shown on the maps of the section titled **"Site Layout"**. EPE used the wind data measured at the meteorological tower installed at the site located to the West of Winsted Norfolk Road 44, approximately three miles West of Colebrook town. The measurements covered nearly 13.4 months, ranging from *12-12-2008 to 01-24-2010.* The assessment was run using WindPro©.

Additionally, EPE used for this analysis the sodar data measured by the Triton Profiler located approximately 95 meters North-West of the meteorological tower and at around 5 meters lower elevation as shown in ***Figure 4***. The sodar data covered nearly 3.4 months, ranging from 10-30-2009 to 02-10-2010. The sodar measurements record accurately up to 120 meters and even up to 200 meters frequently. Per BNE's request, the sodar data was used only to evaluate the wind shear for one of the scenarios considered in this report, where the wind shear is relevant to the extrapolation of measured wind speeds to higher levels. EPE used the sodar data measured at heights up to 100 meters in the shear calculation since the quality of the data averaged to more than 93%, which is a good indication of the accuracy of this data. Please refer to ***Table 5*** for more details.

Per BNE's request, three scenarios were adopted in this analysis:

- Scenario 1: Extrapolation of measured wind speeds to higher levels was based on wind shear exponents calculated from the 3.4 month sodar data (sodar shear). The sodar shear averaged to 0.383
- Scenario 2: Extrapolation of measured wind speeds to higher levels was based on wind shear exponents calculated from the 13.4 months of measured wind data (tower shear). The measured shear averaged to 0.303
- Scenario 3: Extrapolation of measured wind speeds to higher levels was based on the average of the sodar shear and the tower shear (average shear). The average shear is equal to 0.343

The sodar shear is higher than the tower shear, as indicated above. This is likely attributed to the fact that at higher elevations, which the tower does not reach, obstructions behind the site are cleared, and wind flow is more significant.

The 13.4 month site measured wind data indicated average wind speeds of approximately 6.02 m/s at 60 meters. The predominant wind direction is from the North-West as shown in the Wind Rose of ***Figure 5***. Wind speeds at 80 and 100 meters were extrapolated under the three scenarios as follows:

- Scenario 1: 6.8 m/s at 80 m, and 7.4 m/s at 100 m
- Scenario 2: 6.6 m/s at 80 m, and 7.1 m/s at 100 m
- Scenario 3: 6.7 m/s at 80 m, and 7.2 m/s at 100 m

EPE studied in this report several turbine types in order to provide insight on preliminary energy yeild capability. In this analysis, turbines were placed on the Colebrook site as shown in the figures of the section titled **"Site Layout"**. The "**Energy Calculations**" section of this report provides more details on this analysis.

This report calculated capacity factors for the three scenarios under study, *using the 13.4 month site measured wind speeds*. Below are the calculated capacity factors after the deduction of typical wind farm related losses that are assumed to be around 10%:

- Scenario 1: From **21.8%** to **35.5%** at 80 m hub heights
- Scenario 2: From **20.7%** to **34.0%** at 80 m hub heights
- Scenario 3: From **21.3%** to **34.7%** at 80 m hub heights

The findings of this analysis revealed that the "**Vestas V100 1.8 MW**" provided the highest capacity factor of **35.5%** under scenario 1, **34%** under scenario 2 and **34.7%** under scenario 3 at 80 m hub height, and up to **39.9%** under scenario 1, **37.3%** under scenario 2 and **38.6%** under scenario 3 at 95 m hub height after the deduction of typical wind farm related losses; The "**GE 1.6 XLE 1.6 MW**" also provided high capacity factors of **36.8%** under scenario 1, **33.9%** under scenario 2 and **35.4%** under scenario 3 at 100 m hub height, and up to **31.1%** under scenario 1, **29.7%** under scenario 2 and **30.4%** under scenario 3 at 80 m hub height. The Vestas V100 is a Class II turbine whereas the GE XLE 1.6 is a Class III turbine, and the applicability of these turbines to the Colebrook site must be analyzed before assuming the adoption of these turbines in any additional studies. Refer to information on estimated annual energy yeild figures in the following section.

Energy Yield Calculations

The following tables summarize the capacity factor analysis EPE conducted with thirteen (13) wind turbine types per BNE's request. For more details on wind turbine placement, please refer to the figures of the section titled **"Site Layout"**. The study was conducted for the following three scenarios:

- Scenario 1: Extrapolation of measured wind speeds to higher levels was based on wind shear exponents calculated from the 3.4 month sodar data (sodar shear). The sodar shear averaged to 0.383
- Scenario 2: Extrapolation of measured wind speeds to higher levels was based on wind shear exponents calculated from the 13.4 months of measured wind data (tower shear). The measured shear averaged to 0.303
- Scenario 3: Extrapolation of measured wind speeds to higher levels was based on the average of the sodar shear and the tower shear (average shear). The average shear is equal to 0.343

The "**Vestas V100 1.8 MW**" produced better capacity factors than the other turbines analyzed in this report. The capacity factor figures are calculated after deduction of 10% typical electrical and other losses. The applicability of the Vestas V100 1.8 MW turbines to the Colebrook site however remains to be studied with Vestas in terms of turbulence levels at the site, the Vestas V100 being a Class II turbine.

