# LAND USE REGULATION COMMISSION GRID SCALE WIND ENERGY DEVELOPMENT APPLICATION

APPENDIX 12-2
Rare, Threatened, and Endangered Wildlife Survey Report
Highland Wind Project
Somerset County, Maine

January 2010


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PN 195600385

## 1.0 INTRODUCTION

Highland Wind LLC (Highland) has proposed to construct a 128.6-megawatt (MW) wind energy project located in Highland Plantation and Pleasant Ridge Plantation, Somerset County, Maine (Figure 1). The Highland Wind Project (Project) includes 48 turbines, a 34.5-kilovolt (kV) electrical collector system, an electrical collection substation, a 115-kV generator lead, an Operations and Maintenance building, and 4 permanent 80-meter meteorological towers. The approximately 11-mile long, 115-kV generator lead will connect the on-site collector station to the existing Wyman Dam substation located in Moscow, Maine, where power will be transferred to the Central Maine Power Company system and ultimately distributed to the New England grid.

In 2009, Stantec Consulting (Stantec) completed targeted surveys to determine the presence/absence of three species of wildlife on the Project summits: the northern bog lemming (*Synaptomys borealis*), northern spring salamander (*Gyrinophilus porphyriticus*), and Roaring Brook mayfly (*Epeorus frisoni*). In Maine, northern bog lemming is listed as Threatened, Roaring Brook mayfly is listed as Endangered, and northern spring salamander is listed as Special Concern. These surveys were prompted by Stantec's preliminary natural resource investigations (e.g., wetland and stream delineations conducted in 2008) and subsequent consultation with the Maine Department of Inland Fisheries and Wildlife (MDIFW). In April 2009, Stantec prepared a study plan that outlined the anticipated approach and methodology necessary to conduct these targeted surveys.[1] The study plan was provided to the MDIFW for review and comment prior to the initiation of field surveys. This report presents the results of the 2009 field surveys

## 2.0 METHODOLGY

Appropriate survey methodology was developed for each target species through consultation with the MDIFW. The field surveys were conducted by two Stantec ecologists, one of whom is a Certified Ecologist, working in close proximity to each other.

### 2.1 NORTHERN SPRING SALAMANDER SURVEY METHODOLOGY

Prior to conducting field surveys, a landscape analysis was completed to identify potentially suitable northern spring salamander stream habitat within the summit portion of the Project area. The landscape analysis included a review of relevant literature on the known habitat preferences of northern spring salamander in New England. The literature indicated that the northern spring salamander prefers cold, clean, largely fishless, and relatively undisturbed mountain headwater streams (Hunter *et al.* 1992; DeGraaf and Yamasaki 2001; Lowe and Bolger 2002).

In conjunction with the landscape analysis and literature review, streams identified during wetland delineations were reviewed to determine if any of these resources could provide suitable habitat for the northern spring salamander. This stream analysis included a review of photographs and data on size, hydrology, substrate, and condition, as well as consultation with Stantec field staff directly involved with the on-site delineations. A list of streams containing potentially suitable northern spring habitat was generated to target field surveys.

Field surveys were conducted on July 27, 28, and 29, 2009. During the surveys, Stantec visited each stream that was previously identified as providing suitable habitat. If the stream contained potential habitat, a minimum of one hour was spent surveying the stream for northern spring salamanders. This effort included turning over rocks and logs of various sizes within and adjacent to the stream, targeting habitat areas for both adults and larvae. A small household aquarium-sized dip net was used to catch unidentifiable individuals. Captured individuals were promptly identified, photographed, and returned to the stream at the capture location. Once a northern spring salamander was documented within a stream reach, survey efforts in that reach were considered complete.

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[1] Stantec Consulting. 2009. *Proposed Work Plan for Natural Resource Studies at the Proposed Highland Wind Project, Highland Plantation, Maine, April 2009*. Prepared for Highland Wind LLC.

### 2.2 NORTHERN BOG LEMMING SURVEY METHODOLOGY

Little is known about the specific habitat requirements of northern bog lemming. The MDIFW reports that the species is known to occur in moist, wet meadows or boggy areas often in alpine settings or spruce-fir forests. The species is reportedly found in association with springs or lush, mossy logs and rocks. In Maine, it is reported to occur in moist peat moss (*Sphagnum* spp.) boggy areas in both low and high elevation settings (MDIFW 2003). In the fall of 2008, Stantec wetland scientists and ecologists completed delineations of the summit portion of the Project area, and several potentially suitable habitats for the northern bog lemming were identified. In general, these areas were characterized as woodland wetlands dominated by scattered trees and shrubs of red spruce (*Picea rubens*), balsam fir (*Abies balsamea*), and northern white cedar (*Thuja occidentalis*). The understory contained a thick layer of peat moss (*Sphagnum* spp.) and three-seeded sedge (*Carex trisperma*) over deep, mucky organic soils.

Seasonally appropriate field surveys for the northern bog lemming were conducted in mid to late summer 2009 to coincide with the anticipated seasonal peak activity. Field surveys consisted of two Stantec ecologists conducting meander surveys within potentially suitable habitats to locate and document evidence of bog lemming activity. Such evidence included visual observations of bog lemmings, as well as indirect observations of bog lemming activity such as runways and tunnels through the peat moss (*Sphagnum* spp.), browse and clippings on graminoid vegetation, and fecal pellets. According to Kurta (1995), bright green fecal pellets and evenly clipped stems of grasses and sedges along well-defined runways indicate bog lemming activity. However, visual observations and presence of these indicators is not conclusive evidence of the presence of the northern bog lemming because the northern bog lemming and southern bog lemming (*Synaptomys cooperi*) can only be definitively separated based upon enamel patterns on their lower teeth. Stantec did not trap habitats to positively identify northern bog lemmings. Rather, these field efforts were conducted to assess the presence of bog lemming activity. For the purposes of this Project, any bog lemming activity will be treated as if it were evidence of the presence northern bog lemming.

The locations of bog lemming activity were recorded with a Garmin® eTrex Global Positioning System (GPS) receiver. Representative photos were taken as appropriate.

### 2.3 ROARING BROOK MAYFLY SURVEY METHODOLOGY

Prior to the Roaring Brook mayfly field surveys, a landscape analysis, similar to that completed for northern spring salamander, was conducted to identify potentially suitable stream habitat. A review of relevant literature and direct consultation with the MDIFW on Roaring Brook mayfly indicated that the species prefers cold, undisturbed, perennial streams in high elevation habitats (i.e., above 1,000 feet in elevation) that contain high ephemeral flows (Swartz *et al*. 2004, Burain *et al*. 2008). Furthermore, suitable stream habitats typically occur in undisturbed mixed forested stands with a semi-open to closed canopy. Selection of the best candidate streams for survey was based upon field notes and photographs taken during Stantec’s 2008 wetland delineation, as well as based on subsequent data collected during the July 2009 northern spring salamander surveys. To allow review and comment on these candidate streams prior to field surveys, Stantec provided the MDIFW with photographs and pertinent data relative to the streams identified as potentially suitable for Roaring Brook mayfly, as well as examples of streams that Stantec ecologists considered unsuitable habitat. Once streams were selected for surveys, a Scientific Collection Permit (permit # 2009-286) was obtained from the MDIFW.

Roaring Brook mayfly field surveys were conducted in accordance with guidelines presented by the MDIFW in the *DRAFT Recommended Survey Protocol for the Roaring Brook Mayfly* (*Epeorus frisoni*) (Siebenmann and Swartz 2009). Field surveys were conducted during the late summer to maximize the likelihood of obtaining final instar (i.e., pre-emergent) larvae of *Epeorus* species, which are needed for positive species identification. In summary, Stantec ecologists collected macroinvertebrate samples from various microhabitats throughout the stream reach using D-frame dip nets with a 500-microgram mess bag. In-stream sampling involved placing the dip net firmly on the substrate. Using a jarring and kicking motion, the substrate directly upstream of the dip net was agitated to dislodge macroinvertebrates into the dip net. In addition, larger rocks upstream of the dip net were scrubbed by hand to wash any attached macroinvertebrates into the dip net. Samples were taken from numerous microhabitat types throughout the targeted stream reach, including sites at the base of riffles and runs, pools, leaf packs and snags, and the middle of riffles and runs. Samples were placed into sorting trays, and species of *Epeorus* and similar looking species were collected and placed into ethanol for preservation. At the request of the MDIFW, preserved macroinvertebrate specimens were sent to Dr. Steven Burian at Southern Connecticut State University for identification. In-stream sampling of each targeted reach was considered complete once suitable microhabitats within the Project area had been thoroughly and effectively surveyed for *Epeorus* species. Representative photographs were taken of the stream habitats, and GPS points were taken at the start and end points of the in-stream sampling.

## 3.0 RESULTS AND DISCUSSION

The following sections present the results of the field surveys. Representative photographs are included in Appendix A. Completed rare animal field forms are included in Appendix B.

### 3.1 NORTHERN SPRING SALAMANDER RESULTS

Based upon the landscape analysis and review of available site specific information, 23 streams within the summit portion of the Project area were identified as potentially having suitable habitat for the northern spring salamander (Figures 2A through 2L). Northern spring salamanders were documented within two streams that occur within the Stony Brook watershed, located in the central portion of the Project area (Figures 2F and 2H). Table 1 summarizes the results of the stream surveys.

**Table 1. Summary of Northern Spring Salamander Surveys**

| Stream* | Date Surveyed | Spring Salamander Documented? | Figure | Comments |
|---|---|---|---|---|
| 07DD/04ED | 7/27/09 | N | 2A | Stream with steep relief and small cascades, sand-cobble-gravel-boulder. Recent skidder trails up slope in watershed. |
| 14DD | 7/27/09 | N | 2A | Small stream approximately 3 feet wide, cobble-gravel-sand. |
| 15ED/17ED | 7/27/09 | N | 2A | Small stream, approximately 3-4 feet wide, sand-cobble-gravel substrate. |
| 29DD | 7/27/09 | N | 2C | Small stream 3-4 feet wide, boulder-cobble-sand-gravel substrate. |
| 29ED | 7/27/09 | Y? | 2C | Observation of unidentified salamander in fall 2008, boulder-cobble-gravel-sand substrate, appears suitable habitat, cold stream with clear water and cascades. |
| 18DD | 7/27/09 | N | 2B | Poor habitat, small stream 2-3 feet wide, water shallow, tannic, cobble-gravel-sand substrate, recent harvests in watershed. |
| 14TT | 7/28/09 | N | 2G | Poor habitat, shallow, slow-flowing, likely intermittent. |
| 34AS | 7/28/09 | N | 2D | Poor habitat, stream fed by runoff from road crossing upstream. |
| 28RL | 7/28/09 | N | 2D | Poor habitat, stream with sedimentation from upstream road crossing and timber harvest. |
| 57AA | 7/28/09 | Y | 2F | Larval spring salamander documented. |
| 03CF | 7/28/09 | N | 2E | Excellent spring salamander habitat, cobble-gravel-boulder substrate, swift flowing at 6-10 inches per second. |

| Stream* | Date Surveyed | Spring Salamander Documented? | Figure | Comments |
|---|---|---|---|---|
| 32CF | 7/28/09 | N | 2E | Good spring salamander habitat, sand-cobble-gravel-boulder substrate, swift flowing 10-15 inches per second, deep pools, riffles. |
| 89AA | 7/28/09 | N | 2H | Not suitable habitat, small, shallow, intermittent stream. |
| 35CF | 7/28/09, 7/29/09 | Y | 2H | Two adult spring salamanders documented, one larval spring salamander incidentally observed on 8/20/09. |
| 45CF | 7/29/09 | N | 2I | Cobble-gravel-boulder-sand substrate, marginal spring salamander habitat, timber harvests in watershed, and logging road crosses stream. |
| 96AA | 7/29/09 | N | 2I | Boulder-sand-cobble-silt-gravel substrate, likely too silted for spring salamander. |
| 03AS | 7/29/09 | N | 2J | Marginal habitat, boulder-cobble-gravel-sand, shallow, slow flow, likely poorly oxygenated. |
| 28AS | 7/29/09 | N | 2J | Not suitable habitat, shallow, silted, mucky, and likely poorly oxygenated. |
| 01AS | 7/29/09 | N | 2J | Dry stream bed, not suitable habitat. |
| 06AA | 7/29/09 | N | 2K | Poor habitat, very shallow, slow flow, intermittent. |
| 59ED | 7/29/09 | N | 2K | Boulder-cobble-sand-gravel substrate, slow flowing and silted in areas, lacking deep pools. |
| 11RL | 7/29/09 | N | 2L | Poor habitat, slow flowing, shallow with likely poor oxygenation. |
| 23AA | 7/29/09 | N | 2L | Poor habitat, shallow, slow flowing, intermittent, with likely poor oxygenation. |
| *Stream identifiers based upon Stantec's 2008 wetland delineation | | | | |

On July 28, 2009, a larval northern spring salamander was documented in stream 57AA.[2] Stream 57AA is a small perennial stream with a wetted width of four to five feet and a sand-cobble-gravel substrate. At the time of the field survey, water depths within pools were approximately four to five inches. The stream was slow flowing, and eroded banks indicate that the stream is flashy and subject to high ephemeral flows. The surrounding watershed is a young second growth forest that has been impacted by recent timber harvests. The stream has been disturbed, evidenced by a skidder trail crossing downstream of the northern spring salamander observation point.

A dead adult northern spring salamander was found on July 28, 2009, in stream 35CF. This individual was found upstream of a logging road bridge that crosses the stream among some woody snags. A subsequent field survey on July 29 documented an additional adult northern spring salamander approximately 100 feet upstream of the road crossing. On August 20, 2009, during surveys for the Roaring Brook mayfly, a larval spring salamander was observed incidentally within stream 35CF. The stream is large and perennial with a sand-cobble-gravel substrate and run-riffle habitat. The bankful width of the stream is approximately eight feet. At the time of the field survey, the wetted width of the stream averaged approximately four to five feet. At the time of the field surveys, the average water depth of the pools was approximately eight inches. Land areas within the immediate watershed have been altered through past and present timber harvests.

[2] Stream identifier based upon Stantec's 2008 wetland delineation.

Most of the remaining streams surveyed do not contain suitable habitat for the northern spring salamander. Many of these streams were slow flowing with shallow pools and/or intermittent sections. The landscape surrounding these streams has been historically and/or recently harvested, and that activity has involved canopy removal, skidder activity, and road construction. In some instances, overland flows have washed sediments from exposed soils in ruts and along roadways into the streams. As northern spring salamanders are robust, they rely on considerable amounts of dissolved oxygen within their habitats (Hunter *et al.* 1992). The shallow water, slow flow, and sedimentation within many of these streams likely limit the dissolved oxygen concentrations, thereby lowering the quality of habitat for this species. Furthermore, northern spring salamanders have a multi-year aquatic larval period that averages four years (Hunter *et al*. 1992). As such, shallow or ephemeral streams do not provide the necessary perennial aquatic habitat necessary for larval development.

Some streams surveyed do not contain northern spring salamanders but likely provide suitable habitat. These include 03CF and 32CF and the lower reaches of 45CF and 96AA. These streams are generally larger and perennial with riffles, runs, and deeper pools. Based upon their physical characteristics and proximity to other streams where northern spring salamanders have been documented, there is a strong likelihood that this species is present within these streams. Northern spring salamanders are elusive and may have gone undetected during field surveys by utilizing burrows in undercut banks, under root masses, or under boulders that were too large to move.

There is also a strong likelihood that northern spring salamanders are present in stream 29ED. During the fall of 2008, an unidentified large stream salamander was observed within this stream. While surveys conducted in 2009 did not yield any observations of northern spring salamanders, the habitat within this stream is suitable for northern spring salamanders (i.e., high gradient flows with a series of cascades and pools in the upper reach that provide a well-oxygenated habitat). The stream is characterized by a cobble-gravel-boulder-sand substrate with numerous large unmovable boulders. As with most of the other surveyed streams, two-lined salamanders (*Eurycea bislineata*) were observed within stream 29ED.

### 3.2 Northern Bog Lemming Results

Based on the wetland delineations conducted in fall 2008, six wetlands were identified as having potentially suitable habitat for the northern bog lemming. They are located along the ridgelines of Witham and Stewart Mountains. As discussed above, each wetland is characterized as a partially forested with scattered trees of red spruce, balsam fir, and northern white cedar with a thick carpet of peat moss (*Sphagnum* spp.) and three-seeded sedge over mucky organic soils in the understory.

The field surveys were conducted on July 27 and July 28, 2009 (Figures 3A-3D). Bog lemming activity was observed in three of the surveyed wetlands:[3] W011, W067, and W134 (Figures 3A, 3B and 3D). Within each wetland, indirect evidence of bog lemming activity was observed, including well-defined runways and tunnels through peat moss and sedges, browsed and clipped three-seeded sedge stems, and bright green fecal pellets. As Stantec did not conduct trapping, it is not possible to determine if the observed activity was northern bog lemming or southern bog lemming.

Bog lemming activity was not observed in wetlands W072, W073, or W112 (Figures 3B and 3C); however, the habitat within these wetlands is comparable to the habitats were bog lemming activity was observed. In addition, the proximity of wetlands W072 and W073 to wetland W067 suggests that they could function or may have historically functioned as dispersal sites for bog lemmings.

### 3.3 Roaring Brook Mayfly Results

Based on the landscape analysis and subsequent northern spring salamander surveys, five streams were identified as containing potentially suitable Roaring Brook mayfly habitat and were targeted for field surveys. The streams identified are characterized as coldwater perennial streams with good water clarity

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[3] Wetland identifiers presented in the *Wetland and Waterbody Resource Delineation Report*, *Highland Wind Project* prepared by Stantec.

and well-oxygenated habitat conditions as a result of swift flows, and are located in relatively intact watersheds with minimal disturbance from recent timber harvests or stream crossings.

Field surveys were conducted on August 20, 2009. The streams surveyed include 29ED, 03CF, 32CF, 33CF (Stony Brook), and 35CF (Figures 2C, 2E and 2H). Species of *Epeorus* were documented from each stream with the exception of stream 29ED. A total of 27 *Epeorus* specimens were provided to Dr. Steven Burian for identification. Based on his identification results, two specimens of Roaring Brook mayfly were collected from stream 33CF and one specimen was collected from stream 35CF. The remaining *Epeorus* specimens were determined to be *Epeorus fragilis*, a more common species of mayfly.

As discussed above, streams 35CF and 33CF are larger perennial streams with riffles, runs, and deeper pools. The bankful width of stream 33CF is approximately 15 feet. At the time of the field survey, its wetted width was approximately six to eight feet. The depth of this stream varied from 4 to 10 inches between riffles and pools. The water temperature was $17.1^{o}$ Celsius, and the flow was approximately 2 to 5 inches/second. The stream parallels an existing logging road. At the time of the field survey, active timber harvests were occurring within the surrounding watershed. Stream 35CF is similar to stream 33CF. At the time of the field survey, the wetted width was approximately 5 to 8 feet with a depth of 4 to 10 inches. The water temperature was $16.5^{o}$ Celsius and the flow was 2 to 5 inches/second. A logging road crosses the stream below the sampling location. At the time of the field survey, timber harvests were on-going within the watershed.

Streams 32CF and 03CF share similar habitat characteristics with streams 35CF and 33CF. Based on these habitat characteristics, including presence within the same watershed as 35CF and 33CF, it is likely that Roaring Brook mayfly is also present within streams 32CF and 03CF.

### 3.4 INCIDENTAL OBSERVATIONS

Incidental observations of northern spring salamanders were made during wetland delineations of the proposed aboveground collector line between Stewart and Witham Mountains and along the proposed electrical generator lead (Figures 4A through 4G). Adult northern spring salamanders were observed in streams 33KW/53TT, 128ED, and 131ED. Completed Rare Animal Forms are included in Appendix B. These streams are perennial with a cobble-gravel-sand substrate and relatively high gradient flows. Streams 128ED and 131ED are adjacent to an existing open transmission line corridor in areas less than 700 feet in elevation. Based on these incidental observations, it is likely that similar streams within the proposed generator lead corridor also contain northern spring salamanders. Table 2 presents a list of streams within the proposed aboveground collector line and generator lead corridors that may contain suitable northern spring salamander habitat. This list was generated through a landscape analysis and using data and photographs collected during delineations within the Project area. These streams are characterized by perennial hydrology, coarse substrates, and moderate to fast gradients.

**Table 2. Streams Containing Potentially Suitable Spring Salamander Habitat within the Proposed Aboveground Collector Line and Generator Lead Corridors**

| Stream | Figure | Comments |
|---|---|---|
| 16KW/120ED | 4A | Marginal habitat, boulder-sand substrate with abundant snags |
| 18KW/122ED | 4A | Small stream with sand-cobble-gravel substrate |
| 57TT | 4A | Small stream with sand-gravel-cobble substrate |
| 33KW/53TT | 4A | Northern spring salamander documented |
| 10KW | 4B | Lower reach of 45CF stream, perennial stream with gravel-cobble-sand substrate, habitat is better than upstream portion of |

| Stream | Figure | Comments |
|---|---|---|
| | | 45CF |
| 116ED/118ED | 4C | Perennial stream with cobble-gravel-sand substrate, good northern spring salamander habitat |
| 13KW | 4C | Perennial stream with cobble-gravel-sand-boulder substrate, good northern spring salamander habitat. Stream supports brook trout (*Salvelinus fontinalis*). |
| 29TT | 4D | Small stream with sand-gravel substrate, marginal habitat |
| 32TT/33TT | 4D | Moderate stream with sand-cobble-gravel-boulder substrate, riffles and cascades, good northern spring salamander habitat |
| 35TT | 4E | Small stream with marginal northern spring salamander habitat; portions of stream are likely intermittent |
| 38TT/39TT | 4E | Small perennial stream with sand-boulder-cobble substrate |
| 06MJ | 4F | Perennial stream with cobble-sand-gravel substrate |
| 132ED | 4F | Perennial stream with cobble-gravel-sand substrate, good northern spring salamander habitat |
| 131ED/04MJ/05MJ | 4F | Northern spring salamander documented |
| 128ED | 4G | Northern spring salamander documented |

## 4.0 SUMMARY

Northern spring salamanders were documented in two streams, 57AA and 35CF, located in the central portion of the summit Project area. Additional suitable habitat occurs in streams 29ED, 03CF, 32CF, 45CF and 96AA. It is likely that northern spring salamanders are present in these five streams based on habitat quality, proximity to known northern spring salamander locations, and/or unconfirmed northern spring salamander observations. In addition, northern spring salamanders were incidentally documented in one stream, 33KW/53TT, within the proposed aboveground collector line and two streams, 131ED/04MJ/05MJ, and 128ED, within the proposed electrical generator lead. Twelve additional streams within either the proposed aboveground collector line or electrical generator lead were identified as having potentially suitable northern spring salamander habitat.

Bog lemming activity was documented in three wetland areas within the Project area: W011, W067, and W134. Since trapping was not conducted to confirm species identification, it is not known whether these occurrences are of northern bog lemming or southern bog lemming.

Roaring Brook mayfly was documented from streams 33CF and 35CF. Additional suitable habitat occurs in streams 03CF and 32CF. Based on the habitat quality and proximity, including watershed continuity to known Roaring Brook mayfly populations, there is a strong likelihood that Roaring Brook mayfly also occurs within these streams.

## 5.0 RECOMMENDATIONS

In regard to those streams known to support the northern spring salamander and/or the Roaring Brook mayfly, management recommendations would involve employing best management practices (BMP) when working in the immediate watershed of these resources or if stream crossings are unavoidable. Use of BMPs will help reduce both indirect and direct impacts to these resources. The maintenance of existing wooded buffers or the re-establishment of wooded buffers on these streams would help reduce potential sedimentation and maintain cool water temperatures. If it is necessary to cross any of these streams, the use of existing roads/trails may help protect water quality and prevent possible fragmentation of the habitat. Using these existing crossing also would reduce the need for vegetation clearing and help maintain existing buffers. For overhead utility crossings, vegetation clearing should be minimized to the extent practicable, and poles should be placed as far from these resources as design allows. Stantec recommends using these same BMPs at those streams identified as having a high probability of supporting northern spring salamanders and/or Roaring Brook mayfly. More specific details on BMPs can be determined through consultation with Stantec and MDIFW biologists.

For those three wetlands identified as having bog lemming activity, direct impacts should be avoided and wooded buffers should be maintained where practicable. It is also recommended that efforts be employed to avoid inadvertently altering the hydrology of these wetlands. This can be accomplished by such methods as bridging streams within the immediate watershed of these wetlands to avoid redirecting the natural flow of water or otherwise changing the hydro-period of these wetlands. Stantec also recommends maintaining travel corridors in the wetland complex that includes wetlands W067, W072, and W073 to maintain current and allow future dispersal of bog lemmings to and from these wetlands. More specific management recommendations (i.e., buffer widths) can be determined through consultation with Stantec and MDIFW biologists.

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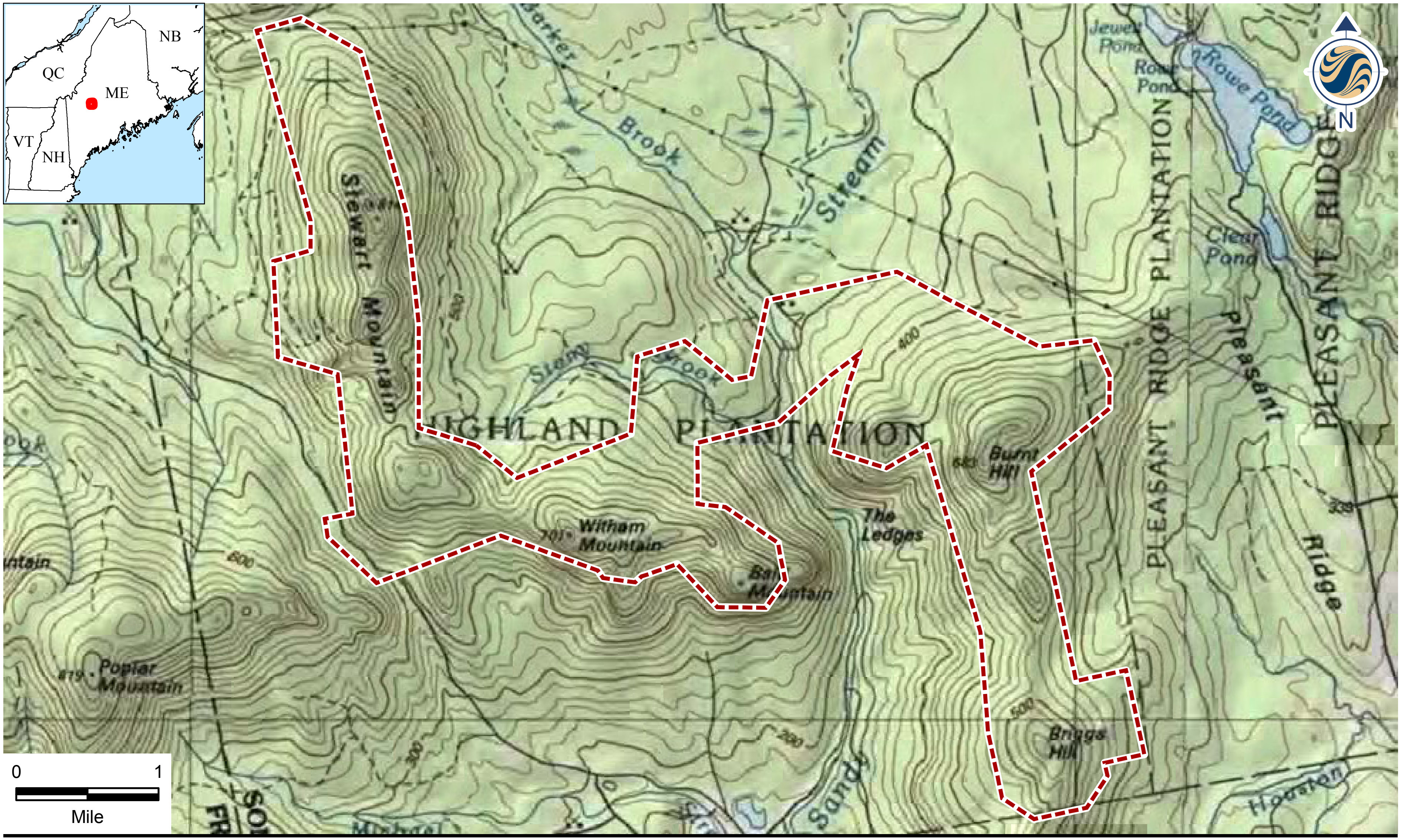
# FIGURES

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00385-F001-Site-Locus.mxd

**Legend**

Approximate Project Area

**Client/Project**

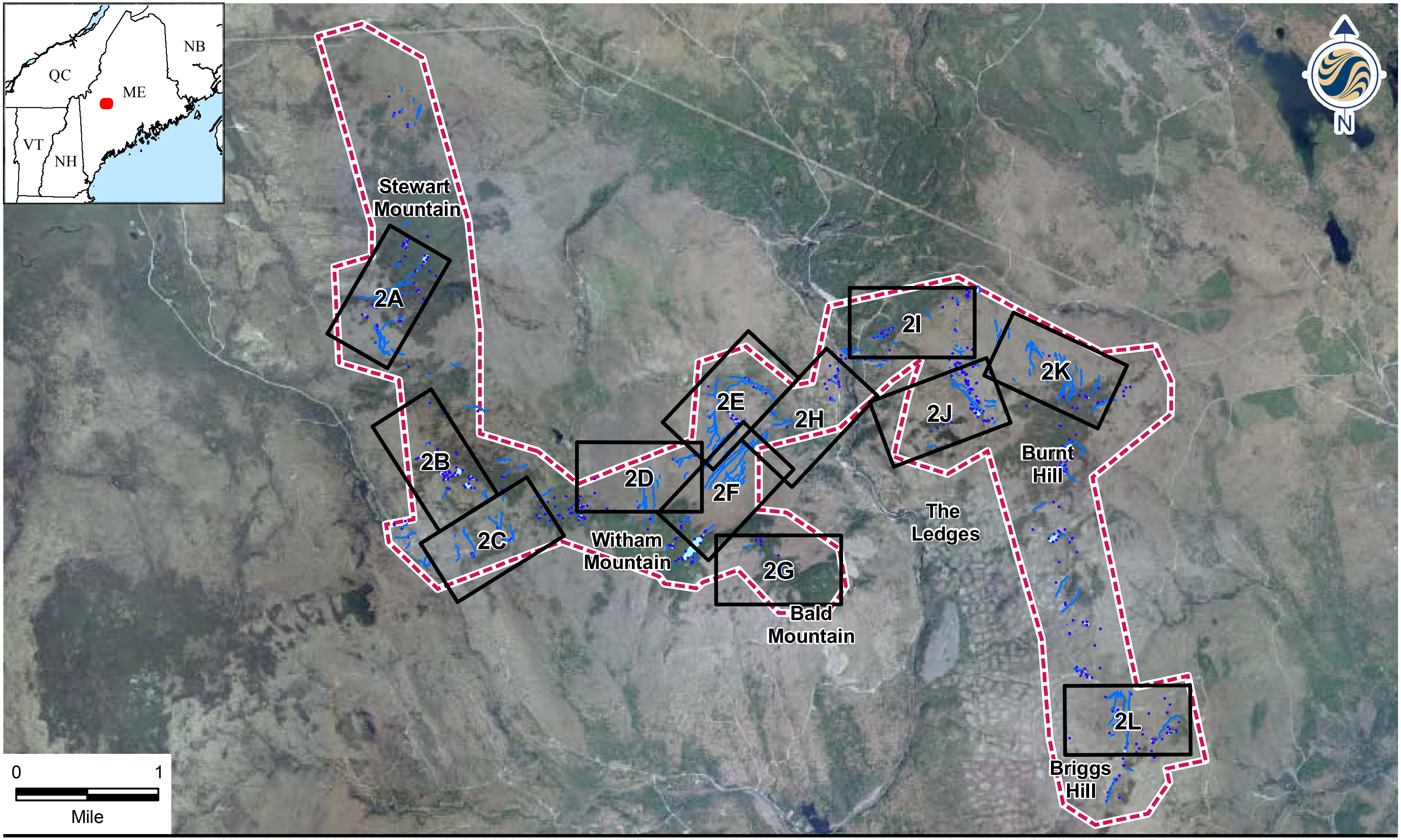
**Highland Wind, LLC**
**Highland Wind Project**
**Highland Plantation, Maine**

Figure No.

1

Title

Project Location Map
October 27, 2009

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**Legend**

- Approximate Project Area
- Delineated Streams
- Delineated Wetland
- Map Extents

Client/Project

**Highland Wind, LLC**
**Highland Wind Project**
**Highland Plantation, Maine**

Figure No.

Map Key

Title

Northern Spring Salamander and
Roaring Brook Mayfly Map
October 27, 2009

00385-F000-Northern-Spring-Salamander-Survey.mxd


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00385-F002A-Northern-Spring-Salamander-Survey.mxd

**Legend**

- Approximate Project Area
- Roaring Brook Mayfly Documented
- Northern Spring Salamander Documented
- Northern Spring Salamander & Roaring Brook Mayfly Documented
- Stream Surveyed for Rare Species
- Delineated Stream
- Contours
- Delineated Wetland

Client/Project

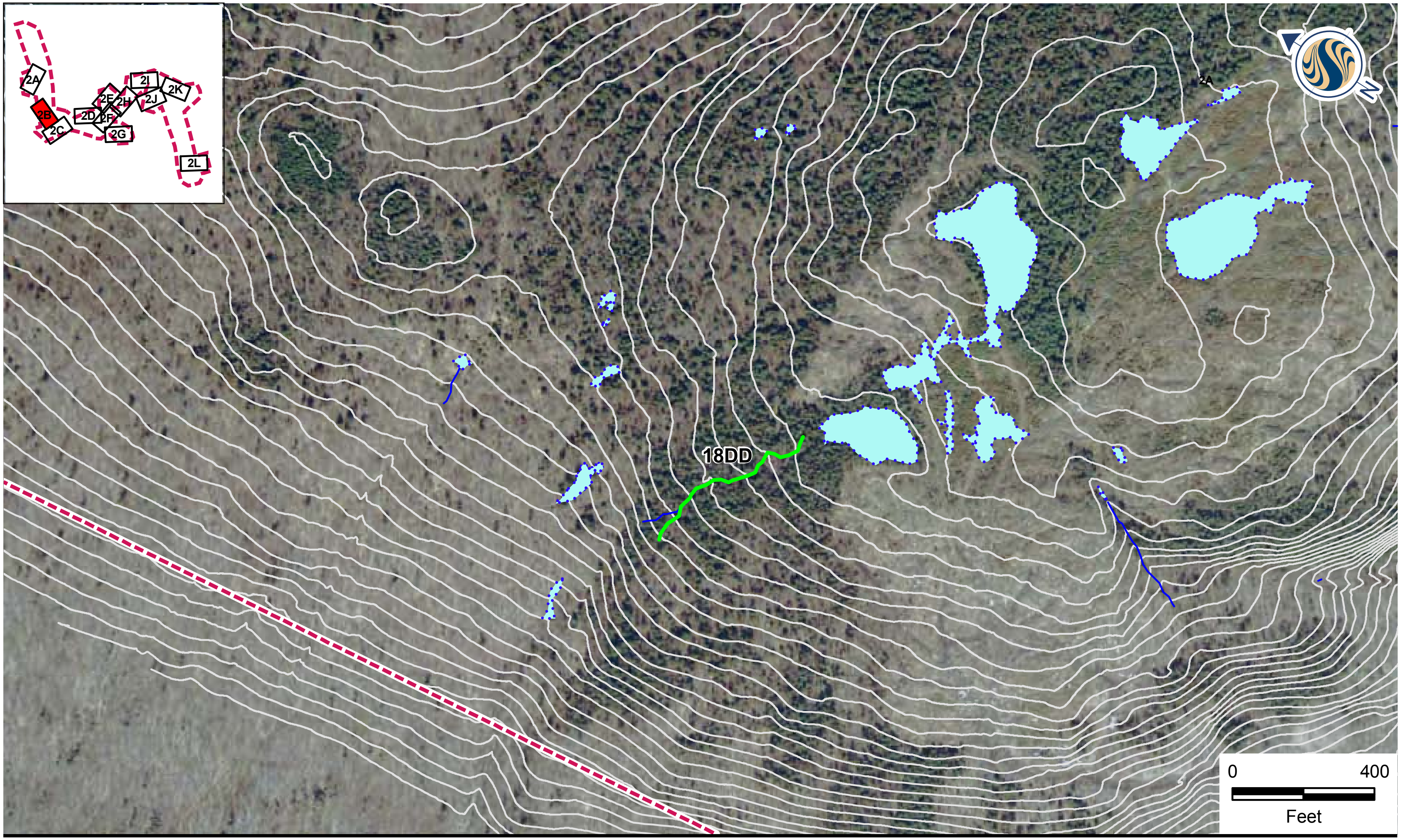
**Highland Wind, LLC**
**Highland Wind Project**
**Highland Plantation, Maine**

Figure No.

2A

Title

Northern Spring Salamander and
Roaring Brook Mayfly Map
October 27, 2009

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00385-F002B-Northern-Spring-Salamander-Survey.mxd

**Legend**

- Approximate Project Area
- Roaring Brook Mayfly Documented
- Northern Spring Salamander Documented
- Northern Spring Salamander & Roaring Brook Mayfly Documented
- Stream Surveyed for Rare Species
- Delineated Stream
- Contours
- Delineated Wetland

Client/Project

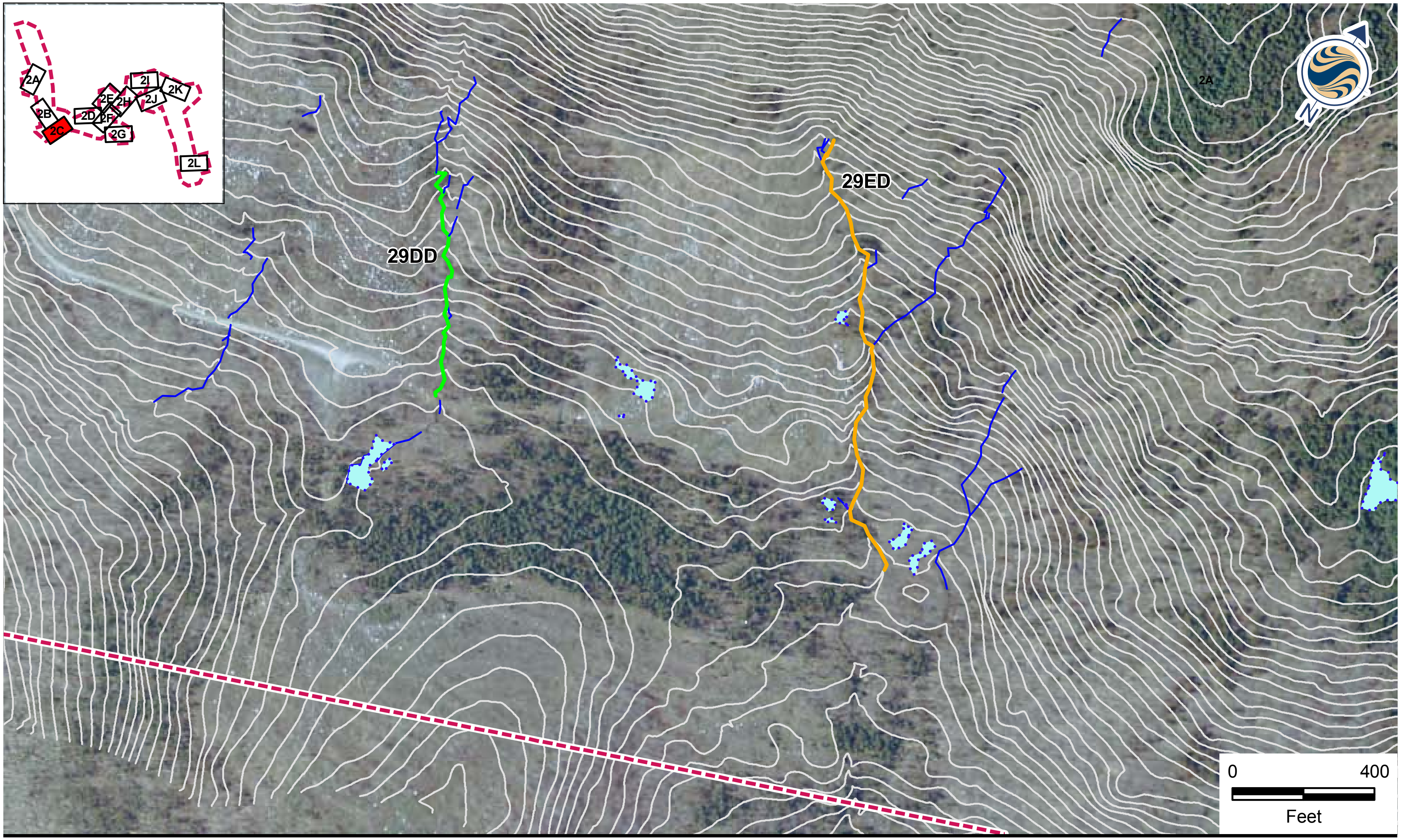
**Highland Wind, LLC**
**Highland Wind Project**
**Highland Plantation, Maine**

Figure No.

2B

Title

Northern Spring Salamander and
Roaring Brook Mayfly Map
October 27, 2009

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00385-F002C-Northern-Spring-Salamander-Survey.mxd

**Legend**

- Approximate Project Area
- Roaring Brook Mayfly Documented
- Northern Spring Salamander Documented
- Northern Spring Salamander & Roaring Brook Mayfly Documented
- Stream Surveyed for Rare Species
- Delineated Stream
- Contours
- Delineated Wetland

Client/Project

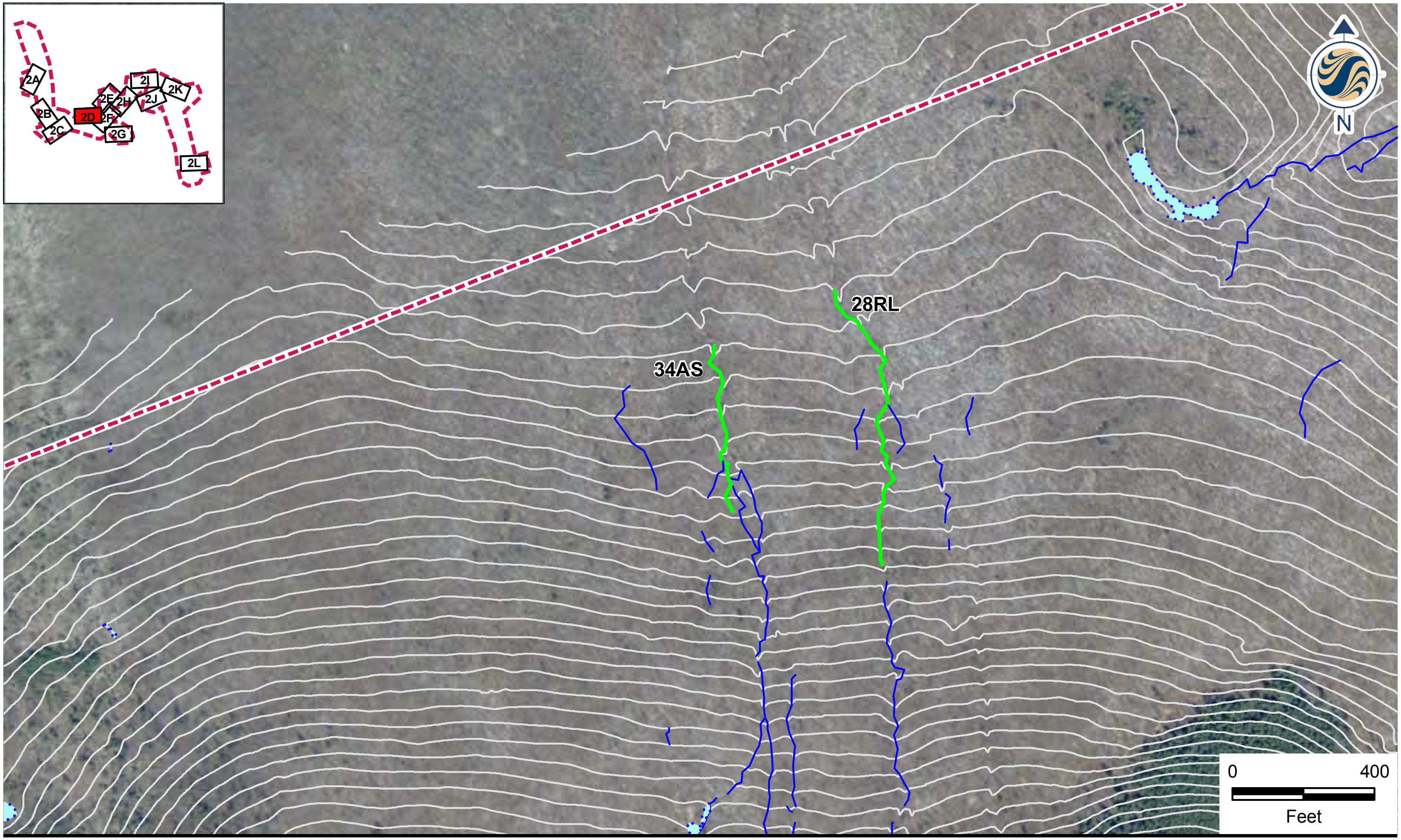
**Highland Wind, LLC**
**Highland Wind Project**
**Highland Plantation, Maine**

Figure No.