The "**GE 2.5 XL 2.5 MW**" at 100 m hub height provided the most annual energy yield of 7,296 MWhr per year under scenario 1, after deduction of 10% typical electrical and other losses as shown in the following tables, that machine being one of the largest generators investigated in this report. The GE 2.5 XL outperformed the Nordex 2.5 N90 HS 2.5 MW machine. However, this large turbine does not meet the fall zone requirements from the project boundary, and further investigation is necessary to mitigate this requirement. Alternatively, the "**Vestas V100 1.8 MW**" at 80 m hub height meets the fall zone requirements and may provide as high as 5,600 MWhr per year under scenario 1.

The capacity factors and annual energy yield estimates shown in the table below are calculated using the site specific 13.4 month measured data. The calculations used an air density of 1.24 kg/m^3 that was adopted from the regional reference at the Hartford/Bradley meteo station, approximately 39 Km from the Colebrook CT site. Note that this value is adjusted to our site internally by Windpro to be 1.183 kg/m^3.

It is to be noted that humidity, pressure as well as temperature data were measured by the Triton Profiler (sodar data) from 10-30-2009. Using this data provides means to calculate the air density at site to be 1.187 kg/m^3. This air density is fairly close to the regional reference. However, the duration of the recorded data is not long enough to be adopted in the energy calculations of this report, and the regional reference continues to be adopted for air density in the analysis underlying this report.

Table 1. Annual average Capacity Factor and energy yield estimates for several turbine types using 13.4 months of measured wind data – Scenario 1 (Sodar Shear)

	# of Turbines	Hub Height	Rotor Diameter	Capacity Factor Before Deduction of 10% Losses	Capacity Factor After Deduction of 10% Losses	Annual Energy Yield in MWhr after Deduction of 10% losses
GE 2.5 XL 2.5 MW	1*	100 m	100 m	**37.0%**	**33.3%**	**7,296.2**
GE 2.5 XL 2.5 MW	1*	85 m	100 m	**32.6 %**	**29.3%**	**6,430.6**
GE 1.6 XLE 1.6 MW	1*	100 m	82.5 m	**40.9%**	**36.8%**	**5,165.8**
GE 1.6 XLE 1.6 MW	1	80 m	82.5 m	**34.6%**	**31.1%**	**4,365.1**
GE 1.5 SLE 1.5 MW	1	100 m	77 m	**37.0%**	**33.3%**	**4,375.5**
GE 1.5 SLE 1.5 MW	1	80 m	77 m	**31.0%**	**27.9%**	**3,671.1**
Nordex N90 HS 2.5 MW	1	80 m	90 m	**27.6%**	**24.8%**	**5,436.6**
Vestas V100 1.8 MW	1*	95 m	100 m	**44.3%**	**39.9%**	**6,297.5**
Vestas V100 1.8 MW	1	80 m	100 m	**39.4%**	**35.5%**	**5,600.0**
Vestas V90 3.0 MW	1	80 m	90 m	**24.3%**	**21.8%**	**5,741.1**
Vestas V90 1.8 MW	1*	95 m	90 m	**39.6%**	**35.6%**	**5,622.1**
Vestas V90 1.8 MW	1	80 m	90 m	**34.8%**	**31.3%**	**4,944.4**
Gamesa G90 2 MW	1*	100 m	90 m	**38.8%**	**34.9%**	**6,116.6**
Gamesa G90 2 MW	1	78 m	90 m	**32.1%**	**28.9%**	**5,071.4**
Gamesa G58 850 kW	1	65 m	58 m	**27.0%**	**24.3%**	**1,813.4**
Gamesa G58 850 kW	1	55 m	58 m	**24.0%**	**21.6%**	**1,612.1**
Fuhrlander 1250 1.3 MW	1	70 m	62 m	**20.8%**	**18.7%**	**2,053.6**
Fuhrlander 1250 1.3 MW	1	50 m	62 m	**15.0%**	**13.5%**	**1,475.4**
Fuhrlander 600 600 kW	1	75 m	50 m	**32.6%**	**29.3%**	**1,541.0**
Fuhrlander 600 600 kW	2	50 m	50 m	**23.2%**	**20.9%**	**2,195.5**
Unison U57 750 kW	1	68 m	57 m	**29.2%**	**26.3%**	**1,729.5**
Mitsubishi MWT-1000 1MW	1	69 m	61.4 m	**25.4%**	**22.8%**	**2,000.9**
Mitsubishi MWT-1000 1MW	1	60 m	61.4 m	**22.0%**	**19.8%**	**1,736.6**

This turbine does not meet fall zone requirements from the project boundary, and further investigation is necessary to mitigate this requirement.

Table 2. Annual average Capacity Factors and energy yield estimates for several turbine types using 13.4 months of measured wind data – Scenario 2 (Tower Shear)

	# of Turbines	Hub Height	Rotor Diameter	Capacity Factor Before Deduction of 10% Losses	Capacity Factor After Deduction of 10% Losses	Annual Energy Yield in MWhr after Deduction of 10% losses
GE 2.5 XL 2.5 MW	1*	100 m	100 m	**34.0%**	**30.6%**	**6,700.8**
GE 2.5 XL 2.5 MW	1*	85 m	100 m	**30.7%**	**27.6%**	**6,046.3**
GE 1.6 XLE 1.6 MW	1*	100 m	82.5 m	**37.7%**	**33.9%**	**4,760.7**
GE 1.6 XLE 1.6 MW	1	80 m	82.5 m	**33.0%**	**29.7%**	**4,163.4**
GE 1.5 SLE 1.5 MW	1	100 m	77 m	**34.0%**	**30.6%**	**4,019.0**
GE 1.5 SLE 1.5 MW	1	80 m	77 m	**29.5%**	**26.6%**	**3,494.6**
Nordex N90 HS 2.5 MW	1	80 m	90 m	**26.2%**	**23.6%**	**5,161.2**
Vestas V100 1.8 MW	1*	95 m	100 m	**41.4%**	**37.3%**	**5,882.1**
Vestas V100 1.8 MW	1	80 m	100 m	**37.8%**	**34.0%**	**5,365.3**
Vestas V90 3.0 MW	1	80 m	90 m	**23.1%**	**20.7%**	**5,441.6**
Vestas V90 1.8 MW	1*	95 m	90 m	**36.8%**	**33.1%**	**5,219.7**
Vestas V90 1.8 MW	1	80 m	90 m	**33.2%**	**29.9%**	**4,721.6**
Gamesa G90 2 MW	1*	100 m	90 m	**35.7%**	**32.2%**	**5,637.4**
Gamesa G90 2 MW	1	78 m	90 m	**30.8%**	**27.7%**	**4,858.3**
Gamesa G58 850 kW	1	65 m	58 m	**26.6%**	**24.0%**	**1,785.3**
Gamesa G58 850 kW	1	55 m	58 m	**23.6%**	**21.2%**	**1,581.1**
Fuhrlander 1250 1.3 MW	1	70 m	62 m	**20.2%**	**18.1%**	**1,987.6**
Fuhrlander 1250 1.3 MW	1	50 m	62 m	**15.0%**	**13.5%**	**1,475.4**
Fuhrlander 600 600 kW	1	75 m	50 m	**31.4%**	**28.2%**	**1,485.8**
Fuhrlander 600 600 kW	2	50 m	50 m	**23.2%**	**20.9%**	**2,195.5**
Unison U57 750 kW	1	68 m	57 m	**28.6%**	**25.7%**	**1,690.4**
Mitsubishi MWT-1000 1MW	1	69 m	61.4 m	**24.7%**	**22.2%**	**1,944.9**
Mitsubishi MWT-1000 1MW	1	60 m	61.4 m	**22.0%**	**19.8%**	**1,736.6**

This turbine does not meet fall zone requirements from the project boundary, and further investigation is necessary to mitigate this requirement.

Table 3. Annual average Capacity Factors and energy yield estimates for several turbine types using 13.4 months of measured wind data – Scenario 3 (Average Shear)

	# of Turbines	Hub Height	Rotor Diameter	Capacity Factor Before Deduction of 10% Losses	Capacity Factor After Deduction of 10% Losses	Annual Energy Yield in MWhr after Deduction of 10% losses
GE 2.5 XL 2.5 MW	1*	100 m	100 m	**35.5%**	**31.9%**	**6,999.8**
GE 2.5 XL 2.5 MW	1*	85 m	100 m	**31.6%**	**28.4%**	**6,232.9**
GE 1.6 XLE 1.6 MW	1*	100 m	82.5 m	**39.3%**	**35.4%**	**4,965.0**
GE 1.6 XLE 1.6 MW	1	80 m	82.5 m	**33.8%**	**30.4%**	**4,262.2**
GE 1.5 SLE 1.5 MW	1	100 m	77 m	**35.5%**	**31.9%**	**4,198.3**
GE 1.5 SLE 1.5 MW	1	80 m	77 m	**30.3%**	**27.2%**	**3,581.4**
Nordex N90 HS 2.5 MW	1	80 m	90 m	**26.9%**	**24.2%**	**5,296.2**
Vestas V100 1.8 MW	1*	95 m	100 m	**42.9%**	**38.6%**	**6,092.4**
Vestas V100 1.8 MW	1	80 m	100 m	**38.6%**	**34.7%**	**5,481.8**
Vestas V90 3.0 MW	1	80 m	90 m	**23.7%**	**21.3%**	**5,588.5**
Vestas V90 1.8 MW	1*	95 m	90 m	**38.2%**	**34.4%**	**5,422.2**
Vestas V90 1.8 MW	1	80 m	90 m	**34.0%**	**30.6%**	**4,831.3**
Gamesa G90 2 MW	1*	100 m	90 m	**37.3%**	**33.5%**	**5,878.5**
Gamesa G90 2 MW	1	78 m	90 m	**31.5%**	**28.3%**	**4,964.3**
Gamesa G58 850 kW	1	65 m	58 m	**26.8%**	**24.2%**	**1,799.5**
Gamesa G58 850 kW	1	55 m	58 m	**23.8%**	**21.4%**	**1,596.7**
Fuhrlander 1250 1.3 MW	1	70 m	62 m	**20.5%**	**18.4%**	**2,021.0**
Fuhrlander 1250 1.3 MW	1	50 m	62 m	**15.0%**	**13.5%**	**1,475.4**
Fuhrlander 600 600 kW	1	75 m	50 m	**32.0%**	**28.8%**	**1,513.7**
Fuhrlander 600 600 kW	2	50 m	50 m	**23.2%**	**20.9%**	**2,195.5**
Unison U57 750 kW	1	68 m	57 m	**28.9%**	**26.0%**	**1,710.2**
Mitsubishi MWT-1000 1MW	1	69 m	61.4 m	**25.0%**	**22.5%**	**1,973.2**
Mitsubishi MWT-1000 1MW	1	60 m	61.4 m	**22.0%**	**19.8%**	**1,736.6**

**** This turbine does not meet fall zone requirements from the project boundary, and further investigation is necessary to mitigate this requirement.***

Site Layout

The figures below show the Colebrook CT meteorological tower location to the West of Winsted Norfolk Road 44 approximately three miles West of Colebrook Connecticut as well as the wind turbine layout considered in this study. ***Figure 4*** shows the Triton Profiler to be located near the meteorological tower (95 meters away, and 5 meters lower in elevation).