2C

Title

Northern Spring Salamander and
Roaring Brook Mayfly Map
October 27, 2009

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00385-F002D-Northern-Spring-Salamander-Survey.mxd

**Legend**

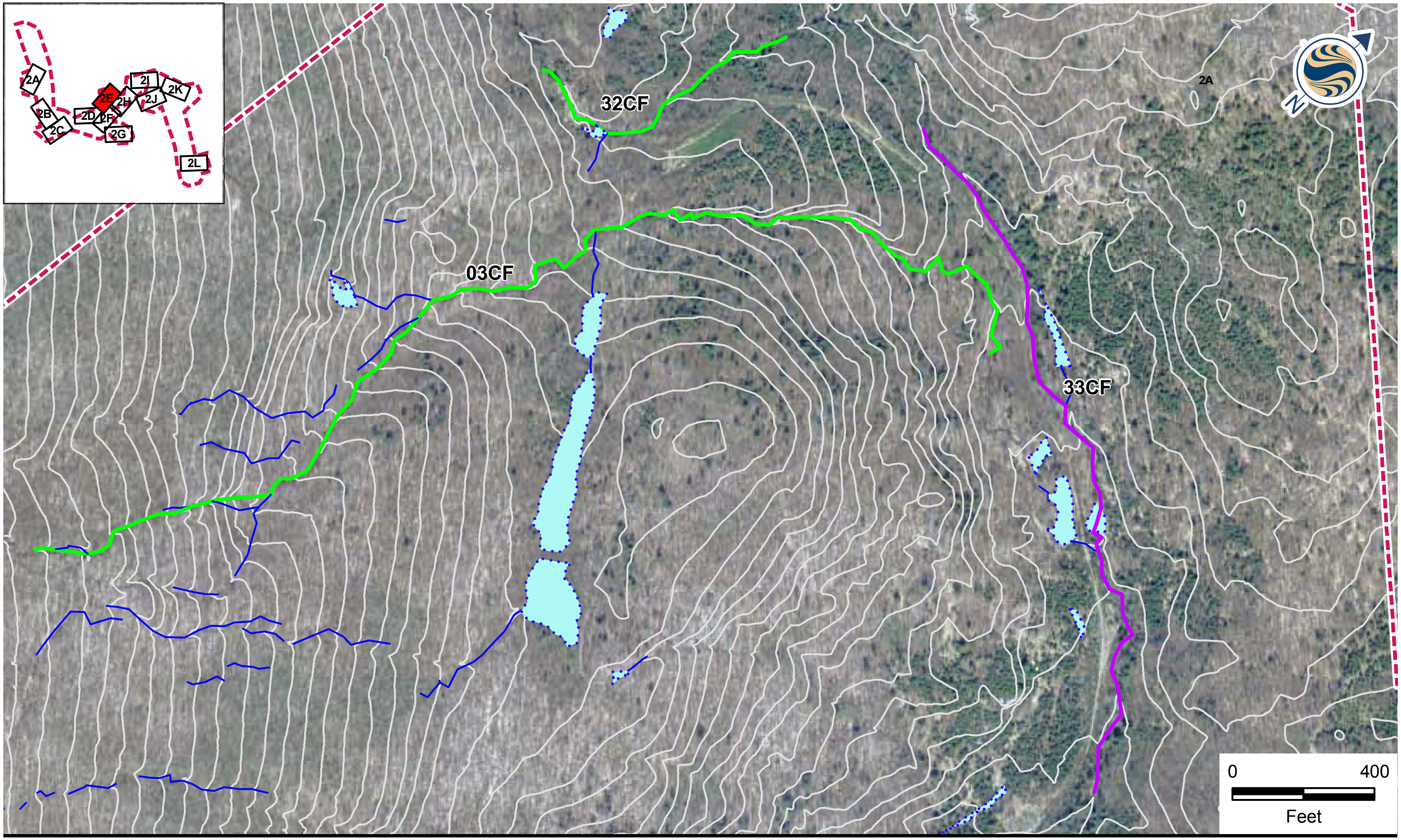
- Approximate Project Area
- Roaring Brook Mayfly Documented
- Northern Spring Salamander Documented
- Northern Spring Salamander & Roaring Brook Mayfly Documented
- Stream Surveyed for Rare Species
- Delineated Stream
- Contours
- Delineated Wetland

**Client/Project**

**Highland Wind, LLC**
**Highland Wind Project**
**Highland Plantation, Maine**

Figure No.
2D

Title
Northern Spring Salamander and
Roaring Brook Mayfly Map
October 27, 2009

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00385-F002E-Northern-Spring-Salamander-Survey.mxd

**Legend**

- Approximate Project Area
- Roaring Brook Mayfly Documented
- Northern Spring Salamander Documented
- Northern Spring Salamander & Roaring Brook Mayfly Documented
- Stream Surveyed for Rare Species
- Delineated Stream
- Contours
- Delineated Wetland

**Client/Project**

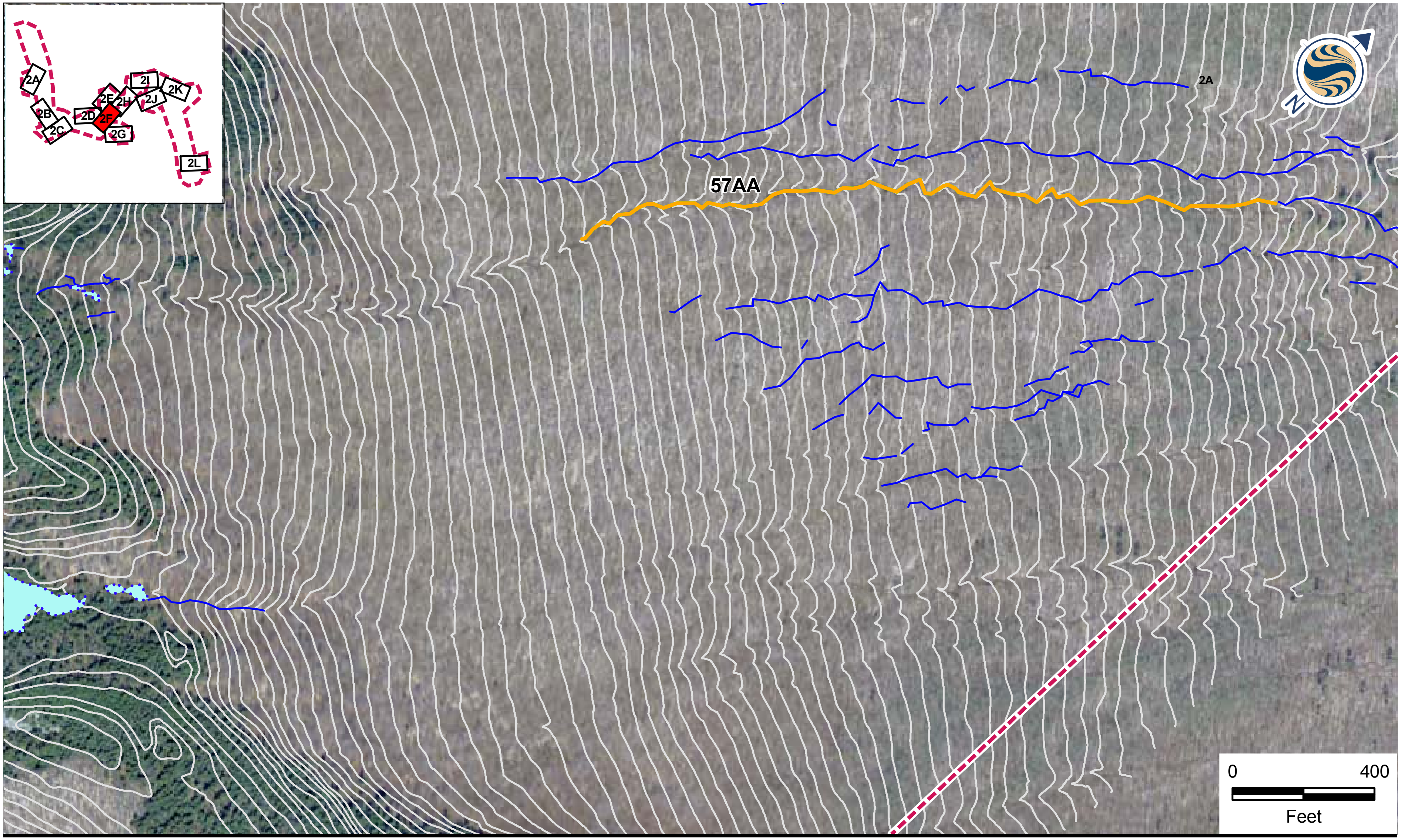
**Highland Wind, LLC**
**Highland Wind Project**
**Highland Plantation, Maine**

Figure No.

2E

Title

Northern Spring Salamander and
Roaring Brook Mayfly Map
October 27, 2009

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00385-F002F-Northern-Spring-Salamander-Survey.mxd

**Legend**

- Approximate Project Area
- Roaring Brook Mayfly Documented
- Northern Spring Salamander Documented
- Northern Spring Salamander & Roaring Brook Mayfly Documented
- Stream Surveyed for Rare Species
- Delineated Stream
- Contours
- Delineated Wetland

**Client/Project**

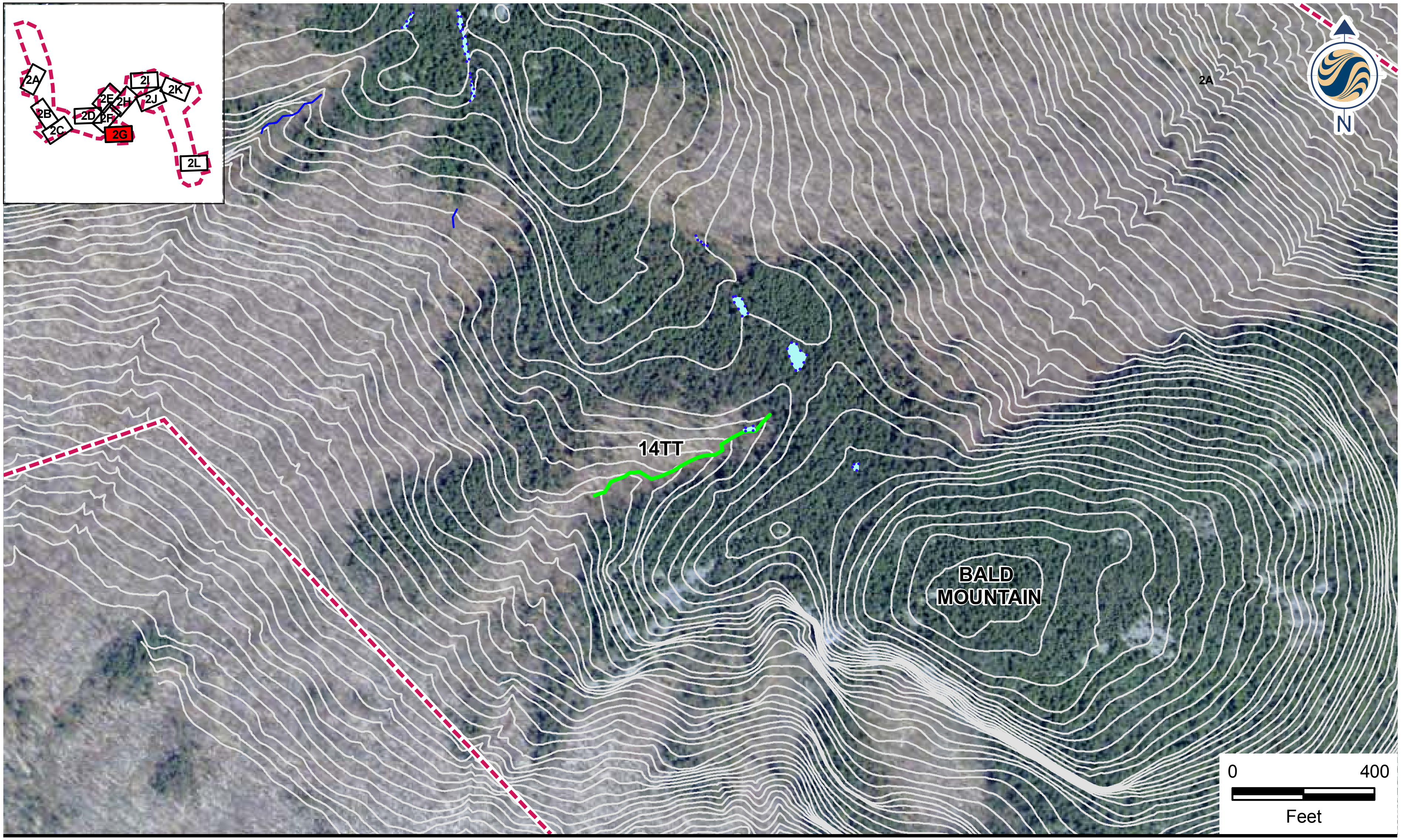
**Highland Wind, LLC**
**Highland Wind Project**
**Highland Plantation, Maine**

Figure No.

2F

Title

Northern Spring Salamander and
Roaring Brook Mayfly Map
October 27, 2009

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00385-F002G-Northern-Spring-Salamander-Survey.mxd

**Legend**

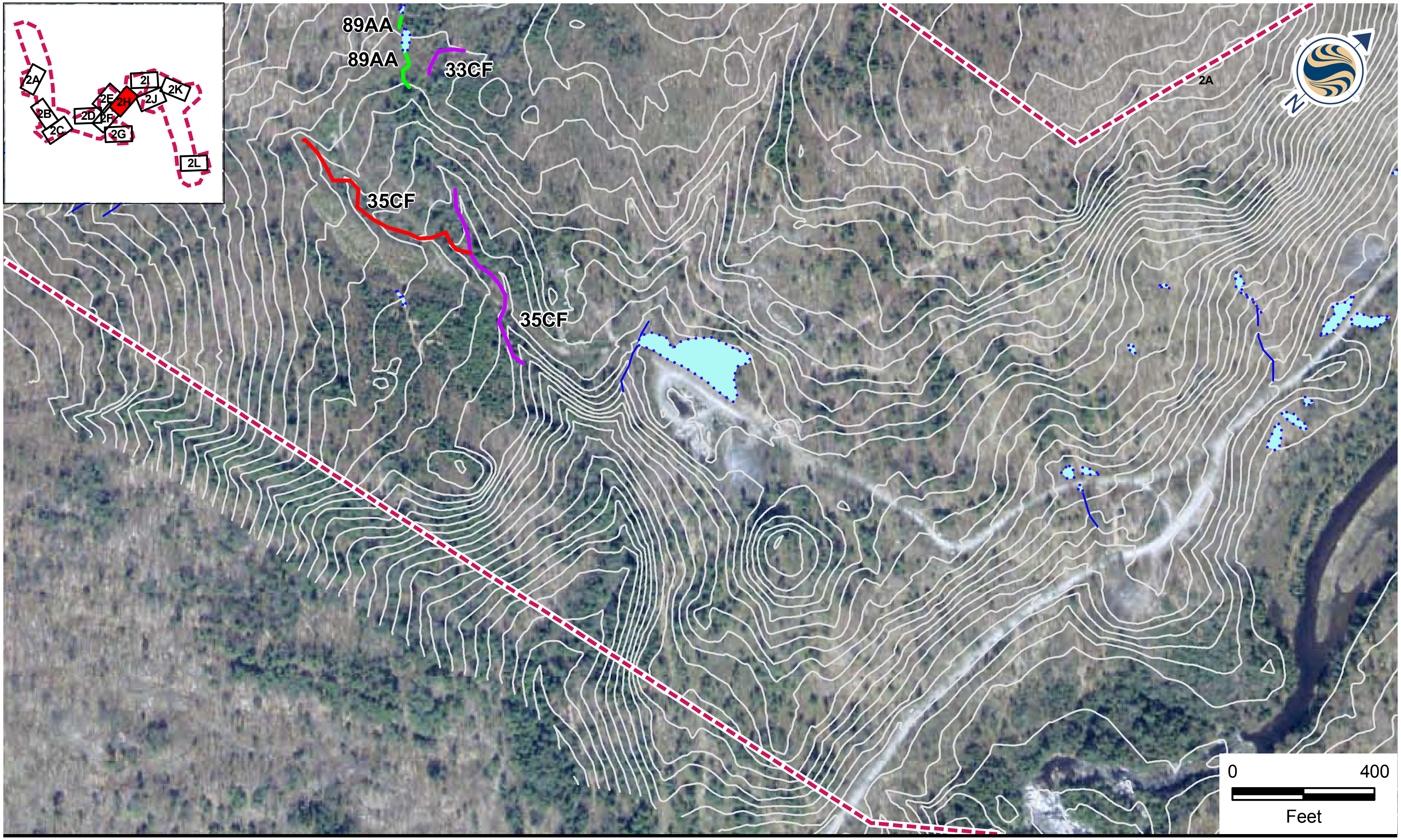
- Approximate Project Area
- Roaring Brook Mayfly Documented
- Northern Spring Salamander Documented
- Northern Spring Salamander & Roaring Brook Mayfly Documented
- Stream Surveyed for Rare Species
- Delineated Stream
- Contours
- Delineated Wetland

**Client/Project**

**Highland Wind, LLC**
**Highland Wind Project**
**Highland Plantation, Maine**

Figure No.
2G

Title
Northern Spring Salamander and
Roaring Brook Mayfly Map
October 27, 2009

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00385-F002H-Northern-Spring-Salamander-Survey.mxd

**Legend**

- Approximate Project Area
- Roaring Brook Mayfly Documented
- Northern Spring Salamander Documented
- Northern Spring Salamander & Roaring Brook Mayfly Documented
- Stream Surveyed for Rare Species
- Delineated Stream
- Contours
- Delineated Wetland

Client/Project

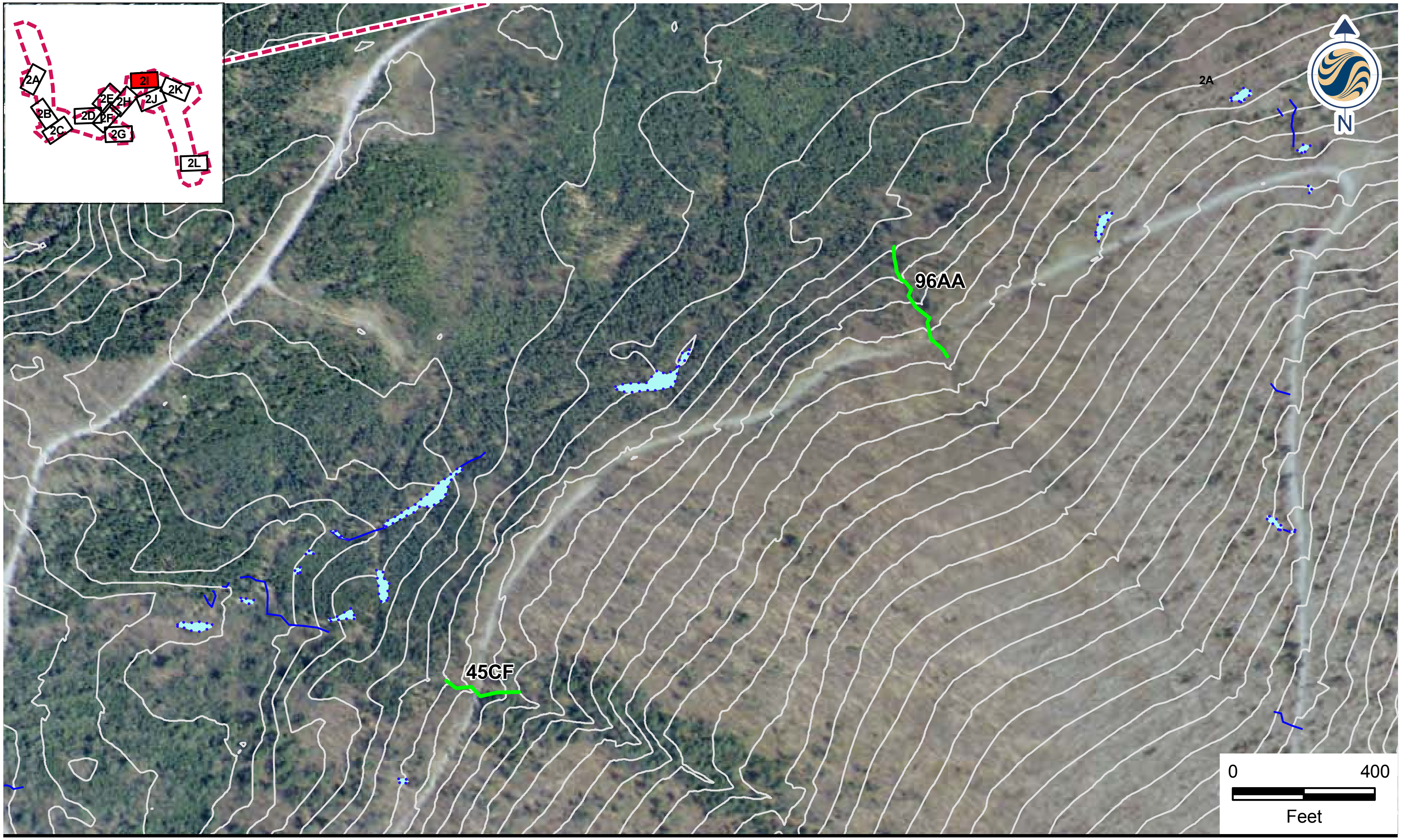
**Highland Wind, LLC**
**Highland Wind Project**
**Highland Plantation, Maine**

Figure No.

2H

Title

Northern Spring Salamander and
Roaring Brook Mayfly Map
October 27, 2009

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00385-F002I-Northern-Spring-Salamander-Survey.mxd

**Legend**

- Approximate Project Area
- Roaring Brook Mayfly Documented
- Northern Spring Salamander Documented
- Northern Spring Salamander & Roaring Brook Mayfly Documented
- Stream Surveyed for Rare Species
- Delineated Stream
- Contours
- Delineated Wetland

**Client/Project**

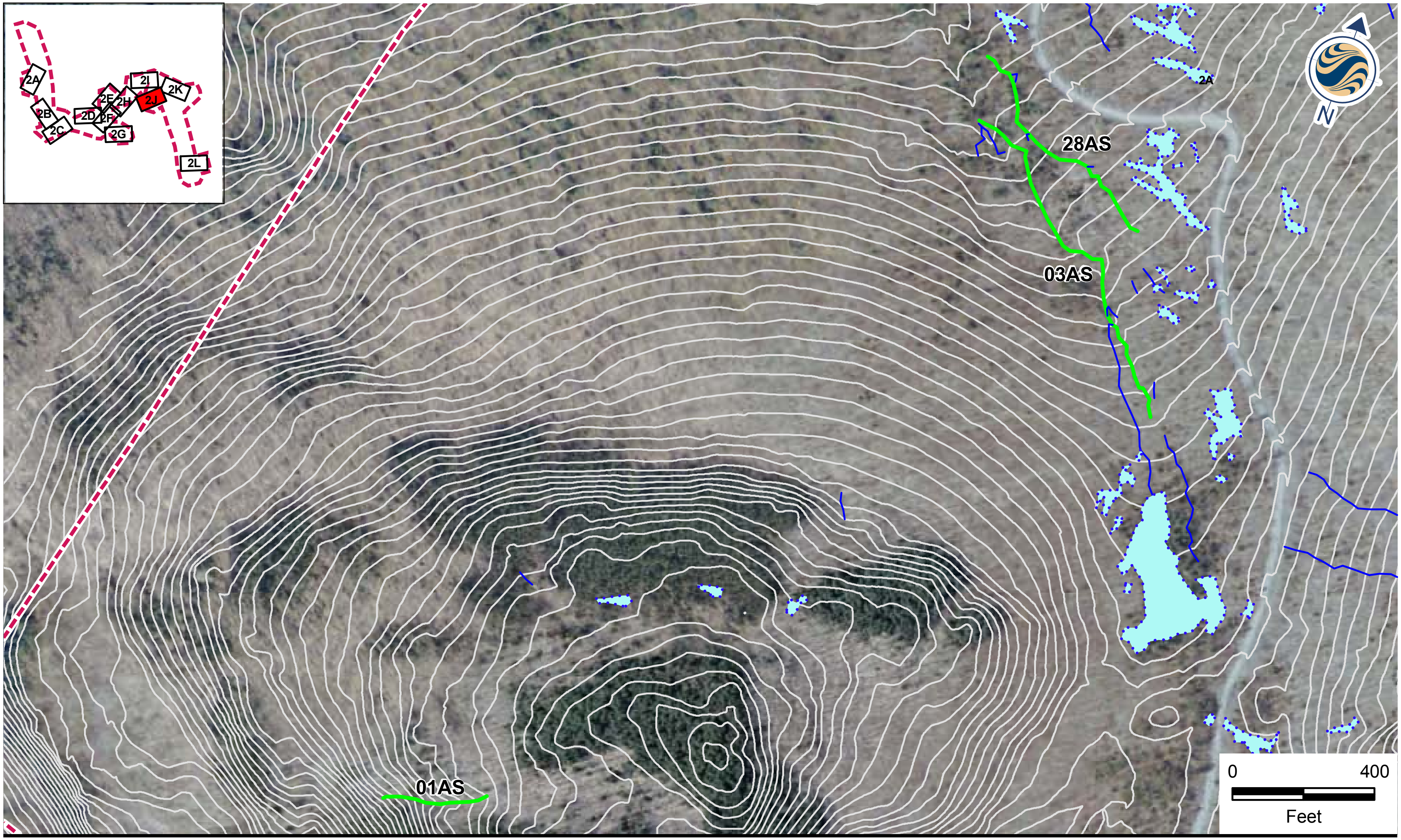
**Highland Wind, LLC**
**Highland Wind Project**
**Highland Plantation, Maine**

Figure No.

2I

Title

Northern Spring Salamander and
Roaring Brook Mayfly Map
October 27, 2009

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00385-F002J-Northern-Spring-Salamander-Survey.mxd

**Legend**

- Approximate Project Area
- Roaring Brook Mayfly Documented
- Northern Spring Salamander Documented
- Northern Spring Salamander & Roaring Brook Mayfly Documented
- Stream Surveyed for Rare Species
- Delineated Stream
- Contours
- Delineated Wetland

**Client/Project**

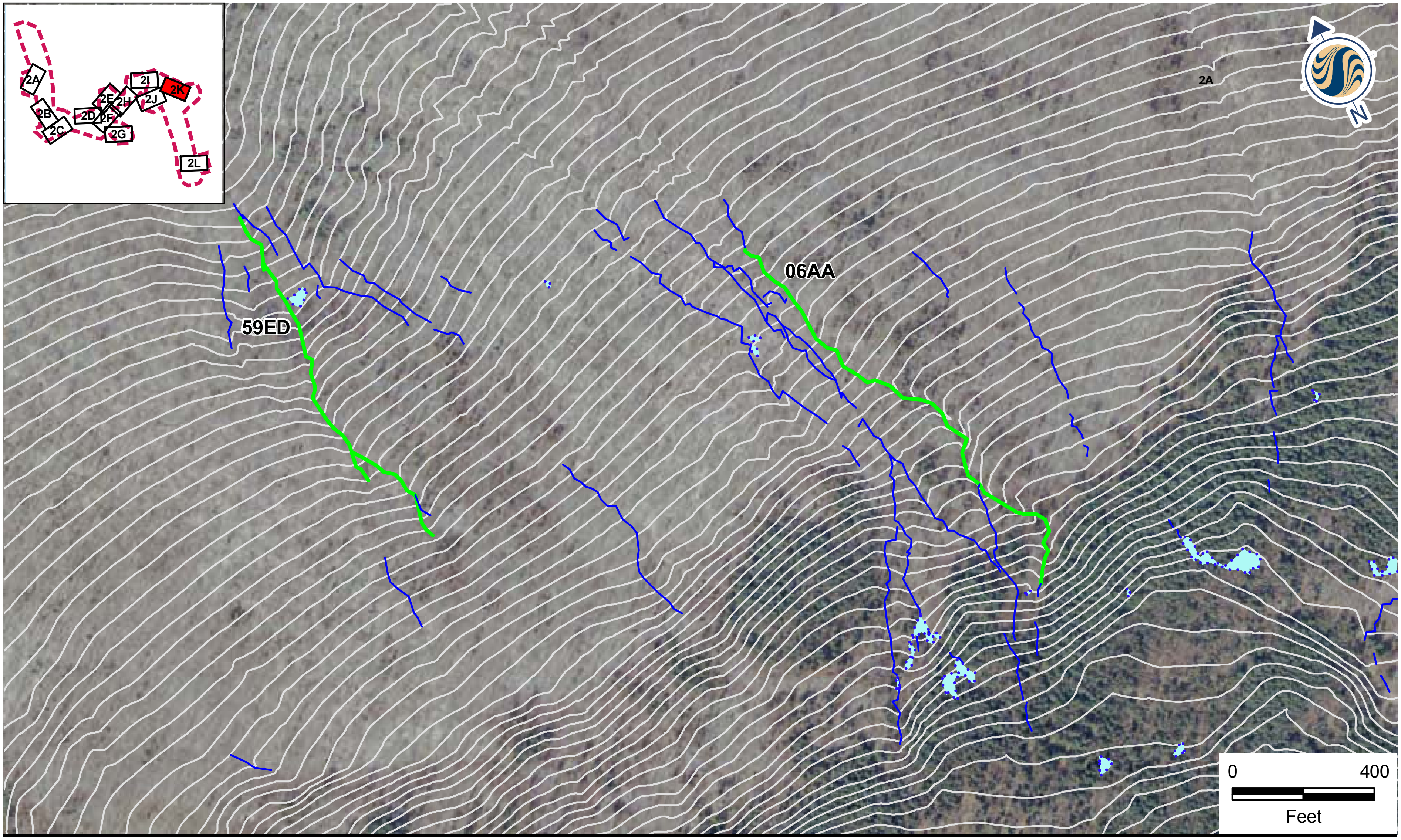
**Highland Wind, LLC**
**Highland Wind Project**
**Highland Plantation, Maine**

Figure No.

2J

Title

Northern Spring Salamander and
Roaring Brook Mayfly Map
October 27, 2009

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00385-F002K-Northern-Spring-Salamander-Survey.mxd

**Legend**

- Approximate Project Area
- Roaring Brook Mayfly Documented
- Northern Spring Salamander Documented
- Northern Spring Salamander & Roaring Brook Mayfly Documented
- Stream Surveyed for Rare Species
- Delineated Stream
- Contours
- Delineated Wetland

**Client/Project**

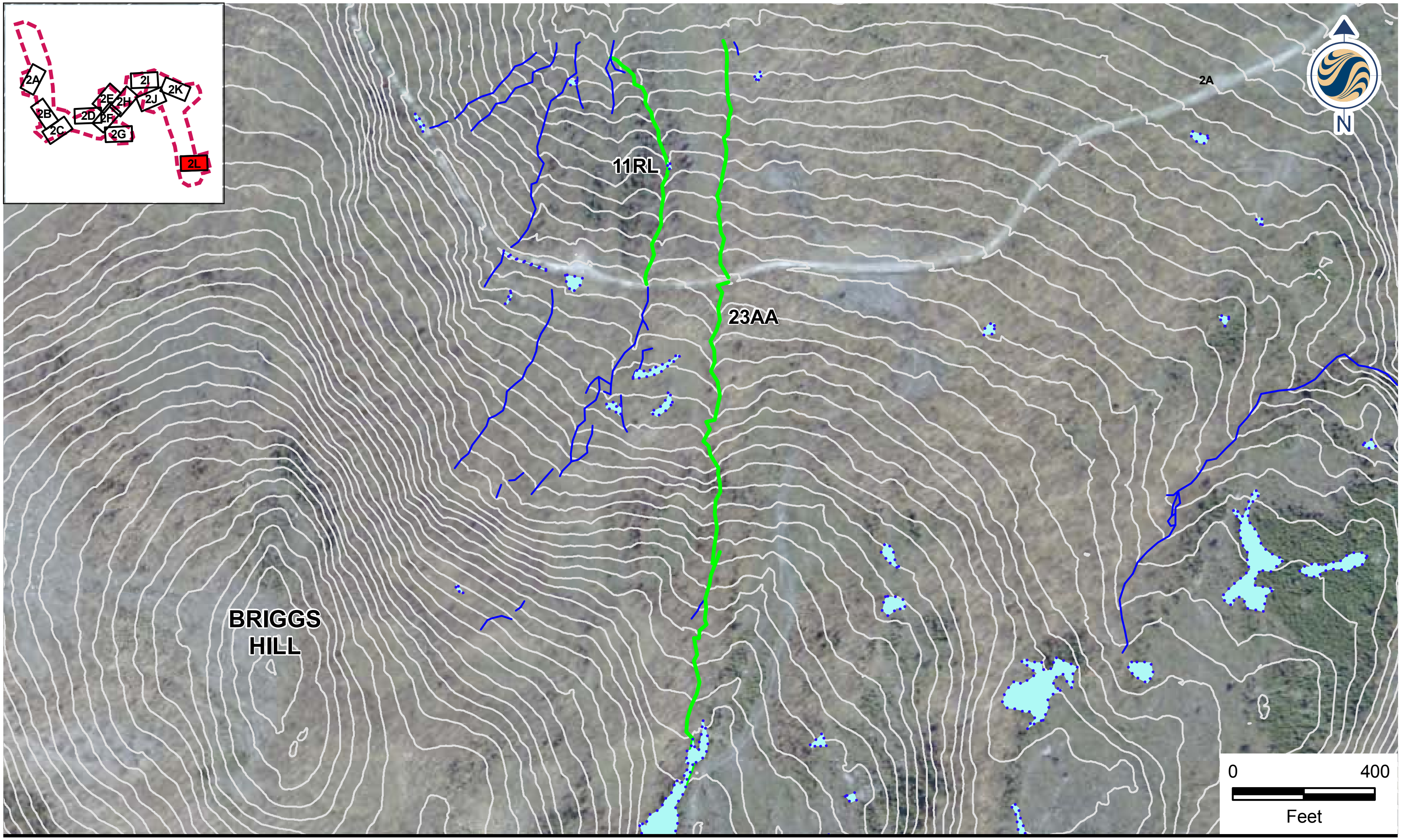
**Highland Wind, LLC**
**Highland Wind Project**
**Highland Plantation, Maine**

Figure No.

2K

Title

Northern Spring Salamander and
Roaring Brook Mayfly Map
October 27, 2009

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00385-F002L-Northern-Spring-Salamander-Survey.mxd

**Legend**

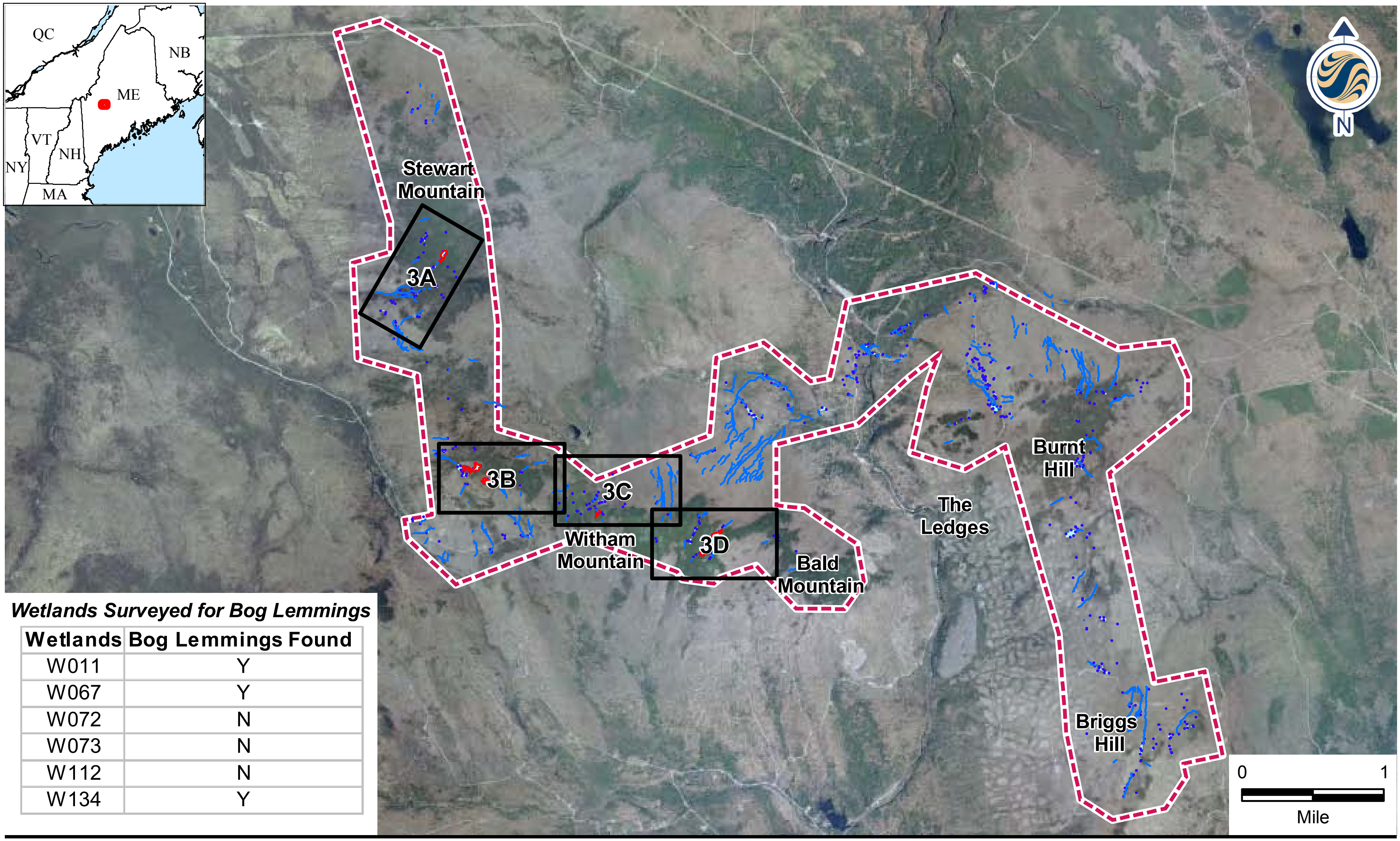
- Approximate Project Area
- Roaring Brook Mayfly Documented
- Northern Spring Salamander Documented
- Northern Spring Salamander & Roaring Brook Mayfly Documented
- Stream Surveyed for Rare Species
- Delineated Stream
- Contours
- Delineated Wetland

**Client/Project**

**Highland Wind, LLC**
**Highland Wind Project**
**Highland Plantation, Maine**

Figure No.
2L

Title
Northern Spring Salamander and
Roaring Brook Mayfly Map
October 27, 2009




***Wetlands Surveyed for Bog Lemmings***

| Wetlands | Bog Lemmings Found |
|---|---|
| W011 | Y |
| W067 | Y |
| W072 | N |
| W073 | N |
| W112 | N |
| W134 | Y |

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**Legend**

- Map Extents
- Wetland Surveyed for Bog Lemming
- Delineated Wetland
- Approximate Project Area
- Delineated Stream

Client/Project

**Highland Wind, LLC**
**Highland Wind Project**
**Highland Plantation, Maine**

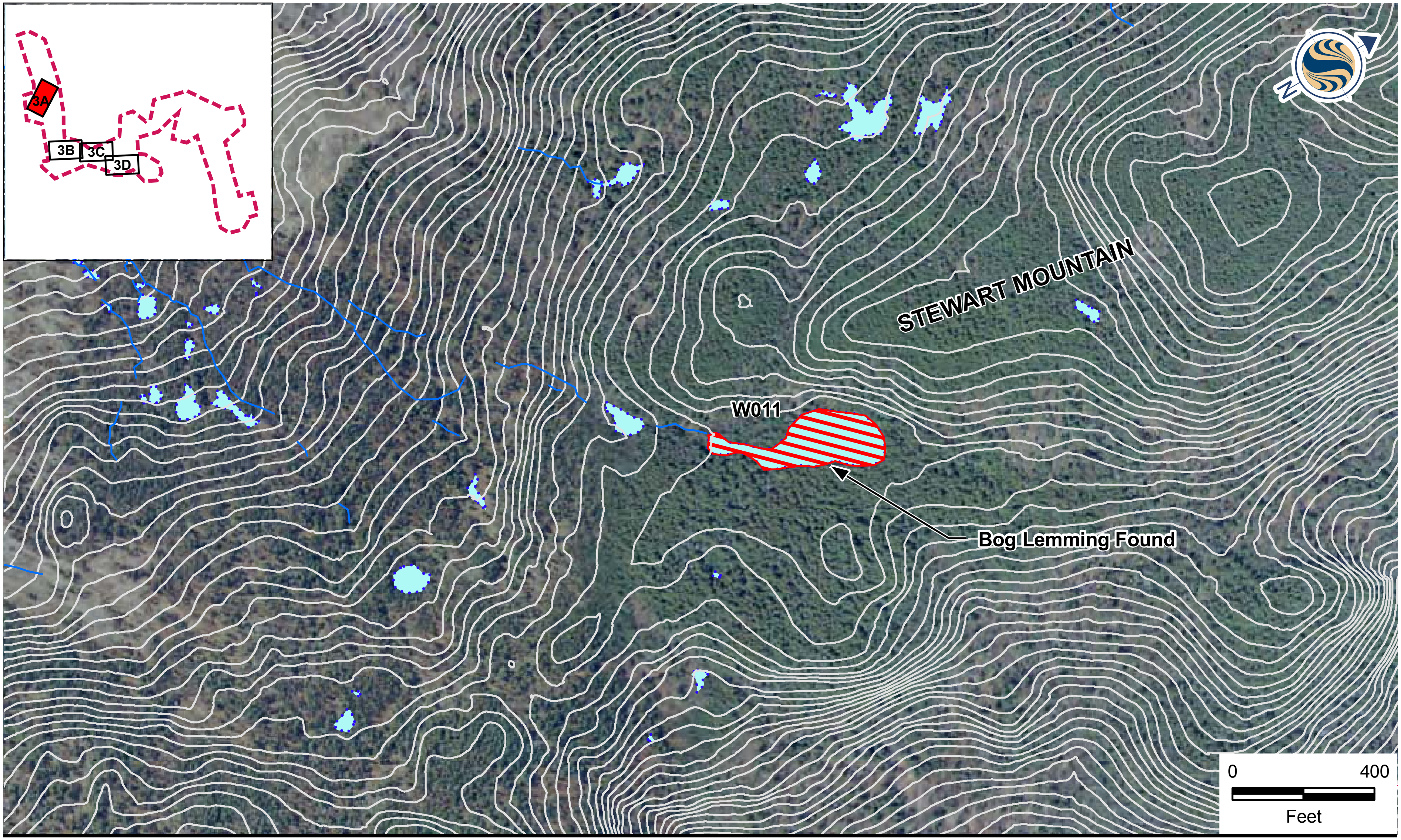
Figure No.

Map Key

Title

Northern Bog Lemming Survey Locations Map
October 27, 2009

00385-F000-Northern-Bog-Lemming.mxd

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**Legend**

- Wetland Surveyed for Bog Lemming
- Delineated Wetland
- Approximate Project Area
- Delineated Stream
- Contours

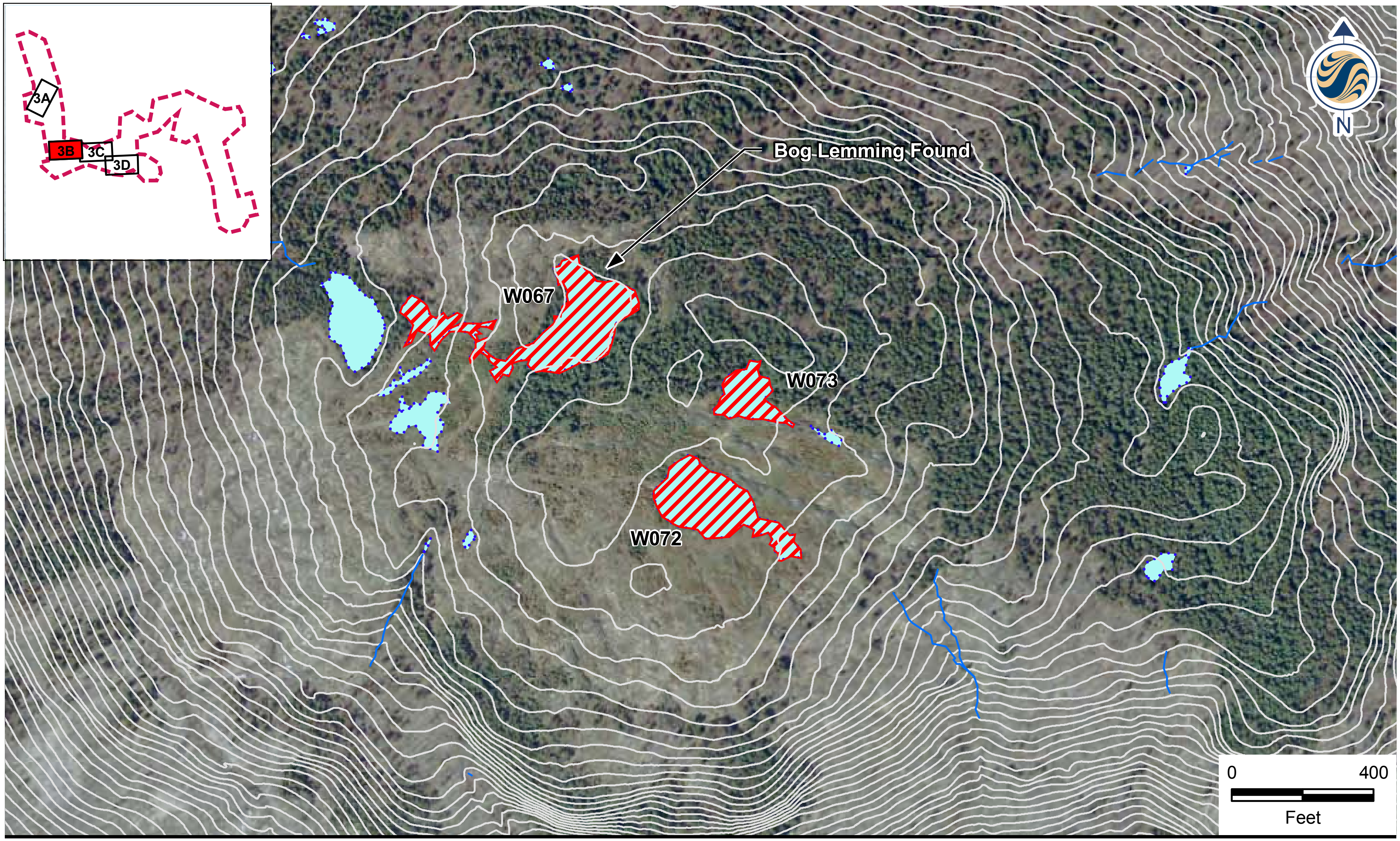
**Client/Project**

**Highland Wind, LLC**
**Highland Wind Project**
**Highland Plantation, Maine**

Figure No.
3A

Title
Northern Bog Lemming Survey Locations Map
October 27, 2009

00385-F003A-Northern-Bog-Lemming.mxd

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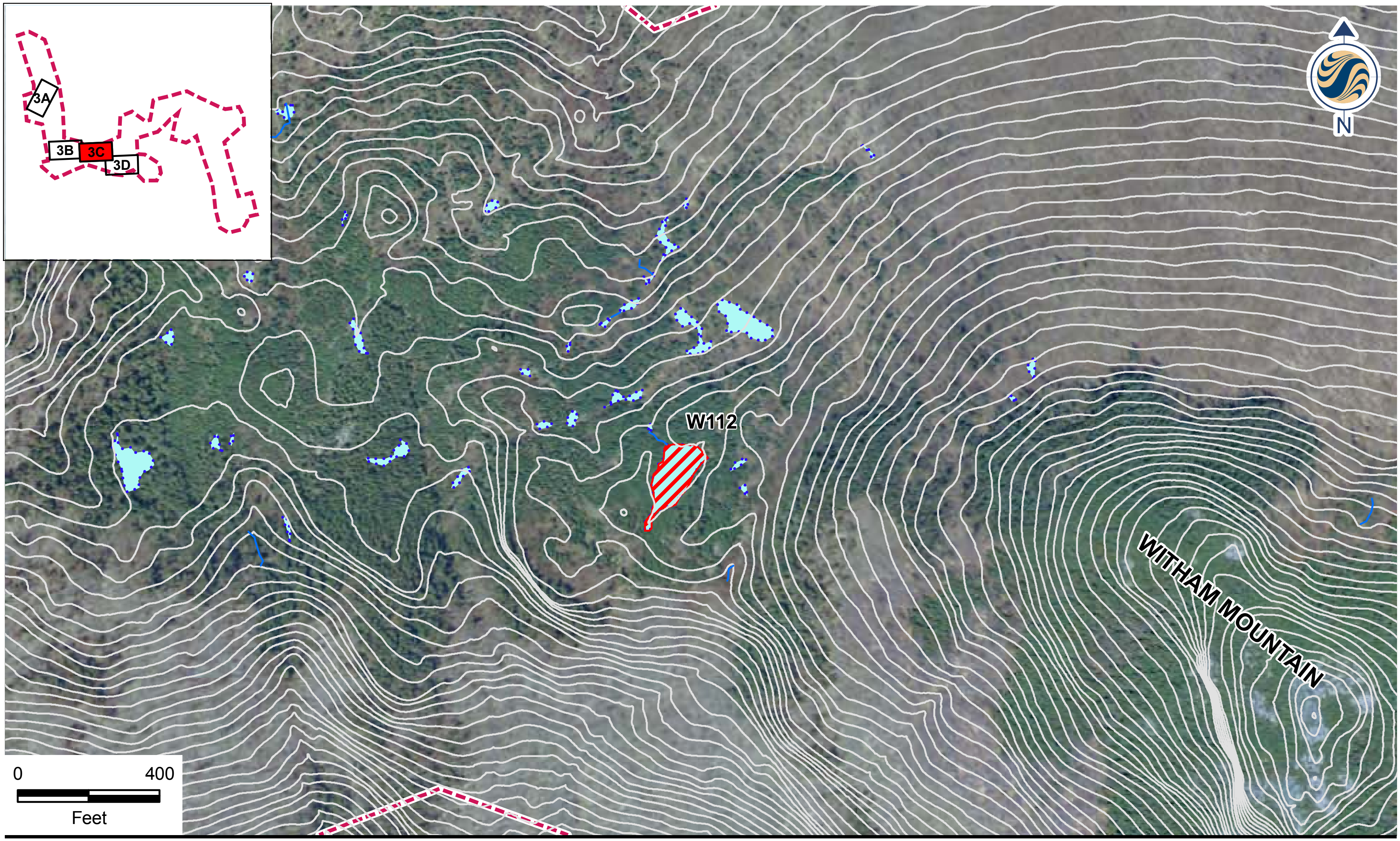
**Legend**
- Wetland Surveyed for Bog Lemming
- Delineated Wetland
- Approximate Project Area
- Delineated Stream
- Contours

**Client/Project**
**Highland Wind, LLC**
**Highland Wind Project**
**Highland Plantation, Maine**

Figure No.
3B

Title
Northern Bog Lemming Survey Locations Map
October 27, 2009

00385-F003B-Northern-Bog-Lemming.mxd

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**Legend**

- Wetland Surveyed for Bog Lemming
- Delineated Wetland
- Approximate Project Area
- Delineated Stream
- Contours