EPE based turbine placement on the following criteria:

- 2 X rotor diameter spacing between turbines in 1 row (cross wind). Note that generally 4 X rotor diameter is recommended, however, for this project, and due to site limitations, a smaller spacing was assumed with the understanding of negative impact on turbine power production performance
- 5 X rotor diameter spacing in between rows of turbines. Note that generally 7 X rotor diameter is recommended, however, for this project, and due to site limitations, a smaller spacing was assumed with the understanding of negative impact on turbine power production performance
- 1.5 X total turbine height (fall height) to the boundary of the site.

Figure 1. Colebrook CT meteorological tower location

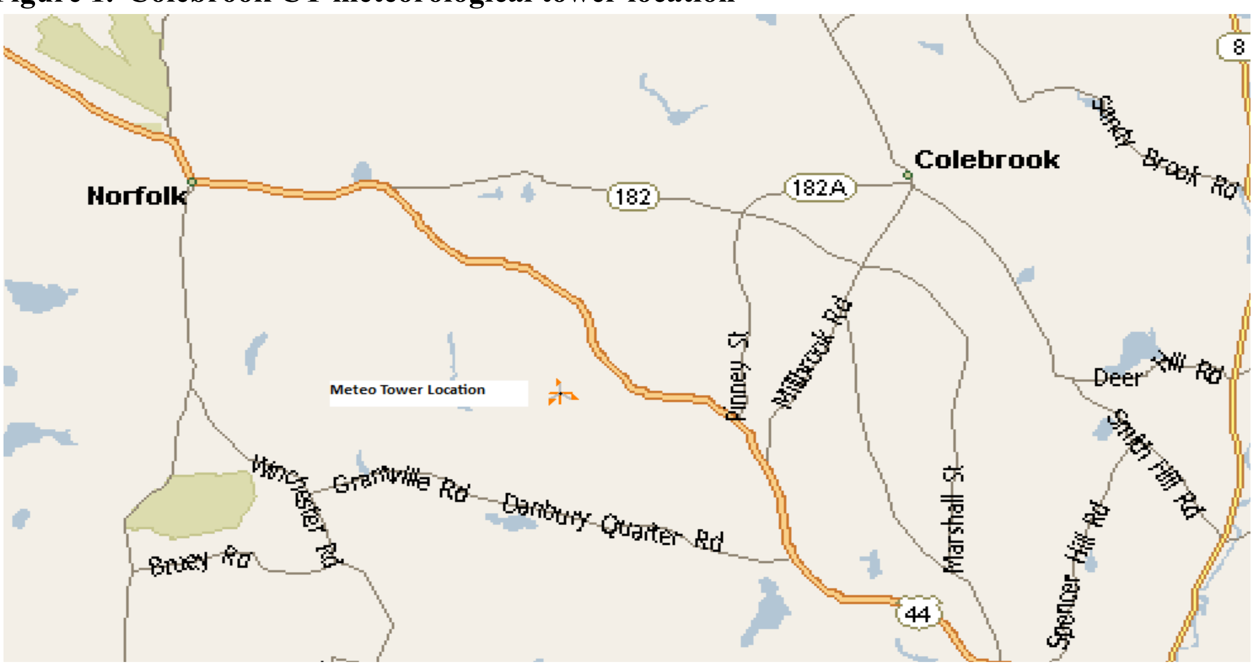
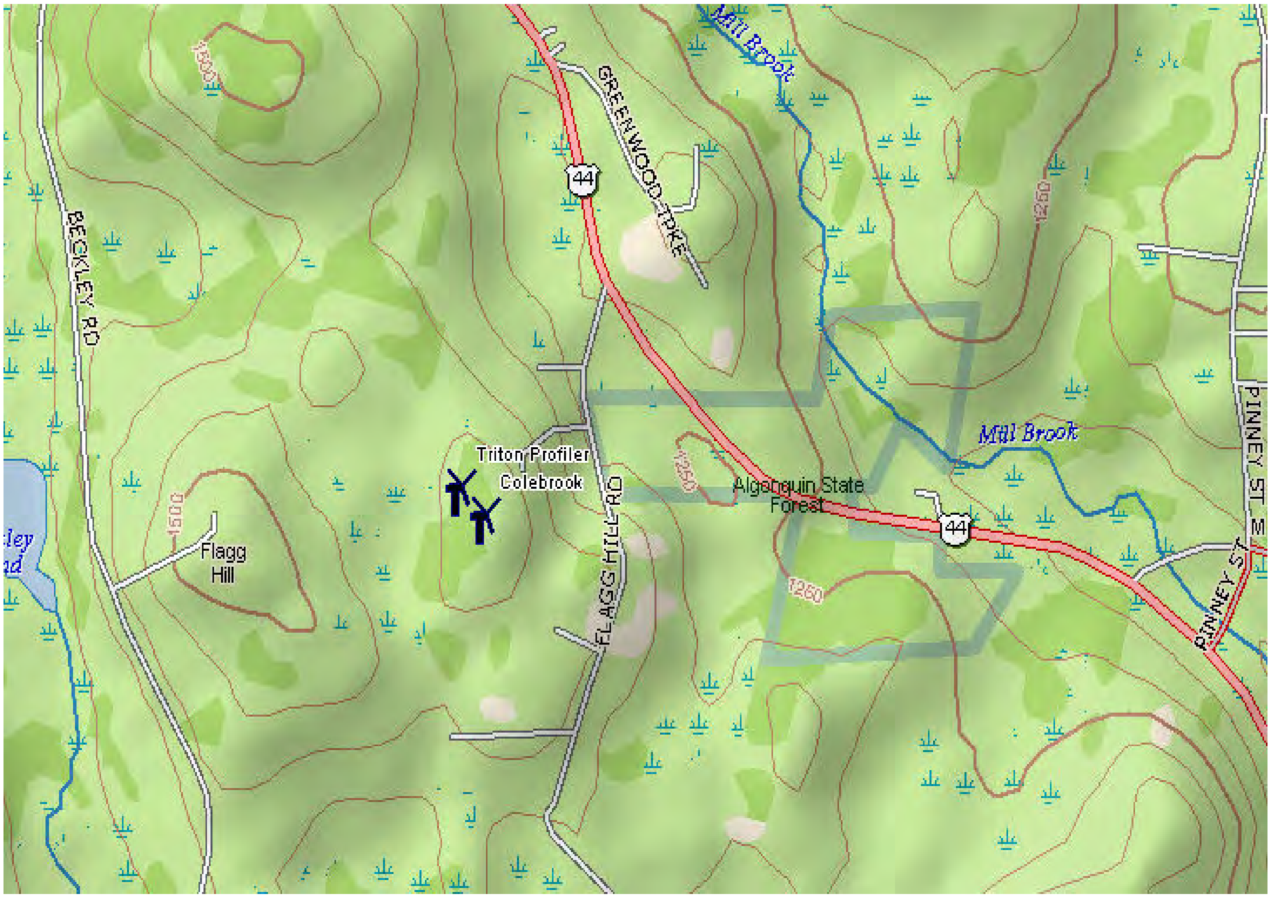


Figure 2. Map sketch of one wind turbine placement next to the meteorological tower

Figure 3. Map sketch of two wind turbines placement next to the meteorological tower

Figure 4. Triton Profiler location next to the Colebrook meteorological tower



Wind Speed Analysis

The 13.4 month site measured wind data at Colebrook indicated average wind speeds of approximately 6.02 m/s at 60 m. Wind speeds at 80 and 100 meters were extrapolated under the three scenarios:

- Scenario 1: 6.8 m/s at 80 m, and 7.4 m/s at 100 m
- Scenario 2: 6.6 m/s at 80 m, and 7.1 m/s at 100 m
- Scenario 3: 6.7 m/s at 80 m, and 7.2 m/s at 100 m

Please refer to the numerous tables and graphs on the following pages which provide details and statistics on measured and extrapolated wind speeds.

The gaps identified in the site measured wind data amount to about 12.90% of the total measurements. These gaps are most likely due to icing or temporary failure of any one anemometer. The gaps were replaced in this analysis according to the following methodology:

- If one of the anemometers at a certain height failed, then the gaps in the data were substituted from the data of the other working anemometer.
- If both anemometers at a certain height failed, the gaps in the data were substituted from the Prospect CT measured data for the same time period when available, where Prospect measurements are recorded by BNE at the site located two miles South of Prospect town, approximately 55 Km from Colebrook. However, if Prospect CT measured data was not available for this time period, then the gaps in Colebrook CT measured data were substituted with the data recorded on the nearest possible days at the Colebrook CT site and in the same time frame.

EPE used, for Scnearios 2 and 3 of this report, the sodar data measured by the Triton Profiler, to evaluate the wind shear applied in the analysis, where the wind shear is relevant to the extrapolation of measured wind speeds to higher levels. EPE used the sodar data measured at heights up to 100 meters in the shear calculation since the quality of the data averaged to more than 93%, which is a good indication of the accuracy of this data. The third column in ***Table 5*** shows the average quality of measurements at each height of the sodar data.

The following ***Table 4***, ***Table 5*** and ***Table 6***, summarize the mean wind speeds for the Tower and Triton Profiler (sodar) measurements, at different heights for the different sensors.

Table 4. Mean wind speeds of the 13.4 month site measured wind data (Tower)

Height of Measurements	Mean Wind Speeds for the 13.4 Months of Site Measured Wind Data		
	Scenario 1 (Sodar Shear)	Scenario 2 (Tower Shear)	Scenario 3 (Average Shear)
40 m – 1	5.32 m/s		
40 m – 2	5.29 m/s		
50 m – 3	5.67 m/s		
50 m – 4	5.65 m/s		
60 m – 5	6.02 m/s		
60 m – 6	5.98 m/s		
Extrapolated to 80 m	6.8 m/s	6.6 m/s	6.7 m/s
Extrapolated to 100 m	7.4 m/s	7.1 m/s	7.2 m/s

Table 5. Mean wind speeds of the 3.4 month sodar data (Triton Profiler)

Height of measurements	Mean Wind Speeds for the 3.4 months sodar data	Average quality of measurements
40m – 1	5.84 m/s	95.4%
50m – 2	6.39 m/s	95.8%
60m – 3	6.9 m/s	93.8%
80m – 4	7.68 m/s	94.8%
100m – 5	8.28 m/s	93.1%
120m – 6	8.81 m/s	87%
140m – 7	9.13 m/s	80%
160m – 8	9.13 m/s	71.6%
180m – 9	8.98 m/s	59.5%
200m - 10	8.73 m/s	48.1%

The mean wind speeds of the sodar data are higher than the site Tower measured wind data since these was recorded in a windy period, namely from 10-30-2009 to 02-10-2010.