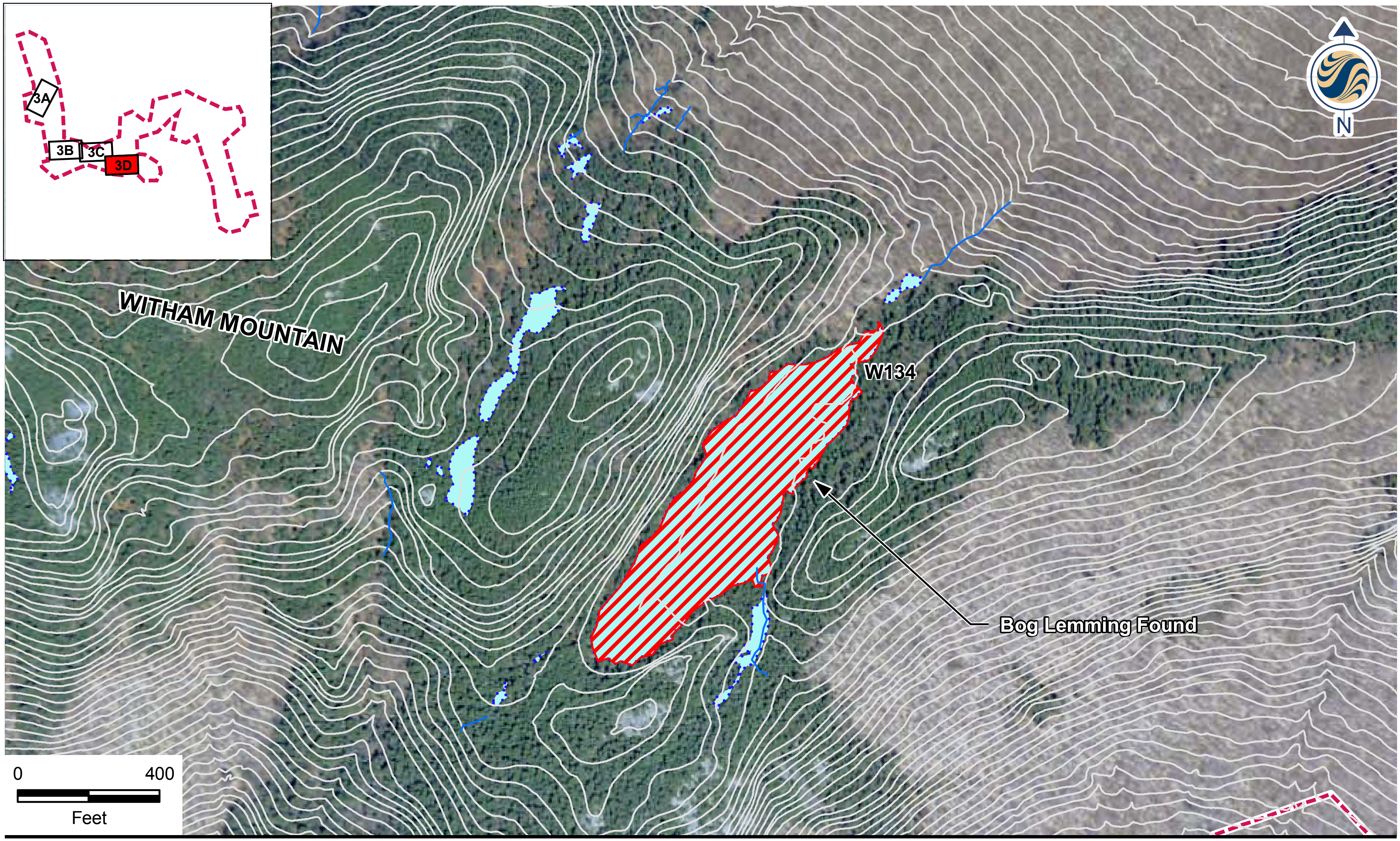
**Client/Project**

**Highland Wind, LLC**
**Highland Wind Project**
**Highland Plantation, Maine**

Figure No.
3C

Title
Northern Bog Lemming Survey Locations Map
October 27, 2009

00385-F003C-Northern-Bog-Lemming.mxd

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**Legend**

- Wetland Surveyed for Bog Lemming
- Delineated Wetland
- Approximate Project Area
- Delineated Stream
- Contours

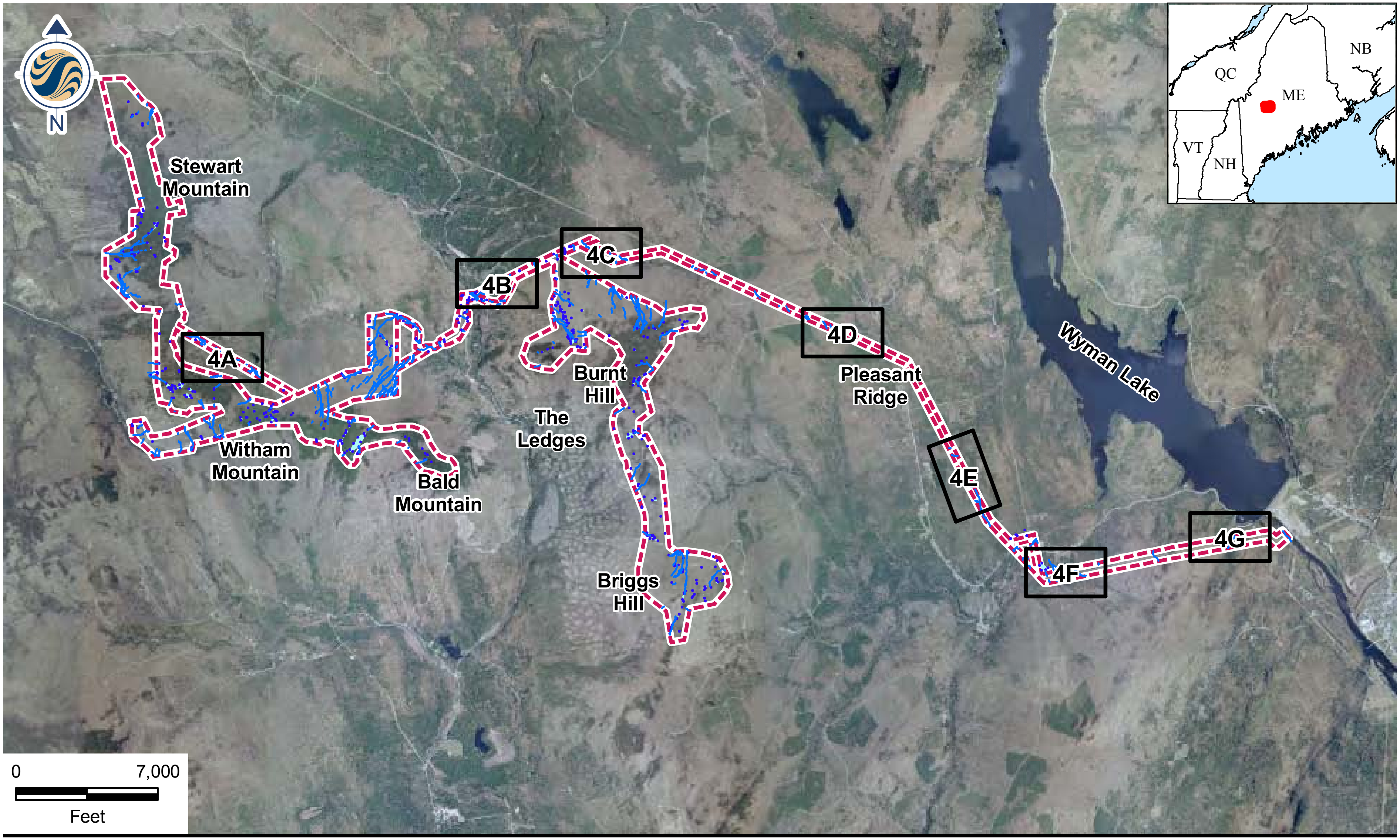
Client/Project

**Highland Wind, LLC**
**Highland Wind Project**
**Highland Plantation, Maine**

Figure No.
3D

Title
Northern Bog Lemming Survey Locations Map
October 27, 2009

00385-F003D-Northern-Bog-Lemming.mxd

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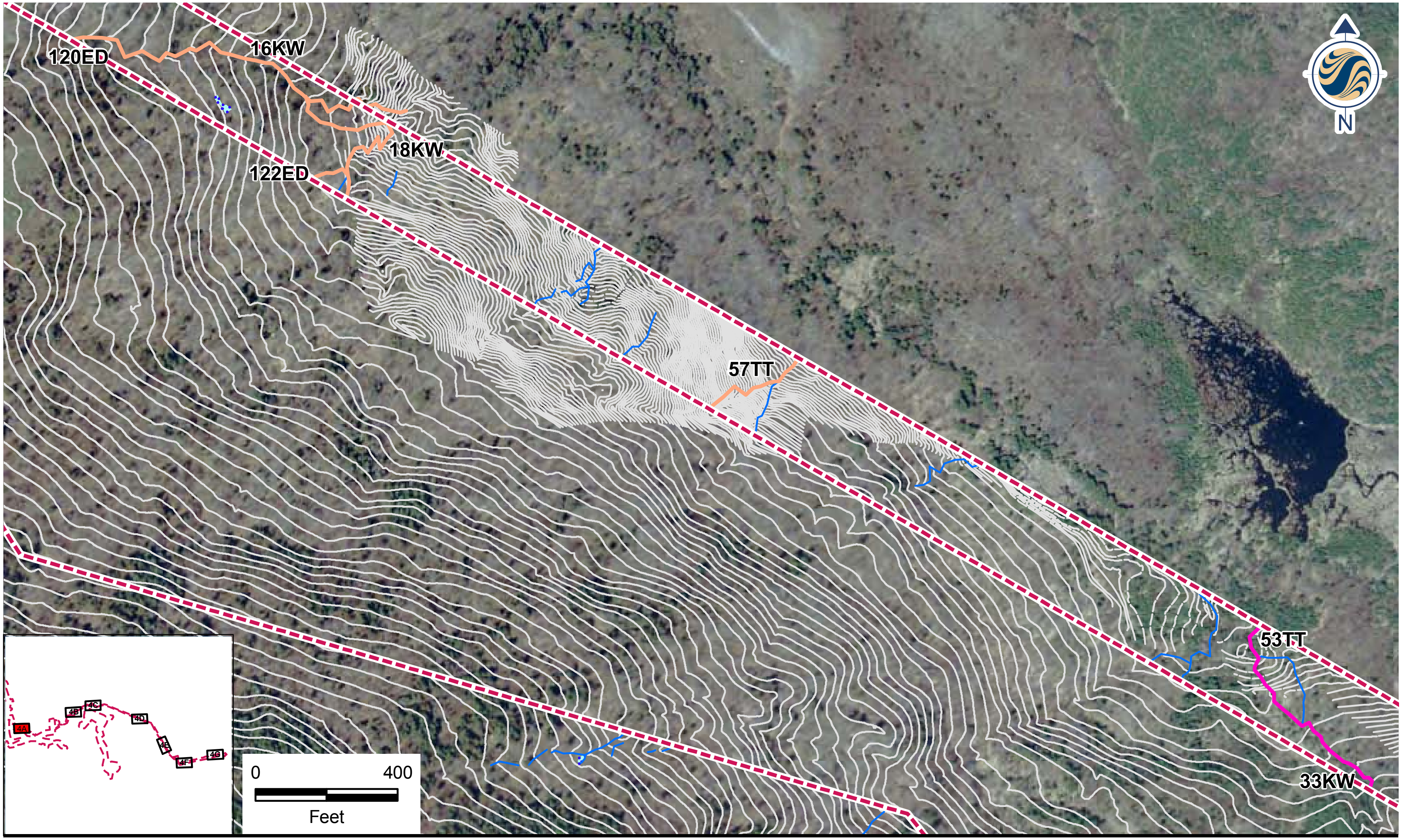
**Legend**
- Approximate Project Area
- Delineated Streams
- Delineated Wetland
- Map Extents

Client/Project
**Highland Wind, LLC**
**Highland Wind Project**
**Highland Plantation, Maine**

Figure No.
Map-Key

Title
Incidental Spring Salamander Location Map
November 3, 2009

00385-F000-Incidental-Spring-Salamander-Location-Maps.mxd

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00385-F004A-Incidental-Spring-Salamander-Location-Maps.mxd

**Legend**

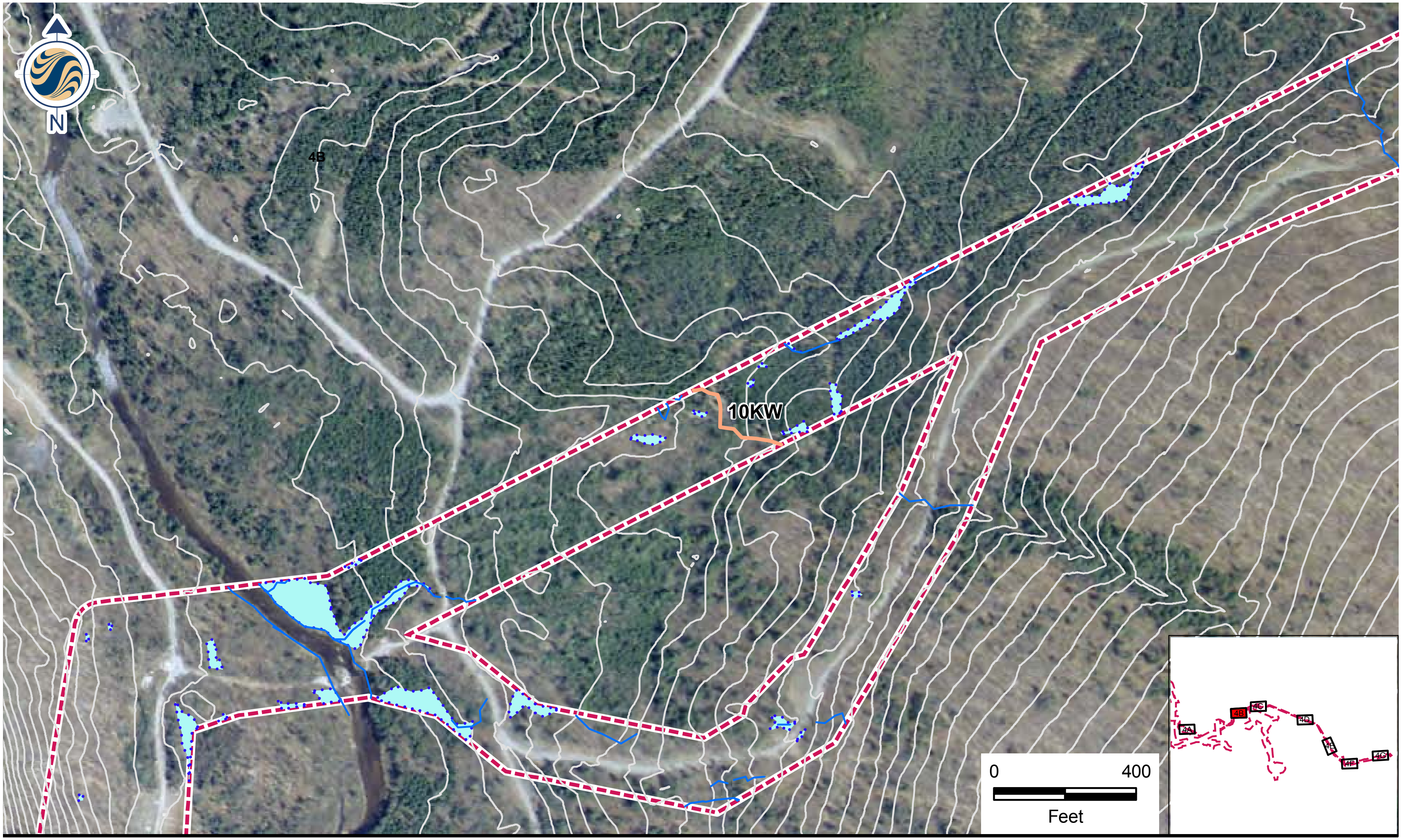
- Approximate Project Area
- Incidental Spring Salamander Documented
- Streams Suitable for Spring Salamander Habitat
- Delineated Streams
- Contours
- Delineated Wetland

Client/Project

**Highland Wind, LLC**
**Highland Wind Project**
**Highland Plantation, Maine**

Figure No.
4A

Title
Incidental Spring Salamander Location Map
November 3, 2009

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00385-F004B-Incidental-Spring-Salamander-Location-Maps.mxd

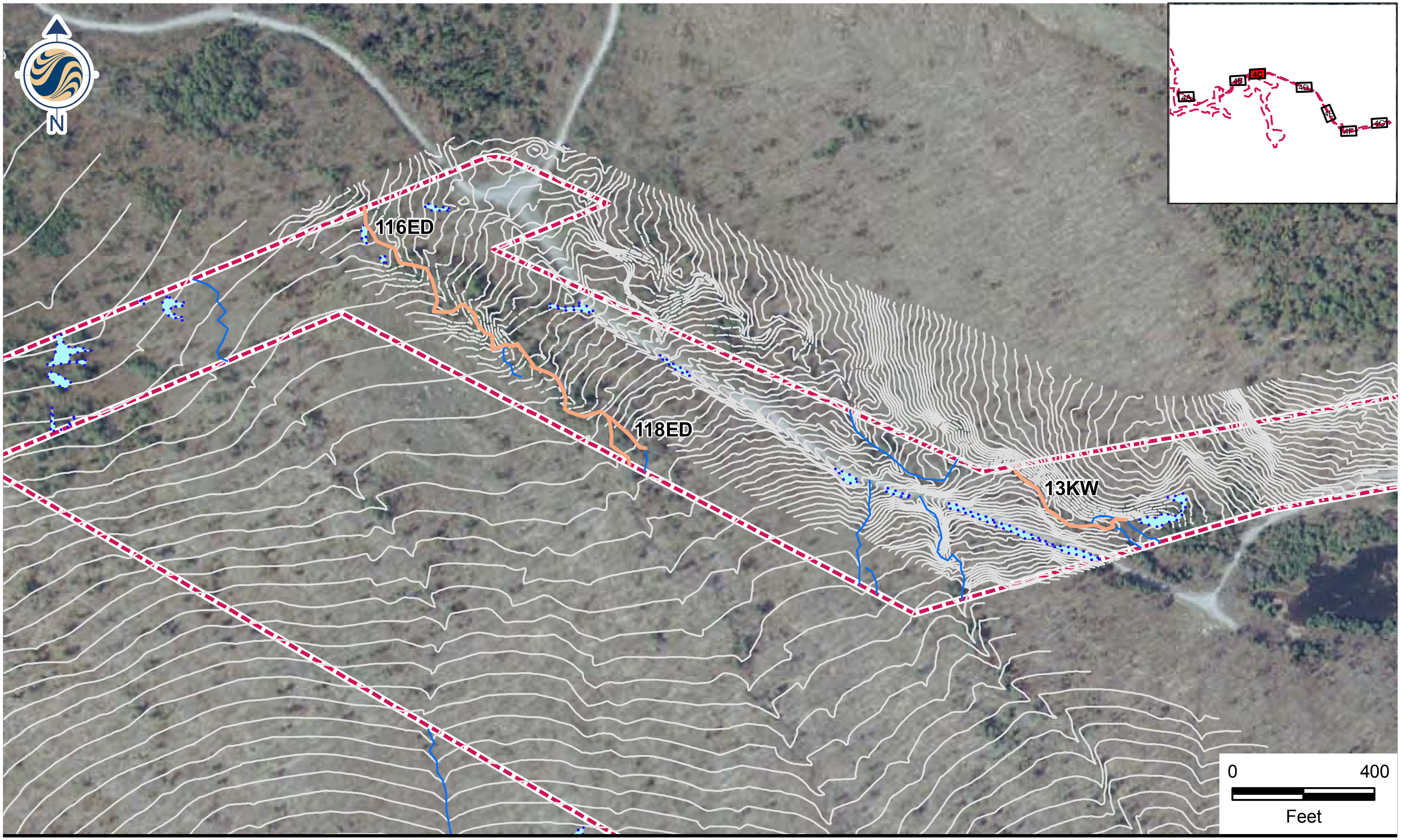
**Legend**

- Approximate Project Area
- Incidental Spring Salamander Documented
- Streams Suitable for Spring Salamander Habitat
- Delineated Streams
- Contours
- Delineated Wetland

**Client/Project**
**Highland Wind, LLC**
**Highland Wind Project**
**Highland Plantation, Maine**

Figure No.
4B

Title
Incidental Spring Salamander Location Map
November 3, 2009

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00385-F004C-Incidental-Spring-Salamander-Location-Maps.mxd

**Legend**

- Approximate Project Area
- Incidental Spring Salamander Documented
- Streams Suitable for Spring Salamander Habitat
- Delineated Streams
- Contours
- Delineated Wetland

Client/Project

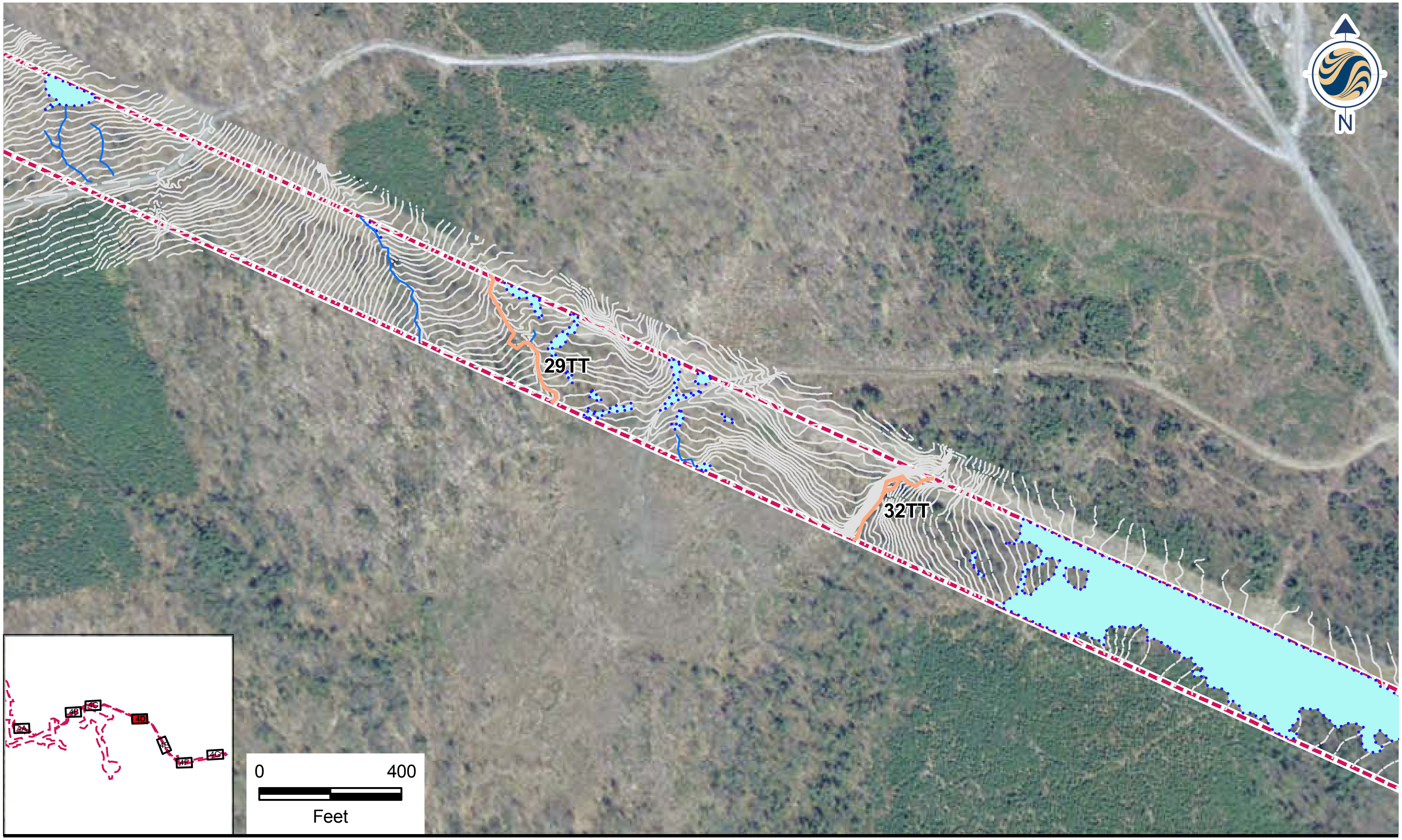
**Highland Wind, LLC**
**Highland Wind Project**
**Highland Plantation, Maine**

Figure No.

4C

Title

Incidental Spring Salamander Location Map
November 3, 2009

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00385-F004D-Incidental-Spring-Salamander-Location-Maps.mxd

**Legend**

- Approximate Project Area
- Incidental Spring Salamander Documented
- Streams Suitable for Spring Salamander Habitat
- Delineated Streams
- Contours
- Delineated Wetland

**Client/Project**

**Highland Wind, LLC**
**Highland Wind Project**
**Highland Plantation, Maine**

Figure No.

4D

Title

Incidental Spring Salamander Location Map
November 3, 2009


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00385-F004E-Incidental-Spring-Salamander-Location-Maps.mxd

**Legend**

- Approximate Project Area
- Incidental Spring Salamander Documented
- Streams Suitable for Spring Salamander Habitat
- Delineated Streams
- Contours
- Delineated Wetland

Client/Project

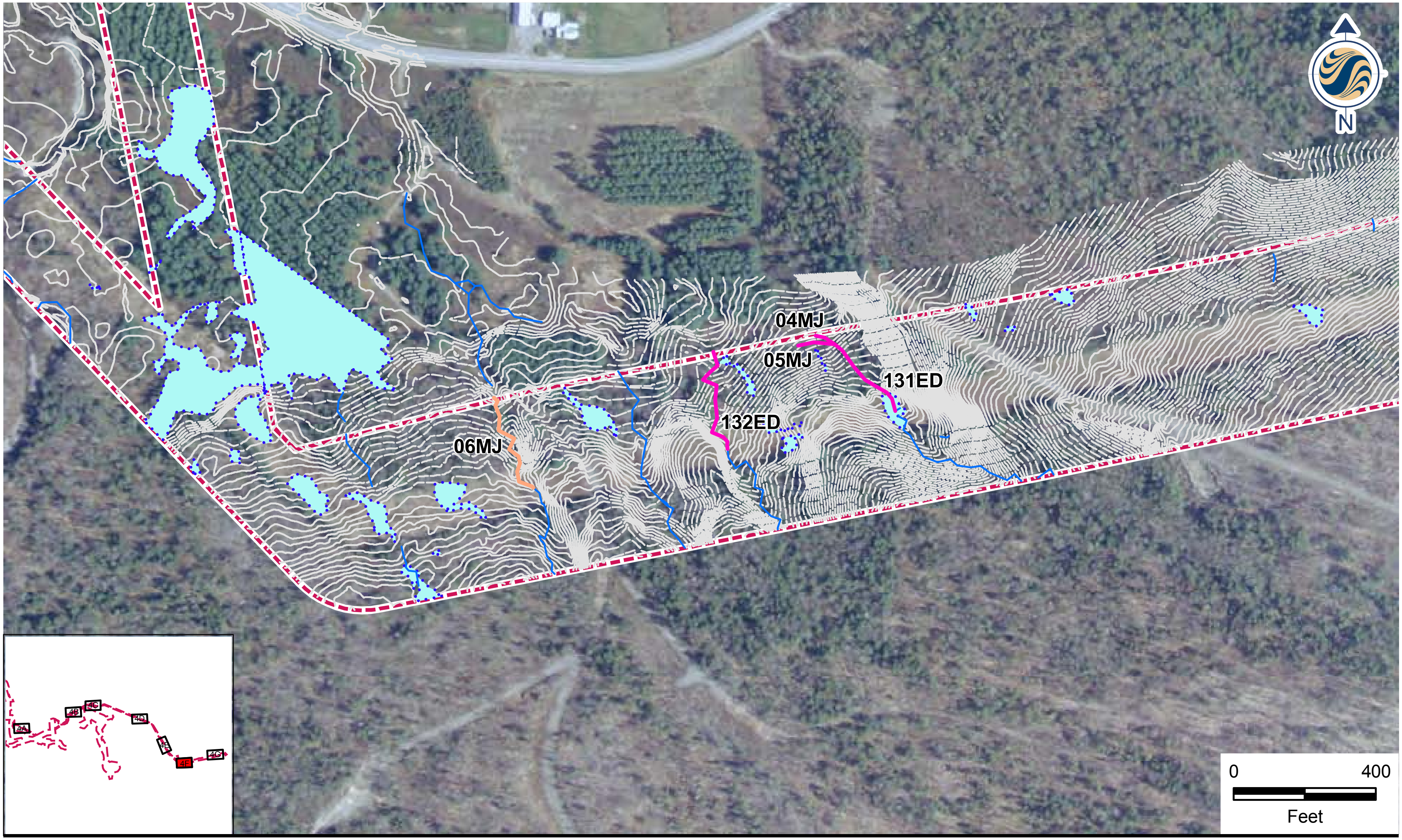
**Highland Wind, LLC**
**Highland Wind Project**
**Highland Plantation, Maine**

Figure No.

4E

Title

Incidental Spring Salamander Location Map
November 3, 2009

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00385-F004F-Incidental-Spring-Salamander-Location-Maps.mxd

**Legend**

- Approximate Project Area
- Incidental Spring Salamander Documented
- Streams Suitable for Spring Salamander Habitat
- Delineated Streams
- Contours
- Delineated Wetland

**Client/Project**

**Highland Wind, LLC**
**Highland Wind Project**
**Highland Plantation, Maine**

Figure No.

4F

Title

Incidental Spring Salamander Location Map
November 3, 2009


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00385-F004G-Incidental-Spring-Salamander-Location-Maps.mxd

**Legend**

- Approximate Project Area
- Incidental Spring Salamander Documented
- Streams Suitable for Spring Salamander Habitat
- Delineated Streams
- Contours
- Delineated Wetland

Client/Project
**Highland Wind, LLC**
**Highland Wind Project**
**Highland Plantation, Maine**

Figure No.
4G

Title
Incidental Spring Salamander Location Map
November 3, 2009

# APPENDIX A

**Photo 1.** Spring salamander larvae in stream 57AA. Stantec Consulting. July 28, 2009.

**Photo 2.** Stream 57AA habitat. Stantec Consulting. July 28, 2009.

**Photo 3.**  Adult spring salamander in stream 35CF.  Stantec Consulting.  July 29, 2009.

**Photo 4.**  Stream 35CF habitat.  Stantec Consulting.  July 29, 2009.

**Photo 5.** Stream 29ED habitat. Stantec Consulting. July 27, 2009.

**Photo 6.** Stream 29ED habitat. Stantec Consulting. August 20, 2009.

**Photo 7.** Stream 03CF habitat. Stantec Consulting. August 20, 2009.

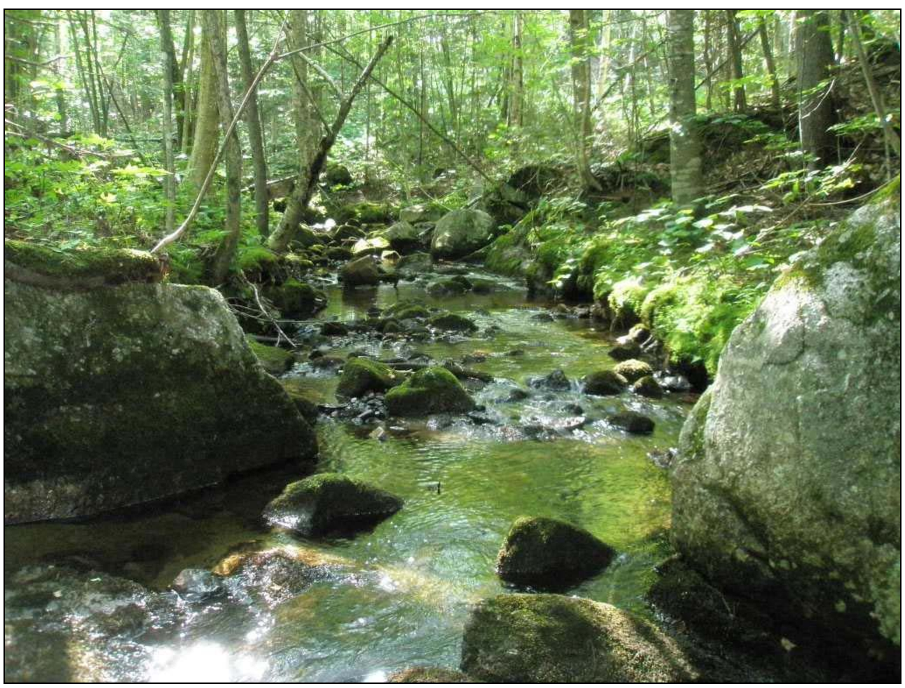


**Photo 8.** Stream 32CF habitat. Stantec Consulting. July 28, 2009.

**Photo 9.** Stream 33CF habitat. Stantec Consulting. August 20, 2009.

**Photo 10.** Wetland W011 bog lemming habitat. Stantec Consulting. July 27, 2009.

**Photo 11.** Bog lemming fecal pellets in wetland W011. Stantec Consulting. July 27, 2009.

**Photo 12.** Habitat in wetland W067. Stantec Consulting. July 27, 2009.

**Photo 13:** Bog lemming habitat in wetland W072. Stantec Consulting. July 27, 2009.

**Photo 14.** Bog lemming runway in wetland W134. Stantec Consulting. July 28, 2009.

**Photo 15:** Habitat in wetland W112. Stantec Consulting. July 28, 2009.

**Photo 16.** Poor quality northern spring salamander and Roaring Brook mayfly habitat in stream 28RL. Stantec Consulting. July 28, 2009.

**Photo 17.** Poor quality northern spring salamander and Roaring Brook mayfly habitat in stream 17DD. Stantec Consulting. July 28, 2009.

**Photo 18.** Poor quality northern spring salamander and Roaring Brook mayfly habitat in stream 59ED. Stantec Consulting. July 29, 2009.

**Photo 19.** Poor quality northern spring salamander and Roaring Brook mayfly habitat in stream 03KW. Stantec Consulting. July 29, 2009.

**Photo 20.** Poor quality northern spring salamander and Roaring Brook mayfly habitat in stream 07DD. Stantec Consulting. September 15, 2008.

# APPENDIX B

**INSTRUCTIONS**: Complete 1 form per visit. **Grayed sections are for Heritage office use only.** rev. 02/06/2008

# RARE ANIMAL SURVEY FORM

MDIFW
650 State St.
Bangor, ME 04401

**Completed By**: Matt Arsenault **Date**: 10/2/09 Review by (MDIFW): Date:

**SURVEYSITE**: Witham Mountain, Stony Brook tributary **TOWNSHIP**: Highland Plantation

NEW EO (check): UPDATE (check): (EO NUM: ) **DELORME PAGE & GRID (e.g. 04B2)**: **Map 30 C-2**

## ELEMENT INFORMATION

**Common Name**: Roaring Brook Mayfly **Scientific Name**: Epeorus frisoni

## SURVEYOR INFORMATION

Survey date 08/20/09 Time from: 2:10 to: 3:00 am or **pm** Sourcecode: F_ _ _ _ _ _ _

Surveyors (principal surveyor first, include first & last name and contact information): Matt Arsenault, Michael Johnson, Stantec Consulting, 30 Park Dr., Topsham, ME 04086 (207) 729-1199

## IDENTIFICATION

Photograph/slide taken? Yes__ No X Notes & repository:

Specimen collected? Yes X No__ Specimen # and repository: Voucher provided to MDIFW

Identification problems? Yes X No__ Explain: E. cf frisoni Identification provided by Dr. Steven Burian of Southern CT State University

## ELEMENT OCCURRENCE INFORMATION

1. Type of Observation: sight__ vocalization__ handled X Collected X other (explain):
2. Observed Abundance (incl. age and sex): 1
3. Estimated Abundance (and basis for estimate): Unknown
4. Evidence of Reproduction and/or Other Behaviors: Pre-emergent
5. Misc. Notes: Occurring with Epeorus fragilis, northern spring salamander larvae caught in dip net sample.

## HABITAT DESCRIPTION

Describe the specific habitat or micro-habitats where this animal occurs. Convey a mental image of the habitat and its features including: land forms, aquatic features, vegetation, slope, aspect, soils, associated plant and animal species, natural disturbances.

Perennial stream at ~1000+ elevation with boulder-cobble-gravel-sand substrate. Stream has high ephemeral gradients during snow melt and other significant rain events as evidence by extensive drift lines along banks. Base flows in stream are very low with intermittent portions. Bankfull width up to 15' wide, wetted width 5-8' wide, flow was 5-10 cm/s, temperature was 16.5 °C during field survey. Stream habitat includes shallow trickles and riffles over and through boulders and cobbles, banks are undercut on outside of curves, deeper pools are present in low-gradient portions of stream. Stream is fed by several small intermittent streams upstream within watershed. Watershed drains northern side of Witham Mountain, forests are second-growth forests dominated by northern hardwoods (beech-birch-sugar maple) and red spruce. Active commercial timber harvests were occurring in the watershed at the time of the field surveys. Maintained logging road crosses stream near confluence with Stony Brook. Conducted dip net sampling in riffles, pools, and snags for the species.

THREATS AND/OR MANAGEMENT CONCERNS: Timber harvests in watershed present risk of sedimentation into stream

## DIRECTIONS

Provide detailed directions to this element occurrence (versus the survey site) using a readily locatable and relatively permanent landmark as a starting point. Refer to nearby landmarks, roads and villages. Include distances, compass directions (North, South etc.).

From Long Falls Dam Road in North New Portland, turn north onto Sandy Stream Valley Road. Follow for approx 4 miles. Turn sharply to the left (west) up an unnamed logging road that largely parallels Stony Brook. The sample reach occurred form the bridge crossing to a point approximately 600 feet upstream where the stream became intermittent.

OWNER: (If known, indicate name of owner(s), address and phone number): Wagner Forest Management

**LOCATION of OBSERVATION**

***Source 1:*** ____0416091 ______________ UTM-E / Lat ______4993609____________ UTM-N / Long **NAD 83**

***Source 2:*** ________________________ UTM-E / Lat ________________________ UTM-N / Long **NAD** 83 / 27 (circle one)

**Coordinates / polygon provide location of:**

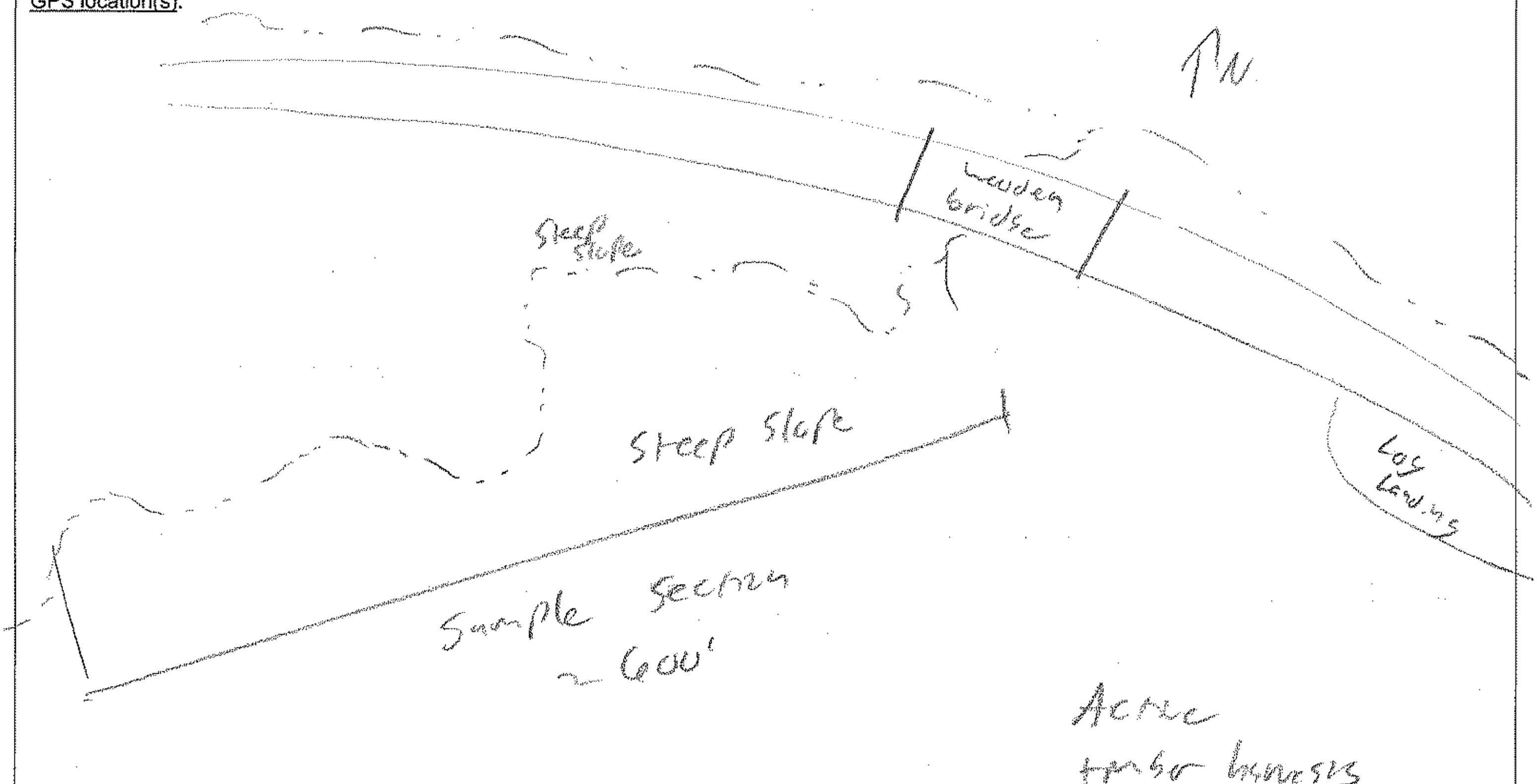
× Animal/habitat feature(s) **OR** Observer--DISTANCE / DIRECTION to animal/habitat feature: ______ meters / feet at ______ °

**GPS Unit Information**

Differentially corrected × Unit accuracy for location: ±__10______m # of Satellites = ________ 2D / 3D

Unit Model _______Garmin eTrex Legend________________________________

**LOCATION SKETCH (or attach aerial photograph/photocopied topo)** Sketch fine details of an overhead view of this observation that may not be apparent on a topo map. Indicate landmarks, important features, route taken, animal/habitat observed, disturbances & threats, scale, and north. Include GPS location(s).




**DIGITIZED IN GIS**

Scale digitized at = 1:________________

1:24,000 topographic maps

Orthophoto (pixel size = _______ m / ft), date = ____________

Other: ___________________________

**HAND-DRAWN**

Scale drawn at = 1:________________

Topographic map (scale = 1:_________)

Aerial imagery Other: ___________________

scale = 1: ___________

date = ____________

**OVERALL LOCATION ACCURACY:** including uncertainty about where the animal/habitat feature was and mapping accuracy related to the GPS unit used, resolution of reference information like topographic maps or aerial photos used, etc.:

± ___________ meters / feet / kilometers / miles

Stream 53 CF



**INSTRUCTIONS:** Complete 1 form per visit. **Grayed sections are for Heritage office use only**.

rev. 02/06/2008

# RARE ANIMAL SURVEY FORM

MDIFW
650 State St.
Bangor, ME 04401

**Completed By:** Matt Arsenault **Date:** 10/2/09 Review by (MDIFW): Date:

**SURVEYSITE:** Witham Mountain, Stony Brook **TOWNSHIP:** Highland Plantation

NEW EO (check): UPDATE (check): (EO NUM: ) **DELORME PAGE & GRID (e.g. 04B2):** **Map 30 C-2**

## ELEMENT INFORMATION

**Common Name:** Roaring Brook Mayfly **Scientific Name:** Epeorus frisoni

## SURVEYOR INFORMATION

Survey date 08/20/09 | Time from: 1:05 to: 2:05 am or **pm** | Sourcecode: F_ _ _ _ _ _ _

Surveyors (principal surveyor first, include first & last name and contact information): Matt Arsenault, Michael Johnson, Stantec Consulting, 30 Park Dr., Topsham, ME 04086 (207) 729-1199

## IDENTIFICATION

Photograph/slide taken? Yes__ No X Notes & repository:

Specimen collected? Yes X No__ Specimen # and repository: Voucher provided to MDIFW

Identification problems? Yes X No__ Explain: E. cf frisoni Identification provided by Dr. Steven Burian of Southern CT State University

## ELEMENT OCCURRENCE INFORMATION

1. Type of Observation: sight__ vocalization__ handled X Collected X other (explain):
2. Observed Abundance (incl. age and sex): 2
3. Estimated Abundance (and basis for estimate): Unknown
4. Evidence of Reproduction and/or Other Behaviors: Pre-emergent
5. Misc. Notes: Occurring with Epeorus fragilis

## HABITAT DESCRIPTION

Describe the specific habitat or micro-habitats where this animal occurs. Convey a mental image of the habitat and its features including: land forms, aquatic features, vegetation, slope, aspect, soils, associated plant and animal species, natural disturbances.

Perennial stream at ~1000+ elevation with boulder-cobble-gravel-sand substrate. Stream has high ephemeral gradients during snow melt and other significant rain events as evidence by extensive drift lines along banks. Base flows in stream are very low with intermittent portions. During field survey, flow was approximately 5-12 cm/s. Stream temperature during the field survey was 17.1 $^{o}$C. Bankfull width approx 6-8' feet wide, wetted width 6-8'. Stream habitat includes shallow trickles and riffles over and through boulders and cobbles, banks are undercut on outside of curves, deeper pools are present in low-gradient portions of stream. Stream is fed by several small intermittent streams upstream within watershed. Watershed drains northern side of Witham Mountain, forests are second-growth forests dominated by northern hardwoods (beech-birch-sugar maple) and red spruce. Active commercial timber harvests were occurring in the watershed at the time of the field surveys. Maintained logging road crosses stream near confluence with Stony Brook. Conducted dip net sampling in riffles, pools, and snags for the species.

THREATS AND/OR MANAGEMENT CONCERNS: Timber harvests in watershed present risk of sedimentation into stream

## DIRECTIONS

Provide detailed directions to this element occurrence (versus the survey site) using a readily locatable and relatively permanent landmark as a starting point. Refer to nearby landmarks, roads and villages. Include distances, compass directions (North, South etc.).

From Long Falls Dam Road in North New Portland, turn north onto Sandy Stream Valley Road. Follow for approx 4 miles. Turn sharply to the left (west) up an unnamed logging road that largely parallels Stony Brook. After approximately 1 mile, the road turns sharply to the left (south). The sample reach occurred from this point where the stream parallels the road to a point approximately 800 feet downstream.

OWNER: (If known, indicate name of owner(s), address and phone number): Wagner Forest Management

**LOCATION of OBSERVATION**

***Source 1:*** ____ 45° 5.734' ~~UTM-E~~ / Lat ______70° 5.369'______________ ~~UTM-N~~ / Long **NAD 83**

***Source 2:*** ____________________________ UTM-E / Lat ____________________________ UTM-N / Long **NAD** 83 **/** 27 (circle one)

**Coordinates / polygon provide location of:**

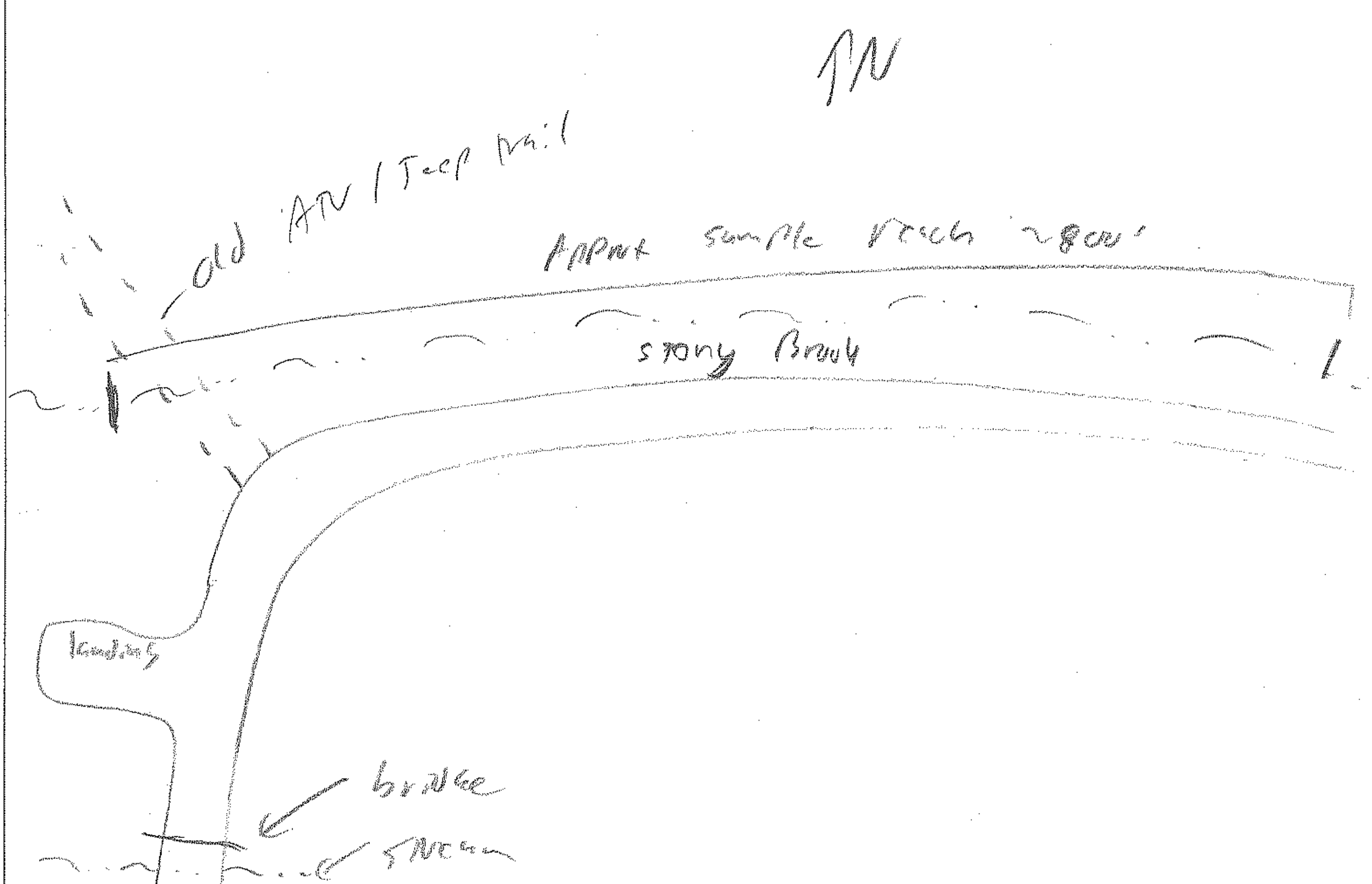
× Animal/habitat feature(s) **OR** Observer--DISTANCE / DIRECTION to animal/habitat feature: ______ meters / feet at _______°

**GPS Unit Information**

Differentially corrected × Unit accuracy for location: ±__30______m # of Satellites = _________ 2D / 3D

Unit Model ________Garmin eTrex Legend________________________________________

**LOCATION SKETCH (or attach aerial photograph/photocopied topo)** Sketch fine details of an overhead view of this observation that may not be apparent on a topo map. Indicate landmarks, important features, route taken, animal/habitat observed, disturbances & threats, scale, and north. Include GPS location(s).




| **DIGITIZED IN GIS** | **HAND-DRAWN** |
|---|---|
| Scale digitized at = 1:__________________ | Scale drawn at = 1:__________________ |
| 1:24,000 topographic maps | Topographic map (scale = 1:_________) |
| Orthophoto (pixel size = ________ m / ft), date = ____________ | Aerial imagery Other: ___________________ |
| Other: _______________________________ | scale = 1: ___________ |
| | date = ____________ |

**OVERALL LOCATION ACCURACY:** including uncertainty about where the animal/habitat feature was and mapping accuracy related to the GPS unit used, resolution of reference information like topographic maps or aerial photos used, etc.:

± _____________ meters / feet / kilometers / miles

Stream 57AA



**INSTRUCTIONS**: Complete 1 form per visit. **Grayed sections are for Heritage office use only**.

rev. 02/06/2008

# RARE ANIMAL SURVEY FORM

MDIFW
650 State St.
Bangor, ME 04401

**Completed By**: Matt Arsenault **Date**: 10/2/09 Review by (MDIFW): Date:

**SURVEYSITE**: Witham Mountain, Stony Brook tributary | **TOWNSHIP**: Highland Plantation

NEW EO (check): | UPDATE (check): | (EO NUM: ) | **DELORME PAGE & GRID (e.g. 04B2)**: **Map 30 C-2**

## ELEMENT INFORMATION

**Common Name**: Northern Spring Salamander **Scientific Name**: Gyrinophilus porphyriticus

## SURVEYOR INFORMATION

Survey date 07/28/2009 | Time from: to: am or pm | Sourcecode: F________

Surveyors (principal surveyor first, include first & last name and contact information): Matt Arsenault, Eric Doucette Stantec Consulting, 30 Park Dr., Topsham, ME 04086 (207) 729-1199

## IDENTIFICATION

Photograph/slide taken? Yes X No__ Notes & repository:

Specimen collected? Yes__ No X Specimen # and repository:

Identification problems? Yes__ No X Explain:

## ELEMENT OCCURRENCE INFORMATION

1. Type of Observation: sight X vocalization__ handled X collected__ other (explain):
2. Observed Abundance (incl. age and sex): 1 larvae
3. Estimated Abundance (and basis for estimate): Unknown
4. Evidence of Reproduction and/or Other Behaviors: Larval spring salamander present in stream
5. Misc. Notes: Stream feeds into larger perennial stream where additional adult and larval spring salamanders were subsequently documented

## HABITAT DESCRIPTION

Describe the specific habitat or micro-habitats where this animal occurs. Convey a mental image of the habitat and its features including: land forms, aquatic features, vegetation, slope, aspect, soils, associated plant and animal species, natural disturbances.

Small perennial stream with sand-cobble-gravel substrate. Stream is flashy with high ephemeral flows during snowmelt and heavy rain events as evidenced by drift lines along banks and bank erosion. Bankfull width of the stream is approximately 3-5. The channel flow linear along a moderate slope. During low flow periods, the stream may have intermittent sections. At the time of the field survey, water depths within pools were approximately 4-5 inches deep. The eroded banks and flashy nature of the stream likely increase sedimentation into the stream which may not be sustainable for spring salamanders in this reach. The surrounding forests are mixed second-growth uplands dominated by beech, birch, sugar maple, and red spruce. Active timber harvests were occurring within the watershed at the time of the field survey.

THREATS AND/OR MANAGEMENT CONCERNS: Timber harvests in watershed present risk of sedimentation into stream

## DIRECTIONS

Provide detailed directions to this element occurrence (versus the survey site) using a readily locatable and relatively permanent landmark as a starting point. Refer to nearby landmarks, roads and villages. Include distances, compass directions (North, South etc.).

From Long Falls Dam Road in North New Portland, turn north onto Sandy Stream Valley Road. Follow for approx 4 miles. Turn sharply to the left (west) up an unnamed logging road that largely parallels Stony Brook. After approximately 1 mile, the road will curve sharply to the left (south) and immediately crosses a wooded bridge. Continue up the road to a point where it curves sharply uphill to the right. Look for an old skidder trail continuing straight (south) from the road. Follow this to the second stream crossing this skidder trail. A larval spring salamander was observed approximately 100 feet upstream of this location

OWNER: (If known, indicate name of owner(s), address and phone number): Wagner Forest Management

**LOCATION of OBSERVATION**

***Source 1:*** ____0415438 ______________ UTM-E / Lat ______4993111____________ UTM-N / Long **NAD 83**

***Source 2:*** ________________________ UTM-E / Lat ________________________ UTM-N / Long **NAD** 83 / 27 (circle one)

**Coordinates / polygon provide location of:**

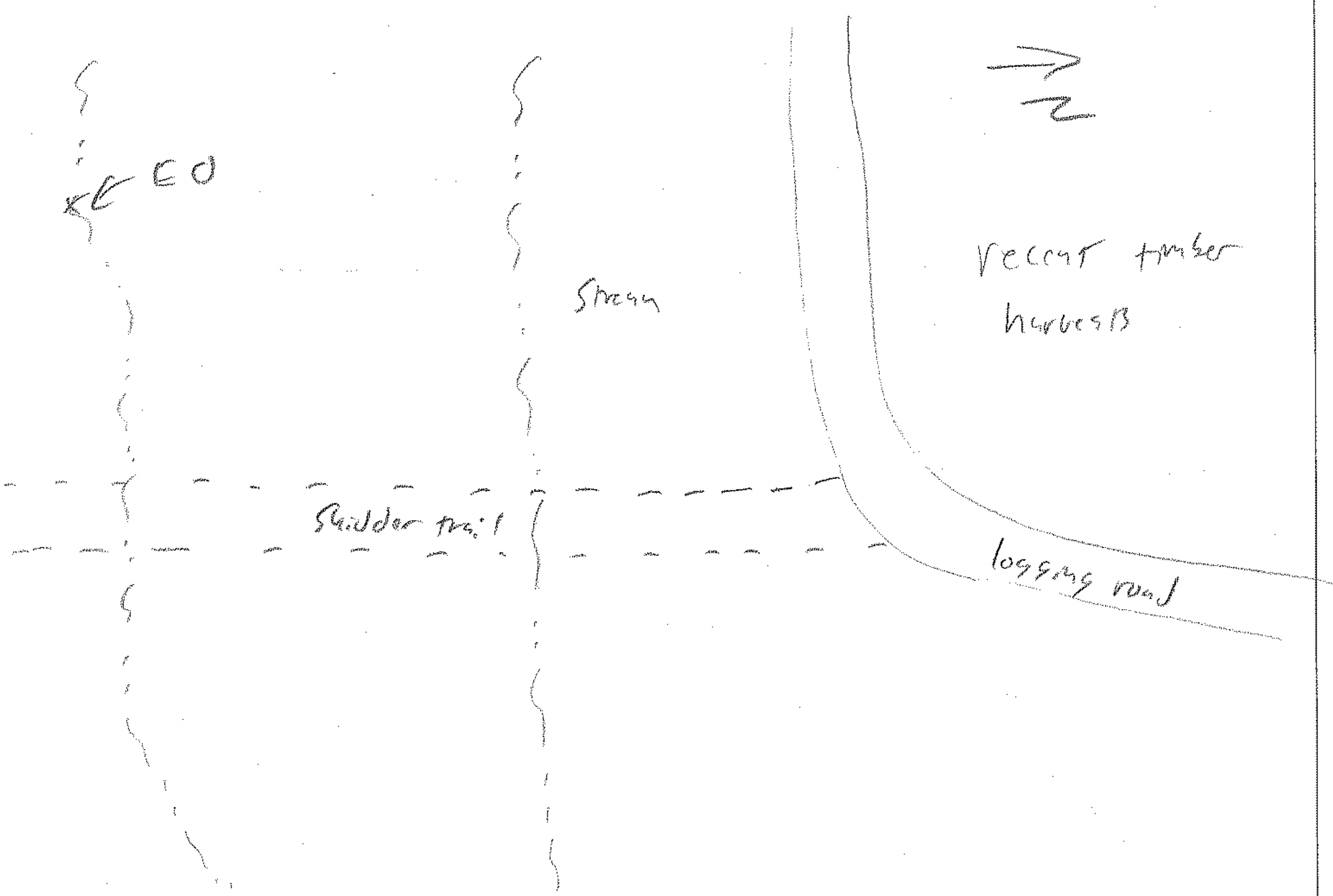
× Animal/habitat feature(s) **OR** Observer--DISTANCE / DIRECTION to animal/habitat feature: ______ meters / feet at _______ °

**GPS Unit Information**

Differentially corrected × Unit accuracy for location: ±__10______m # of Satellites = ________ 2D / 3D

Unit Model _______Garmin eTrex Legend____________________________________

**LOCATION SKETCH (or attach aerial photograph/photocopied topo)** Sketch fine details of an overhead view of this observation that may not be apparent on a topo map. Indicate landmarks, important features, route taken, animal/habitat observed, disturbances & threats, scale, and north. Include GPS location(s).




| **DIGITIZED IN GIS** | **HAND-DRAWN** |
|---|---|
| Scale digitized at = 1:________________ | Scale drawn at = 1:________________ |
| 1:24,000 topographic maps | Topographic map (scale = 1:_________) |
| Orthophoto (pixel size = _______ m / ft), date = __________ | Aerial imagery scale = 1: __________ date = __________ Other: ________________ |
| Other: ________________________ | |

**OVERALL LOCATION ACCURACY:** including uncertainty about where the animal/habitat feature was and mapping accuracy related to the GPS unit used, resolution of reference information like topographic maps or aerial photos used, etc.:

± ____________ meters / feet / kilometers / miles

Stream SS C1



**INSTRUCTIONS:** Complete 1 form per visit. **Grayed sections are for Heritage office use only.** rev. 02/06/2008

# RARE ANIMAL SURVEY FORM

**Completed By:** Matt Arsenault **Date:** 10/2/09 Review by (MDIFW): Date:

MDIFW
650 State St.
Bangor, ME 04401

| | |
|---|---|
| **SURVEYSITE:** Witham Mountain, Stony Brook tributary | **TOWNSHIP:** Highland Plantation |
| NEW EO (check): UPDATE (check): (EO NUM: ) | **DELORME PAGE & GRID (e.g. 04B2):** Map 30 C-2 |

## ELEMENT INFORMATION

**Common Name:** Northern Spring Salamander **Scientific Name:** Gyrinophilus porphyriticus

## SURVEYOR INFORMATION

| | | |
|---|---|---|
| Survey date 07/28/2009 | Time from: to: am or pm | Sourcecode: F— — — — — — |

Surveyors (principal surveyor first, include first & last name and contact information): Matt Arsenault, Eric Doucette, Michael Johnson, Stantec Consulting, 30 Park Dr., Topsham, ME 04086 (207) 729-1199

## IDENTIFICATION

Photograph/slide taken? Yes X No__ Notes & repository:

Specimen collected? Yes__ No X Specimen # and repository:

Identification problems? Yes__ No X Explain:

## ELEMENT OCCURRENCE INFORMATION

1. Type of Observation: sight X vocalization__ handled X collected__ other (explain):
2. Observed Abundance (incl. age and sex): 3 total (2 Adults including 1 dead adult, 1 larvae)
3. Estimated Abundance (and basis for estimate): Unknown
4. Evidence of Reproduction and/or Other Behaviors: Larval spring salamander present in stream
5. Misc. Notes: Large adult dead salamander 7" long found tangled in debris snag in stream. Adult salamander observed on boulder in stream during rainy evening (~11:00pm) on 7/29/09

## HABITAT DESCRIPTION

Describe the specific habitat or micro-habitats where this animal occurs. Convey a mental image of the habitat and its features including: land forms, aquatic features, vegetation, slope, aspect, soils, associated plant and animal species, natural disturbances.

Perennial stream at ~1000+ elevation with boulder-cobble-gravel-sand substrate. Stream has high ephemeral gradients during snow melt and other significant rain events as evidence by extensive drift lines along banks. Base flows in stream are very low with intermittent portions. Bankfull width ranges from 8-10 feet wide. Stream habitat includes shallow trickles and riffles over and through boulders and cobbles, banks are undercut on outside of curves, deeper pools are present in low-gradient portions of stream. Stream is fed by several small intermittent streams upstream within watershed. Watershed drains northern side of Witham Mountain, forests are second-growth forests dominated by northern hardwoods (beech-birch-sugar maple) and red spruce. Active commercial timber harvests were occurring in the watershed at the time of the field surveys. Maintained logging road crosses stream near confluence with Stony Brook.

THREATS AND/OR MANAGEMENT CONCERNS: Timber harvests in watershed present risk of sedimentation into stream

## DIRECTIONS

Provide detailed directions to this element occurrence (versus the survey site) using a readily locatable and relatively permanent landmark as a starting point. Refer to nearby landmarks, roads and villages. Include distances, compass directions (North, South etc.).

From Long Falls Dam Road in North New Portland, turn north onto Sandy Stream Valley Road. Follow for approx 4 miles. Turn sharply to the left (west) up an unnamed logging road that largely parallels Stony Brook. The EO location is the stream located at the 2$^{nd}$ bridge over the stream. EO was observed at bridge and approximately 100 feet upstream from crossing.

OWNER: (If known, indicate name of owner(s), address and phone number): Wagner Forest Management

**LOCATION of OBSERVATION**

***Source 1:*** ____0416091________________ UTM-E / Lat ________4993609______________ UTM-N / Long **NAD 83**

***Source 2:*** ____________________________ UTM-E / Lat ____________________________ UTM-N / Long **NAD** 83 **/** 27 (circle one)

**Coordinates / polygon provide location of:**

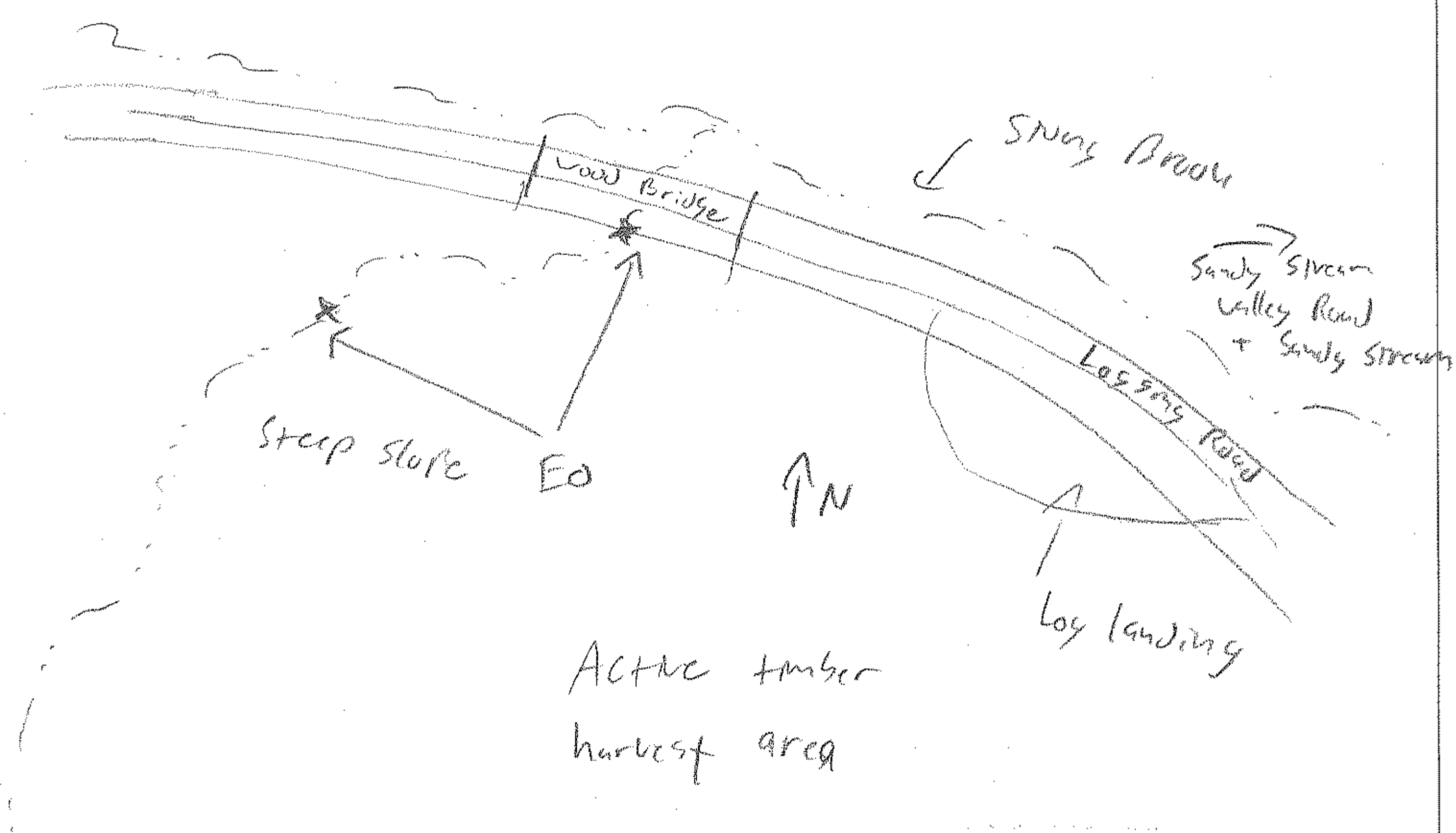
× Animal/habitat feature(s) **OR** Observer--DISTANCE / DIRECTION to animal/habitat feature: ______ meters / feet at ______ °

**GPS Unit Information**

Differentially corrected × Unit accuracy for location: ±__10______m # of Satellites = ________ 2D / 3D

Unit Model ________Garmin eTrex Legend________________________________

**LOCATION SKETCH (or attach aerial photograph/photocopied topo)** Sketch fine details of an overhead view of this observation that may not be apparent on a topo map. Indicate landmarks, important features, route taken, animal/habitat observed, disturbances & threats, scale, and north. Include GPS location(s).




| **DIGITIZED IN GIS** | **HAND-DRAWN** |
|---|---|
| Scale digitized at = 1:________________ | Scale drawn at = 1:________________ |
| 1:24,000 topographic maps | Topographic map (scale = 1:_________) |
| Orthophoto (pixel size = _______ m / ft), date = ___________ | Aerial imagery Other: __________________ |
| Other: ___________________________ | scale = 1: ___________ |
| | date = ______________ |

**OVERALL LOCATION ACCURACY:** including uncertainty about where the animal/habitat feature was and mapping accuracy related to the GPS unit used, resolution of reference information like topographic maps or aerial photos used, etc.:

± ____________ meters / feet / kilometers / miles

**INSTRUCTIONS**: Complete 1 form per visit. **Grayed sections are for Heritage office use only**.

rev. 02/06/2008

# RARE ANIMAL SURVEY FORM

MDIFW
650 State St.
Bangor, ME 04401

**Completed By:** Matt Arsenault **Date:** 11/2/09 Review by (MDIFW): Date:

| | | | |
|---|---|---|---|
| **SURVEYSITE:** Unnamed Fletcher Mtn tributary stream to Wyman Lake | | **TOWNSHIP:** Pleasant Ridge Plantation | |
| NEW EO (check): | UPDATE (check): | (EO NUM: ) | **DELORME PAGE & GRID (e.g. 04B2):** Map 30 D-3 |

## ELEMENT INFORMATION

**Common Name:** Northern Spring Salamander **Scientific Name:** Gyrinophilus porphyriticus

## SURVEYOR INFORMATION

Survey date 09/28/2009 | Time from: to: am or pm | Sourcecode: F______

Surveyors (principal surveyor first, include first & last name and contact information): Matt Arsenault, Eric Doucette, Michael Johnson Stantec Consulting, 30 Park Dr., Topsham, ME 04086 (207) 729-1199

## IDENTIFICATION

Photograph/slide taken? Yes X No __ Notes & repository:

Specimen collected? Yes __ No X Specimen # and repository:

Identification problems? Yes __ No X Explain:

## ELEMENT OCCURRENCE INFORMATION

1. Type of Observation: sight X vocalization __ handled X collected __ other (explain):
2. Observed Abundance (incl. age and sex): 1 adult
3. Estimated Abundance (and basis for estimate): Unknown
4. Evidence of Reproduction and/or Other Behaviors:
5. Misc. Notes: *Stream feeds into Wyman Lake, elevation ~700 feet. Downstream of open transmission line corridor*

## HABITAT DESCRIPTION

Describe the specific habitat or micro-habitats where this animal occurs. Convey a mental image of the habitat and its features including: land forms, aquatic features, vegetation, slope, aspect, soils, associated plant and animal species, natural disturbances.

Small perennial stream with sand-cobble-gravel substrate. Bankfull width up to 10 feet wide, high ephemeral gradients during snowmelt and rain events. EO was downstream of open transmission line corridor. Stream is shaded with canopy of hemlock, balsam fir, and northern hardwoods.

THREATS AND/OR MANAGEMENT CONCERNS: Timber harvests in watershed present risk of sedimentation into stream

## DIRECTIONS

Provide detailed directions to this element occurrence (versus the survey site) using a readily locatable and relatively permanent landmark as a starting point. Refer to nearby landmarks, roads and villages. Include distances, compass directions (North, South etc.).

From Ridge Rd in Pleasant Ridge Plt, park at transmission line crossing on west side of Wyman Lake at Wyman Dam. Walk west up hill. Survey stream is the first perennial stream encountered along open corridor. EO was located approximately 100 feet downstream (north) of open corridor

OWNER: (If known, indicate name of owner(s), address and phone number):

**LOCATION of OBSERVATION**

***Source 1:*** _____45.06189149__________ UTM-E / Lat _____69.94196693___________ UTM-N / Long **NAD 83**

***Source 2:*** __________________________ UTM-E / Lat __________________________ UTM-N / Long NAD 83 / 27 (circle one)

**Coordinates / polygon provide location of:**

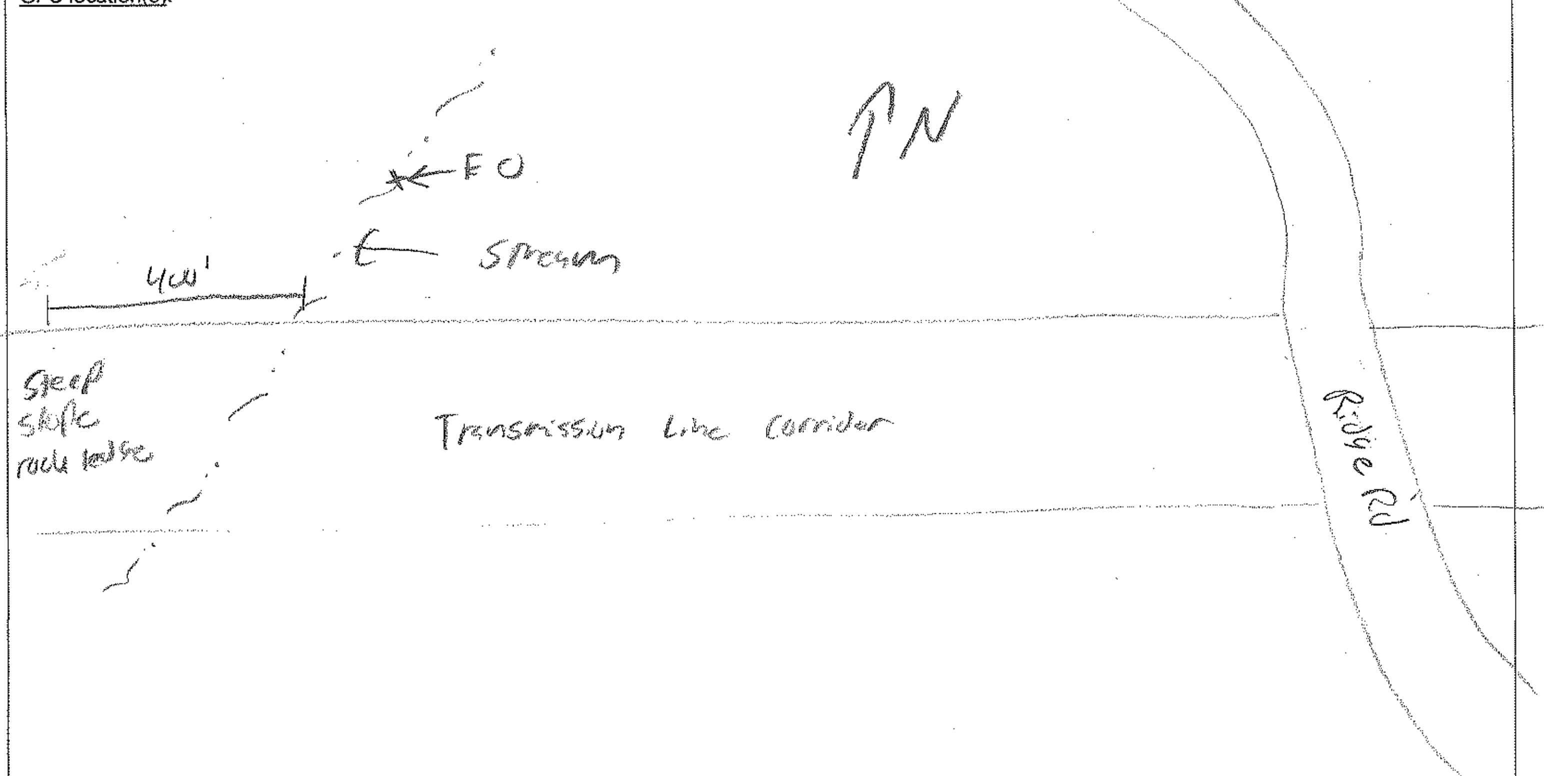
× Animal/habitat feature(s) **OR** Observer--DISTANCE / DIRECTION to animal/habitat feature: ______ meters / feet at _______°

**GPS Unit Information**

Differentially corrected × Unit accuracy for location: ±__10______m # of Satellites = _________ 2D / 3D

Unit Model ________ ______________________________________

**LOCATION SKETCH (or attach aerial photograph/photocopied topo)** Sketch fine details of an overhead view of this observation that may not be apparent on a topo map. Indicate landmarks, important features, route taken, animal/habitat observed, disturbances & threats, scale, and north. Include GPS location(s).




| **DIGITIZED IN GIS** | **HAND-DRAWN** |
|---|---|
| Scale digitized at = 1:_________________ | Scale drawn at = 1:_________________ |
| 1:24,000 topographic maps | Topographic map (scale = 1:_________) |
| Orthophoto (pixel size = _______ m / ft), date = ___________ | Aerial imagery scale = 1: ___________ date = _____________ Other: __________________ |
| Other: ____________________________ | |

**OVERALL LOCATION ACCURACY:** including uncertainty about where the animal/habitat feature was and mapping accuracy related to the GPS unit used, resolution of reference information like topographic maps or aerial photos used, etc.:

± ____________ meters / feet / kilometers / miles

**INSTRUCTIONS:** Complete 1 form per visit. **Grayed sections are for Heritage office use only.** rev. 02/06/2008

# RARE ANIMAL SURVEY FORM

MDIFW
650 State St.
Bangor, ME 04401

**Completed By:** Matt Arsenault **Date:** 11/2/09 Review by (MDIFW): Date:

**SURVEYSITE:** Unnamed Fletcher Mtn tributary stream to Little Houston Brook

**TOWNSHIP:** Pleasant Ridge Plantation

NEW EO (check): UPDATE (check): (EO NUM: )

**DELORME PAGE & GRID (e.g. 04B2):** Map 30 D-3

## ELEMENT INFORMATION

**Common Name:** Northern Spring Salamander **Scientific Name:** Gyrinophilus porphyriticus

## SURVEYOR INFORMATION

Survey date 09/29/09 Time from: to: am or pm Sourcecode: F________

Surveyors (principal surveyor first, include first & last name and contact information): Matt Arsenault, Eric Doucette, Michael Johnson Stantec Consulting, 30 Park Dr., Topsham, ME 04086 (207) 729-1199

## IDENTIFICATION

Photograph/slide taken? Yes X No__ Notes & repository:

Specimen collected? Yes__ No X Specimen # and repository:

Identification problems? Yes__ No X Explain:

## ELEMENT OCCURRENCE INFORMATION

1. Type of Observation: sight X vocalization__ handled X collected__ other (explain):
2. Observed Abundance (incl. age and sex): 1 adult
3. Estimated Abundance (and basis for estimate): Unknown
4. Evidence of Reproduction and/or Other Behaviors:
5. Misc. Notes: Stream feeds into Little Houston Brook, elevation ~700 feet. Downstream of open transmission line corridor

## HABITAT DESCRIPTION

Describe the specific habitat or micro-habitats where this animal occurs. Convey a mental image of the habitat and its features including: land forms, aquatic features, vegetation, slope, aspect, soils, associated plant and animal species, natural disturbances.

Small perennial stream with sand-cobble-gravel substrate. Bankfull width up to 8-10 feet wide, run-riffle habitat, high ephemeral gradients during snowmelt and rain events. EO was downstream of open transmission line corridor. Stream is shaded with canopy of hemlock, balsam fir, and northern hardwoods.

THREATS AND/OR MANAGEMENT CONCERNS: Timber harvests in watershed present risk of sedimentation into stream

## DIRECTIONS

Provide detailed directions to this element occurrence (versus the survey site) using a readily locatable and relatively permanent landmark as a starting point. Refer to nearby landmarks, roads and villages. Include distances, compass directions (North, South etc.).

From Ridge Rd in Pleasant Ridge Plt, turn south onto unnamed dirt road leading up Fletcher Mountain. Road is approximately 100 yards east of crossing over Little Houston Brook. Park at point where the transmission line corridor crosses the road. Walk west down slope along the transmission line. EO is located in the first perennial stream encountered. EO was observed approximately 50 feet downstream of the open corridor.

OWNER: (If known, indicate name of owner(s), address and phone number):

**LOCATION of OBSERVATION**

***Source 1:*** ____45.06679056______________ UTM-E / Lat _______69.91190967__________ UTM-N / Long **NAD 83**

***Source 2:*** _________________________ UTM-E / Lat _________________________ UTM-N / Long NAD 83 / 27 (circle one)

**Coordinates / polygon provide location of:**

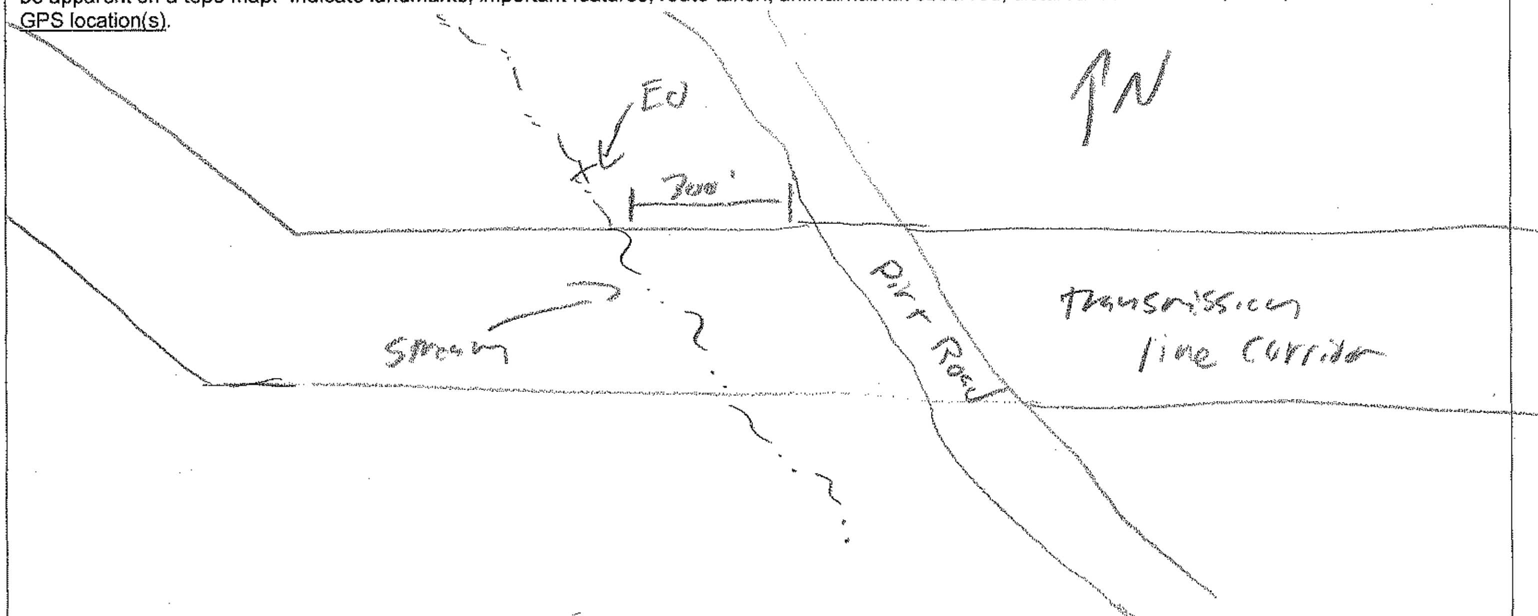
× Animal/habitat feature(s) **OR** Observer--DISTANCE / DIRECTION to animal/habitat feature: ______ meters / feet at ________°

**GPS Unit Information**

Differentially corrected × Unit accuracy for location: ±__10______m # of Satellites = ________ 2D / 3D

Unit Model ________ ________________________________

**LOCATION SKETCH (or attach aerial photograph/photocopied topo)** Sketch fine details of an overhead view of this observation that may not be apparent on a topo map. Indicate landmarks, important features, route taken, animal/habitat observed, disturbances & threats, scale, and north. Include GPS location(s).




**DIGITIZED IN GIS**

Scale digitized at = 1:________________

1:24,000 topographic maps

Orthophoto (pixel size = _______ m / ft), date = ___________

Other: ___________________________

**HAND-DRAWN**

Scale drawn at = 1:_________________

Topographic map (scale = 1:_________)

Aerial imagery

scale = 1: ___________

date = _______________

Other: __________________

**OVERALL LOCATION ACCURACY:** including uncertainty about where the animal/habitat feature was and mapping accuracy related to the GPS unit used, resolution of reference information like topographic maps or aerial photos used, etc.:

± ____________ meters / feet / kilometers / miles

**INSTRUCTIONS**: Complete 1 form per visit. **Grayed sections are for Heritage office use only**. rev. 02/06/2008

# RARE ANIMAL SURVEY FORM

MDIFW
650 State St.
Bangor, ME
04401

**Completed By**: Karol Worden **Date**: ,11/20/2009 Review by (MDIFW): Date:

**SURVEYSITE**: Witham Mountain, Stony Brook tributary **TOWNSHIP**: Highland Plantation

NEW EO (check): UPDATE (check): (EO NUM: ) **DELORME PAGE & GRID (e.g. 04B2): Map 30, C-2**

## ELEMENT INFORMATION

**Common Name**: northern spring salamander **Scientific Name**: *Gyrinophilus porphyriticus*

## SURVEYOR INFORMATION

Survey date (yyyy – mm – dd): 2009-06-30 Time from: to: am or pm Sourcecode: F_ _ _ _ _ _ _

Surveyors (principal surveyor first, include first & last name and contact information): Karol Worden, Stantec Consulting, 30 Park Drive, Topsham, ME 04086; Telephone (207) 729-1199

## IDENTIFICATION

Photograph/slide taken? Yes ☒ No__ Notes & repository:

Specimen collected? Yes__ No ☒ Specimen # and repository:

Identification problems? Yes__ No ☒ Explain:

## ELEMENT OCCURRENCE INFORMATION

1. Type of Observation: sight__ vocalization__ handled__ collected__ other (explain):
2. Observed Abundance (incl. age and sex): One adult
3. Estimated Abundance (and basis for estimate): Incidental observation. Abundance unknown.
4. Evidence of Reproduction and/or Other Behaviors: Incidental observation. No evidence of reproduction observed.
5. Misc. Notes: High-gradient tributary of Stony Brook.

## HABITAT DESCRIPTION

Describe the specific habitat or micro-habitats where this animal occurs. Convey a mental image of the habitat and its features including: land forms, aquatic features, vegetation, slope, aspect, soils, associated plant and animal species, natural disturbances.

High-gradient perennial stream. The stream channel averages approximately 5 feet in width and the substrate is primarily rock and cobble. The surrounding landscape is forested and dominated by deciduous species such as sugar maple (*Acer saccharum*), yellow birch (*Betula alleghaniensis*) and American beech (*Fagus grandifolia*).

THREATS AND/OR MANAGEMENT CONCERNS: Stream is located on property managed for timber production, but no on-going harvesting in the area at the time of the observation.

## DIRECTIONS

Provide detailed directions to this element occurrence (versus the survey site) using a readily locatable and relatively permanent landmark as a starting point. Refer to nearby landmarks, roads and villages. Include distances, compass directions (North, South etc.).

From North New Portland go north on Long Falls Dam Road approximately 6 miles and turn right (northeast) onto a connector road to Sandy Stream Valley Road. Travel northeast about 2 miles where this connector road joins Sandy Stream Valley Road. Continue approximately 2 miles and turn left (west) on un-named logging road and proceed northwest until the road ends in a log yard. Proceed through the woods generally southwest following coordinates provided below to reach stream.

OWNER: (If known, indicate name of owner(s), address and phone number Bayroot, LLC

**LOCATION of OBSERVATION**

***Source 1:*** 1356915 UTM-E / Lat 16381756 UTM-N / Long **NAD** 83

***Source 2:*** ______ UTM-E / Lat ______ UTM-N / Long **NAD** 83 **/** 27 (circle one)

**Coordinates / polygon provide location of:**

☒ Animal/habitat feature(s) **OR** ☐ Observer--DISTANCE / DIRECTION to animal/habitat feature: ______ meters / feet at ________°

**GPS Unit Information**

☒ Differentially corrected ☐ Unit accuracy for location: ±____3_____m ☐ # of Satellites = ________ ☐ 2D / 3D

Unit Model Trimble GEO-XM 2005 Series

**LOCATION SKETCH (or attach aerial photograph/photocopied topo)** Sketch fine details of an overhead view of this observation that may not be apparent on a topo map. Indicate landmarks, important features, route taken, animal/habitat observed, disturbances & threats, scale, and north. Include GPS location(s).

Refer to attached maps: Map-Key and Map 4-A. Stream 33KW/53TT is the location where the northern spring salamander was observed.

| **DIGITIZED IN GIS** | **HAND-DRAWN** |
|---|---|
| Scale digitized at = 1:________________ | Scale drawn at = 1:________________ |
| ☐ 1:24,000 topographic maps | ☐ Topographic map (scale = 1:_________) |
| ☐ Orthophoto (pixel size = _______ m / ft), date = ___________ | ☐ Aerial imagery scale = 1: ___________ date = ______________ ☐ Other: __________________ |
| ☐ Other: __________________________ | |

**OVERALL LOCATION ACCURACY:** including uncertainty about where the animal/habitat feature was and mapping accuracy related to the GPS unit used, resolution of reference information like topographic maps or aerial photos used, etc.:

± ____3 m_______ meters / feet / kilometers / miles

**Photo 1**. Stream 33KW/53TT at the location of the northern spring salamander (*Gyrinophilus porphyriticus*) observation. Stantec Consulting. June 30, 2009.

**Photo 2**. Adult northern spring salamander observed in stream 33KW/53TT. Stantec Consulting. June 30, 2009.

# Section 12
# Wildlife Habitat Report

# 12.0 WILDLIFE HABITAT

## 12.1 PROJECT DESCRIPTION

Highland Wind LLC (Highland) is proposing to construct a 128.6-megawatt (MW) wind energy project located in Highland Plantation and Pleasant Ridge Plantation, Somerset County, Maine (Figure 1). The Highland Wind Project (Project) includes 48 turbines, a 34.5-kilovolt (kV) electrical collector system, an electrical collection substation, a 115-kV generator lead, an Operations and Maintenance (O&M) building, and four permanent 80-meter meteorological (met) towers.

As currently designed, the Project proposes to construct up to 48 wind turbines on two distinct ridgelines in Highland Plantation, Maine. The western string will include 26 turbines located on the ridgeline that connects Stewart Mountain, Witham Mountain, and Bald Mountain. The meteorological data collected on this ridgeline suggests that weather conditions can be extreme, and that the wind resource is excellent. These conditions can support the use of a “Class I turbine” that can generate significant amounts of renewable energy in these high powered winds. The wind regime found on the eastern ridge, on which 22 turbines are proposed, is more moderate. A single, continuous access road will allow construction and maintenance access to both ridgelines.

The 34.5-kV electrical collector system will transfer power from the turbines to the proposed collector substation located north of Witham Mountain. These collector lines will be located underground along the ridgeline to reduce the project footprint and to reduce potential line maintenance costs along the exposed ridges. The approximately 11-mile long, 115-kV generator lead will connect the on-site collector station to the existing Wyman Dam substation located in Moscow, Maine, where power will be transferred to the Central Maine Power Company (CMP) system and ultimately distributed to the New England grid.

The ridgeline area, including the location of the turbine strings, O&M building, and collector substation, currently is managed primarily for commercial timber production, and much of the area has been harvested within the past 10 years. An extensive road system and clearings are present throughout the Project area as a result of these timber management activities. To the extent practicable, the Project design capitalizes on this existing network of roads and clearings and proposes to re-purpose them for the Project. In some instances, these existing roads will need to be widened or, in some locations, realigned to meet minimum road widths and maximum slope requirements for the development.

In advance of permitting activities for the Project, the following ecological field surveys were conducted:

- two seasons of nocturnal radar surveys;
- two seasons of raptor migration surveys;
- two seasons of acoustic bat surveys;
- one season of breeding bird surveys;
- one season of vernal pool surveys;
- wetland delineations;
- rare, threatened, and endangered (RTE) species surveys specifically targeting the northern spring salamander (*Gyrinophilus porphyriticus*), northern bog lemming (*Synaptomys borealis*), and Roaring Brook mayfly (*Epeorus frisoni*); and
- rare plant and natural community surveys, conducted in conjunction with wetland delineation and vernal pool surveys.

These surveys provided data to help assess the Project’s potential to impact birds and bats, RTE plants and animals, breeding amphibians, and wetlands. The scope of the surveys was based on evolving standard pre-construction survey methods within the wind power industry (i.e., guidelines outlined by the U.S. Fish and Wildlife Service [USFWS] and Maine Department of Inland Fisheries and Wildlife [MDIFW]) and is consistent with other studies conducted recently in the state and the northeast. The scope of these surveys was also further informed through the development of an ecological survey work plan developed in consultation with MDIFW. Stantec Consulting (Stantec) met with MDIFW biologists on March 3, 2009 to discuss the work scope and methods for conducting Project surveys and subsequently submitted a finalized work plan on April 17, 2009. Stantec also conducted an on-site meeting with MDIFW biologists in September of 2009 to review some of the initial survey findings.

Following is a brief review of the methods used to conduct wildlife resource surveys, the results of those surveys, and a discussion of potential impacts to the identified resources based on the proposed Project design. Similar discussion for wetland resources and unusual natural areas can be found in application Sections 11 and 13, respectively.

## 12.2 INTRODUCTION

Temporary and permanent changes as a result of the proposed project have the potential to impact wildlife habitat. Impacts to habitats will consist of clearing land on the ridgelines for turbines and roads, the proposed O&M building, and collector substations located in the valleys below the ridgelines, as well as along the proposed collector lines and transmission line. The project area is actively harvested for timber products and has been dissected by skidder roads and haul roads, but it is primarily undeveloped.

Avian and bat mortality through direct collisions with the turbines is one of the primary wildlife impacts expected from this project. In addition, direct and indirect impacts to wildlife such as injury, mortality, or displacement are possible during clearing, construction, and operation of wind turbines, access roads, and electric lines and poles. Once constructed, the turbines and associated facilities are anticipated to pose little threat to terrestrial wildlife.

The following section describes the dominant cover types found in the project area, the wildlife species that are likely to occur within the project area, the potential for adverse impacts to wildlife, and measures to minimize these impacts.

## 12.3 WILDLIFE

### 12.3.1 EXISTING COVER TYPES

*Upland Forests*

Within the Project area, the principal upland forest communities are characterized as Spruce-Northern Hardwoods Forest and Beech-Birch Maple Forests. The Spruce-Northern Hardwood Forests occur along the ridgelines, and Beech-Birch-Maple Forests dominate the mid and lower slopes of the ridgelines as well as the proposed generator lead corridor (Gawler and Cutko 2004). Spruce-Fir-Broom-moss Forests occur as a smaller component of the landscape, present on the summits of Witham Mountain, Stewart Mountain, and Bald Mountain. The Spruce-Fir-Broom-moss Forests on Witham Mountain and Bald Mountain also have inclusions of the Red Spruce-Mixed Conifer Woodlands. These four forested communities are considered common in Maine by the Maine Natural Areas Program (MNAP).[1] In addition, as a result of past timber harvesting, most of these communities currently are second- or third-growth forests. MNAP had suggested that the area characterized as Red Spruce-Mixed Conifer Woodlands had the potential to be an exemplary example of this community type. On Witham Mountain, recent adjacent timber harvesting, as well as historic timber harvests in and around this community, do not support characterizing it as exemplary. The occurrence of the Red Spruce-Mixed Conifer Woodland on Bald Mountain largely occurs outside of the Project area on the steep east and south-facing slopes and will not be impacted as a result of the proposed development.

*Beech-Birch-Maple Forests*

The Beech-Birch-Maple Forest is characterized by sugar maple (*Acer saccharum*), American beech (*Fagus grandifolia*), and yellow birch (*Betula alleghaniensis*) in the forest canopy with an understory typically dominated by hobblebush (*Viburnum lantanoides*), starflower (*Trientalis borealis*), wild sarsaparilla (*Aralia nudicaulis*), Canada mayflower (*Maianthemum canadense*), wild oats (*Uvularia

[1] Each community is has a state rarity rank of S4 indicating that it is considered “Apparently secure in Maine.”