Table 6. Monthly site measured mean wind speeds in m/s at 60 m – C5 (Tower)

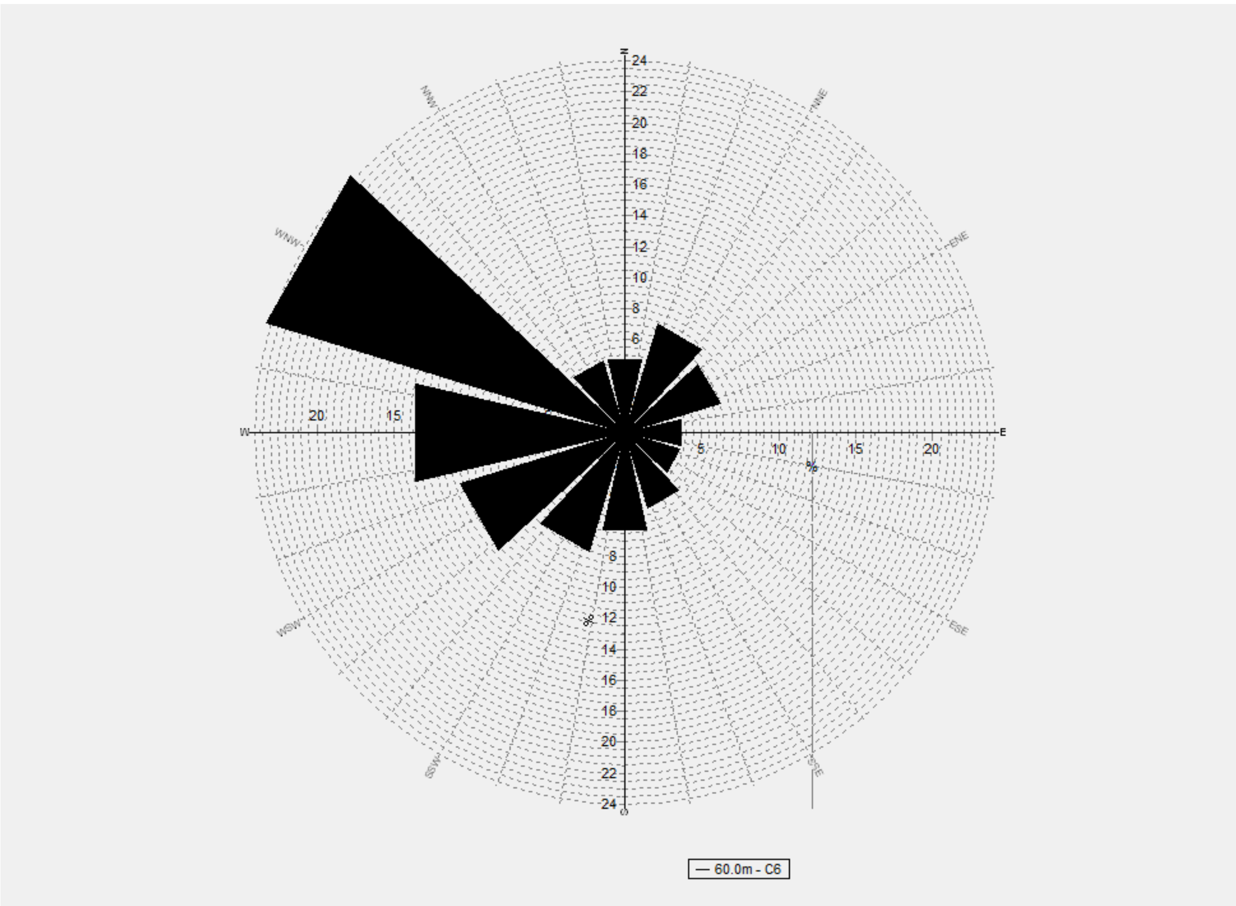
Months	Site average measured wind speeds at 60 m			Mean of all data	Mean of Months
	2008	2009	2010		
January		6.86	7.58	7.18	7.22
February		7.20		7.20	7.20
March		6.03		6.03	6.03
April		6.11		6.11	6.11
May		5.56		5.56	5.56
June		4.21		4.21	4.21
July		4.63		4.63	4.63
August		4.69		4.69	4.69
September		5.44		5.44	5.44
October		5.87		5.87	5.87
November		6.01		6.01	6.01
December	7.04	7.78		7.50	7.41
Mean of Months	5.86				
Mean of all data	**6.02**				

Note that WindPro uses the mean of all data in the calculations.

Wind Rose

The following figure shows the wind rose for the 13.4 month site measured wind data for the Colebrook, CT proposed wind project.