*sessilifolia*), and evergreen wood fern (*Dryopteris intermedia*). Recent and historic timber harvests have occurred throughout these communities within the Project area.

*Spruce-Northern Hardwoods Forest*
The Spruce-Northern Hardwoods Forest occurs primarily along the ridgeline within the Project area as well as locations along the proposed generator lead. The canopy of this forest is dominated by red spruce (*Picea rubens*), yellow birch, sugar maple, and balsam fir with an understory generally dominated by hobblebush, evergreen wood fern, mountain wood fern (*Dryopteris campyloptera*), mountain wood-sorrel (*Oxalis montana*), wild sarsaparilla, starflower, Canada mayflower, whorled aster (*Oclemena acuminata*), large-leaved goldenrod (*Solidago macrophylla*), and shining firmoss (*Huperzia lucidula*). Recent and historic timber harvests have occurred within most of these communities in the Project area.

*Spruce-Fir-Broom-moss Forest*
The Spruce-Fir-Broom-moss Forest is present along the Witham, Bald, and Stewart Mountain summit areas. Species diversity is typically low within these forests. The canopy is dominated by red spruce and balsam fir trees with regenerating balsam fir and red spruce in the understory. Additional understory plants include mountain wood-sorrel, mountain wood fern, evergreen wood fern, starflower, and wild sarsaparilla. Historic timber harvests have generally occurred throughout these forested areas, although some areas on Stewart Mountain, as well as the steeper slopes of Bald and Witham Mountains, are generally intact and mature with limited visible evidence of past timber harvests.

*Red Spruce-Mixed Conifer Woodlands*
Red Spruce-Mixed Conifer Woodlands occurs as inclusions within the larger (i.e., approximately 350-acre) Spruce-Fir-Broom-moss Forest on the summits of Witham Mountain and Bald Mountain. The Red Spruce-Mixed Conifer Woodland is a small-patch community that typically occurs in low-elevation summits with shallow soils and exposed bedrock. This community is dominated by scattered red spruce tress interspersed among lichen-covered ledges and outcrops. Species diversity is generally low within this community with lowbush blueberry (*Vaccinium angustifolium*) and bunchberry (*Cornus canadensis*) dominating the understory along with several moss and lichen species including three-lobed bazzania (*Bazzania trilobata*), broom-moss (*Dicranum scoparium*), red-stemmed moss (*Pleurozium schreberi*), and Cladonia lichens (*Cladonia* spp.). The community consists of approximately 40 acres on the summit of Witham Mountain and approximately 50 acres on the steep south and east-facing slopes of Bald Mountain.

*Wetlands*

*Forested*
Forested wetland communities occur throughout the Project area, often in combination with scrub-shrub or emergent communities. Prior to timber harvesting activities, this would have been the most common wetland community, but many of these resources are now in some stage of regeneration and are either characterized as scrub-shrub or emergent wetlands. Tree species common to these wetlands include yellow birch (*Betula. alleghaniensis*), red maple (*Acer rubrum*), balsam fir (*Abies balsamea*), red spruce (*Picea rubens*), green ash (*Fraxinus pennsylvanica*), black ash (*Fraxinus nigra*), and northern white-cedar (*Thuja occidentalis*). The shrub layer includes these same tree species and shrub species such as hobblebush (*Viburnum lantanoides*), speckled alder (*Alnus incana*) and witch-hazel (*Hamamelis virginiana*). Commonly occurring herbaceous species include cinnamon fern (*Osmunda cinnamomea*), sensitive fern (*Onoclea sensibilis*), northeastern mannagrass (*Glyceria melicaria*), fowl mannagrass (*Glyceria striata*), Canada reed grass (*Calamagrostis canadensis*), fringed sedge (*Carex crinita*) and three-seeded sedge (*Carex trisperma*). These wetlands are typically characterized by pit and mound micro-topography, are seasonally inundated, and have soils that remain saturated at or near the surface for much of the year. Representative examples of this community type include wetlands W148, W273 and W419.

*Scrub-shrub*

Scrub-shrub wetlands are present throughout the Project area and often appear in conjunction with either forested or emergent wetland communities.  Scrub-shrub wetlands, particularly on the ridgelines, are typically regenerating forested wetlands that have undergone timber harvesting.  Naturally occurring scrub-shrub communities are more commonly found in association with the larger watercourses.  In those regenerating forested wetlands, the shrub layer is dominated by tree species such as balsam fir, red spruce, red maple and yellow birch.  Red raspberry (*Rubus idaeus*), a common early successional species, also is present in many of these wetlands.  The herbaceous layer includes species such as sensitive fern, cinnamon fern, rough-stemmed goldenrod (*Solidago rugosa*), tall white-aster (*Doellingeria umbellata*), fowl mannagrass, northeastern mannagrass, and Canada reed grass.  In the naturally occurring scrub-shrub communities, the shrub layer is typically dominated by speckled alder mixed with tree species such as red spruce, northern white-cedar, and yellow birch.  Species that occur within the herbaceous layer are similar to those identified in the regenerating forested wetlands.  These wetlands have soils that remain saturated at or near the surface for much of the year and may experience at least periodic inundation.  Representative examples of this community type include wetlands W018, W197, W173, and W447.

*Emergent*

Emergent wetlands are common throughout the Project area, often in areas that have been disturbed by timber harvesting activities or within the maintained transmission line.  These types of emergent wetlands are typically referred to as wet meadows.  Wet meadows are dominated by herbaceous species that are adapted to saturated soil conditions but are not adapted to long periods of inundations as would be common in marsh habitats.  The emergent wetlands within the Project area are typically dominated by herbaceous species such common woolsedge (*Scirpus cyperinus*), fowl mannagrass, Canada reed grass, fringed sedge, eastern rough sedge (*Carex scabrata*), awl-fruited sedge (*Carex stipata*), barber-pole bulrush (*Scirpus microcarpus*), dwarf raspberry (*Rubus pubescens*), and spotted-touch-me-not (*Impatiens capensis*).  These wetlands also support red raspberry, rosy meadowsweet (*Spiraea tomentosa*), white meadowsweet (*Spiraea alba* var. *latifolia*) and seedlings of the tree species mentioned in the preceding sections.  These wetlands have soils that remain saturated at or near the surface for much of the year and may experience at least periodic inundation.  Representative examples of this community type include wetlands W041, W306 and W409.

*Open Water*

Open water wetland communities only occur in three locations within the Project area.  One of these communities is a naturally occurring beaver pond, and the other two are man-made excavations adjacent to gravel access roads.  These occur in wetlands W163, W336 and W392.

### 12.3.2 WILDLIFE USE

*Topography and Setting*

The Project area is located within the Central and Western Mountains Ecoregion as defined in Maine's Comprehensive Wildlife Conservation Strategy (MDIFW 2005).  This ecoregion is a consolidation of the Western Mountains and Central Mountains biophysical regions originally described by McMahon (1990). The Central and Western Mountains Ecoregion extends from the New Hampshire boarder south to the White Mountains National Forest, north to Aroostook County and east to the western foothills.  The average elevation within the western portion of the ecoregion (former Western Mountain Biophysical Region) is between approximately 305 meters and 610 meters (1,000' to 2,000') with several peaks exceeding 823 meters (2,700').  The northern portion of this ecoregion includes some of the highest peaks in the state, with elevations ranging from 183 meters to 1,603 meters (600' to 5,258').  The climate of this ecoregion is characterized by relatively low annual precipitation and cool temperatures.  Heavy snow fall prolongs the winter, resulting in a relatively short growing season (McMahon 1990).  In general, ridge tops within this ecoregion are dominated by red spruce and balsam fir with lower elevations supporting deciduous species such as sugar maple, yellow birch, and American beech.

*General Wildlife Use*

Communities within the Project area include forested uplands, forested wetlands, scrub-shrub wetlands, emergent wetlands, and streams. The upland forest community is dominated by Beech-Birch-Maple Forest and Spruce-Northern Hardwoods Forest.[2] Both forested communities occur in various stages of succession due to forestry management practices. Wetland communities are varied, but in general also have been altered by timber harvesting. Bird species that nest on the ground or in shrubs and that were documented in the Project area include ovenbird (*Seiurus aurocapillus*), dark-eyed junco (*Junco hyemalis*), ruffed grouse (*Bonasa umbellus*), and chestnut-sided warbler (*Dendroica pensylvanica*). Cavity and canopy nesting birds observed in the Project area include rose-breasted grosbeak (*Pheucticus ludovicianus*), American robin (*Turdus migratorius*), blue jay (*Cyanocitta cristata*), black-capped chickadee (*Poecile atricapillus*), downy woodpecker (*Picoides pubescens*), hairy woodpecker (*Picoides villosus*), northern flicker (*Colaptes auratus*), pileated woodpecker (*Dryocopus pileatus*), American redstart (*Setophaga ruticilla*), black-throated green warbler (*Dendroica virens*), and red-eyed vireo (*Vireo olivaceus*). Raptor and owl species observed include broad-winged hawk (*Buteo platypterus*), sharp-shinned hawk (*Accipiter striatus*), red-tailed hawk (*Buteo jamaicensis*), and barred owl (*Strix varia*).

Large mammals observed within or near the Project area include white-tailed deer (*Odocoileus virginianus*), moose (*Alces alces*), black bear (*Ursus americanus*), coyote (*Canis latrans)* and bobcat (*Lynx rufus*). Small mammal species documented in the Project area include red squirrel (*Tamiasciurus hudsonicus*), eastern chipmunk (*Tamias striatus*), snowshoe hare (*Lepus americanus*), and porcupine (*Erethizon dorsatum*). Some of the other small mammals that could be present based upon available habitat include short-tailed shrew (*Blarina brevicauda*), southern red-backed vole (*Clethrionomys gapperi*), deer mouse (*Peromyscus maniculatus*), and white-footed mouse (*Peromyscus leucopus*). Eight species of bat also could occur in the area based upon their normal geographical range. These include the little brown myotis (*Myotis lucifugus)*, northern myotis *(Myotis septentrionalis*), eastern small-footed bat (*Myotis lebeiii*), silver-haired bat (*Lasionycteris noctivagans*), big brown bat (*Eptesicus fuscus*), eastern red bat (*Lasiurus borealis*), hoary bat (*Lasiurus cinereus*), and tri-colored bat (*Perimyotis subflavus*).[3]

Amphibians and reptiles observed in the Project area include spotted salamander (*Ambystoma maculatum*), wood frog (*Rana sylvatica*), American toad (*Bufo americanus*), green frog (*Rana clamitans*), spring peeper (*Pseudacris crucifer*), two-lined salamander (*Eurycea wilderae*), northern dusky salamander (*Desmognathus f. fuscus*), and eastern garter snake (*Thamnophis sirtalis*).

### 12.3.3 NOCTURNAL MIGRANTS

Unlike raptors, which migrate during the day, the majority of North American passerines (songbirds) migrate at night. The soaring flight of raptors uses laminar flow of air over the landscape, which creates warm daytime updrafts along hillsides and ridgelines. In contrast, passerines may have evolved to employ the strategy of migrating at night to take advantage of more stable atmospheric conditions for their flapping flight (Kerlinger 1995). Waiting to migrate during the cooler nighttime temperatures also may provide passerines with a more efficient method of regulating body temperature during their more active, flapping flight, as well as reduce predation risk while in flight (Alerstam 1990, Kerlinger 1995). As a result of this evolutionary distinction, documenting the patterns of nocturnal migrants, including passerines and bats, requires the use of radar or other non-visual technologies. The goal of the surveys conducted for this Project was to document the overall passage rates for nocturnal migration in the vicinity of the Project area, including the number of migrants, their flight direction, and their flight altitude.

In the fall of 2008 and spring of 2009, nocturnal radar surveys were conducted using marine surveillance radar. This radar has the ability to track small animals, including birds and bats, but it cannot distinguish between different types or species of animals. Consequently, all animals observed on the radar screen were identified as bird/bat targets or insect “targets” based on their flight speeds. To help maximize the

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[2] Gawler, S.C. and A.R. Cutko, 2004. Natural Landscapes of Maine: A Classification of Vegetated Natural Communities and Ecosystems, Maine Natural Areas Program, Maine Department Of Conservation, Augusta, Maine.

[3] Formerly known as the eastern pipistrelle (*Pipistrellus subflavus*).

airspace sampled and reduce “ground clutter” on the radar screen, the radar antennae were elevated to the height of the surrounding trees (i.e., approximately 3 meters or 10 feet). In 2008, the radar surveys were conducted from the southern summit of Stewart Mountain, which afforded coverage of the Stewart Mountain ridgeline to the north and Witham Mountain to the east. In 2009, a radar unit was located at the southern summit of Stewart Mountain and a second unit was placed on Briggs Hill. Surveys were conducted from sunset to sunrise each survey night. The fall 2008 surveys occurred on 20 nights between August 30 and October 7. During the spring 2009 surveys, data was collected on 21 nights at the Briggs Hill radar site (April 29 to May 31, 2009) and 19 nights at the south Stewart Mountain radar site (April 29 to May 26, 2009). Of those nights, surveys were performed simultaneously at both radar sites on 16 nights.

During the fall 2008 surveys, the mean passage rate for the entire survey period was 549 targets/kilometer/hour (t/km/hr) ± 32 t/km/hr and mean flight direction was to the southwest. The seasonal mean flight height of all targets was 348 ± 8 meters (1142’ ± 26’) above the radar site. The percent of targets observed flying below 130.5 meters (428’), the proposed maximum turbine height, averaged 16 percent for the season and varied by night from 4 to 27 percent.

During the spring 2009 surveys, the mean passage rate for the entire survey period was 496 ± 31 t/km/hr at Briggs Hill and 511± 46 t/km/hr at south Stewart. For both sites the mean flight direction was to the northeast. The seasonal mean flight height of all targets at Briggs Hill was 287 ± 8 m above the radar site and at South Stewart it was 314 ± 10 m. The percent of targets observed flying below 130.5 m averaged 26 percent at Briggs Hill for the season and 23 percent at south Stewart for the season.

Based upon the flight heights documented from these site specific surveys, as well as emerging evidence from other studies that indicates flight height is more important in determining potential collision risk than factors such as passage rate or flight direction, there appears to limited collision risk for nocturnal migrants. For further details and the complete nocturnal radar survey results, refer to the *Fall 2008 Bird and Bat Migration Report* and the *Spring 2009 Ecological Survey Report* in Appendix 12-1.

### 12.3.4 BREEDING BIRDS

Stantec conducted breeding bird surveys during three separate visits to the Project area on May 21-22, June 9-10, and June 21 and 25-26, 2009. This time frame corresponds to typical peak spring avian breeding season in Maine. Surveys were conducted at a total of 35 point-count locations across the Project area ridgelines. Point-counts were categorized as one of four habitat types based upon dominant vegetation: coniferous forest, deciduous forest, mixed forest, and disturbed habitat. The disturbed habitat category included clearings created for met towers, as well as early successional cuts created by timber harvesting. Protocol followed the United Stages Geological Survey North American Breeding Bird Survey methods, and surveys targeted days when weather would not inhibit detection of birds. During the point-count surveys, 1,057 individual birds were detected. These birds represented 52 species plus an unidentified woodpecker and two unidentified ducks. Three additional species were detected incidentally between point-count locations: American kestrel (*Falco sparverius*), American woodcock (*Scolopax minor*), and eastern phoebe (*Sayornis phoebe*).

Species with the greatest relative abundance[4] (RA) among the 35 point-count locations were white-throated sparrow (*Zonotrichia albicollis*; RA=1.02), chestnut-sided warbler (RA=0.68), black-throated-blue warbler (*Dendroica caerulescens*; RA=0.67), and dark-eyed junco (RA=0.60). With the exception of the black-throated blue warbler, these species are often associated with clear cuts or second-growth forests. The black-throated blue warbler has been associated with increased timber harvest levels in eastern Maine but is generally considered a species associated with large, continuous tracts of forests (DeGraaf and Yamasaki 2001).

[4] Relative abundance measures the number of individuals of a species within a habitat classification or across the Project area, and takes into account the number of times each point is surveyed and the number of points per habitat, or per Project area.

No state- or federally-listed endangered or threatened species were observed during the 2009 breeding bird surveys, but 10 state-listed Species of Special Concern were documented (Refer to Section 4.5).

### 12.3.5 DIURNAL MIGRATING RAPTORS

Surveys for raptors were conducted within the Project area in 2008 and 2009. Surveys were based on Hawk Migration Association of North America (HMANA) methods (HMANA 2007), but data collection was adapted to provide additional information, including relative flight heights, general flight path through the Project area, and total raptors observed (resident and migrant based upon flight behavior).

In 2008, fall raptor surveys were conducted from Witham Mountain and Burnt Hill. The Witham Mountain location provided relatively unobstructed views in all directions and, although some views were slightly obstructed, Burnt Hill provided the observer good opportunities to see southerly moving migrants. Between September 3 and October 21, 2008, Stantec conducted raptor surveys on 15 days (5 of which were performed simultaneously by observers in two different locations) for a total of 135 survey hours. A total of 301 raptors[5] representing 10 species, plus individuals that could not be identified to species, were observed. These results yielded an overall observation rate of 2.25 individuals/hour. Broad-winged hawks and sharp-shinned hawks were the most commonly observed species (n=134 and n=74, respectively). Based upon flight behavior, approximately 90 percent of these two species were categorized as migrants. As raptors passed through the area, observers documented the flight positions of each individual in relationship to the ridge tops, slopes of the ridges, or adjacent valleys. For those flight positions within the Project boundary most likely associated with the proposed turbine locations, flight heights were categorized as above or below the proposed maximum turbine height of 130.5 meters (428’). Of those raptors observed within the 1 kilometer-radius circle from the observer (n=251), 43 percent were flying at or below 130.5 meters above the ground for at least a portion of their flight through the Project area, and 40 percent were observed flying above 130.5 meters. The remaining 17 percent of raptors were observed outside of the 1 km-radius circle with an average estimated flight height of 286 m (938’) above ground.

In 2009, spring raptor surveys were conducted from Witham Mountain and Briggs Hill. Briggs Hill was chosen for the spring surveys because it falls within the southern portion of the Project area and provided good opportunities to view migrants moving north. Raptor surveys were conducted from March 25, 2009, to May 19, 2009, resulting in a total of 139 survey hours. Surveys included 12 days (83 hours) on Witham Mountain and 8 days (56 hours) on Briggs Hill. During these surveys, a total of 260 raptors representing 10 species, as well as unidentified raptors and unidentified buteos, were observed. The overall passage rate was 1.87 birds per hour (birds/hr). At Witham, a total of 153 raptors were observed for a passage rate of 1.84 birds/hr. At Briggs, a total of 107 raptors were observed resulting in a passage rate of 1.91 birds/hr. Turkey vultures (*Cathartes aura*) were the most commonly observed species from both observation sites (Witham, n=57; Briggs, n=75). At Witham, red-tailed hawks (n=46) and sharp-shinned hawk (n=15) were the next most commonly observed species. Similarly, at Briggs red-tailed hawks (n=14; 13 percent) were the most commonly observed species after turkey vultures. Sixty-three percent of all raptors observed during these surveys were considered to be non-migrants, 33 percent were considered to be migrants, and 4 percent could not be categorized based on observed flight behaviors. Eighty percent of the raptors observed from Witham and 86 percent observed from Briggs Hill occurred below the proposed maximum rotor height during some point of their flight.

In 2008, no state or federally-listed threatened or endangered species were documented during the course of the raptor surveys. In 2009, a single juvenile peregrine falcon (*Falco peregrinus*), the breeding population of which is a state threatened species, was documented within the Project area. Two state-listed Species of Special Concern, bald eagle (*Haliaeetus leucocephalus*) and northern harrier (*Circus cyaneus*), were documented during both the 2008 and 2009 surveys. Four bald eagles were observed within the Project boundary in 2008 and seven in 2009. Of the four bald eagles observed in

[5] While turkey vultures are not phylogenetically considered true raptors, they are diurnal migrants that exhibit flight characteristics similar to *Buteos, Accipiters* and other *Falconiformes* species, therefore vultures are typically included during these surveys.

2008, only one had any portion of its flight height below the proposed maximum turbine height. Of the seven bald eagles observed within the Project boundary in 2009, four crossed over one of the Project ridgelines, and three of these had some portion of their flight path below the proposed maximum turbine height. For additional discussion of bald eagles within the Project area, refer to Section 4.1.

Despite variations that might be caused by regional population fluctuations and weather conditions, the results of the surveys appear to be representative of typical migrations for the Project area. When the respective Project area surveys were compared to survey results from HMANA hawk watch sites, passage rates within the Project area were relatively low in both 2008 and 2009. The results of the Project area raptor surveys fell within the range of data for other proposed wind power development projects in this region, but were generally at the lower end of the data range. Studies have documented that raptors display high turbine collision avoidance behaviors at modern wind facilities (Whitfield and Madders 2006, Chamberlain *et al.* 2006), so despite the relatively low flight heights of raptors within the Project area, there appears to be a relatively low collision risk. As most raptors are diurnal, they may be able to visually, as well as acoustically, detect turbines during periods of fair weather. Foraging raptors that may become distracted by prey, or migrant raptors flying during periods of reduced visibility, may be at increased risk of collision with wind turbines.

### 12.3.6 BATS

Eight species of bats occur in Maine, based upon their normal geographical range. These are the big brown bat, silver-haired bat, eastern red bat, hoary bat, eastern small-footed bat, little brown bat, northern bat, and tri-colored bat (BCI 2001 and 2009). Of these, the eastern small-footed myotis, eastern red bat, hoary bat, and silver-haired bat are listed in Maine as Species of Special Concern. All but the eastern small-footed bat are believed to be present in most of the state (DeGraaf and Yamasaki 2001). Foraging habitat for these species includes forest openings, trail and road corridors, open wetlands, and waterbodies. Mature trees, particularly those with loose bark or cavities, caves, and a variety of man-made structures provide sites for roosting and hibernation. The Project area includes a variety of natural and artificial edge habitats such as wetlands, road edges and regenerating cuts.

In the late summer/early fall of 2008 and the spring/summer of 2009, Stantec conducted acoustic surveys for bats using Anabat II and Anabat SD1 detectors (Titley Electronics Pty Ltd.) The objectives of acoustic surveys at the Project were (1) to document bat activity patterns in airspace near the rotor zones of the proposed turbines, at an intermediate height and (2) to document bat activity patterns in relation to weather factors, including wind speed, temperature, and barometric pressure. Because acoustic surveys include several major assumptions (Hayes 2000), results should not be used to determine the number of bats inhabiting an area or to determine the number of bats that may collide with the proposed turbines. However, acoustic surveys can provide insight into seasonal patterns in activity levels and examine how weather conditions influence bat activity. This data may be useful in predicting trends in post-construction mortality rates.

Six bat detectors were deployed during the course of each survey period. In 2008, detectors were initially deployed in trees along the ridgeline and were placed at an approximate height of two to eight meters above the ground. Following construction of met towers on Stewart Mountain, Witham Mountain, and Briggs Hill, the detectors were relocated. At each of the three locations, two detectors were suspended from the met tower guy wires. One was placed at approximately 25 meters (low detector) and one at approximately 45 meters (high detector) above the ground. In 2009, detectors were deployed at the three met tower locations and at the same heights. Detectors were deployed from August 11 to October 20, 2008, and from April 23 and August 17, 2009. With the exclusion of time during which any one detector malfunctioned, recordings were made on 360 detector-nights in 2008 and 553 detector-nights in 2009.

In 2008, met tower detectors recorded a total of 67 bat call sequences (0.3 recordings/detector/night), and tree detectors recorded a total of 11,516 call sequences (106 recordings/detector/night). There also was a distinction in the composition of species detected at the met tower detectors versus the tree detectors, although this was influenced to some degree by the high percentage of call sequences characterized as “Unknown” because of the quality or duration of the call. Only one percent of identified call sequences at the met towers were determined to be of the genus *Myotis*, whereas 57 percent of the call sequences at the tree detectors were of the genus *Myotis*. The difference in detection levels, as well as the composition of species detected, is likely a combination of several factors. First, the tree detectors were all placed at a height of 8 meters (25') or less; therefore, they were primarily picking up the activity of species that forage or are active closer to the ground. Based upon all of the call sequences collected during this field season, the highest percentage of identified calls (56.3 percent) were from genus *Myotis*, and these species are more commonly detected beneath canopy level (Arnett *et al.* 2006). Putting these two factors together, the detectors placed in the trees were in a position to pick up more of the *Myotis* activity. Secondly, timing or seasonality of deployment also likely influenced call detection. Nightly activity rates at ground-level detectors were generally greatest during the first two weeks of sampling, and appeared to be generally declining by the end of August and early September when the detectors were moved to the met towers. Given the emerging relationship between bat activity and temperature at ground-level detectors documented in recent studies (Arnett *et al.* 2006), it is likely that ground-level detectors would have documented a substantial decline in activity during September and October had they remained deployed, since nightly average temperatures from September through October averaged only 8.6° Celsius, with only 32 percent of nights having average nightly temperatures over 10° Celsius.

In 2009, a total of 166 bat call sequences were recorded (0.3 recordings/detector/night). This is same detection rate that was recorded by the detectors deployed in the met towers in 2008; however, this detection rate is relatively low for the summer season. Weather conditions during this time period, particularly high rainfall amounts, may have significantly influenced bat activity and resulting detection rates. In addition, the 2009 spring/summer survey did not include the activity peak that typically occurs later in the season (mid-August to early September). This later season period was captured during the 2008 acoustic surveys. Most recorded call sequences were classified as the big brown bat/silver haired bat guild (n = 63; 38.0%), followed by call sequences characterized as Unknown (n = 57; 34.3%). Remaining sequences were split roughly evenly between hoary bat (n = 26; 15.7%) and bats in the genus *Myotis* (n = 20; 12.0%). Sixty-eight percent of Unknown sequences were identified as being low-frequency Unknown, which would include the hoary bat, silver-haired bat, and big brown bat.

Qualitatively speaking, acoustic surveys at the Project area mirror similar surveys conducted in the Northeast. Specifically, detection rates at detectors suspended from met towers were low (less than 1 recording/detector/night), and detectors operating at ground-level exhibited tremendous variation, ranging from less than 10 to over 300 recordings/detector/night. This type of variation reflects differing conditions (e.g., habitat, microclimates) and differing timing of operation among detectors. The results of these Project-specific surveys, including variability in bat activity and generally low detection rates above canopy height, are consistent with other publicly available acoustic surveys conducted at proposed wind developments in the Northeast. This Project area does appear to have activity levels that are consistently below those of similar surveys conducted in the region. For further details and the complete acoustic survey results, refer to the *Fall 2008 Bird and Bat Migration Report* and the *Spring 2009 Ecological Survey Report* in Appendix 12-1.

## 12.4 SIGNIFICANT OR SENSITIVE WILDLIFE HABITAT

Under Chapter 10, the Land Use Regulation Commission regulates activities that would impact Significant Wildlife Habitat. Significant Wildlife Habitats would include the following areas as they have been identified by MDIFW: habitats of state or federally-listed threatened or endangered animal species; Deer Wintering Areas (DWA) and travel corridors; high and moderate value Inland Waterfowl and Wading Bird Habitats (IWWH); shorebird nesting, feeding and staging areas; seabird nesting islands; and significant vernal pools. Significant Wildlife Habitat also would include critical spawning and nursery areas for Atlantic sea run salmon (*Salmo salar*) as determined by the Atlantic Sea Run Salmon Commission. State and federal resource agencies were contacted in regard to the proposed Project and have provided comments attached in Section 11. Refer to Section 11 of this permit application for details on significant vernal pools.

### 12.4.1 BALD EAGLE NEST SITES

Bald eagles (*Haliaeetus leucocephalus*) are widely distributed throughout Maine and as of 2008, there were at least 477 nesting pairs in the state (Todd and Matula 2008). In 2007, this species was removed from the federal list of endangered and threatened species, but it remains protected under the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act (Buehler 2000). In September 2009, the bald eagle was removed from the State of Maine's list of endangered and threatened species, but it remains on the list of Species of Special Concern.

Bald eagles typically nest close to water in proximity to lakes and large rivers, and along the marine coast (Baicich and Harrison 1997). They have high nest-site fidelity and will use nest for multiple years, although nesting territories often include more than one nest (MDIFW 2003). Bald eagles lay between one and three eggs annually, but clutches typically consist of two eggs (Baicich and Harrison 1997). In Maine, eggs typically are laid during March and April, and incubation lasts approximately 35 days (MDIFW 2003). Bald eagles are opportunistic foragers, but fish are their primary food source. Research conducted in Maine found that although bald eagles consumed a variety of prey including birds, mammals, and invertebrates, fish comprised 79 percent of the remains collected from breeding and wintering areas in the interior portion of the state (Todd *et al.* 1982). The most common fish species documented during this study in interior Maine were white sucker (*Catostomus commersoni*), chain pickerel (*Essox niger*), and brown bullheads (*Ictalurus nebulosus*).

Bald eagles nest sites occur in the larger region surrounding the Project area, but no nests are documented within the Project area. Based upon available information, the nearest known nests are located more than four miles from the Project ridgeline[6].

In the fall of 2008 and spring of 2009, surveys were conducted within the Project area to document migratory movements of raptors, including bald eagles. A total of 12 separate bald eagle observations were documented during the two survey periods. In 2008, these observations included two adults and two juveniles. Observations occurred within a one-kilometer buffer zone of the Project area as the individuals crossed the ridgelines, and only one bird had a portion of its flight path below the proposed maximum turbine height. Three of the four individuals observed appeared to be residents based on their flight paths and behavior patterns. In 2009, seven bald eagles were documented in the Project area, including four adults, one sub-adult, one juvenile, and one eagle of indeterminate age. Four of the bald eagles crossed over the ridge and three of these were below the maximum turbine height for a portion of their flight. Six observations included flight paths along the slope, three of which included portions below maximum turbine height. One additional bald eagle was observed during the 2009 surveys, but it occurred outside of the one-kilometer Project boundary. Studies have documented that raptors generally employ a high level of collision avoidance behaviors at modern wind facilities (Whitfield and Madders 2006, Chamberlain *et al.* 2006). At 14 wind projects in the United States (outside California), over 15,000 turbine searches have been conducted over a 15-year period. During these searches, fewer than 40 raptor fatalities have been reported, and none were bald eagles. As most raptors are diurnal, they may be able to visually, as well as acoustically, detect turbines during periods of fair weather. Foraging raptors that may become distracted by prey, or migrant raptors flying during periods of reduced visibility, may be at increased risk of collision with wind turbines. For further details and the complete raptor survey results, refer to the *Fall 2008 Bird and Bat Migration Report* and the *Spring 2009 Ecological Survey Report* in Appendix 12-1.

### 12.4.2 CANADA LYNX HABITAT

The Canada lynx (*Lynx canadensis*) is federally listed as a threatened species and is considered a Species of Special Concern in Maine. Northern Maine is designated as Critical Habitat[7] Unit 1 for the

[6] Bald eagle nest site locations based on data available from the Maine Department of Inland Fisheries and Wildlife dated 2009.

lynx. This approximately 9,497-square mile unit extends from northern Aroostook County south to a line roughly extending from Route 11 south of Millinocket west to the Maine/Quebec border (50 CFR pt. 17). The proposed Project is located outside of this designated Critical Habitat. The Project is located within the extended review area developed by the Maine Field Office of the USFWS shortly after the Critical Habitat units were codified.

Canada lynx typically occur in moist boreal forests in regions with cold and snowy winters and a well established prey base of snowshoe hare (50 CFR pt. 17). Canada lynx populations are strongly tied to their primary prey, snowshoe hare (*Lepus americanus*), and lynx will disperse from areas following declines in hare populations. In Maine, good habitat for the Canada lynx is characterized as large tracts of young, dense balsam fir and northern hardwood species, which corresponds to habitat that supports larger snowshoe hare populations (MDIFW 2003, 50 CFR pt. 17). These preferred forest stands typically become established 15-30 years following a disturbance such as a fire or clear cut. In general, timber management practices (i.e., clear cutting) that encourage dense understory development are considered beneficial for this species (MDIFW 2003, 50 CFR pt. 17). Forest management roads are not considered a barrier to movement for the Canada lynx, but they can increase the potential for human intrusion into this habitat (MDIFW 2003). A desktop analysis using aerial photography and cover type maps provided by the land manager suggests that there is minimal high value snowshoe hare habitat in Highland Plantation.

### 12.4.3 INLAND WATERFOWL AND WADING BIRD HABITAT

Based upon information provided by the MDIFW, there are seven IWWH mapped in the vicinity of the Project area, but only one is located within the actual Project area. This mapped habitat, which is associated with Stony Brook, is located north of the proposed collector line that will run between Stewart and Witham Mountains. The proposed corridor will be located outside of the mapped habitat, including its 250-buffer. Since construction activities will be outside of habitat buffer, adverse impacts are expected to be limited. Refer to the *Wetland and Waterbody Delineation Report* located in Section 11 for additional discussion of this habitat.

### 12.4.4 DEER WINTERING AREAS

There is no mapped DWA within or in proximity to the ridgeline portion of the Project area. A single mapped DWA is located approximately 0.5 mile west of the proposed generator lead corridor in Pleasant Ridge Plantation and is separated from the corridor by Pleasant Ridge Road. As designed, the proposed project is not expected to have an adverse impact on this DWA.

### 12.4.5 RARE, THREATENED AND ENDANGERED SPECIES

Targeted surveys for rare, threatened and endangered wildlife species were conducted in 2009 based upon a work plan developed by Stantec and approved by MDIFW. Refer to the *Highland Wind Project Rare, Threatened and Endangered Wildlife Survey Report* in Appendix 12-2 for additional details related to these surveys. Other Project specific surveys also resulted in incidental observations of rare, threatened and endangered wildlife species.

*Northern Spring Salamander*
The northern spring salamander is listed as a Species of Special Concern in Maine. The species prefers cold, clean and relatively undisturbed steep mountain streams that have limited to no populations of fish (Hunter *et al*. 1999; DeGraaf and Yamasaki 2001; Lowe and Bolger 2002). In addition, they also may inhabit cool seeps and springs within forested settings. Based upon Stantec's wetland delineations conducted in 2008 and 2009 and additional landscape-level analysis, 23 streams within the ridgeline portion of the Project area were identified as having strong potential to support northern spring salamanders. Surveys of these streams were conducted between July 27 and July 29, 2009. Northern

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[7] Critical habitat as defined by the federal Endangered Species Act is a designated geographic area that contains critical elements for the conservation of a threatened or endangered species and that may require special management or protection.

spring salamanders were observed in two of the surveyed streams, both of which are located in the Stony Brook watershed. A single larval northern spring salamander was documented in stream 57AA, and two adult northern spring salamanders (one dead and one alive) were found in stream 35CF. A larval northern spring salamander also was found in stream 35CF during the course of surveys for the Roaring Brook mayfly in August 2009. Four additional streams, 03CF, 32CF, 45CF and 96AA, are large perennial streams with suitable habitat, but no northern spring salamanders were found in these water courses. The other surveyed streams did not contain suitable habitat for this species. In addition to these targeted surveys, northern spring salamanders were observed incidentally in three other streams during the course of wetland delineations. An adult northern spring salamander was observed in stream 33KW, located on the north side of Witham Mountain, and two streams along the generator lead corridor in Pleasant Ridge Plantation also had northern spring salamanders. A large salamander observed within stream 29ED on the lower slopes of south Stewart Mountain also may have been a northern spring salamander.

Based upon a September 21, 2009, site visit with staff from MDIFW, it was decided that those perennial streams with suitable habitat would be treated as if they supported northern spring salamanders. To that end, the Project design avoided direct impacts to perennial streams where practicable and utilized existing stream crossings when possible. To limit impacts where the new access road must cross 29ED and an adjacent tributary, the streams will be bridged, and clearing at the crossings will be reduced to approximately 40 feet. The access road design also was modified at the crossing of 96AA where a bridge will be used rather than the originally proposed culverts. In addition, the Project design included the maintenance of existing forested buffers where possible along perennial streams and the use of BMPs to reduce potential sedimentation of these resources. For example, clearing within the proposed collector line and that portion of the generator lead with single pole construction will have reduced clearing limits at all stream crossings. Within 100 feet of each stream, the typical 80-foot clearing width will be reduced to a maximum of 50 feet. Clearing will occur along stream 57AA for the aboveground collector line and across stream 96AA for the generator lead.

*Northern Bog Lemming*

The northern bog lemming is a state-listed threatened species in Maine. Information on the life history and habitat requirements of this species is not well known. In Maine, the northern bog lemming is reported to occur in habitats with deep, moist peat moss (*Sphagnum* spp.) and to be present in both low and high elevation areas (MDIFW 2003). Other general habitat characteristics include the presence of springs or other sources of water and moss covered logs and rocks. During wetland delineations completed by Stantec in the fall of 2008, six areas with potentially suitable habitats were identified along the Project area ridgelines. In general, these areas were characterized as woodland wetlands dominated by scattered trees and shrubs of red spruce, balsam fir, and northern white cedar. The understory contained a thick layer of peat moss and three-seeded sedge (*Carex trisperma*) over deep, mucky organic soils.

On July 27 and 28, 2009, Stantec conducted field surveys of the six areas thought to most likely support the northern bog lemming within the Project area. Field surveys consisted of meander surveys within suitable habitat to locate evidence such as runways and tunnels through peat moss, browse and clippings on graminoid vegetation, and fecal pellets. According to Kurta (1995), bright green fecal pellets and evenly clipped stems of grasses and sedges along well-defined runways indicate bog lemming activity. Since northern bog lemmings and southern bog lemmings (*Synaptomys cooper*) can only be separated based upon dental characteristics, any evidence was considered to be undetermined bog lemming. Of the six surveyed areas, evidence of bog lemming activity was found in three wetlands: W011, W067, and W134. Evidence included well defined runways and tunnels through peat moss and sedges, clipped stems of three-seeded sedge, and bright green fecal pellets. Bog lemming activity was not observed in wetlands W072, W073 and W112 despite the presence of similar habitat characteristics.

The proposed Project design avoided direct impacts to those wetlands where bog lemming activity was observed, as well as wetlands immediately adjacent to wetland W067 where suitable bog lemming habitat also exists. To minimize potential indirect impacts, the road alignment northeast of wetland W134 was redesigned to place the road at least 125 feet from this wetland. The road design at this location also will include a bridge to cross a small stream, which should reduce potential changes to the hydrology of wetlands W135 and W134. In addition, the pad for Turbine W21 was redesigned to minimize its size, reduce necessary grading and provide drainage that will direct stormwater away from wetland W134. The intent of these efforts was to minimize potential sedimentation or other effect on this wetland.

*Roaring Brook Mayfly*
The Roaring Brook mayfly [also known as the flat-headed mayfly (*Epeorus frisoni*)] is listed as a state-endangered species. The life history of this species is not well documented, in large part because it is known from so few locations. Its habitat is described as cold, undisturbed, perennial streams in high elevation habitats (i.e., above 1,000 feet in elevation), which contain high ephemeral flows (Swartz *et al.* 2004, Burain *et al.* 2008). Other stream characteristics include cascades, large boulders, and coarse granite substrates (MDIFW 2003). Suitable stream habitats typically occur in undisturbed mixed forested stands with a semi-open to closed canopy. Based upon Stantec's wetland delineations conducted in 2008 and 2009 and an additional landscape-level analysis, five streams were identified as providing potentially suitable habitat for this species. The suitability of these streams was verified during northern spring salamander surveys completed in July 2009 and Roaring Brook mayfly surveys conducted on August 20, 2009. Survey methods followed guidelines presented in the *DRAFT Recommended Survey Protocol for the Roaring Brook Mayfly* (*Epeorus frisoni*) (Siebenmann and Swartz 2009). Under a Scientific Collection Permit issued by MDIFW, Stantec ecologists collected larvae of the genus *Epeorus* from the targeted streams using dip nets. The collected specimens then were sent to Southern Connecticut State University for identification. Roaring Brook mayflies were identified from two of the five sampled streams, 33CF and 35CF. A total of three Roaring Brook mayfly larvae were identified from the 27 *Epeorus* specimens collected during the surveys.

The Project was designed to avoided direct impacts to streams 33CF and 35CF, as well as streams 32CF and 03CF, where suitable habitat exists, but surveys documented no Roaring Brook mayfly larvae. In these locations an existing access road will be used to avoid new crossings of these streams. The use of BMPs will reduce potential sedimentation of these resources during construction and subsequent maintenance.

*Rare, Threatened and Endangered Avian Species*

In 2008, no state or federally-listed threatened or endangered species were documented during the course of the raptor surveys. In 2009, a single juvenile peregrine falcon (*Falco peregrinus*), the breeding population of which is a state threatened species, was documented within the Project area. Two state-listed Species of Special Concern, bald eagle (*Haliaeetus leucocephalus*) and northern harrier (*Circus cyaneus*), were documented during both the 2008 and 2009 surveys. Four bald eagles were observed within the Project boundary in 2008 and seven in 2009.

No state- or federally-listed endangered or threatened species were observed during the 2009 breeding bird surveys, but 10 state-listed Species of Special Concern were documented (Table 1). In addition, incidental observations made during Project raptor surveys included six state-listed Species of Special Concern: tree swallow (*Tachycineta bicolor*), chimney swift (*Chaetura pelagica*), American redstart (*Setophaga ruticilla*), black-and-white warbler, chestnut-sided warbler (*Dendroica pensylvanica*), and white-throated sparrow (*Zonotrichia albicollis*). Although these species are listed as Species of Special Concern in Maine, several of them are considered globally and regionally secure (NatureServe Explorer 2009). For example, the chestnut-sided warbler has shown no statistically significant decline and no clear population trends across its range. White-throated sparrow and chestnut-sided warbler, two species that respond well to regeneration following timber harvesting, had the highest relative abundance (RA) during the point count surveys. With the possible exception of the black-throated blue warbler, the species with the greatest RA among all points sampled are forest edge-dwelling species and will inhabit areas with past forest disturbances such as timber harvesting. In general, the species that were detected on-site are common and regionally abundant species, and they are representative of the habitats in which they were detected. For further details and the complete breeding bird survey results, refer to the *Spring 2009 Ecological Survey Report* in Appendix 12-1.

**Table 1.** Maine Species of Special Concern detected during the 2009 breeding bird surveys

| Species | Relative abundance among all points |
|---|---|
| least flycatcher | 0.01 |
| yellow warbler | 0.01 |
| Tennessee warbler | 0.03 |
| Canada warbler | 0.04 |
| American redstart | 0.24 |
| black-and-white warbler | 0.28 |
| chestnut-sided warbler | 0.68 |
| white-throated sparrow | 1.02 |
| olive-sided flycatcher | * |
| eastern wood-pewee | * |
| *Observed greater than 100 meters from observer. | |

## 12.5 FISHERIES

The ridgeline portion of the Project area includes numerous stream resources, many of which are small and high-gradient with only intermittent flows. It is unlikely that these smaller intermittent streams would be able to support fish. Because of their high gradient nature and very low summer flow, many of the larger perennial streams such as Stony Brook have only limited potential to support fisheries. The presence of northern spring salamanders in some of these perennial streams further suggests that fisheries are limited since northern spring salamanders typically select streams without fish. Although these intermittent and smaller perennial streams may not directly support fish, their flows feed watercourses lower in the watershed where fisheries are present. The larger, named perennial streams located in the lower lying valleys, including Sandy Stream, Churchill Brook and Houston Brook, each have existing fisheries.

Although other fisheries are present, Sandy Stream, which is an indirect tributary to the Kennebec River, is not designated as critical habitat for Atlantic salmon (*Salmo salar*). According to the Federal Register (50 CFR pt. 226), unoccupied habitat, including the area upstream of the confluence of the Kennebec River and Sandy River, did not qualify as critical habitat because these waters were not occupied by Atlantic salmon at the time the species was federally listed as endangered. During a site visit to the Project area by Wende Mahaney of the USFWS, she confirmed that Sandy Stream is not critical habitat. The Kennebec River is located at the eastern extent of the Project area at the point where the proposed generator lead will connect to the existing CMP substation below Wyman Dam. The Kennebec River has existing fisheries, including a self-sustaining population of rainbow trout (*Oncorhyncus mykiss*) located below Wyman Dam (MDIFW 2002). As with Sandy Stream, this portion of the Kennebec River is not considered critical habitat for Atlantic salmon as it was not occupied by the species at the time it was federally listed as endangered. Both Sandy Stream and the Kennebec River immediately below Wyman Dam are designated as Essential Fish Habitat for Atlantic salmon. Essential Fish Habitat (EFH) as determined by the National Marine Fisheries Service (NMFS) is defined as all waters currently or historically accessible to Atlantic salmon including streams, rivers, lakes, ponds, wetland and other water bodies within the six New England states. Norm Dube from the Maine Department of Marine Resources and Sean McDermont from the NMFS stated in e-mail communications that natural barriers to Atlantic salmon passage are located up-stream of Wyman Dam and above Sandy Stream so although this species is not currently present in these areas it could have been historically[8]. In regard to EFH, the NMFS will assess the potential of the Project to have an adverse effect on this habitat. An adverse effect would include any impact that reduces the quality and/or quantity of EFH whether that is a direct or indirect effect and whether the effect is individual or cumulative.

[8] E-mail communications from Norm Dube and Sean McDermont to Karol Worden of Stantec dated November 23, 2009.

To address habitat quality, the crossing of Sandy Stream will be accomplished using a bridge that will be located at a former road crossing. This approach will avoid direct in-stream work and because the bridge will be located at a former crossing, stream-side clearing of vegetation should be minimal. The bridge should have a positive effect on the thermal character of the stream by providing shading at this location; however there potentially will be some thermal gain from aboveground electrical lines that will cross immediately adjacent to and upstream of the bridge. The Project will be using existing roads in the immediate Sandy Stream watershed, which will reduce the number of new crossings of tributary streams. At the Kennebec River, the generator lead will be co-located with an existing CMP transmission line. This crossing will not involve any in-stream work and will require only limited vegetation clearing on the west side of the river.

Impacts to stream resources from access roads and turbine construction include crossings of 33 intermittent streams and 21 perennials streams, some of which involve more than one crossing of the individual resources. Based upon the results of wetland delineations completed for the Project, 11 of these crossings are existing culverts or bridges. The largest of the new crossings will be the bridge constructed over Sandy Stream for the connector access road. As stated above, the proposed bridge will not require any in-stream work and will be located at a previous road crossing, which will reduce the need for vegetation clearing. Of these 54 streams, fish were only observed in one, Sandy Stream, during the course of Project wetland delineations.[9] Impacts to fisheries associated with road and turbine construction are expected to be limited.

The proposed generator lead, combined with the portion of the collector line system not located with the access roads, will cross a total of 43 intermittent streams and 27 perennials streams, including Churchill Brook, Houston Brook and the Kennebec River. No fish were observed in the intermittent streams during the course of the resource delineation, and it is unlikely that they are capable of supporting fish. During the course of wetland delineations completed for the Project, fish were observed in seven of these perennial watercourses, including Sandy Stream, Churchill Brook, Houston Brook and the Kennebec River. It is also possible that the other perennial streams may support limited fisheries. Impacts to the streams will only occur through limited clearing of the vegetated buffer and temporary impacts related to construction access. The clearing width at Sandy Stream will be approximately 50 feet and clearing width at the crossing of the other three named resources will be approximately 100 feet. Some vegetation clearing will be required on both banks at the proposed Sandy Stream and Churchill Brook crossings. The northwestern side of Houston Brook at the proposed crossing is maintained by at least periodic mowing so vegetation clearing should only be required along the southeast bank. The crossing of the Kennebec River will occur at the location of an existing CMP transmission line. There will be some additional clearing in the uplands above the river along its western bank, but no additional clearing should be required along its eastern bank, which is already developed. A small amount of thermal gain is expected directly after clearing, but these areas will revegetate with a shrub buffer. Crossings of all streams within aboveground portion of the collector line and the portion of the generator lead constructed with single poles will have clearing limits reduced to at least 50 feet to reduce thermal gain and protect water quality. The buffer clearing requirements that will be utilized to minimize impacts to fisheries are discussed in Section 10 of this permit application.

[9] Although streams were searched for evidence of aquatic life during the course of the delineation, specific surveys for fish were not conducted.

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# Appendix 12-1

# Fall 2008 Bird and Bat Migration Survey Report

## Radar and Acoustic Avian and Bat Surveys for the Highland Wind Project Highland Plantation, Maine

**February 2009 (Revised November 2009)**

Prepared for

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Prepared by

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# Executive Summary

Highland Wind LLC (Highland) has proposed to construct a 128.6-megawatt (MW) wind energy project located in Highland Plantation and Pleasant Ridge Plantation, Somerset County, Maine (Figure 1-1). The Highland Wind Project (Project) includes 48 turbines, a 34.5 kV electrical collector system, an electrical collection substation, a 115 kV generator lead, an Operations and Maintenance (O&M) Building, and permanent meteorological towers.

The turbines will be located in two distinct strings. The western string will include 26 turbines located on the ridgeline that connects Stewart Mountain, Witham Mountain and Bald Mountain. The meteorological data collected on this ridgeline suggests that weather conditions can be extreme and that the wind resource is excellent. These conditions require a Class I turbine and the Project has opted to use Vestas V90 3 MW turbines in most of the 26 turbine locations along the western string. The Vestas turbines have an 80 meter (m) hub height, a 90 m rotor diameter and a maximum tip-of-blade height of 125 m. The eastern string will include 22 turbines extending from the northeastern end of Burnt Hill south to Briggs Hill. Because of a more moderate wind capacity, Siemens SWT-2.3-101 turbines will be used along the eastern string to maximize energy output. These turbines have an 80 m hub height, a 101 m rotor diameter and a maximum tip-of-blade height of 130.5 m. Turbines will be located at elevations between 1550 and 2670 feet above sea level.

The electrical collector system will transfer power from the turbines to the proposed collector substation located north of Witham Mountain. These collector lines will be located underground along the ridgeline to reduce the project footprint and to reduce potential line maintenance costs along the exposed ridges. The approximately 11 mile long 115 kV generator lead will connect the on-site collector station to the existing Wyman Dam substation located in Moscow, Maine, where power will be transferred to the Central Maine Power (CMP) system and ultimately distributed to the New England grid.

In planning for this Project, Highland Wind contracted with Stantec Consulting (Stantec) to perform a variety of environmental surveys. In 2008, Stantec conducted surveys to document nocturnal and diurnal biological activity focusing on avian and bat populations.

*Nocturnal Radar Survey*

The fall 2008 field survey targeted 20 nights from August 30 to October 7, 2008. Surveys were conducted using X-band radar, sampling from sunset to sunrise. Each hour of sampling included the recording of radar video files during horizontal and vertical operation. The radar site was located on a small knoll of a ridge. The site provided good visibility of the surrounding airspace and targets were observed in most areas of the radar display unit. The radar site provided excellent visibility and, therefore, the radar was capable of detecting targets within nearly all of its detection range.

Radar surveys are intended to document several variables determinant of nocturnal migration and biological activity within the Project area: passage rates, flight heights, and flight direction. The overall seasonal average was 549 targets per kilometer per hour (t/km/hr). Nightly passage rates varied from 68 t/km/hr on October 7.to 1201 t/km/h on September 15. Passage rates varied greatly between nights during the season, indicating migration occurred in pulses, with rates of migration likely influenced by weather patterns and conditions from night to night. Whereas, flight heights remained fairly consistent both throughout the survey period and in comparison with other seasons, suggesting a similar "use" of the airspace above the ridgeline by nocturnal migrants in both seasons. The seasonal average flight height was 348 ± 8 m (1142 ± 26') above the radar site. The average nightly flight height ranged from 250 m (820') on September 16 to 531 m (1742') on October 6. Flight heights indicate that the percentage of targets flying below 130.5 m (428') ranged from 4 to 27 percent with a seasonal average of 16 percent. Mean flight direction through the Project area was southwesterly at 227° ± 51.

Fall radar surveys at the Project documented patterns in nocturnal migration similar to those documented at most recent radar surveys. These include highly variable passage rates between nights, a generally southwestward flight direction, and flight heights primarily occurring between 200 and 600 m above the ridgeline. Within nights, migration activity was generally greatest two to four hours after sunset and declined steadily through the end of the night. While comparisons between radar studies are vague at best due to the variability of site circumstances, studies performed in similar regions, habitats, and at equivalent levels of effort to those at the Project do reveal consistent patterns in nocturnal migratory activity.

*Bat Acoustic Survey*

The fall 2008 field survey used Anabat detectors from August to October in order to document bat activity patterns near the rotor zone of the proposed turbines, at an intermediate height, and near the ground within the proposed Project area.

Surveys were conducted from August 11 to October 20, 2008 using six Anabat detectors. During August, six detectors were placed in trees in various locations in the Project area. When meteorological measurement (met) towers were erected in early September, the previously deployed detectors were moved to the three met towers locations. A total of 11,583 ultrasound bat calls were recorded over 360 detector-nights (mean [$\bar{x}$] = 20.8 ± 1.4 SE recordings/detector/night [r/d/n]). Detection rates at tree detectors were generally higher ($\bar{x}$ = 14.8 ± 1.0 r/d/n), than detection rates at the met tower detectors ($\bar{x}$ = 3.0 ± 0.6 r/d/n). Increased detection rates at met tower detectors in September and October was largely attributed to Lasiurine species (i.e., eastern red bat (*Lasiurus borealis*) and hoary bat (*L. cinereus*).

Bat calls were identified to the lowest possible taxonomic level. These were then grouped into four guilds based on similarity in call characteristics between some species and the uncertainty in the ability of frequency division detectors to adequately provide information for this differentiation. The majority of calls were identified as belonging to the *Myotis* guild (*n* = 6,521; 56.3%), or were categorized as Unknown because they could not be identified to species (n =

4,909; 42.4%). Less than 1% of calls were identified as belonging to the big brown/silver-haired/hoary bat guild (*n* = 112) red bat/tri-colored guild (*n* = 28), or hoary bat guild (n = 13).

When considering the level of activity documented in the Project area from August to October, it is important to acknowledge that numbers of recorded bat call sequences are not necessarily correlated with number of bats in an area. Acoustic detectors do not allow for differentiation between a single bat making multiple passes and multiple bats each recorded a single time.

*Diurnal Raptor Survey*

The fall 2008 field survey included 15 survey days (five of which were performed simultaneously by two surveyors in two different locations) totaling 135 hours of fall diurnal raptor migration surveys between September 3 and October 31, 2008 from Witham Mountain and Burnt Hill, to document the number and species of raptors migrating above the Project area, as well as flight height, general direction and flight path, and other notable flight behaviors.

During 2008 fall surveys, a total of 301 raptors representing 10 species were observed, yielding an overall observation rate of 2.25 individuals/hour. Broad-winged hawks (*Buteo platypterus*) were the most commonly observed raptor (n=134, 45%), sharp-shinned hawks (*Accipiter striatus*) the second, representing 25 percent of all observations (n=74), and turkey vultures (*Cathartes aura*) were the third, accounting for 7 percent of all observations (n=20). There were four bald eagle (*Haliaeetus leucocephalus*), currently listed as a State Threatened species in Maine, observations over the Project area on September 16 and 22 and October 7 and 15, 2008.

The majority of individuals observed during raptor surveys were believed to be migrant birds. Migrating raptors were generally observed moving directly in a southerly direction, parallel to the ridgeline or directly above the ridge; whereas, resident birds were generally observed circling, perching, or foraging over the ridgeline or adjacent valleys. Of those raptors observed within the 1 km-radius circle from the observer (n=251), 43 percent were flying less than or equal to 130.5 m above the ground for at least a portion of their flight through the Project area. The average estimated flight height of those birds observed outside of the 1 km-radius circle from the observer is 286 m (938’) above ground.

Raptor activity in the Project during fall 2008 was similar to passage rates observed in the region in recent years. The flight paths of raptors observed in the Project area varied between survey dates and were influenced by varying wind direction and weather. The greater occurrence of migrants at low altitudes increases the potential for migrating raptors to come into the vicinity of the proposed wind turbines. However, raptors have demonstrated high collision turbine avoidance behaviors and relatively low collision mortality at existing wind farms in the region.

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# 1.0 Introduction

Highland Wind LLC (Highland) has proposed to construct a 128.6-megawatt (MW) wind energy project located in Highland Plantation and Pleasant Ridge Plantation, Somerset County, Maine (Figure 1-1). The Highland Wind Project (Project) includes 48 turbines, a 34.5 kV electrical collector system, an electrical collection substation, a 115 kV generator lead, an Operations and Maintenance (O&M) Building, and permanent meteorological towers.

The turbines will be located in two distinct strings. The western string will include 26 turbines located on the ridgeline that connects Stewart Mountain, Witham Mountain and Bald Mountain. The meteorological data collected on this ridgeline suggests that weather conditions can be extreme and that the wind resource is excellent. These conditions require a Class I turbine and the Project has opted to use Vestas V90 3 MW turbines in most of the 26 turbine locations along the western string. The Vestas turbines have an 80 meter (m) hub height, a 90 m rotor diameter and a maximum tip-of-blade height of 125 m. The eastern string will include 22 turbines extending from the northeastern end of Burnt Hill south to Briggs Hill. Because of a more moderate wind capacity, Siemens SWT-2.3-101 turbines will be used along the eastern string to maximize energy output. These turbines have an 80 m hub height, a 101 m rotor diameter and a maximum tip-of-blade height of 130.5 m[1]. Turbines will be located at elevations between 1,550 and 2,670 feet above sea level.

The electrical collector system will transfer power from the turbines to the proposed collector substation located north of Witham Mountain. These collector lines will be located underground along the ridgeline to reduce the project footprint and to reduce potential line maintenance costs along the exposed ridges. The approximately 11 mile long 115 kV generator lead will connect the on-site collector station to the existing Wyman Dam substation located in Moscow, Maine, where power will be transferred to the Central Maine Power (CMP) system and ultimately distributed to the New England grid.

In planning for this Project, Highland Wind contracted with Stantec Consulting (Stantec) to perform a variety of environmental surveys to characterize bird and bat activity within the Project area. This work included nocturnal radar surveys, acoustic bat surveys, and diurnal raptor surveys to help assess the Project's potential to impact birds and bats. The scope of the surveys was based on a combination of developing standard methods within the wind power industry for pre-construction surveys, guidelines outlined by U.S. Fish and Wildlife Service (USFWS) and Maine Department of Inland Fisheries and Wildlife (MDIFW), and is consistent with other studies conducted recently in the state and the Northeast. The surveys and methods used were briefly discussed with staff from MDIFW at a meeting in Sidney, Maine on September 11, 2008.

Following is a brief description of the Project; a review of the methods used to conduct scientific surveys and the results of those surveys; a discussion of results; and the conclusions reached based on those results.

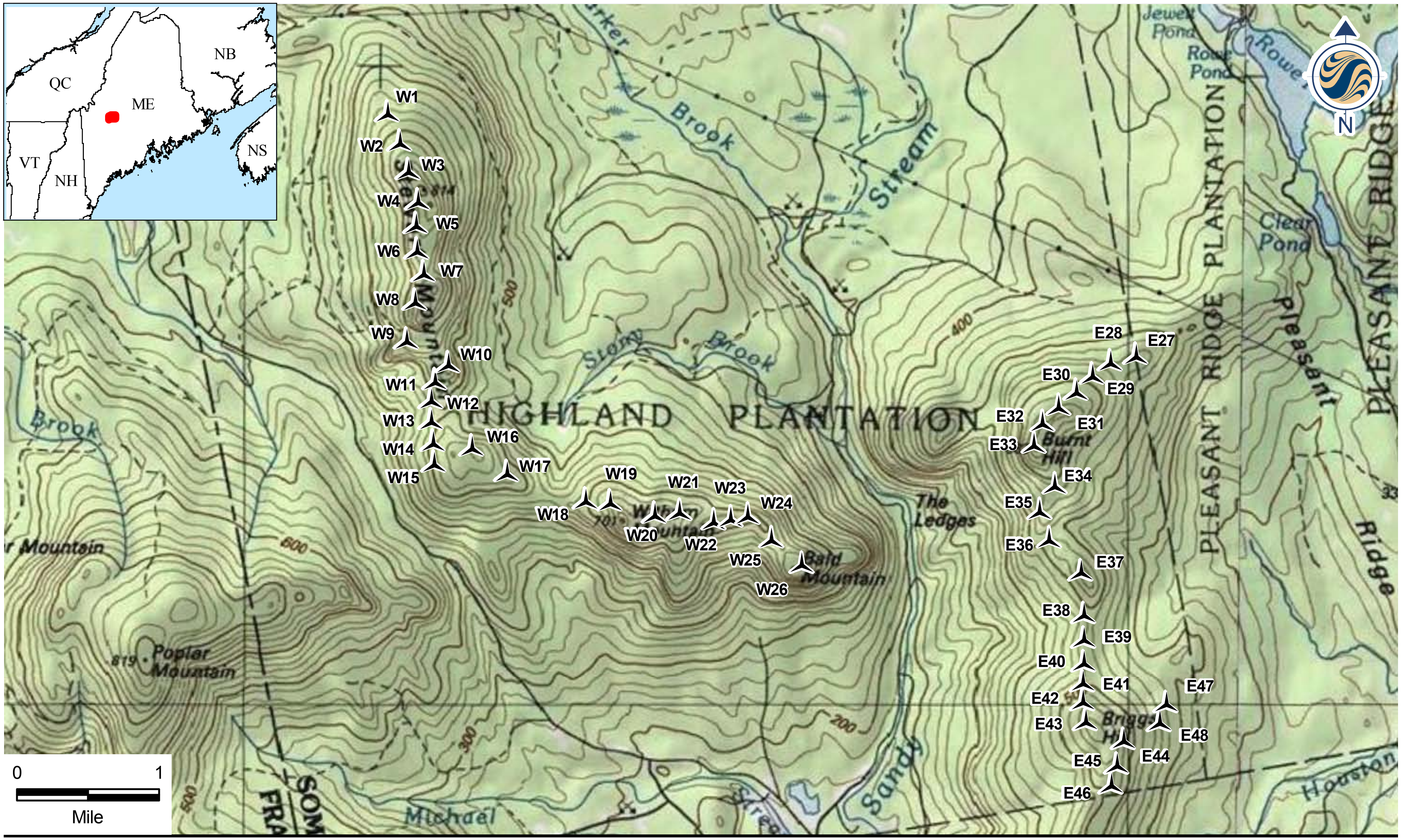
[1] Initial Project design included turbines with a maximum height of 128 m., This has changed with additional information about site wind conditions.

## 1.1 PROJECT AREA DESCRIPTION

The Project area is located within the Central and Western Mountains Ecoregion as defined in *Maine's Comprehensive Wildlife Conservation Strategy* (MDIFW 2005). This ecoregion is a consolidation of the Western Mountains and Central Mountains biophysical regions originally described by McMahon (1990). The Central and Western Mountains Ecoregion extends from the New Hampshire boarder south the White Mountains National Forest, north to Aroostook County and east to the western foothills. The average elevation within the western portion of the ecoregion (former Western Mountain Biophysical Region) is between approximately 305 m to 610 m (1,000' to 2,000') with several peaks exceeding 823 m (2,700'). The northern portion of this ecoregion includes some of the highest peaks in the state and has elevations that range from 183 m to 1,603 m (600' to 5,258'). The climate of this ecoregion is characterized by relatively low annual precipitation and cool temperatures. Heavy snow fall prolongs the winter resulting in a relatively short growing season (McMahon 1990). In general, ridge tops within this ecoregion are dominated by red spruce (*Picea rubens*) and balsam fir (*Abies balsamea*) with lower elevations supporting deciduous species such as sugar maple (*Acer saccharum*), yellow birch (*Betula alleghaniensis*) and American beech (*Fagus grandifolia*).

The Project area is located primarily within land managed by Wagner Forest Management, Ltd. These include Stewart Mountain, Witham Mountain, Bald Mountain Briggs Hill and Burnt Hill. Stewart Mountain represents the western boundary of the project and Briggs and Burnt Hill represent the eastern boundary. These two ridgelines are separated by Sandy Stream Valley. The northern end of Stewart Mountain is the highest in elevation reaching 817 m (2,680') and decreases southward to 671 m (2,200'). Witham Mountain is the next highest in elevation reaching nearly 701 m (2,300'); the remaining ridgelines heights are approximately 671 m (2,200') and lower.

Due to its relatively low elevation, the vegetation in the Project area is dominantly northern hardwood species and includes: sugar maple (*Acer saccharum*), yellow birch (*Betula alleghaniensis*), and American beech (*Fagus randifolia*). Red spruce (*picea rubens*) and balsam fir (*Abies balsamea*) are present primarily on those ridge tops that exceed approximately 610 m (2,000'). Historically and presently, the land within and surrounding the Project area, including the summits of the ridgelines, have been used for commercial timber management. This is evident by the recent and past cuts as well as the presence of the network of haul roads that extend through the Project area. These forest management operations have resulted in a variation of forest age classes.

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**Legend**

Turbine

Client/Project
**Highland Wind, LLC**
**Highland Wind Project**
**Highland Plantation, Maine**

Figure No.
1-1

Title
Project Location Map
November 4, 2009

00385-F101-Locus.mxd

### 1.2 SURVEY OVERVIEW

Stantec conducted field surveys for bird and bat migration during fall 2008. The overall goals of the investigations were to document:

- passage rates for nocturnal migration in the vicinity of the Project area, including the number of migrants, their flight direction, and their flight altitude;
- species composition and activity patterns of bats within the Project area including the rate of occurrence and relationship with weather factors and;
- passage rates and species composition of raptors migrating through the Project area;

The following sections outline the survey methodology and results contributing toward the achievement of survey goals. Discussion of survey results and subsequent conclusions follow each section.

## 2.0 Nocturnal Radar Survey

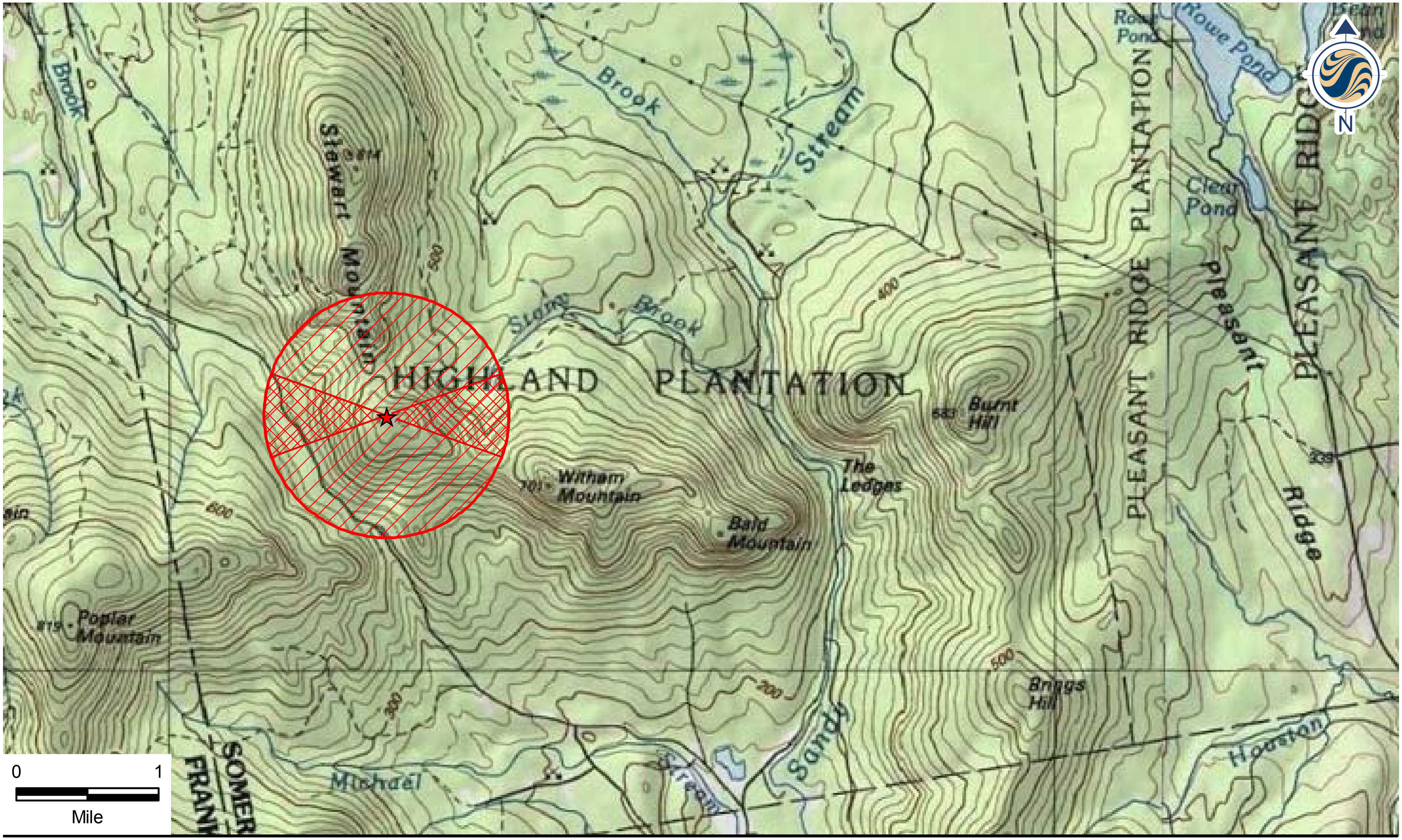
### 2.1 INTRODUCTION

Nocturnal radar surveys were conducted in the Project area to characterize fall 2008 nocturnal migration patterns. The majority of North American passerines (songbirds) migrate at night, unlike raptors that use rising day time thermals during migration. Raptors soaring flight uses the laminar flow of air over the landscape, which creates updrafts along hillsides and ridgelines. In contrast, passerines may have evolved to take advantage of more stable nighttime atmospheric conditions for their flapping flight (Kerlinger 1995). Nighttime migration during the cooler nighttime temperatures also may provide passerines a more efficient method of regulating body temperature during more active, flapping flight and reduce the risk of predation (Alerstam 1990, Kerlinger 1995). Therefore, while raptor migration can be documented by visual daytime (diurnal) surveys, documenting the patterns of nocturnal migrants such as passerines and bats requires the use of radar or other non-visual technologies. The goal of the surveys was to document the overall passage rates for nocturnal migration in the vicinity of the Project area, including the number of migrants, their flight direction, and their flight altitude.

### 2.2 METHODS

Marine surveillance radar, similar to that described by Cooper *et al.* (1991), was used during field data collection. The radar has a peak power output of 12 kilowatts (kW) and has the ability to track small animals, including birds, bats, and even insects, based on settings selected for the radar functions. It cannot, however, readily distinguish between the types of animals or species of animals that are detected. Consequently, all animals observed on the radar screen were identified as bird/bat targets or insect “targets” based on their flight speeds. The radar has an “echo trail” function which captures past echoes of flight trails, enabling determination of flight direction and flight speed. Flight speed was further analyzed to compensate for wind speed and direction. During all operations, the radar's echo trail was set to 30 seconds. The radar was equipped with a 2 m (6.5') waveguide antenna with a vertical beam height of 20° (10° above and below horizontal).

The radar study was conducted from the southern summit of Stewart Mountain at an elevation of approximately 671 m (2200') (Figure 2-1). Objects on the ground (e.g., trees and hillsides) detected by the radar cause returns on the radar screen (echoes) that appear as blotches called ground clutter (Figures 2-2 and 2-3). Large amounts of ground clutter reduce the ability of the radar to track targets flying over those areas. Therefore, efforts were made to maximize the airspace sampled by elevating the antennae to the height of the surrounding trees, approximately 3 m (10') , thus reducing the amount of the radar beam reflected back from surrounding vegetation or hillsides to the center of the radar screen (Figures 2-3 and 2-4).

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**Legend**

- Radar Location
- Horizontal Radar Detection Range
- Alignment Vertical Radar Sweep

Client/Project

**Highland Wind, LLC**
**Highland Wind Project**
**Highland Plantation, Maine**

Figure No.
2-1

Title
Radar Location Map
November 5, 2009

00385-F201-Radar-Location-Map.mxd

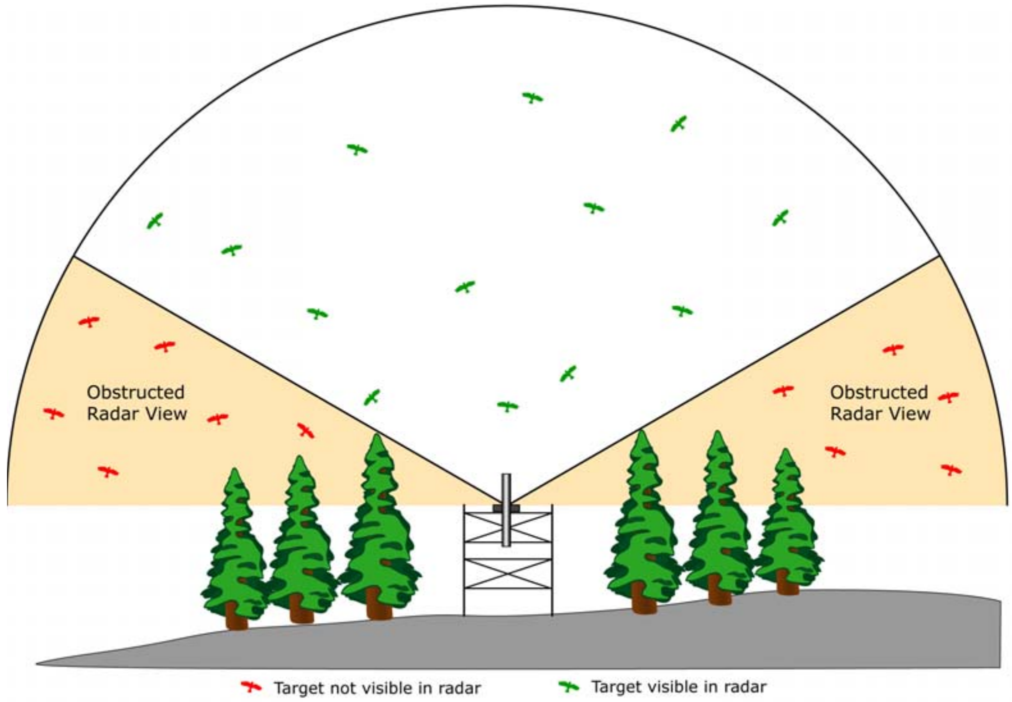
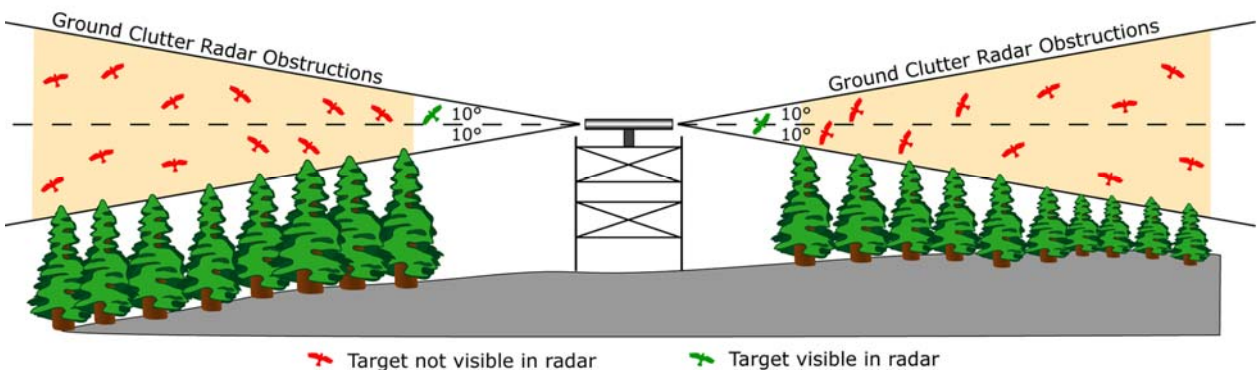



**Figure 2-2.** Examples of surrounding vegetation that causes "ground clutter" obstructions in vertical mode (top) and horizontal mode (bottom). Although the radar records three-dimensional space, it translates ground clutter on the radar screen into a two dimensional representation, which can cause targets to be obscured from view.



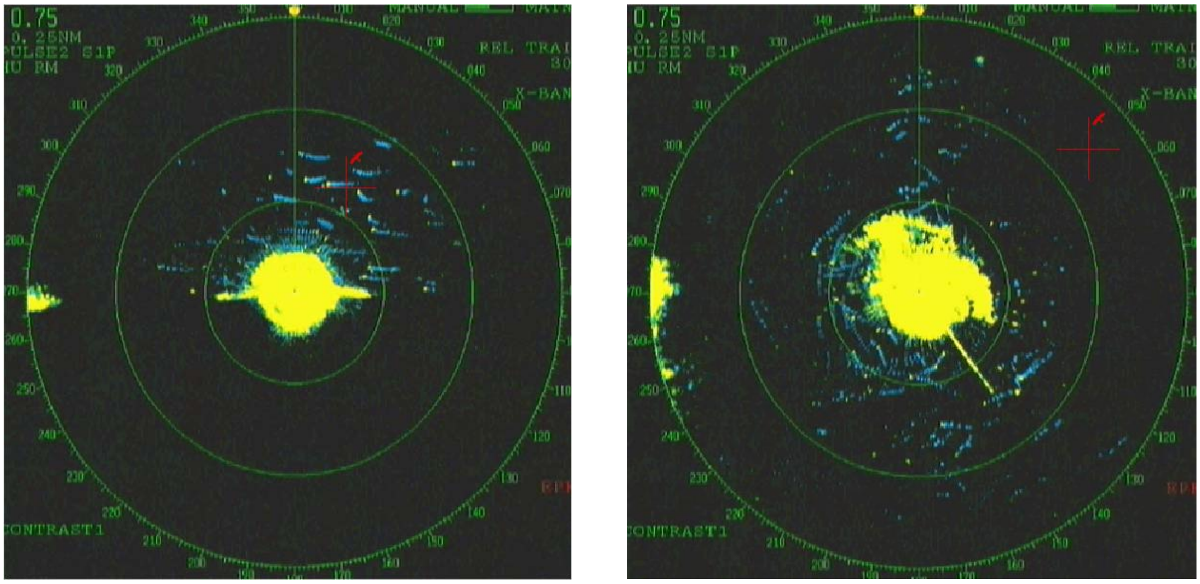


**Figure 2-3.** Radar Screenshot showing ground clutter (yellow). Note the ground clutter is restricted to the center of the radar screen (*left – vertical mode; right – horizontal mode*). Proper site selection can reduce ground clutter to the center of the radar screen, so that the majority of the two-dimensional radar screen remains relatively uncluttered, allowing targets to be tracked as they both enter and leave the cluttered area.

Vegetation and hilltops near the radar can be used to reduce or eliminate ground clutter by "hiding" clutter-causing objects from the radar. These nearby features also cause ground clutter, but their proximity to the radar antenna generally limits the ground clutter to the center of the radar screen (Figure 2-3 and 2-4).

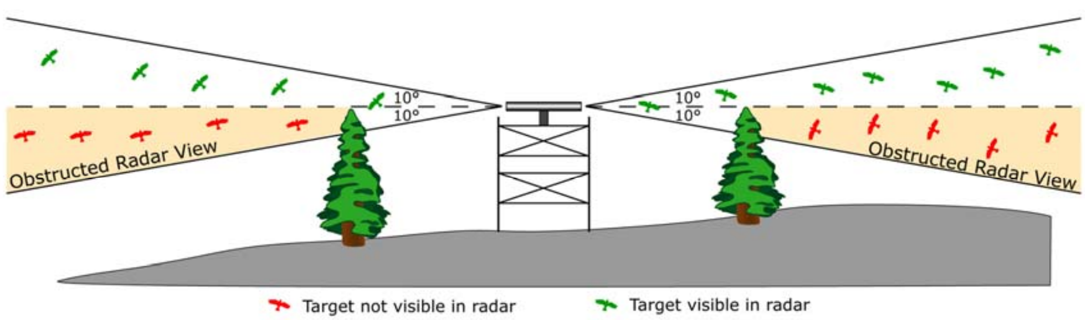



**Figure 2-4.** Positioning of radar near potential ground clutter can reduce or "hide" clutter-causing objects from the radar.

The irregular shape of the ground clutter shown on the horizontal screen shot (*right*) in Figure 2-3 is caused from the lower 10 degrees of the radar beam, as depicted in Figure 2-4, detecting the shape of the met tower opening until it reaches the surrounding tree-line. Once at the tree line the lower 10 degree portion of the 20 degree beam is stopped, allowing for a clear view of the airspace above tree-line up to a height of approximately 245 meters (203'). The area of ground clutter to the west (Figure 2-3) is a result of the radar beam detecting the eastern slope of Poplar Mountain across the valley nearly 1.4 km away.

The radar at this location (Figure 2-1) afforded coverage of the Stewart Mountain ridgeline to the north as well as Witham Mountain to the east. The goal of this particular location was to document nocturnal migration activity along these ridges as well as the saddle between them. This location also provided coverage of the valley west of Stewart Mountain which is bisected by the Long Falls Dam Road. The radar site, at an elevation of 671 m (2,200') and elevated even with the surrounding tree height provided excellent sampling of the airspace within 0.75 nautical miles (1.4 km, 4,557') of the site. One hundred percent of all quadrants were visible on the radar screen. In vertical mode views 5 degrees below the horizon to the west into the valley below were attainable due to low tree heights and steep topography on the western side of the radar location on south Stewart Mountain (Figure 2-1).

Radar surveys were conducted from sunset to sunrise, and were scheduled to occur on 20 nights between August 30 and October 7. Because the anti-rain function of the radar must be turned down to detect small songbirds and bats, surveys could not be conducted during active rainfall. Therefore, surveys were planned largely for nights without rain. However, in order to characterize migration patterns during nights without optimal conditions, some nights with weather forecasts including occasional showers, mist, or fog were sampled.

The radar was operated in two modes throughout the course of each night. In surveillance mode, the antenna spins horizontally to survey the airspace around the radar and detects the number of targets and their flight direction as they pass within .75 NM (1.4 km; the radar viewshed) surrounding the radar (Figure 2-3 and 2-4). At this range, the echoes of small birds can be easily detected, observed, and tracked. At greater ranges, larger targets can be detected, but the echoes of small birds are reduced in size and restricted to a smaller portion of the radar screen, thus limiting the ability to observe the movement pattern of individual targets. By analyzing the echo trail, the flight direction and flight speed of targets can be determined. In vertical mode, the radar unit is tilted 90º to vertically survey the airspace above the radar (Harmata *et al.* 1999). In vertical mode, target echoes do not provide directional data, but do provide information on the altitude of targets passing through the vertical, 20º radar beam (Figures 2-2 and 2-5). Both modes of operation were used during each hour of sampling.

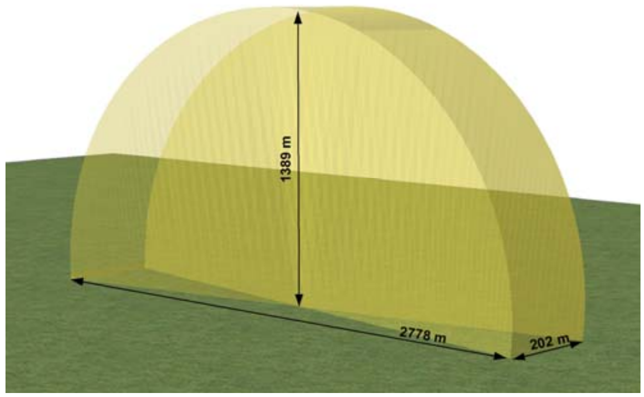



**Figure 2-5**. Detection Range of the radar in vertical mode

### 2.2.1 Data Collection

The radar display was connected to the video recording software of a computer enabling digital archiving of the radar data for subsequent analysis. This software recorded and archived video samples continuously every hour from sunset to sunrise of each survey night. By alternating the radar antenna every ten minutes from vertical mode to horizontal mode, a total of 30 minutes of vertical samples and 30 minutes of horizontal samples were collected within each hour. Video recordings were subsequently analyzed based on a random schedule for each night. This sampling schedule allowed for randomization of data analysis and prevented double-counting of targets due to the 30-second echo trail used to determine the flight path vector.

### 2.2.2 Data Analysis

Video samples were analyzed using a digital analysis software tool developed by Stantec. For horizontal samples, targets (either birds or bats) were differentiated from insects based on their flight speed. Following adjustment for wind speed and direction, targets traveling faster than approximately 6 m (20’) per second were identified as a bird or bat target (Larkin 1991, Bruderer and Boldt 2001). The software tool recorded the time, location, and flight vector for each target traveling fast enough to be a bird or bat within each horizontal sample, and these results were output to a spreadsheet. For vertical samples, the software tool recorded the entry point of targets passing through the vertical radar beam, the time, and flight altitude above the radar location, and then subsequently outputs the data to a spreadsheet. These datasets were then used to calculate passage rate (reported as targets per kilometer of migratory front per hour), flight direction, and flight altitude of targets.

Mean target flight directions (± 1 circular standard deviation) were summarized using software designed specifically to analyze directional data (Oriana2© Kovach Computing Services). The statistics used for this analysis are based on those used by Batschelet (1965), because they take into account the circular nature of the data. Nightly wind direction, which was collected from the north Stewart met tower, was also summarized using this method.

Flight altitude data were summarized using linear statistics. Mean flight altitudes (± 1 standard error [SE]) were calculated by hour, night, and overall season. The percent of targets flying below 130.5 m (428'), the approximate maximum height of the proposed wind turbines with blades, was also calculated hourly, for each night, and for the entire survey period.

### 2.2.3 Weather Data

Wind speed and direction were recorded on an hourly basis by the north Stewart met tower for the duration of the radar survey period. Temperature, relative humidity, wind speed, dew point, and barometric were also recorded for the duration of the survey period at hourly intervals by a weather station (HOBO Micro Station H21-002) located at the radar station. The mean, maximum, and minimum temperature, mean and maximum wind speed, relative humidity, barometric pressure, and dew point were calculated for each night. However, for the purposes of this report, weather data was used from the north Stewart met tower because this data is from heights closer to where migrants were observed to fly and the height of the proposed wind turbines.

## 2.3 RESULTS

Radar surveys were conducted during 20 nights from August 30 to October 7 (Appendix A, Table 1). The radar was located in the center of the meteorological tower (met tower) clearing, which was bordered by standing dead trees (snags) and regenerating red spruce (*Picea rubens*) (Figure 2-6). In vertical mode tree heights did not affect the radar view because the radar beam was directed vertically into the sky. Furthermore, as a result of elevating the radar antenna even with the heights of the surrounding trees and the steep topography to the west of the radar location, some targets were observed 5 degrees below the horizon in the valley to the west over the Long Falls Dam Road. Figure 2-3 shows the detection of the ridgeline to the west of the Long Falls Dam Road in both Horizontal and Vertical modes, showing that the range of the radar extended that far and provided full coverage of the valley.

**Figure 2-6.** Radar situated in Highland Project area.

### 2.3.1 Passage Rates

The mean passage rate for the entire survey period was 549 targets/kilometer/hour (t/km/hr) ± 32 t/km/hr (Figure 2-7; Appendix A, Table 1). Nightly passage rates varied from 68 targets per kilometer per hour (t/km/hr) on October 7 to 1201 t/km/h on September 15. Individual hourly passage rates ranged from 0 to 2480 t/km/h (Appendix A, Table 2). Hourly passage rates varied between and within nights throughout the season. For the entire season, passage rates were highest during the fourth hour after sunset and dropped off significantly during the fifth hour through sunrise (Figure 2-8).

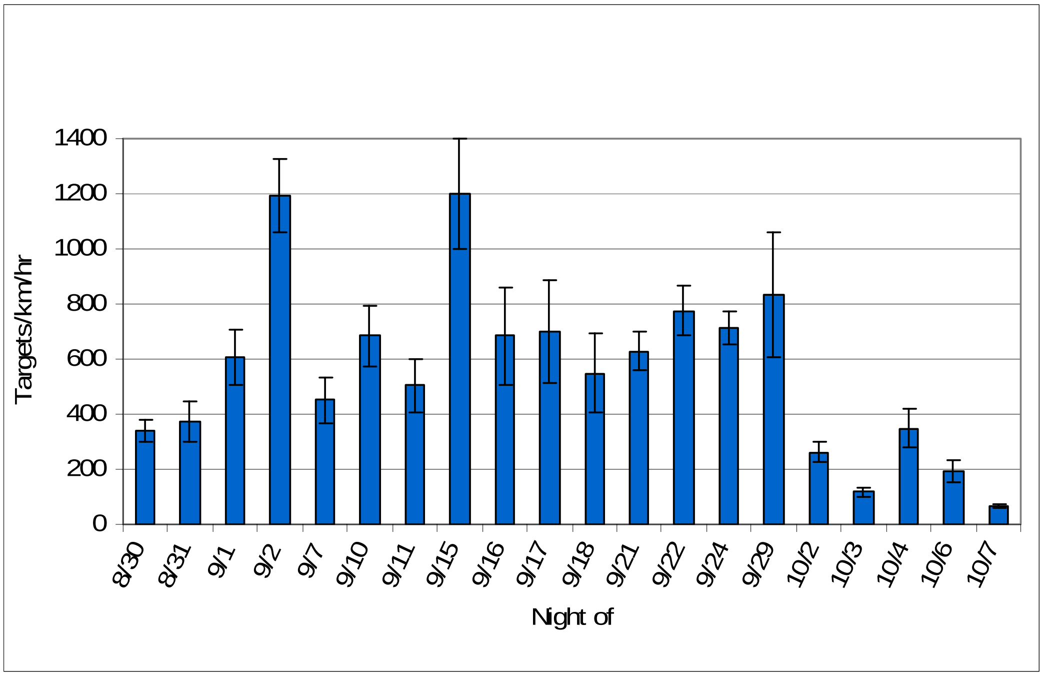



**Figure 2-7.** Nightly passage rates observed (error bars ± 1 SE)

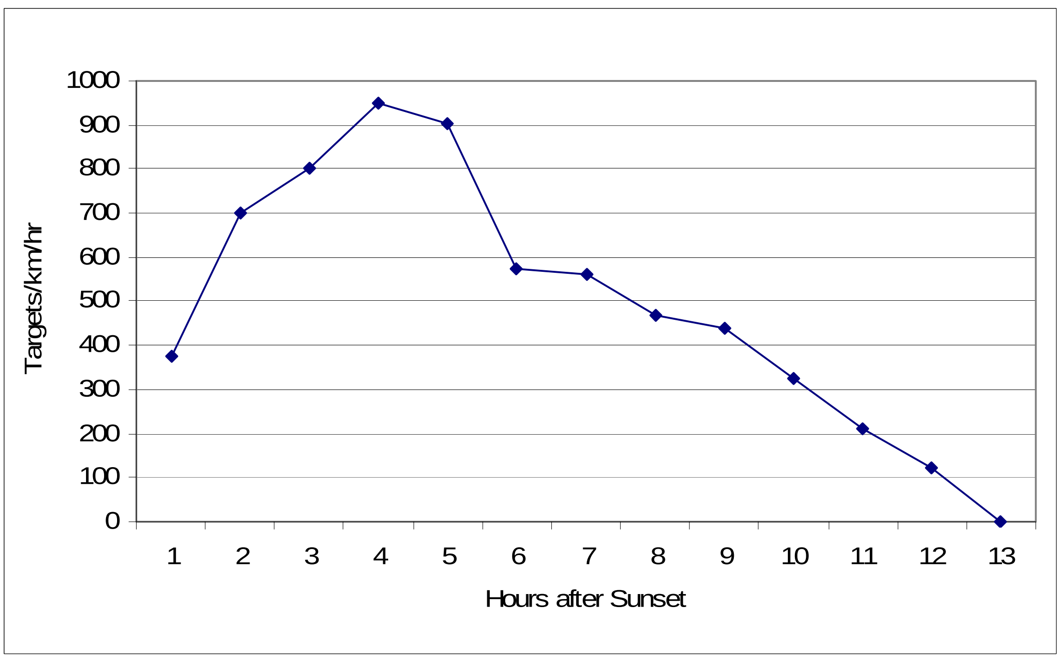



**Figure 2-8.** Hourly passage rates for entire season

### 2.3.2 Flight Direction

Mean flight direction through the Project area was 227° ± 51 (Figure 2-9). There was some variation between nights in mean flight direction, although most nights included flight directions generally to the southwest (Appendix A, Table 3).

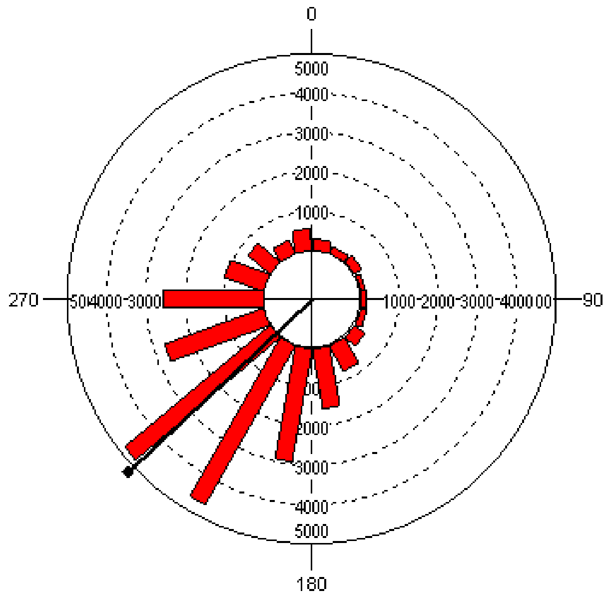



**Figure 2-9.** Mean flight direction for the entire season (the bracket along the margin of the histogram is the 95% confidence interval)

### 2.3.3 Flight Altitude

The seasonal mean flight height of all targets was 348 ± 8 m (1142' ± 26') above the radar site. The average nightly flight height ranged from 250 m (820') on September 16 to 531 m (1742') on October 6 (Figure 2-10; Appendix A, Table 4). The percent of targets observed flying below 130.5 m (428') averaged 16 percent for the season and varied by night from 4 to 27 percent (Figure 2-11). The mean hourly flight height for the entire season was relatively constant throughout the first eleven hours, but increased significantly in the twelfth hour (Figure 2-12). Overall, within each night, flight heights remained relatively constant while much more variation was observed between nights.