Figure 5. Wind Rose at the height of 60 meters for the 13.4 month site measured wind data



Knowing that the winds were going to be from the North West and the West, the location of the Colebrook CT wind turbine(s), in this analysis, was chosen accordingly in favor of collecting the highest possible amount of wind energy as shown in ***Figure 2*** and ***Figure 3***. The wind turbines were placed westerly facing and on a ridge which makes the collected wind speeds higher.

Wind Data Statistics

The following tables and graphs provide wind data statistics for the 13.4 month site measured wind data.

Table 7. Colebrook CT site measured wind statistics from 12-12-2008 till 01-24-2010 (Tower)

	Signal	Unit	Mean	Std dev	Min	Max
40.0m - 1	Mean wind speed, all	m/s	5.32		0.26	21.74
40.0m - 1	Wind direction, all	Degrees	294.1		0.0	360
40.0m - 1	Turbulence intensity, all		0.2102	0.1279	0.0000	6.0141
40.0m - 2	Mean wind speed, all	m/s	5.29		0.26	19.07
40.0m - 2	Wind direction, all	Degrees	294.1		0.0	360
40.0m - 2	Turbulence intensity, all		0.2167	0.1510	0.0000	6.5091
50.0m - 3	Mean wind speed, all	m/s	5.67		0.23	20.63
50.0m - 3	Wind direction, all	Degrees	279.3		0	360
50.0m - 3	Turbulence intensity, all		0.1939	0.1069	0.0000	2.2263
50.0m - 4	Mean wind speed, all	m/s	5.65		0.23	23.90
50.0m - 4	Wind direction, all	Degrees	279.3		0	360
50.0m - 4	Turbulence intensity, all		0.2073	0.1186	0.000	3.7385
60.0m - 5	Mean wind speed, all	m/s	6.02		0.23	24.95
60.0m - 5	Wind direction, all	Degrees	279.3		0	360
60.0m - 5	Turbulence intensity, all		0.1527	0.1582	0.0001	9.5525
60.0m – 6	Mean wind speed, all	m/s	5.98		0.23	24.98
60.0m - 6	Wind direction, all	Degrees	279.3		0	360
60.0m - 6	Turbulence intensity, all		0.1840	0.1702	0.0000	11.8120

Figure 6. Daily average wind speeds at 60 meters – (m/s) for the site measured wind data (Tower)

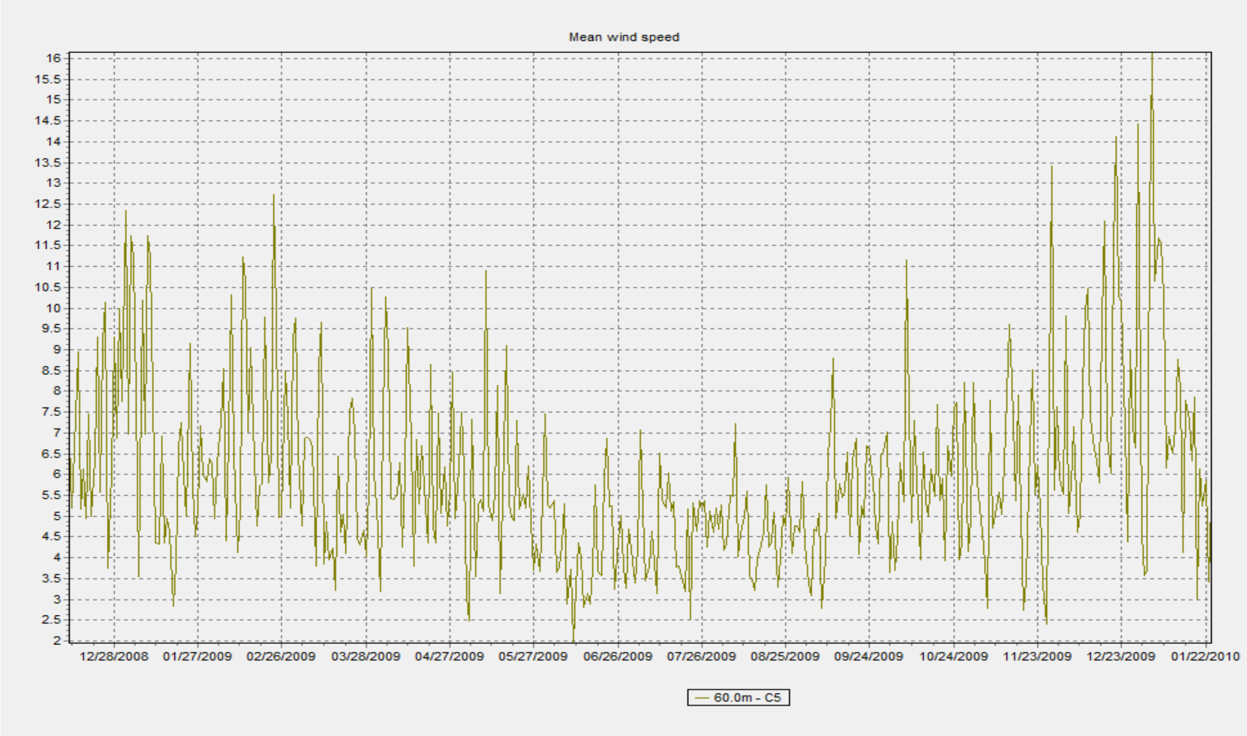


Figure 7. Monthly average wind speeds at 60 meters – (m/s) for the site measured wind data (Tower)