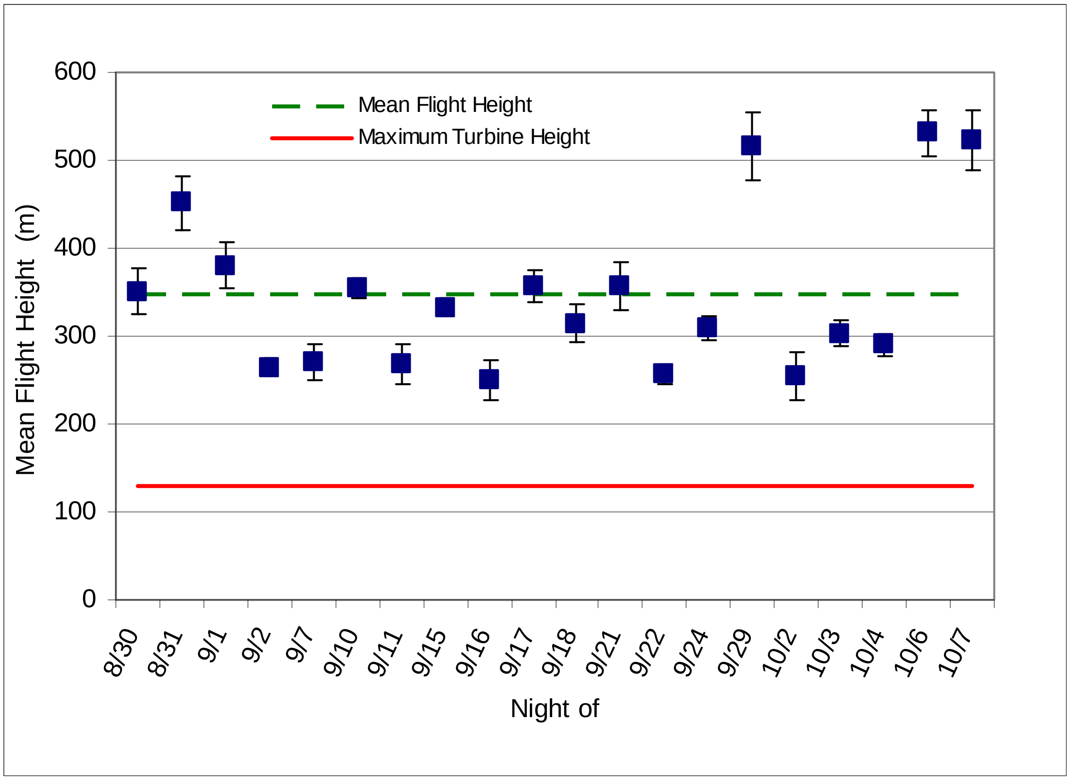



**Figure 2-10.** Mean nightly flight height of targets (error bars ± 1 SE)

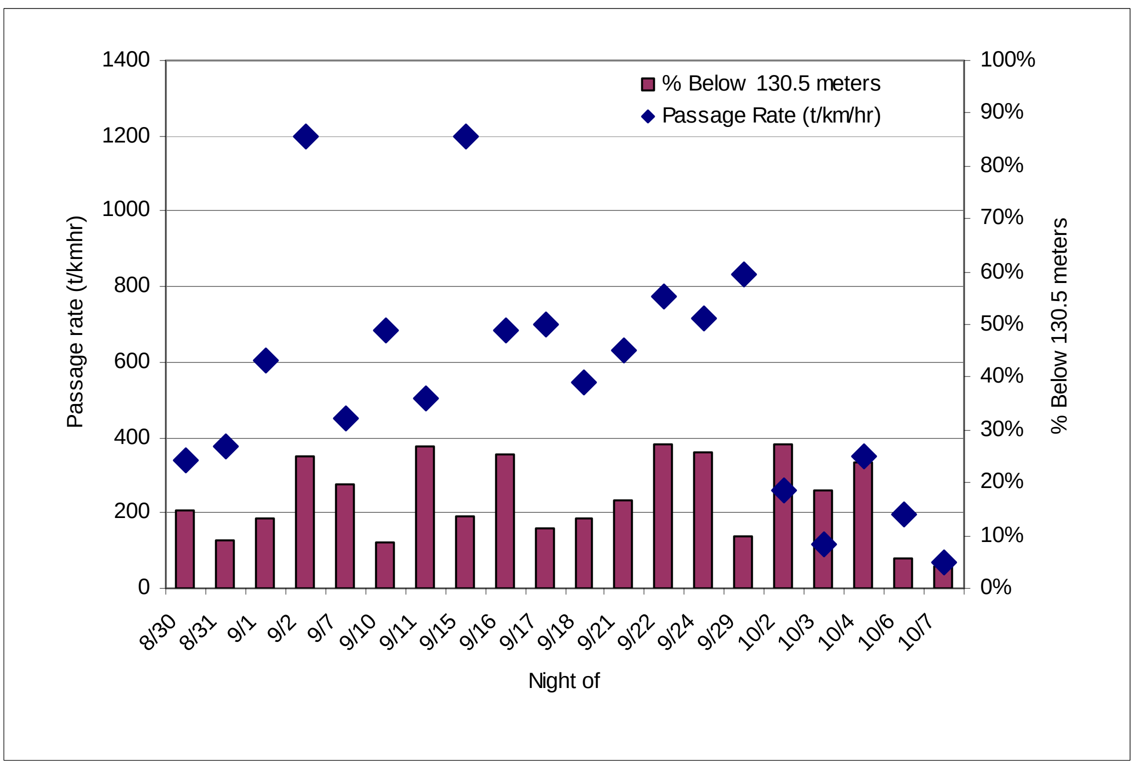



**Figure 2-11.** Percent of targets observed flying below a height of 130.5 m (428')

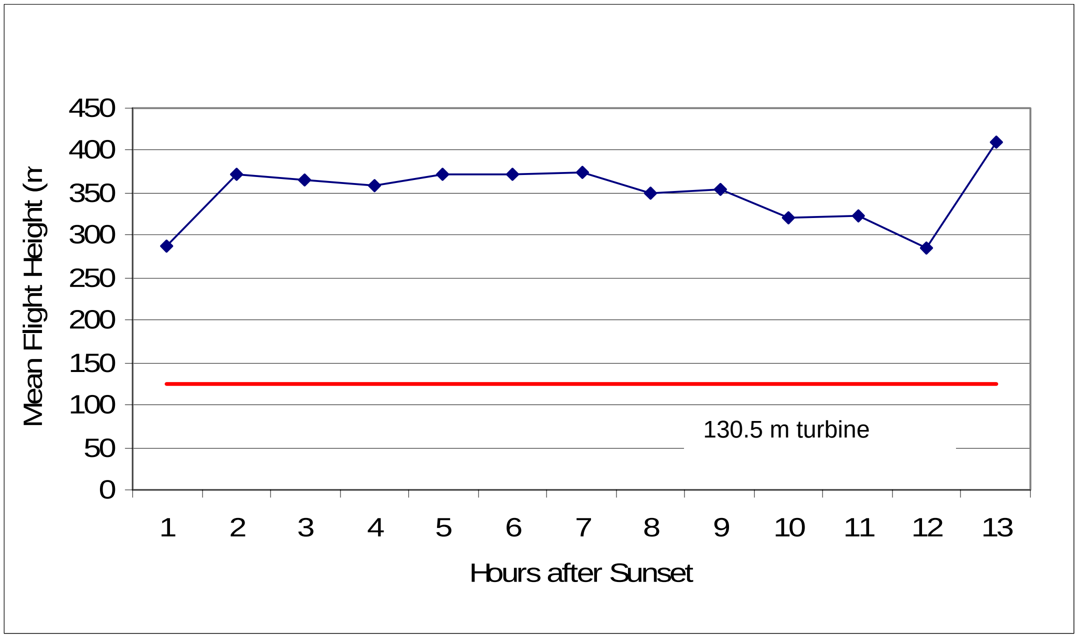



**Figure 2-12.** Hourly target flight height distribution. The peak in flight height during the 13th hour after sunset includes data from only four nights at the end of the season and is not necessarily directly comparable to other hourly blocks. Prior to the end of September, sunrise occurred prior to this 13th hour therefore no data was collected.

### 2.3.4 Weather Data

Mean nightly wind speeds in the Project area from August 30 to October 7 varied between 2 and 8 meters per second (m/s), with an overall mean of 4 m/s (Figure 2-13). Mean nightly temperatures varied between 3ºC and 16ºC, with an overall mean 9ºC (Figure 2-14).

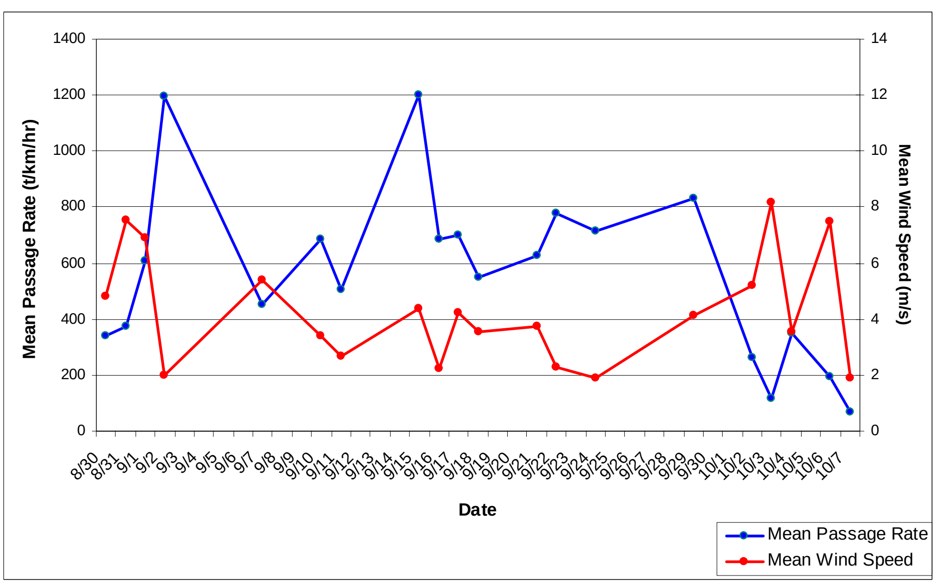



**Figure 2-13**. Mean wind speed versus passage rate in the Project area

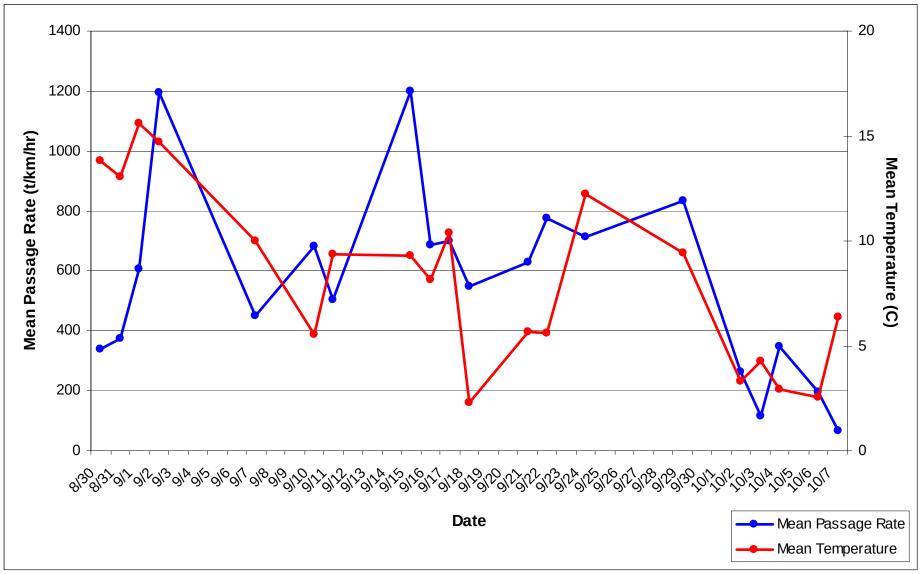



**Figure 2-14.** Passage rate versus mean temperature in the Project area

## 2.4 DISCUSSION

The results of this field survey provide useful information about site-specific migration activity and patterns in the Project area. Within the last several years, data from nocturnal radar surveys completed using similar methods and equipment have become available, providing an opportunity to compare the results from this Project with others in Maine and the northeastern United States. It is important to note that there are limitations in comparing data from previous years with data from 2008, as year-to-year variation in populations may influence how many migrants pass through an area. Additionally, differences in site characteristics, particularly the topography, local landscape conditions, and vegetation surrounding a radar survey location, can play a large role in any radar's ability to detect targets and the subsequent calculation of passage rate. These differences should be recognized as one of the more significant limiting factors in making direct site-to-site comparisons of passage rates. Regardless of potential differences between radar survey locations, the results at the Project are within the typical range of results at projects on forested ridges in the northeast (Appendix A, Table 5).

Nightly variation in the magnitude and flight characteristics of nocturnally-migrating songbirds is not uncommon and is often attributed to weather patterns, such as cold fronts and winds aloft (Hassler *et al.* 1963, Gauthreaux and Able 1970, Richardson 1972, Able 1973, Bingman *et al.* 1982, Gauthreaux 1991). Nights with the highest passage rates appeared to have had moderate to light winds (2 to 4 m/s) from the northeast. Temperature does not seem to have an affect on passage rate at this site.

Some research suggests that bird migration may be affected by landscape features, such as coastlines, large river valleys, and mountain ranges. This has been documented for diurnally migrating birds, such as raptors, but is not as well established for nocturnal migrants (Sielman *et* *al*. 1981; Bingman 1980; Bingman *et al*. 1982; Bruderer and Jenni 1990; Richardson 1998; Fortin *et al*. 1999; Williams *et al.* 2001; Diehl *et al*. 2003). Studies suggesting that nocturnal migrants are influenced by topography have typically been conducted in areas of steep and abrupt topography, such as the most rugged areas of the northern Appalachians and the Alps.

Emerging evidence from other Stantec studies, other consultants, and academic research, is beginning to indicate that flight height seems to be more important in determining potential collision risk than passage rate or flight direction (Cooper and Mabee 2000; Cooper *et al*. 2004; Gauthreaux and Livingston 2006; Mizrahi *et al*. 2008). Comparison of flight height between survey sites as measured by radar is generally less influenced by site characteristics as the main portion of the radar beam is directed skyward, and the potential effects of surrounding vegetation on the radar's view can be more easily controlled. The radar, centrally located on an exposed knoll at this Project site, allowed for unobstructed views in vertical mode and targets were observed flying in all areas of the vertical detection range. The radar view in horizontal mode was comparable to other regional studies conducted by Stantec in the state. The emerging body of studies characterizing nocturnal migration shows a relatively consistent pattern in flight altitude, with most migrants appearing to fly at altitudes of several hundred meters or more above the ground (Appendix A, Table 5). This pattern applies to this site, as targets appeared to fly at fairly consistent heights near 300 m above the radar nightly and throughout the survey period. The flight heights at the Project are well above the proposed turbine height of 130.5 m, indicating a limited mortality risk during fall migration.

There is currently no accurate quantitative method of directly correlating pre-construction passage rates at wind farms to operational impacts to birds and bats. Until radar surveys are conducted at a constructed site followed by mortality surveys the morning after, no direct correlations to collision risk can be made. This radar survey is designed to sample migration activity over a given point of time to provide baseline data pre-construction.

# 3.0 Acoustic Bat Survey

## 3.1 INTRODUCTION

Acoustic sampling of bat activity has become a standard aspect of pre-construction surveys for proposed wind-energy developments (Kunz *et al*. 2007a, b). Acoustic surveys are associated with several major assumptions (Hayes 2000) and results should not be used to determine the number of bats inhabiting an area or to determine the number of bats that may collide with the proposed turbines. Acoustic surveys can provide insight into seasonal patterns in activity levels and examine how weather conditions influence bat activity. This data may be useful in predicting trends in post-construction mortality rates. The objectives of acoustic surveys at the Project were (1) to document bat activity patterns from August through October in airspace near the rotor zone of the proposed turbines, at an intermediate height, and near the ground; and (2) to document bat activity patterns in relation to weather factors including wind speed, temperature, and barometric pressure.

Eight species of bats occur in Maine, based upon their normal geographical range. These are the big brown bat (*Eptesicus fuscus*), silver-haired bat (*Lasionycteris noctivagans*), eastern red bat (*Lasiurus borealis*), hoary bat (*L. cinereus*), eastern small-footed myotis (*Myotis leibii*), little brown myotis (*M. lucifugus*), northern myotis, (*M. septentrionalis*), and tri-colored bat[2] (*Perimyotis subflavus*) (BCI 2001). Of these, the eastern small-footed myotis, eastern red bat, hoary bat, and silver-haired bat are listed in Maine as species of special concern.

## 3.2 METHODS

### 3.2.1 Data Collection and Equipment

Anabat II and Anabat SD1 detectors (Titley Electronics Pty Ltd.) were used for the duration of the acoustic bat survey. Anabat detectors were selected based upon their widespread use for this type of survey, their ability to be deployed for long periods of time, and their ability to detect a broad frequency range, which allows detection of all species of bats that could occur in the Project area. Anabat II detectors were coupled with CF Storage ZCAIM (Titley Electronics Pty Ltd.), which programmed the on/off times and stored data on removable 1 GB compact flash cards, while newer SD1 model detectors do not require use of a ZCAIM. Anabat detectors are frequency division detectors that divide the frequency of echolocation sounds made by bats by a factor of 16, and then record these sounds for subsequent analysis. The audio sensitivity setting of each Anabat system was set between six and seven (on a scale of one to ten) to maximize sensitivity while limiting ambient background noise and interference. The sensitivity of individual detectors was then tested using an ultrasonic Bat Chirp (Reno, NV) to ensure that the detectors would be able to detect bats up to a distance of at least 10 m (33’).

Each Anabat detector was powered by 12-volt batteries charged by solar panels. Each solar-powered Anabat system was deployed in waterproof housing enabling the detector to record while unattended for the duration of the survey. The housing suspends the Anabat microphone downward to give maximum protection from precipitation. To compensate for the downward position, a reflector shield of smooth plastic is placed at a 45-degree angle directly below the microphone. The angled reflector allows the microphone to record the airspace horizontally surrounding the detector and is only slightly less sensitive than an unmodified Anabat unit.

Data was collected by five detectors that were deployed in locations throughout the Project area from August 11 to October 20 and were programmed to run continuously between 6:00 PM and 8:00 AM (Figure 3-1). Prior to the installation of the met towers, detectors were initially placed in trees along the ridgelines and were installed at heights ranging from approximately 2 to 8 m. One detector was located in a tree within the Briggs Hill met tower opening, one in a tree within the Burnt Hill met tower opening, one in a tree along the edge of the south Stewart met tower opening, one along a small stream on the western side of Stewart Mountain (Stewart Valley Detector), and one in a tree along the edge of the north Stewart Mountain met tower opening (Figure 3-1). A sixth detector was placed in at tree at the edge of the Witham met tower clearing; however this detector malfunctioned and provided no useable data.

[2] The scientific and common name of the eastern pipistrelle (*Pipistrellus subflavus*) has been changed to the tri-colored bat (*Perimyotis subflavus*).

The detectors were moved to the met towers once these structures were erected (August 11 to August 28, 2008, September 2, and September 8, 2008). Two detectors were suspended at different heights within the guy wire arrays of the south Stewart met tower, Witham Mountain met tower, and Briggs Hill met tower. “High” detectors were suspended at approximately 45 m and “Low” detectors were suspended at approximately 25 m. Maintenance visits for each detector were conducted roughly every two weeks to check on the condition of the detectors and download data to a computer for analysis. The “Low” detector at Witham malfunctioned and provided no useable data.

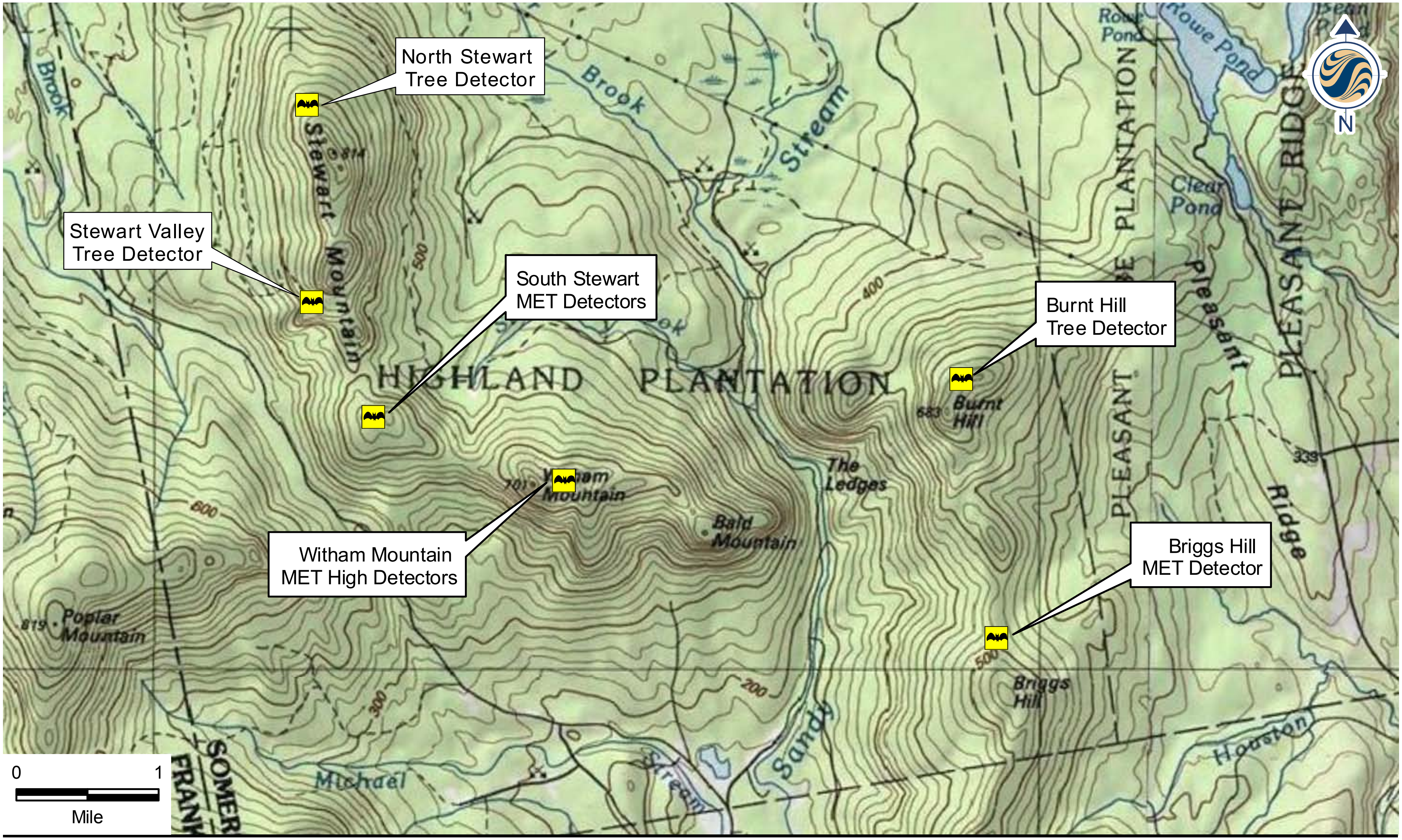
Briggs Hill Tree Detector: The Briggs Hill tree detector was deployed in this location from August 12 to August 28, 2008 until the met tower was installed. At this location the bat detector was suspended from a tree approximately 5 m (15’) high along the western edge of the met tower clearing with the microphone pointing north.

Burnt Hill Tree Detector: The Burnt Hill tree detector was deployed in this location from August 11 to September 2, 2008 until the met tower was installed at Briggs Hill. Once that met tower was installed this detector was moved to the Briggs Hill Met tower. During this period, the detector was attached to a dead softwood snag approximately 2 m (7') high on the summit of Burnt Hill at the edge of the access trail leading to the met tower opening. The microphone was pointed north across the trail.

Stewart Valley Detector: This detector was deployed at this location from August 11 to August 27, 2008 until the South Stewart Met Tower was installed. The detector at this location was approximately 1500' down slope from the Stewart Mountain Summit at approximately 8 m (25') high with the microphone directed across a skidder trail. A small stream crossed the skidder trail at this location and the microphone was directed up stream across the skidder trail.

South Stewart Tree Detector: This detector was deployed at this location from August 11 to September 2, 2008 until the met tower was installed. At this location the detector was positioned in a tree approximately 5 m (15') high at the southern edge of the met tower clearing with the microphone facing north into the met tower clearing.

North Stewart Tree Detector: This detector was deployed at this location from August 11 to September 8, 2008. This detector was deployed approximately 5 m (15') up in a tree with the microphone facing east. This detector was located at the northern edge of the met tower clearing where the trail entered the opening on the summit.

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**Legend**

Bat Detector Location

**Client/Project**

**Highland Wind, LLC**
**Highland Wind Project**
**Highland Plantation, Maine**

Figure No.
3-1

Title
Bat Survey Location Map
November 5, 2009

00385-F301-Bat-Survey-Location-Map.mxd

### 3.2.2 Data Analysis

Ultrasound recordings of bat echolocation may be broken into recordings of a single bat call or recordings of bat call sequences. A call is a single pulse of sound produced by a bat, while a call sequence is a combination of two or more pulses recorded in an Anabat file. Recordings containing less than two calls were eliminated from analysis as has been done in similar studies (Arnett *et al*. 2006).

Potential call files were extracted from data files using CFCread© software. The default settings for CFCread© were used during this file extraction process, as these settings are recommended for the calls that are characteristic of Maine bats. This software screens all data recorded by the bat detector and extracts call files using a filter. Using the default settings for this initial screen also ensures comparability between data sets. Settings used by the filter include a max TBC (time between calls) of 5 seconds, a minimum line length of 5 milliseconds, and a smoothing factor of 50. The smoothing factor refers to whether or not adjacent pixels can be connected with a smooth line. The higher the smoothing factor, the less restrictive the filter is and the more noise files and poor quality call sequences are retained within the data set.

Following extraction of call files, each file was visually inspected for species identification and to ensure that only bat calls were included in the data set. Insect activity, wind, and interference can also sometimes produce Anabat files that pass through the initial filter and need to be visually inspected and removed from the data set. Call sequences are easily differentiated from other recordings, which typically form a diffuse band of dots at either a constant frequency or widely varying frequency.

Because bat activity levels are highly variable among individual nights and individual hours (Hayes 1997, Arnett *et al*. 2006), detection rates are summarized on both of these temporal scales. Nightly detection rates were summarized by month as well as for the entire sampling period. Hourly detection rates were summarized by hour after sunset, as recommended by Kunz *et al*. (2007a,b). Quantitative comparisons among these temporal periods was not attempted because the high amount of variability associated with bat detection would required much larger sample sizes (Arnett *et al*. 2006, Hayes 1997).

Bat call sequences were individually marked and categorized by species group, or “guild” based on visual comparison to reference calls. Qualitative visual comparison of recorded call sequences of sufficient length to reference libraries of bat calls allows for relatively accurate identification of bat species (O’Farrell *et al*. 1999, O’Farrell and Gannon 1999). Call sequences were classified to species whenever possible, based on criteria developed from review of reference calls collected by Chris Corben, the developer of the Anabat system, as well as other bat researchers. However, due to similarity of call signatures between several species, all classified calls have been categorized into five guilds[3] reflecting the bat community in the region of the Project area and is as follows:

[3] Gannon *et al.* 2003 categorized bats into guilds based upon similar minimum frequency and call shape. These guilds were: Unidentified, Myotis, LABO-PISU and EPFU-LANO-LACI. We broke hoary bats out into a separate guild due to the importance of reporting activity patterns of migratory species in the context of wind energy development.

- **Unknown (UNKN)** – All call sequences with less than five calls, or poor quality sequences (those with indistinct call characteristics or background static). These sequences were further identified as either "high frequency unknown" (HFUN) for sequences with a minimum frequency above 30 to 35 kHz, or "low frequency unknown" (LFUN) for sequences with a minimum frequency below 30 to 35 kHz. The unknown calls are separated into these specific high frequency and low frequency groups because some inferences can be made as to the possible guilds based upon bats known to occur in this area. For this area, HFUN most likely represents eastern red bats, tri-colored bats and *Myotis* species since these species typically produce ultrasound sequences of more than 30 kHz. Big brown, silver-haired and hoary bats would be the species in this area typically producing ultrasound sequences of less than 30 kHz.

- **Myotis (MYSP)** – All bats of the genus *Myotis*. While there are some general characteristics believed to be distinctive for several of the species in this genus, these characteristics do not occur consistently enough for any one species to be relied upon at all times when using Anabat recordings.

- **Eastern red bat/tri-colored bat[4] (RBTB)** – Eastern red bats and tri-colored bats. These two species can produce calls distinctive only to each species. However, significant overlap in the call pulse shape, frequency range, and slope can also occur.

- **Big brown/silver-haired bat (BBSH)** – Big brown and silver-haired bats. These species' call signatures commonly overlap and have therefore been included as one guild in this report.

- **Hoary bat (HB)** – Hoary bats. Calls of hoary bats can usually be distinguished from those of big brown and silver-haired bats by minimum frequency extending below 20 kHz or by calls varying widely in minimum frequency across a sequence.

This method of guild identification represents a conservative approach to bat call identification. Since some species sometimes produce calls unique only to that species, all calls were identified to the lowest possible taxonomic level before being grouped into the listed guilds. Tables and figures in the body of this report will reflect those guilds. However, since species-specific identification did occur in some cases, each guild will also be briefly discussed with respect to potential species composition of recorded call sequences.

Once all of the call files were identified and categorized in appropriate guilds, nightly tallies of detected calls were compiled. Mean detection rates (number of recordings/detector-night) for the entire sampling period were calculated for each detector and for all detectors combined.

### 3.2.3 Weather Data

Temperature (°C), wind speed (m/s), and barometric pressure (mbar) was collected from a 50 meter on-site met tower and was provided by Highland Wind for the period from August 11

[4] The scientific and common name of the eastern pipistrelle (*Pipistrellus subflavus*) has been changed to the tri-colored bat (*Perimyotis subflavus*).

through October 20. Mean nightly temperature, barometric pressure, and wind speed were calculated for each night, and nightly averages were plotted against nightly detections for this period for met tower detectors.

## 3.3 RESULTS

### 3.3.1 Detector Call Analysis

Detectors were operational on 360 of 401 potential detector-nights (90%) between August 11 and October 20 (Table 3-1). Detector malfunction at the Witham Low and Witham Tree locations accounted for all 42 detector nights of lost data. All other detectors sampled successfully on 100% of potential detector-nights.

**Table 3-1**. Summary of bat detector field survey effort and results

| Location | Dates | # of Possible Nights | # Detector-Nights* | # Recorded sequences | Detection Rate ** |
|---|---|---|---|---|---|
| Briggs Hill Met High | Aug 28 – Oct 20 | 54 | 54 | 21 | 0.4 |
| Briggs Hill Met Low | Aug 29 - Oct20 | 53 | 53 | 10 | 0.2 |
| Stewart South Met High | Sept 03 - Oct 20 | 48 | 48 | 17 | 0.4 |
| Stewart South Met Low | Aug 28 - Oct 20 | 54 | 54 | 15 | 0.3 |
| Witham Met High | Sept 09 – Oct 20 | 42 | 42 | 4 | 0.1 |
| **Overall Met Tower Results** | | **251** | **251** | **67** | **0.3** |
| Briggs Hill Met Tree | Aug12 - Aug 28 | 17 | 17 | 3731 | 219.5 |
| Stewart South Met Tree | Aug 11 – Sept 02 | 23 | 23 | 37 | 1.6 |
| Stewart Valley Tree | Aug 11 – Aug 27 | 17 | 17 | 5478 | 322.2 |
| Stewart North Met Tree | Aug 11 - Sept 08 | 29 | 29 | 2197 | 75.8 |
| Burnt Hill Tree | Aug 11 – Sept 02 | 23 | 23 | 73 | 3.2 |
| **Overall Tree Results** | | **109** | **109** | **11516** | **106** |
| **Overall Results** | | **360** | **360** | **11583** | **32.2** |

* Detector-night is a sampling unit during which a single detector is deployed overnight. On nights when two detectors are deployed, the sampling effort equals two detector-nights, etc.

** Number of bat passes recorded per detector-night.

The overall mean nightly detection rate at the Project was 32.3 ± 5.8 (standard error [SE]) recordings/detector/night (r/d/n). Mean detection rate was highly variable among detectors and between met- and ground-level detectors (Table 3-2). Qualitatively, ground-level detectors exhibited higher detection rates and greater variability (106.6 ± 17.3 r/d/n) than met tower detectors (0.3 ± 0.1 r/d/n). Total number of detections varied with hour past sunset, with different trends observed at met tower and ground-level detectors (Figures 3-14 through 3-15).

**Table 3-2.** Monthly summary of 2008 acoustic survey results at Project detectors

| Detector / Month | Dates | Number of Nights | Nights Sampled | Sequences Recorded | Detection Rate ** |
|---|---|---|---|---|---|
| **Briggs Mountain Met High** | | | | | |
| August | August 28 - August 31 | 4 | 4 | 14 | 3.5 |
| September | September 01 - September 30 | 30 | 30 | 7 | 0.2 |
| October | October 01 - October 20 | 20 | 20 | 0 | 0.0 |
| **Briggs Mountain Met Low** | | | | | |
| August | August 29 - August 31 | 3 | 3 | 1 | 0.3 |
| September | September 01 - September 30 | 30 | 30 | 8 | 0.3 |
| October | October 01 - October 20 | 20 | 20 | 1 | 0.1 |
| **Briggs Mountain Met Tree** | | | | | |
| August | August 12 - August 28 | 17 | 17 | 3731 | 219.5 |
| September | -- | -- | -- | -- | |
| October | -- | -- | -- | -- | |
| **Stewart South Met High** | | | | | |
| August | -- | -- | -- | -- | |
| September | September 03 - September 30 | 28 | 28 | 13 | 0.5 |
| October | October 01 - October 20 | 20 | 20 | 4 | 0.2 |
| **Stewart South Met Low** | | | | | |
| August | August 28 - August 31 | 4 | 4 | 4 | 1.0 |
| September | September 01 - September 30 | 30 | 30 | 11 | 0.4 |
| October | October 01 - October 20 | 20 | 20 | 0 | 0.0 |
| **Stewart South Met Tree** | | | | | |
| August | August 11 - August 31 | 21 | 21 | 35 | 1.7 |
| September | September 01 - September 02 | 2 | 2 | 2 | 1.0 |
| October | -- | 0 | 0 | | |
| **Stewart Valley Tree** | | | | | |
| August | August 11 - August 27 | 17 | 17 | 5478 | 322.2 |
| September | -- | 0 | 0 | | |
| October | -- | -- | -- | -- | |
| **Stewart North Met Tree** | | | | | |
| August | August 11 - August 31 | 21 | 21 | 2143 | 102.0 |
| September | September 01 - September 08 | 8 | 8 | 54 | 6.8 |
| October | -- | -- | -- | -- | |
| **Witham Met High** | | | | | |
| August | -- | 0 | 0 | | |
| September | September 09 - September 30 | 22 | 22 | 4 | 0.2 |
| October | October 01 - October 20 | 20 | 20 | 0 | 0.0 |
| **Burnt Hill Tree** | | | | | |
| August | August 12 - August 31 | 20 | 20 | 51 | 2.6 |
| September | September 01 - September 02 | 2 | 2 | 22 | 11.0 |
| October | -- | -- | -- | -- | |
| **Overall Results** | | **359** | **359** | **11583** | **32.3** |

* Detector-night is a sampling unit during which a single detector is deployed overnight. On nights when two detectors are deployed, the sampling effort equals two detector-nights, etc.

** Number of ultrasound sequences recorded per detector-night.

The majority of the recorded call sequences were labeled as MYSP (*n* = 6,521; 56.3%), followed by UNKN sequences (*n* = 4,909; 42.4%), the BBSH guild (*n* = 112; 1.0%), the RBTB guild (*n* = 28; 0.2%), and hoary bats (*n* = 13; 0.1%; Table 3-3). Calls identified as UNKN consisted primarily of HFUN calls (*n* = 4,858; 99.0%), followed by LFUN calls (*n* = 49; 0.1%) and calls which could not be classified at all (*n* = 2; <0.1%). Calls identified as BBSH consisted primarily of calls that could not be identified to species (*n* = 85; 75.9%), followed by calls identified as silver-haired bats (*n* = 23; 20.5%), and big brown bats (*n* = 4; 3.6%). Calls identified as RBTB consisted primarily of calls that could not be identified to species (*n* = 17; 60.7%), followed by calls identified as red bats (*n* = 9; 32.1%) and tri-colored bats (*n* = 2; 7.1%).

**Table 3-3.** Distribution of detections by guild for detectors at Highland, ME, August - October, 2008.

| Detector | Guild | | | | | Total |
|---|---|---|---|---|---|---|
| | **BBSH** | **HB** | **RBTB** | **MYSP** | **UNKN** | |
| Briggs Hill Met High | 2 | 1 | 1 | 0 | 17 | 21 |
| Briggs Hill Met Low | 1 | 3 | 0 | 0 | 6 | 10 |
| Stewart South Met High | 6 | 1 | 1 | 0 | 9 | 17 |
| Stewart South Met Low | 3 | 0 | 0 | 1 | 11 | 15 |
| Witham Met High | 1 | 0 | 0 | 0 | 3 | 4 |
| **Overall Met Tower Results** | **13** | **5** | **2** | **1** | **46** | **67** |
| Briggs Hill Met Tree | 93 | 3 | 13 | 1,273 | 2,349 | 3,731 |
| Stewart South Met Tree | 0 | 1 | 0 | 8 | 28 | 37 |
| Stewart Valley Tree | 0 | 0 | 12 | 3,757 | 1,709 | 5,478 |
| Stewart North Met Tree | 0 | 1 | 1 | 1,464 | 731 | 2,197 |
| Burnt Hill Tree | 6 | 3 | 0 | 18 | 46 | 73 |
| **Overall Tree Results** | **99** | **8** | **26** | **6520** | **4863** | **11516** |
| **Overall Results** | **112** | **13** | **28** | **6,521** | **4,909** | **11,583** |
| **Guild Composition %** | **1.0%** | **0.1%** | **0.2%** | **56.3%** | **42.4%** | |

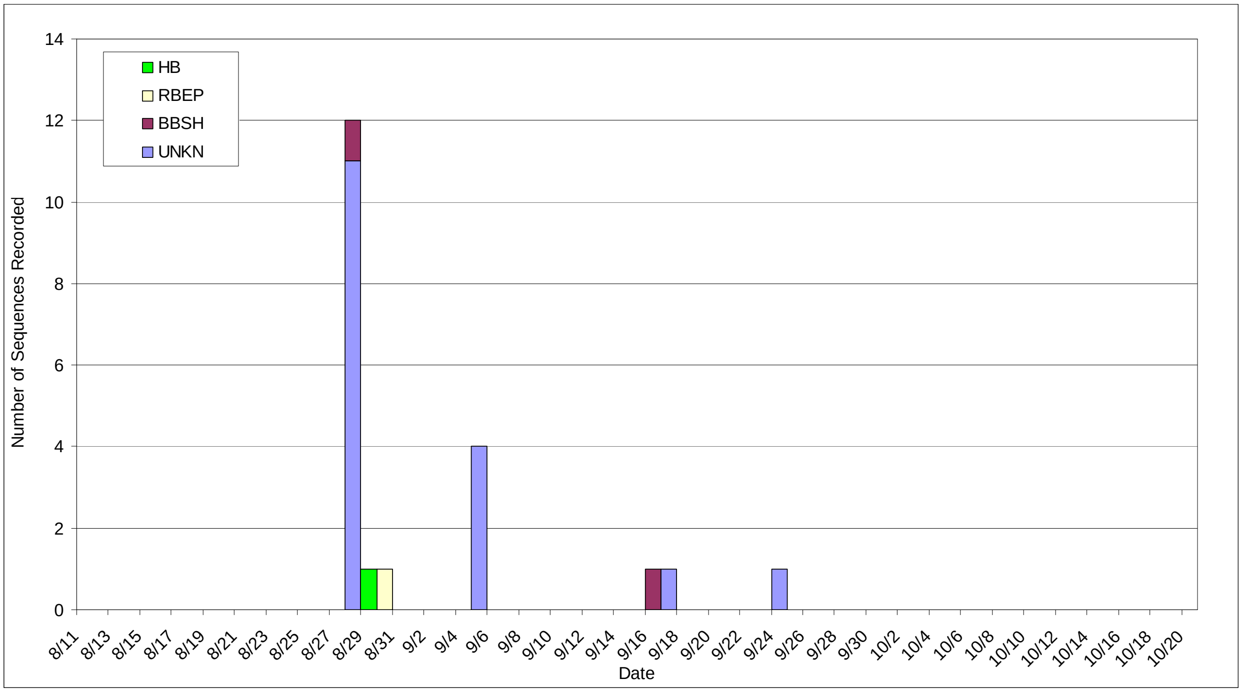



**Figure 3-2**. Nightly detections at the Briggs Hill High Met detector from August through October, 2008. UNKN (*unknown guild*); RBTB (*red bat/tri-colored bat)*; BBSH (*big brown/silver haired*); HB (*hoary bat*); MYSP (*myotis*).

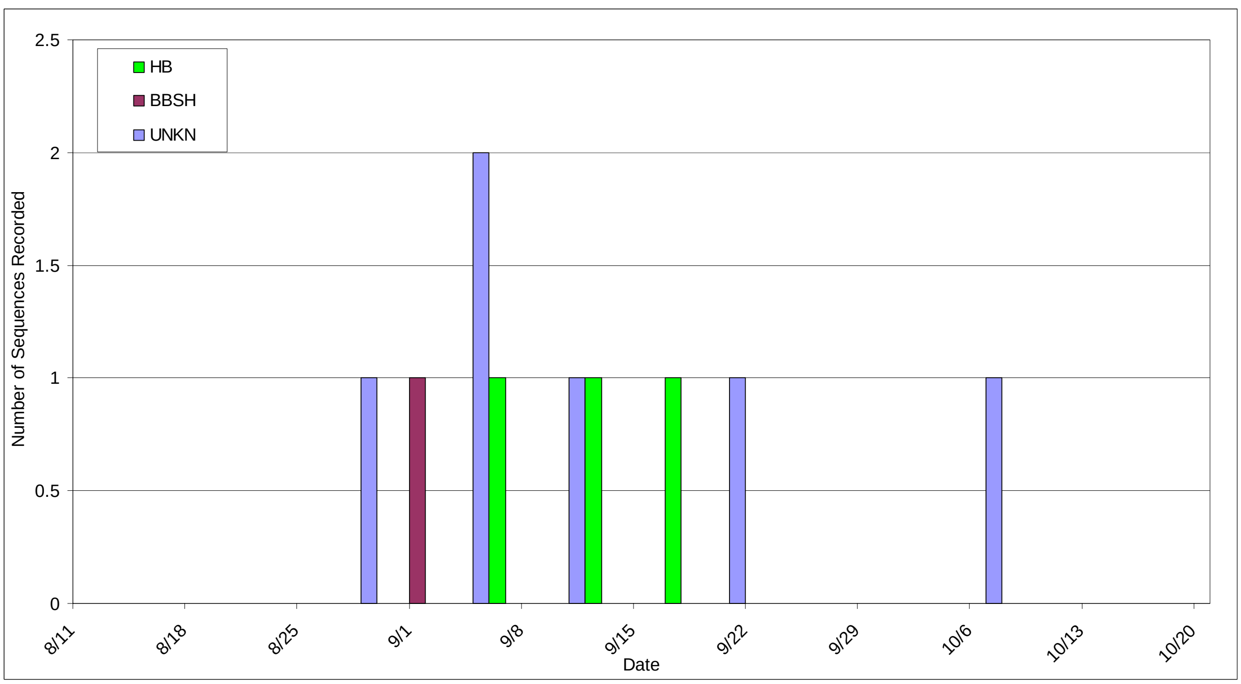



**Figure 3-3**. Nightly detections at the Briggs Hill Low Met detector from August through October, 2008. UNKN (*unknown guild*); RBTB (*red bat/tri-colored bat*); BBSH (*big brown/silver haired*); HB (*hoary bat*); MYSP (*myotis*).

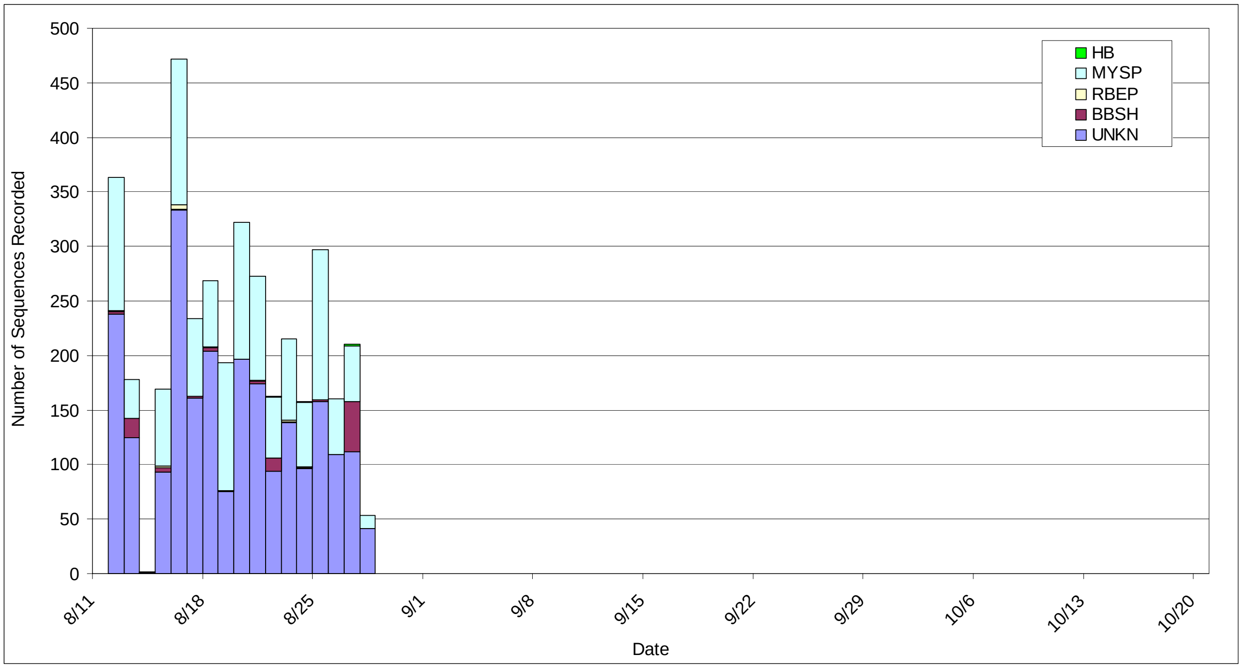



**Figure 3-4**. Nightly detections at the Briggs Hill Met Tree detector in August, 2008. UNKN (*unknown guild*); RBTB (*red bat/tri-colored bat)*; BBSH (*big brown/silver haired*); HB (*hoary bat*); MYSP (*myotis*).

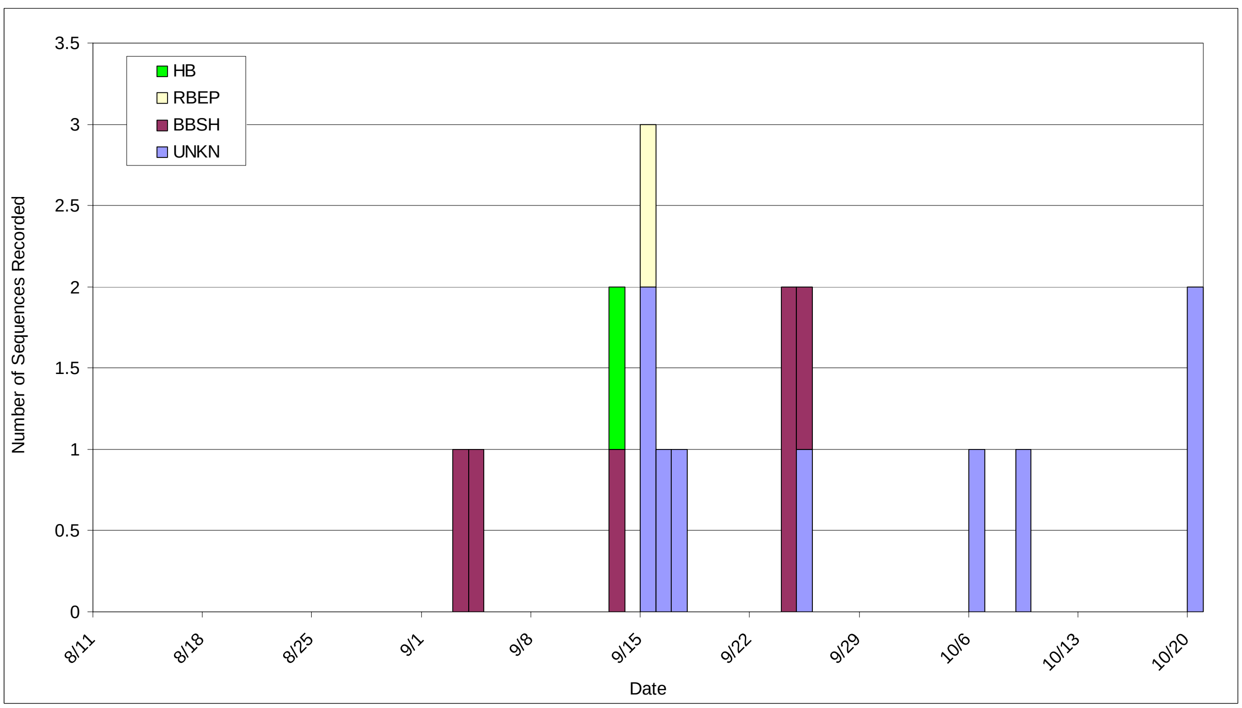



**Figure 3-5**. Nightly detections at the Highland Stewart South Met High detector from September through October, 2008. UNKN (*unknown guild*); RBTB (*red bat/tri-colored bat)*; BBSH (*big brown/silver haired*); HB (*hoary bat*); MYSP (*myotis*).