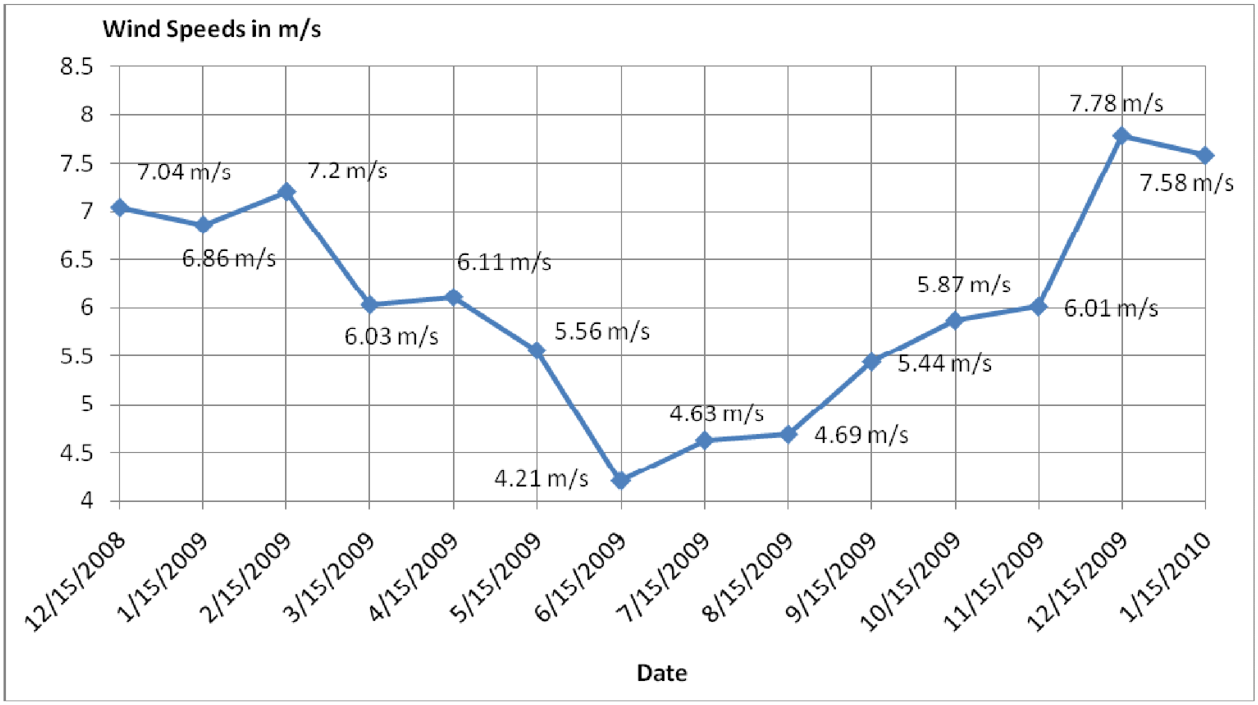


Table 8. Summary of the monthly mean wind speeds for the Colebrook 13.4 months of measured data at 60, 80 and 100 meters in m/s – Scenario 1 (Sodar Shear)

	60m-C5 Site measured mean wind speed	80m Extrapolated mean wind speed	100m Extrapolated mean wind speed
January	7.18	8.0	8.8
February	7.20	8.1	8.9
March	6.03	6.8	7.4
April	6.11	6.9	7.5
May	5.56	6.3	6.9
June	4.21	4.8	5.2
July	4.63	5.2	5.7
August	4.69	5.3	5.8
September	5.44	6.1	6.7
October	5.87	6.6	7.2
November	6.01	6.7	7.3
December	7.50	8.4	9.2
mean of all data	**6.02**	**6.8**	**7.4**

Table 9. Summary of the monthly mean wind speeds for the Colebrook 13.4 months of measured data at 60, 80 and 100 meters in m/s – Scenario 2 (Tower Shear)

	60m-C5 Site measured mean wind speed	80m Extrapolated mean wind speed	100m Extrapolated mean wind speed
January	7.18	7.8	8.4
February	7.20	7.9	8.5
March	6.03	6.6	7.1
April	6.11	6.7	7.2
May	5.56	6.1	6.5
June	4.21	4.6	4.9
July	4.63	5.1	5.5
August	4.69	5.2	5.5
September	5.44	6	6.4
October	5.87	6.4	6.9
November	6.01	6.6	7.1
December	7.50	8.2	8.8
mean of all data	**6.02**	**6.6**	**7.1**

Table 10. Summary of the monthly mean wind speeds for the Colebrook 13.4 months of measured data at 60, 80 and 100 meters in m/s – Scenario 3 (Average Shear)

	60m-C5 Site measured mean wind speed	80m Extrapolated mean wind speed	100m Extrapolated mean wind speed
January	7.18	7.9	8.6
February	7.20	8	8.7
March	6.03	6.7	7.3
April	6.11	6.8	7.3
May	5.56	6.2	6.7
June	4.21	4.7	5.1
July	4.63	5.2	5.6
August	4.69	5.2	5.7
September	5.44	6	6.5
October	5.87	6.5	7.1
November	6.01	6.7	7.2
December	7.50	8.3	9
mean of all data	**6.02**	**6.7**	**7.2**