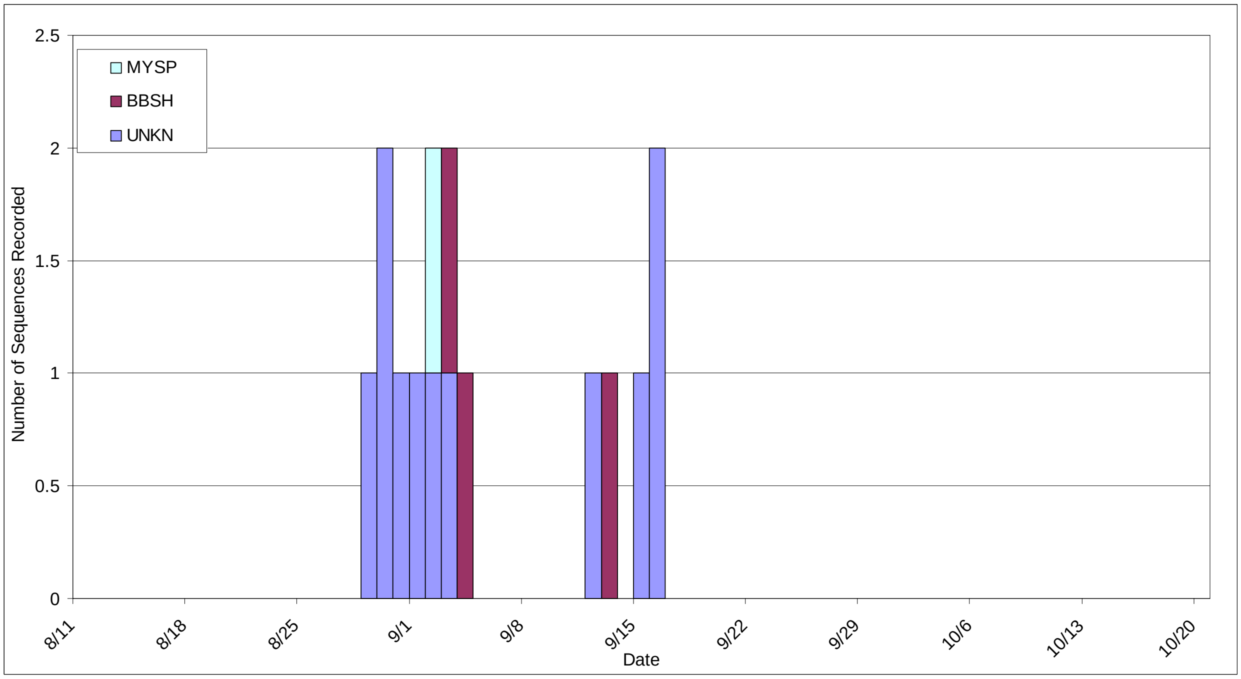



**Figure 3-6**. Nightly detections at the Highland Stewart South Met Low detector from late August through October, 2008. UNKN (*unknown guild*); RBTB (*red bat/tri-colored bat)*; BBSH (*big brown/silver haired*); HB (*hoary bat*); MYSP (*myotis*).

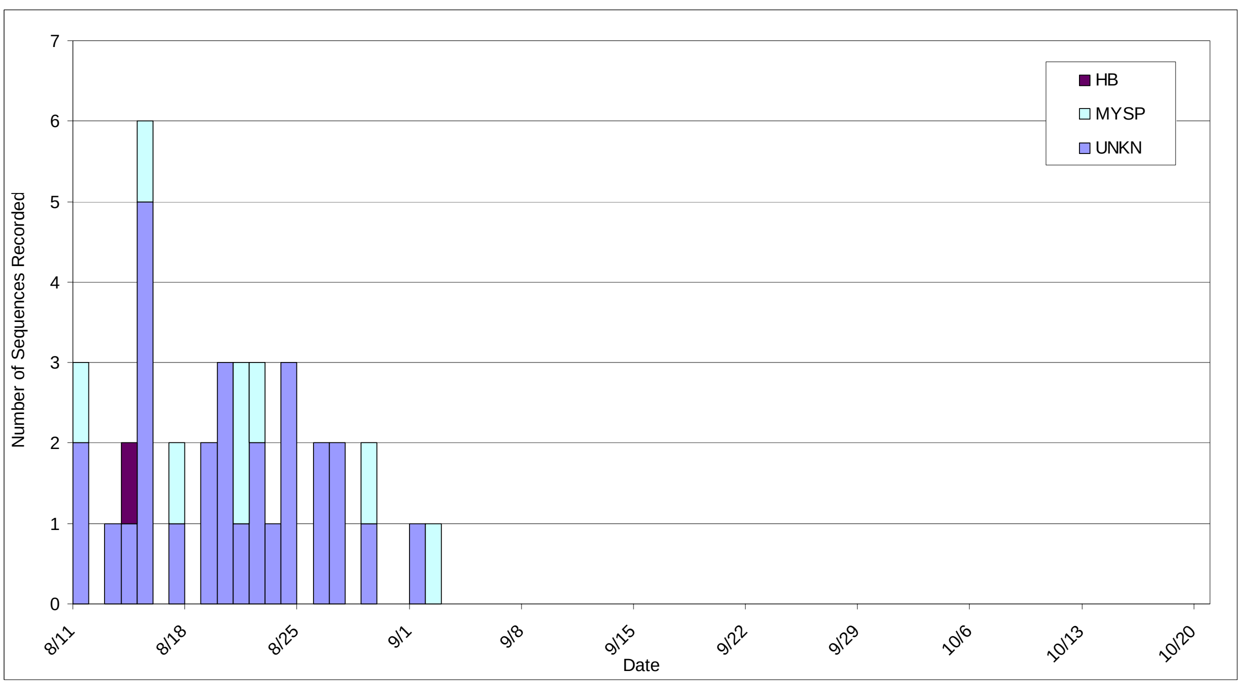



**Figure 3-7**. Nightly detections at the Highland Stewart South Met Tree detector from August through early September, 2008. UNKN (*unknown guild*); RBTB (*red bat/tri-colored bat)*; BBSH (*big brown/silver haired*); HB (*hoary bat*); MYSP (*myotis*).

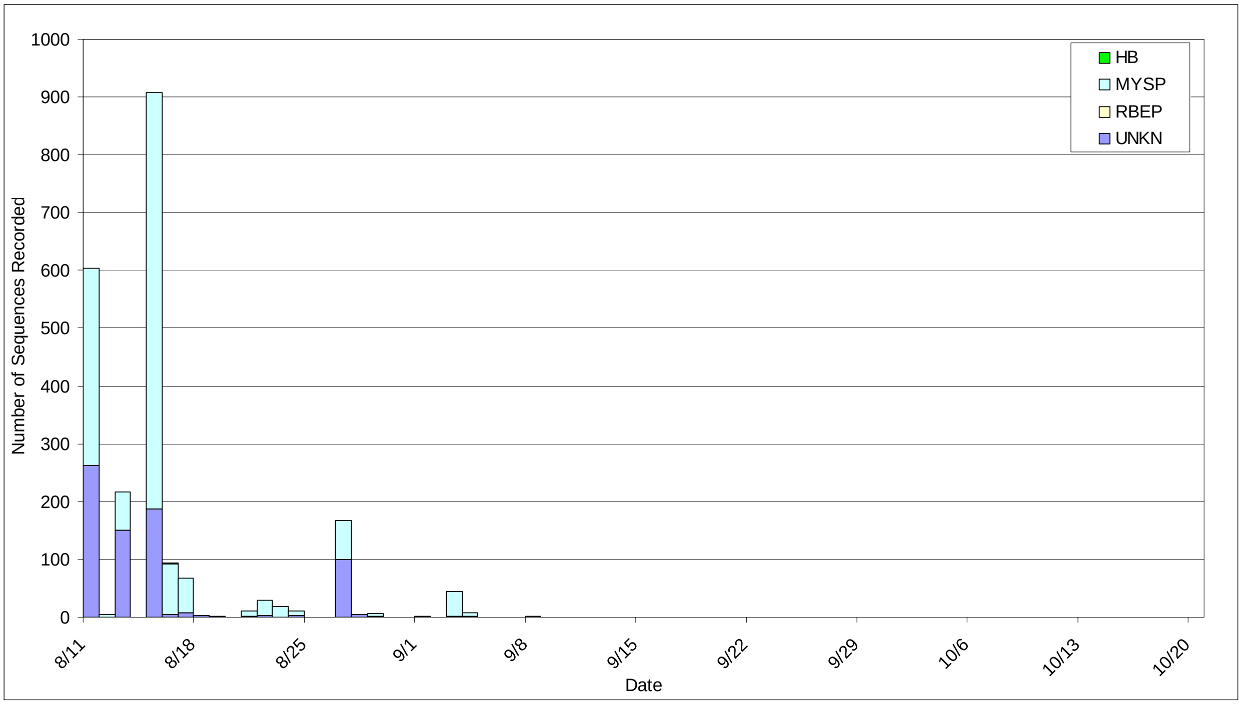



**Figure 3-8**. Nightly detections at the Highland Stewart North Met Tree detector from August through early September, 2008. UNKN (*unknown guild*); RBTB (*red bat/tri-colored bat)*; BBSH (*big brown/silver haired*); HB (*hoary bat*); MYSP (*myotis*).

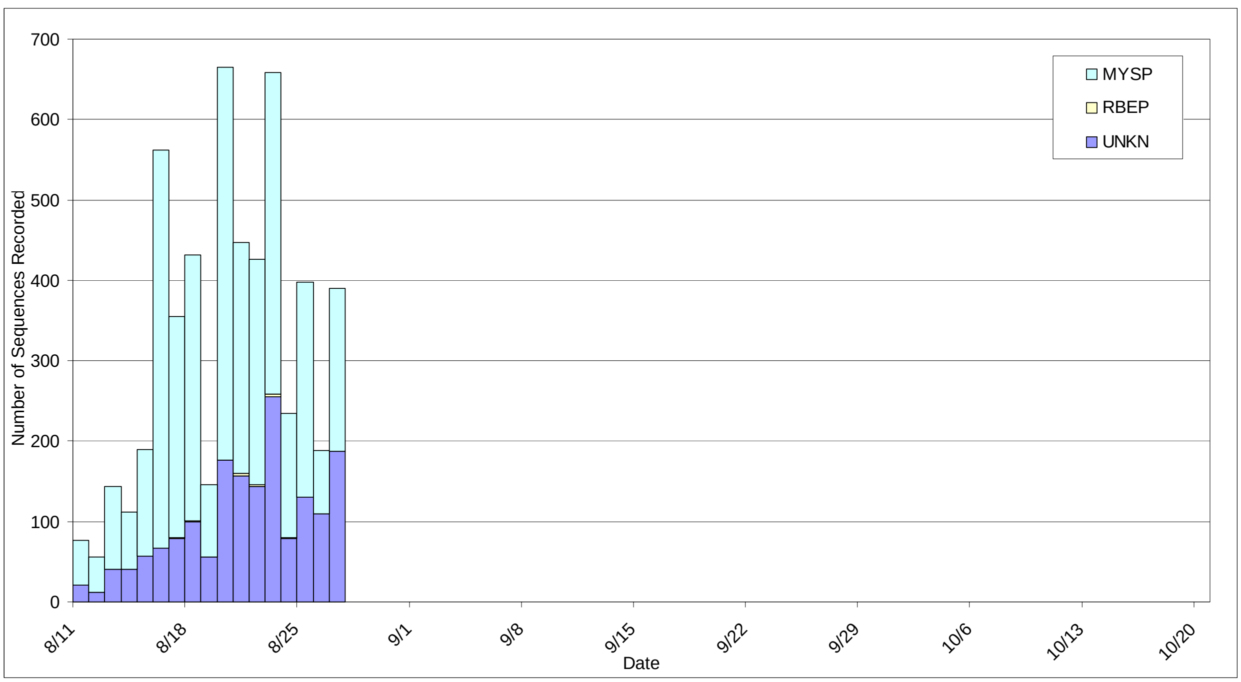



**Figure 3-9**. Nightly detections at the Highland Stewart Valley Tree detector in August, 2008. UNKN (*unknown guild*); RBTB (*red bat/tri-colored bat)*; BBSH (*big brown/silver haired*); HB (*hoary bat*); MYSP (*myotis*).

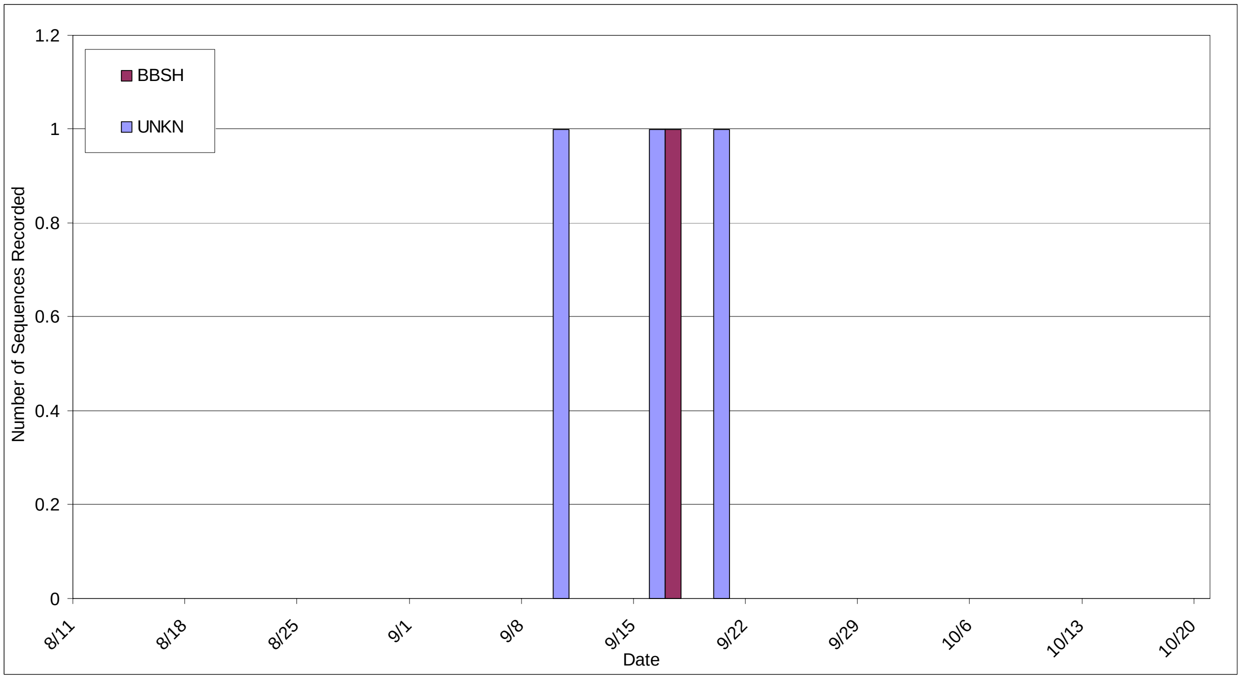



**Figure 3-10**. Nightly detections at the Highland Witham Met High detector from September through October, 2008. UNKN (*unknown guild*); RBTB (*red bat/tri-colored bat)*; BBSH (*big brown/silver haired*); HB (*hoary bat*); MYSP (*myotis*).

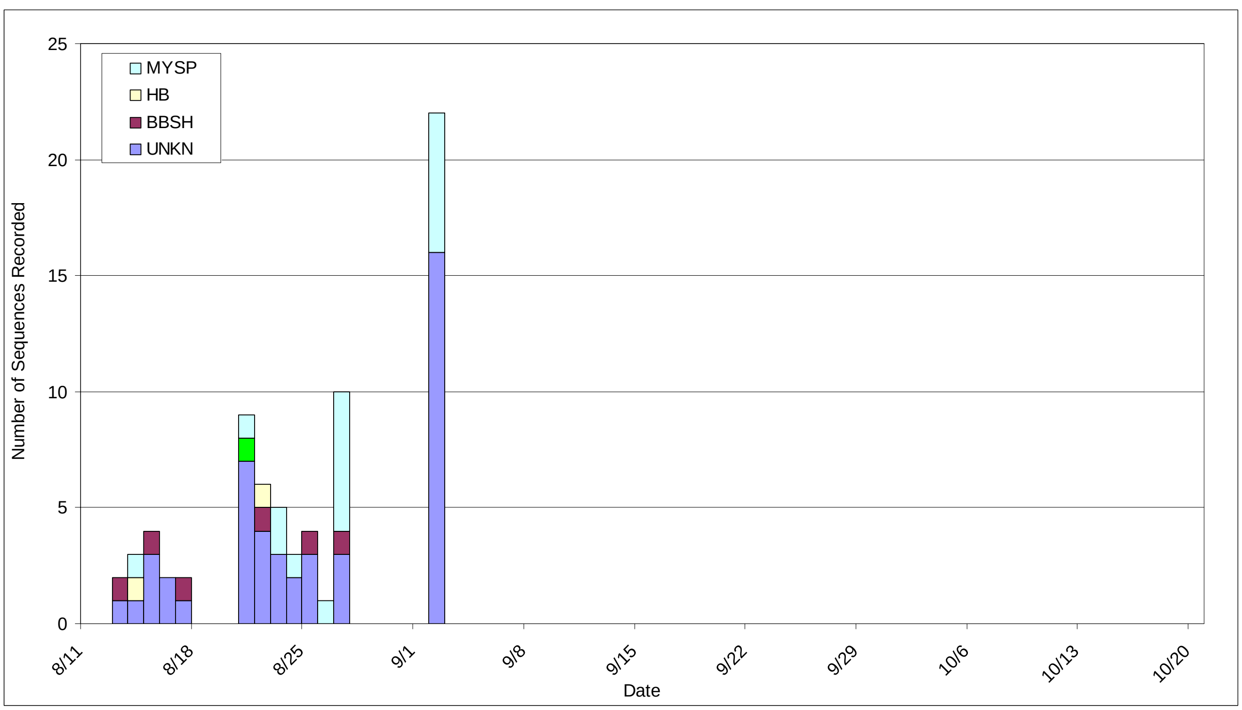



**Figure 3-11**. Nightly detections at the Highland Burnt Hill Tree detector from August through early September, 2008. UNKN (*unknown guild*); RBTB (*red bat/tri-colored bat)*; BBSH (*big brown/silver haired*); HB (*hoary bat*); MYSP (*myotis*).

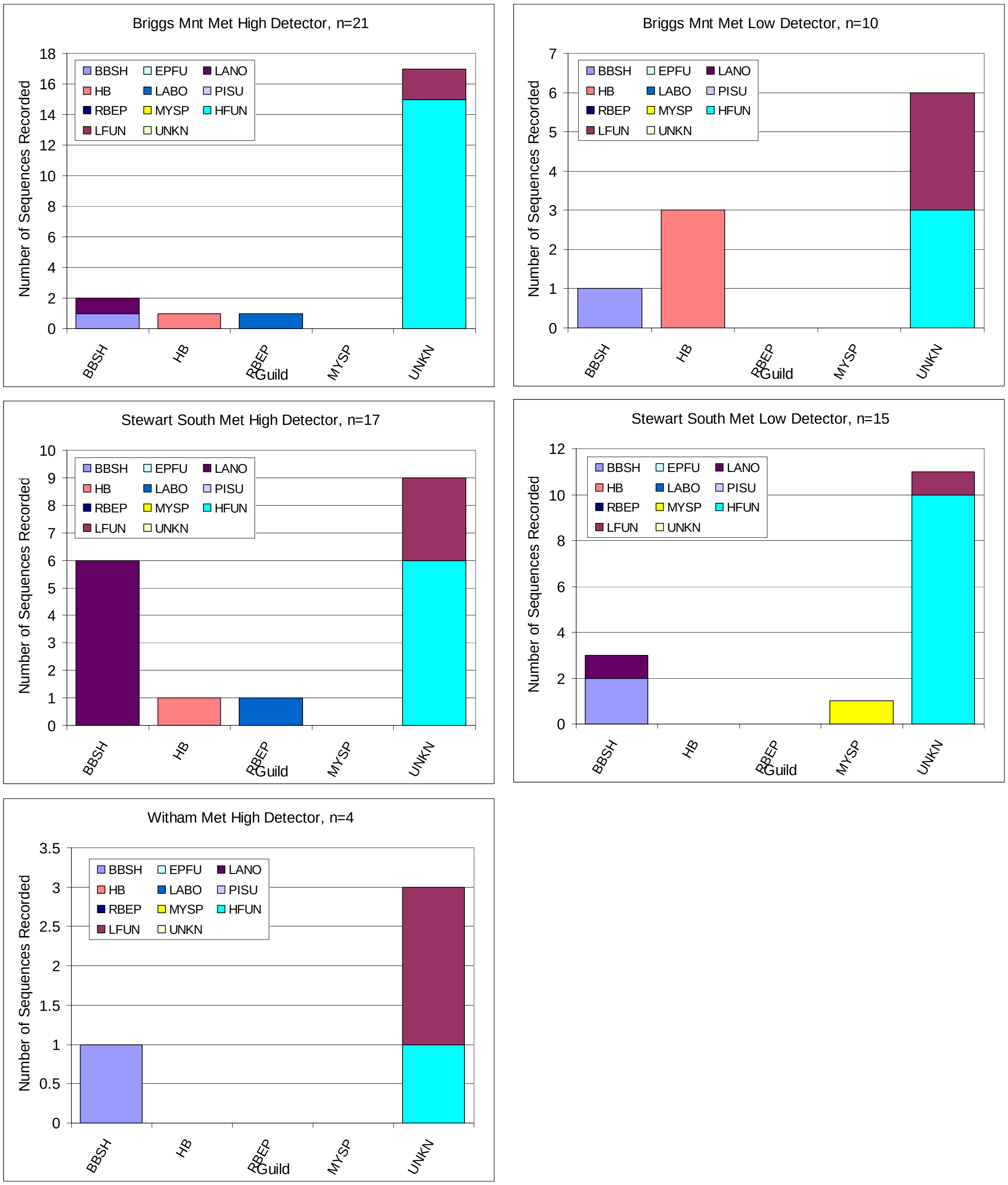



**Figure 3-12**. Number of guild and species detections at Highland met detectors from August through October, 2008. UNKN (*unknown guild*); RBTB (*red bat/tri-colored bat)*; BBSH (*big brown/silver haired*); HB (*hoary bat*); MYSP (*myotis*).

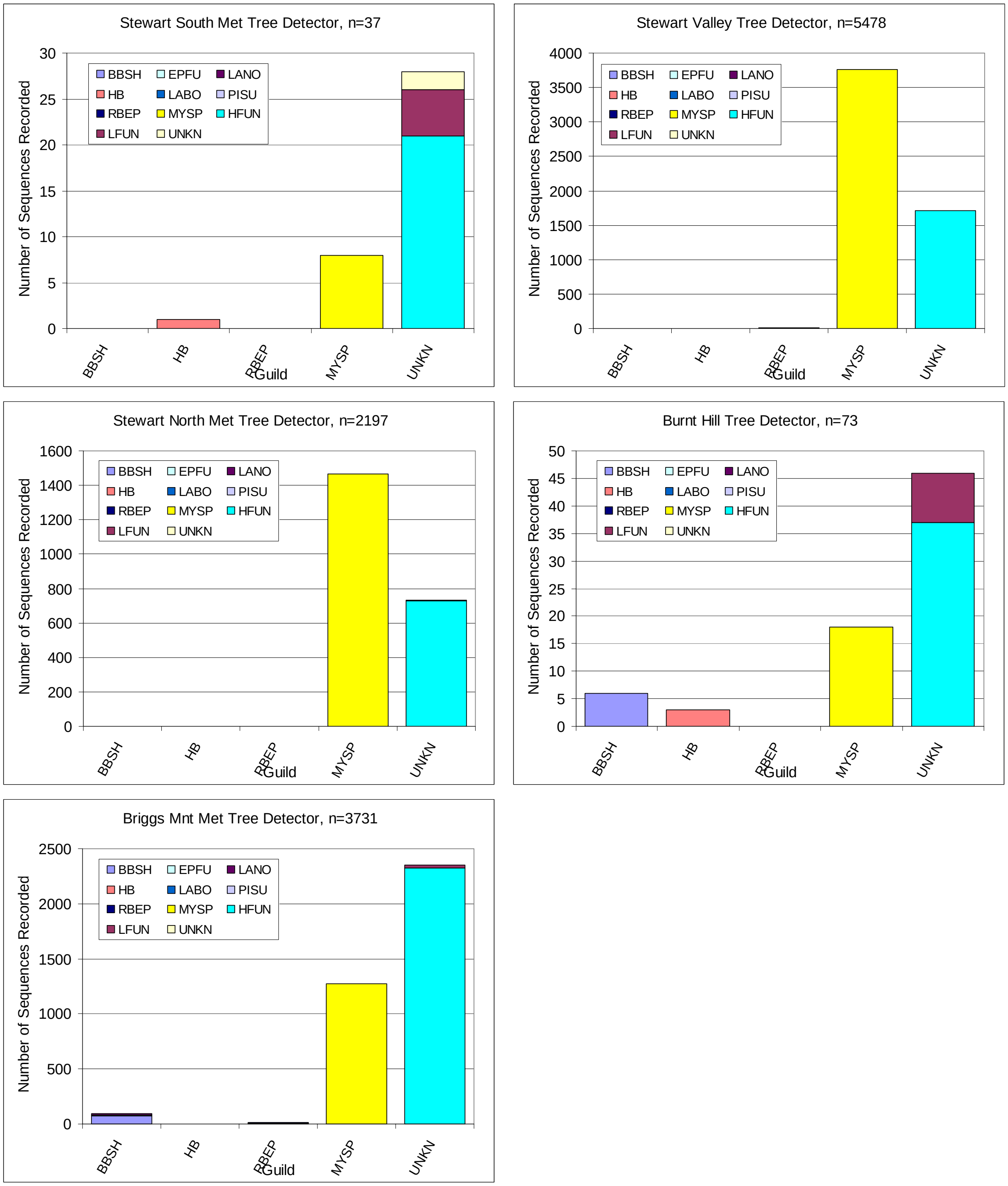



**Figure 3-13**. Number of guild and species detections at Highland ground-level detectors from August through October, 2008. UNKN (*unknown guild*); RBTB (*red bat/tri-colored bat)*; BBSH (*big brown/silver haired*); HB (*hoary bat*); MYSP (*myotis*).

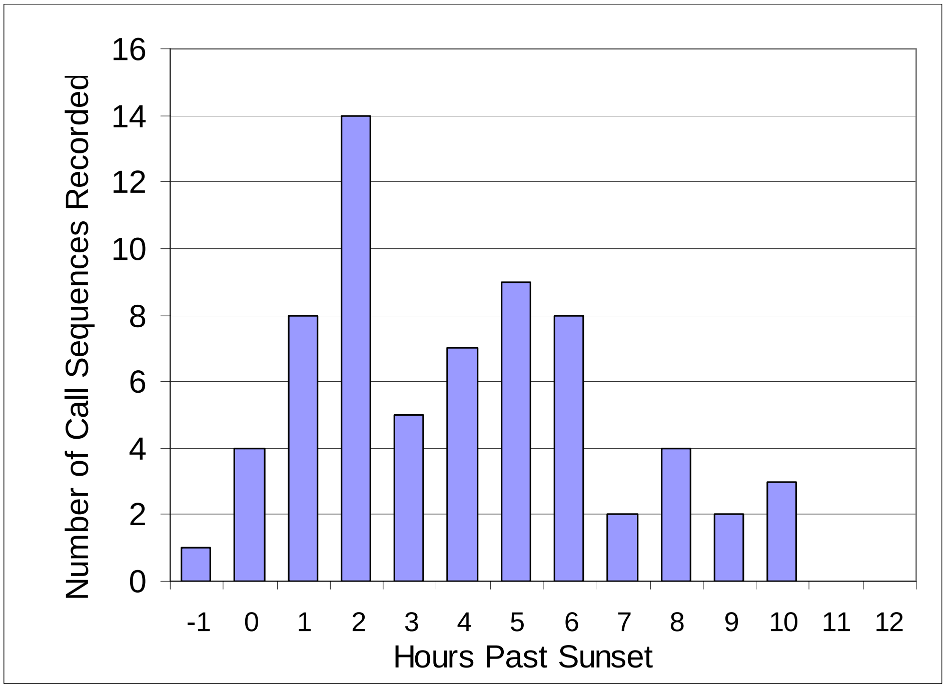



**Figure 3-14**. Distribution of hourly recorded call sequences at Highland Met Tower detectors from August through October, 2008.

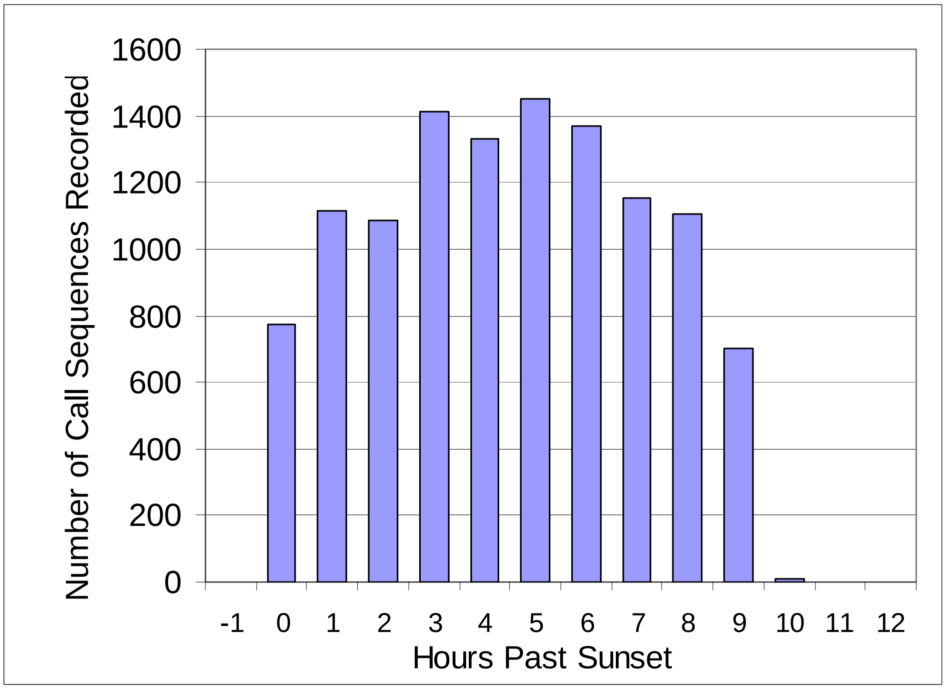



**Figure 3-15**. Distribution of hourly recorded call sequences at Highland ground level detectors from August through October, 2008.

Appendix B provides a series of tables with more specific information on the nightly timing, number, and species composition of recorded bat call sequences. Specifically, Appendix B

Tables 1 through 13 provide information on the number of call sequences, by guild and suspected species, recorded at each detector and the weather conditions for that night.

### 3.3.2 Weather Data

Mean nightly temperature during the sampling period varied from -1.7 to 20.3° C, with a mean of 10.2° C. Mean nightly wind speed varied from 1.7 to 15.5 m/s, with a mean of 7.4 m/s. Mean nightly barometric pressure varied from 911.5 to 955.1 mbar, with a mean of 933.1 mbar. Mean nightly temperature, wind speed, and barometric pressure values were plotted against nightly number of bat detections (Figure 3-16). Data were plotted separately for met tower detectors and ground-level detectors because bats may respond to weather conditions differently at various heights (Arnett *et al*. 2006). A qualitative look at scatter plots of these data show no evident relationships between mean nightly temperature, wind speed, or barometric pressure and nightly bat detections.

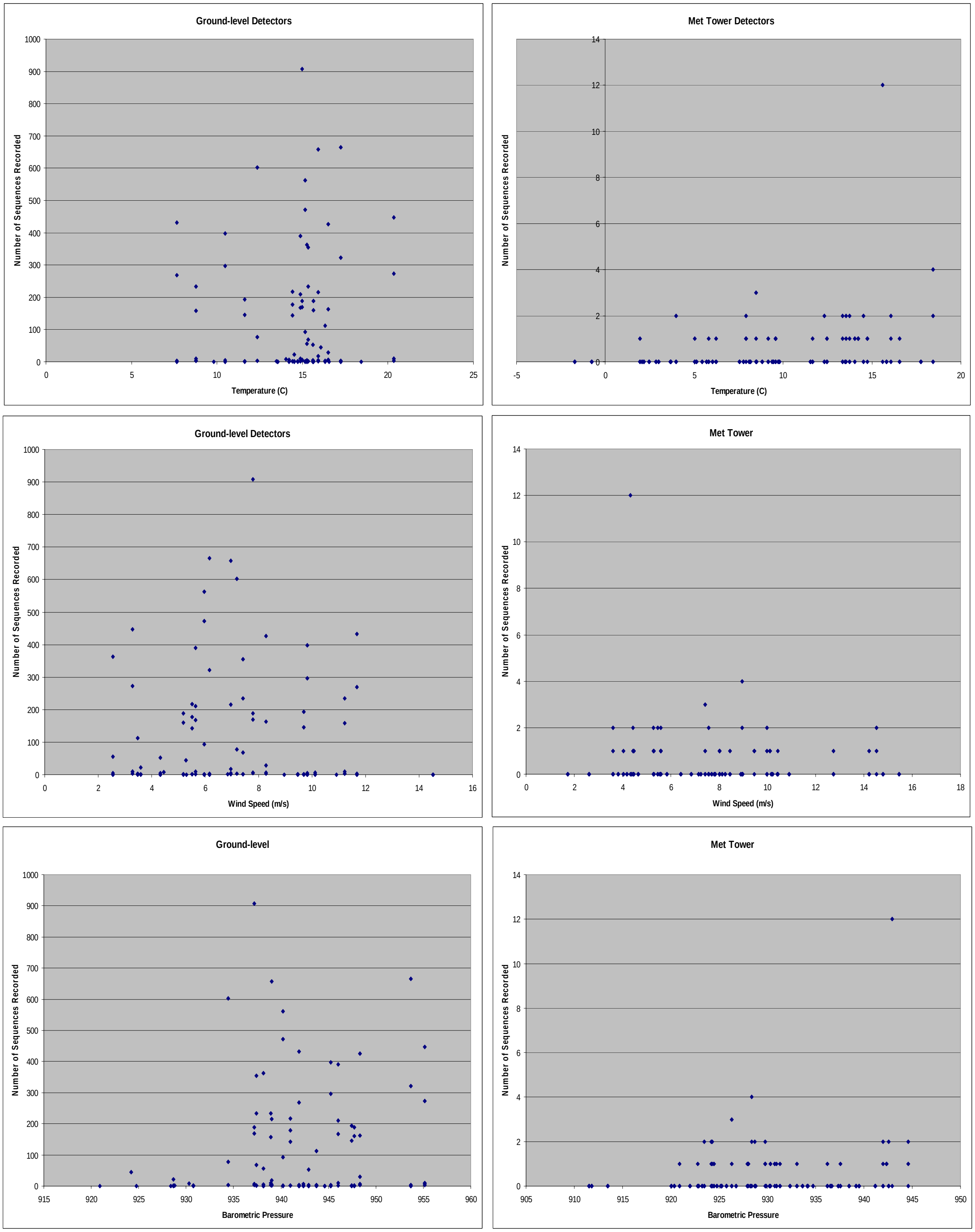



**Figure 3-16**. Nightly bat detections and mean nightly weather conditions at Highland bat detectors from August through October 2008.

## 3.4 DISCUSSION

Bat echolocation surveys provide some insight into possible activity patterns, species composition, and timing of movements of bats in the Project area. Variation in bat detections within and among detectors (Figures 3-2 through 3-15) illustrates the challenges associated with characterizing bat activity using acoustic detectors. However, some trends are evident based on patterns in timing and species composition of recorded call sequences.

Specifically, more than 99% of recorded sequences were collected at the tree detectors prior to being moved to the met towers. This difference in detection levels is likely a combination of several factors. First, the tree detectors were all placed at a height of 8 m (25') or less and therefore they were primarily picking up the activity of species that forage or are active closer to the ground. Based upon all of the call sequences collected during this field season, the highest percentage of identified calls (56.3%) were from genus *Myotis* and these species are more commonly detected beneath canopy level (Arnett *et al.* 2006). Putting these two factors together, the detectors placed in the trees were in a position to pick up more of the *Myotis* activity. Secondly, timing or seasonality of deployment also likely influenced call detection. Nightly activity rates at ground-level detectors were generally greatest during the first two weeks of sampling, and appeared to be generally declining by the end of August and early September when the detectors were moved to the met towers (Figures 3-2 to 3-11). Given the emerging relationship between bat activity and temperature at ground-level detectors documented in recent studies (Arnett *et al*. 2006), it is likely that ground-level detectors would have documented a substantial decline in activity during September and October had they remained deployed, since nightly average temperatures from September through October averaged only 8.6° C, with only 32 percent of nights having average nightly temperatures over 10° C.

Also of interest is the effect of wind speed and barometric pressure on bat detections and bat mortalities at wind developments. Acoustic surveys have documented a decrease in bat activity (or mortality) rates as wind speed increases, and as barometric pressure decreases (Arnett *et al*. 2005, Arnett *et al*. 2006, Arnett *et al*. 2008, Reynolds 2006). These patterns suggest that bats are more likely to migrate on nights with low wind speeds (less than 4 to 6 m/s) and high barometric pressure. No evident relationships were observed between wind speed and bat activity at this Project area.

Nightly trends in mean detections and mean weather conditions mask small-scale variation that occurs within a night. There are many factors driving such small-scale variation in hourly number of recordings, one of which is that most North American bats species emerge from their roost in large numbers shortly after dusk, periodically returning to their roosts for short periods during the night (see Hayes 1997 and cited references). This night-roosting behavior results in relatively higher activity levels shortly after dusk, when bats have not eaten or drank in many hours, and again just before dawn when many individuals will forage and drink again before returning to their roost for daylight hours. Although this bimodal trend in hourly activity rates is seen in many studies, this was not the case at the Highland site. Data from ground-level detectors showed a normal distribution of detections, and data from met towers showed an erratic pattern in hourly detections. While the erratic pattern documented at met detectors may be a result of low sample size, a much larger quantity of data were collected from ground-level detectors. Data are insufficient to explain why hourly detections at ground-level detectors were greatest 3-7 hours after sunset, but may be a reflection of high foraging activity at that period of the night.

Differences in detection rates between guilds at the various detector locations may reflect varying vertical distribution and habitat preferences of bat species (Arnett *et al*. 2006, Hayes 2000). Recent research using Anabat detectors recorded *Myotis* species more frequently at lower heights and larger species such as big brown and hoary bats were more frequently detected at greater heights (Arnett *et al*. 2006). This general trend matches the guild compositions reported in Figures 3-12 and 3-13. However, interpretation of guild composition is confounded by the high number of UNKN call sequences. Unknown call sequences could not be identified to guild or species due to short call sequences (less than five pulses) or poor call signature formation, often a result of bats flying at the edge of the detection zone of the detector or flying away from the microphone. The relatively small area sampled by bat detectors makes scenarios leading to un-identifiable call sequences common, but some information can still be gleaned from these poor recordings.

Specifically, 99 percent of UNKN sequences were identified as being HFUN, nearly all of which likely consist of red bats, pipistrelles, and *Myotis* species, since these species nearly always produce ultrasound sequences greater than 30 kHz. Of those HFUN calls, 99 percent of HFUN sequences were recorded at ground-level detectors. Because *Myotis* species are more frequently detected beneath the canopy level (Arnett *et al*. 2006), the inference is that the majority of HFUN sequences represent *Myotis* species. Conversely, the majority of HFUN sequences recorded at tower detectors (1% of HFUN sequences) are most likely red bats or tri-colored bats.

Qualitatively speaking, acoustic surveys at the Project site mirror similar surveys conducted in the Northeast during the fall. Specifically, detection rates at detectors suspended from met towers were low (less than 1 r/d/n), and detectors operating at ground-level exhibited tremendous variation, ranging from less than 10 to over 300 r/d/n. This type of variation reflects differing conditions (habitat, microclimates, etc.) and differing timing of operation among detectors. Thus, variability in bat activity, with generally low detection rates above canopy height, at the Highland site are consistent with the results of publicly available acoustic surveys conducted at other proposed wind developments in the northeast (Table 3-4).

**Table 3-4.** Summary of available fall bat detector surveys (results reported for individual detectors)

| Year | Project | State | City | Habitat | Height (m) | Detector Nights | Start | End | Calls | Rate | Reference |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Tree or Low Tower detectors (10 m or below)** | | | | | | | | | | | |
| 2005 | Clayton | NY | Clayton | forest edge | 2 | 33 | 8/19 | 9/20 | 154 | 4.7 | Woodlot 2005m |
| 2005 | High Sheldon | NY | Sheldon | field | 2 | 49 | 8/1 | 10/4 | 5535 | 113 | Woodlot 2005n |
| 2005 | Howard | NY | Howard | field | 2 | 25 | 8/3 | 8/27 | 1493 | 51.5 | Woodlot 2005o |
| 2005 | Jordanville | NY | Jordanville | field | 2 | 34 | 8/12 | 9/22 | 124 | 4.4 | Woodlot 2005q |
| 2005 | Lempster | NH | Lempster | forest edge | 7.5 | 34 | 9/20 | 10/31 | 27 | 0.8 | Woodlot 2005d |
| 2005 | Lempster | NH | Lempster | forest edge | 2 | 42 | 9/20 | 10/31 | 2 | 0 | Woodlot 2005d |
| 2005 | Marble River/Churubusco | NY | Churubusco | field | 10 | 34 | 8/1 | 10/11 | 150 | 4.4 | Woodlot 2005l |
| 2005 | Marble River/Churubusco | NY | Churubusco | field | 2 | 18 | 8/1 | 10/11 | 113 | 6.3 | Woodlot 2005l |
| 2005 | Stamford/Moresville | NY | Stamford | forest edge | 2 | 58 | 8/15 | 10/15 | 280 | 4.8 | Woodlot 2005e |
| 2005 | Top Notch | NY | Fairfield | field | 2 | 34 | 8/19 | 9/21 | 44 | 1.3 | Woodlot 2005p |
| 2005 | West Hill | NY | Munnsville | field | 2 | 30 | 8/1 | 10/21 | 10 | 0.3 | Woodlot 2005r |
| 2006 | Lempster | NH | Lempster | forest edge | 10 | 29 | 9/9 | 10/24 | 2 | 0.1 | Woodlot 2007a |
| 2006 | Lempster | NH | Lempster | forest edge | 3 | 44 | 9/9 | 10/24 | 384 | 8.7 | Woodlot 2007a |
| **MET Tower Detectors** | | | | | | | | | | | |
| 2005 | Dans Mountain | MD | Loarville | forest edge | 11 | 53 | 8/1 | 9/22 | 574 | 10.8 | Woodlot 2005a |
| 2006 | Brandon | NY | Brandon | field | 12 | 62 | 7/25 | 10/4 | 1287 | 20.8 | Woodlot 2006j |
| 2005 | Clayton | NY | Clayton | forest edge | 30 | 0 | 8/19 | 9/20 | 0 | 0 | Woodlot 2005m |
| 2005 | Dans Mountain | MD | Loarville | forest edge | 23 | 31 | 8/1 | 9/22 | 388 | 12.5 | Woodlot 2005a |
| 2005 | High Sheldon | NY | Sheldon | field | 15 | 65 | 8/1 | 10/4 | 335 | 5.2 | Woodlot 2005n |
| 2005 | High Sheldon | NY | Sheldon | field | 30 | 58 | 8/1 | 10/4 | 137 | 2.4 | Woodlot 2005n |
| 2005 | Howard | NY | Howard | field | 30 | 13 | 8/3 | 8/19 | 30 | 2.3 | Woodlot 2005o |
| 2005 | Howard | NY | Howard | field | 27 | 15 | 8/3 | 8/14 | 30 | 2 | Woodlot 2005o |
| 2005 | Jordanville | NY | Jordanville | field | 15 | 34 | 8/12 | 9/22 | 143 | 4.2 | Woodlot 2005q |
| 2005 | Jordanville | NY | Jordanville | field | 30 | 41 | 8/12 | 9/22 | 255 | 6.2 | Woodlot 2005q |
| 2005 | Marble River/Churubusco | NY | Churubusco | field | 20 | 39 | 8/1 | 10/11 | 243 | 6.2 | Woodlot 2005l |
| 2005 | Stamford/Moresville | NY | Stamford | forest edge | 15 | 43 | 8/15 | 10/15 | 293 | 6.8 | Woodlot 2005e |
| 2005 | Stamford/Moresville | NY | Stamford | forest edge | 30 | 54 | 8/15 | 10/15 | 285 | 5.3 | Woodlot 2005e |
| 2005 | Top Notch | NY | Fairfield | field | 15 | 34 | 8/19 | 9/21 | 30 | 0.9 | Woodlot 2005p |
| 2005 | Top Notch | NY | Fairfield | field | 30 | 34 | 8/19 | 9/21 | 99 | 3 | Woodlot 2005p |
| 2005 | West Hill | NY | Munnsville | field | 15 | 47 | 8/1 | 10/21 | 179 | 3.8 | Woodlot 2005r |
| 2005 | West Hill | NY | Munnsville | field | 30 | 52 | 8/1 | 10/21 | 106 | 2 | Woodlot 2005r |
| 2006 | Kibby | ME | Eustis | forest edge | 45 | 72 | 6/20 | 10/25 | 18 | 0.3 | Woodlot 2006m |
| 2006 | Kibby | ME | Eustis | forest edge | 45 | 76 | 6/20 | 10/25 | 0 | 0 | Woodlot 2006m |
| 2006 | Kibby | ME | Eustis | forest edge | 20 | 44 | 6/20 | 10/25 | 4 | 0.1 | Woodlot 2006m |
| 2006 | Kibby | ME | Eustis | forest edge | 45 | 20 | 6/20 | 10/25 | 0 | 0 | Woodlot 2006m |
| 2005 | Lempster | NH | Lempster | forest edge | 15 | 42 | 9/20 | 10/31 | 14 | 0.3 | Woodlot 2005d |
| 2006 | Lempster | NH | Lempster | forest edge | 40 | 43 | 9/9 | 10/24 | 16 | 0.4 | Woodlot 2007a |
| 2006 | Redington | ME | Redington | forest edge | 15 | 21 | 8/10 | 10/24 | 0 | 0 | Woodlot 2005u |
| 2006 | Redington | ME | Redington | forest edge | 15 | 48 | 8/10 | 10/24 | 0 | 0 | Woodlot 2005u |
| 2006 | Redington | ME | Redington | forest edge | 30 | 29 | 8/10 | 10/24 | 0 | 0 | Woodlot 2005u |
| 2006 | Redington | ME | Redington | forest edge | 30 | 37 | 8/10 | 10/24 | 0 | 0 | Woodlot 2005u |
| 2006 | Stetson | ME | Danforth | forest edge | 30 | 73 | 6/28 | 10/16 | 8 | 0.1 | Woodlot 2007b |
| 2006 | Stetson | ME | Danforth | forest edge | 30 | 76 | 6/28 | 10/16 | 170 | 2.2 | Woodlot 2007b |
| 2006 | Steuben | NY | Hartsville | field | 15 | 76 | 7/26 | 10/10 | 119 | 1.6 | EDR 2006b |
| 2006 | Steuben | NY | Hartsville | field | 30 | 49 | 7/26 | 10/10 | 84 | 1.7 | EDR 2006b |
| 2006 | Wethersfield | NY | Wethersfield | field | 15 | 54 | 7/25 | 10/9 | 0 | 0 | Woodlot 2006l |
| 2006 | Wethersfield | NY | Wethersfield | field | 30 | 26 | 7/25 | 10/9 | 22 | 0.8 | Woodlot 2006l |
| 2006 | Stetson | ME | Danforth | forest edge | 15 | 105 | 6/28 | 10/16 | 108 | 1 | Woodlot 2007b |
| 2006 | Stetson | ME | Danforth | forest edge | 15 | 107 | 6/28 | 10/16 | 651 | 6.1 | Woodlot 2007b |
| 2006 | Brandon | NY | Brandon | field | 25 | 72 | 7/25 | 10/4 | 464 | 6.4 | Woodlot 2006j |
| 2006 | Centerville | NY | Centerville | field | 15 | 48 | 7/25 | 10/10 | 2 | 0 | Woodlot 2006l |
| 2006 | Centerville | NY | Centerville | field | 35 | 41 | 7/25 | 10/10 | 3 | 0.1 | Woodlot 2006l |
| 2006 | Chateaugay | NY | Chateaugay | field | 40 | 58 | 7/25 | 10/4 | 173 | 3 | Woodlot 2006j |
| 2006 | Chateaugay | NY | Chateaugay | field | 20 | 44 | 7/25 | 10/4 | 345 | 7.8 | Woodlot 2006j |
| 2006 | Dutch Hill | NY | Cohocton | field | 15 | 43 | 8/12 | 10/11 | 46 | 1.1 | Woodlot 2006c |
| 2006 | Dutch Hill | NY | Cohocton | field | 30 | 47 | 8/12 | 10/11 | 57 | 1.2 | Woodlot 2006c |

When considering the level of activity documented at the Project from August to October, it is important to acknowledge that numbers of recorded bat call sequences are not necessarily correlated with number of bats in an area. Acoustic detectors do not allow for differentiation between a single bat making multiple passes and multiple bats each recorded a single time (Hayes 2000). Thus, results of acoustic surveys must be interpreted with caution. However, the discussed patterns in peak timing of detection rates, and patterns of species may be useful for understanding activity levels of bats during the fall migration period and the summer.

# 4.0 Diurnal Raptor Surveys

## 4.1 INTRODUCTION

The Highland Wind Project area is located in the eastern portion of the "Eastern Continental Hawk Flyway,[5]" which extends from the Canadian Maritimes south to eastern Florida. Within this large area, raptors tend to concentrate along linear ridges, which create updrafts or "thermals" that raptors can use to fly long distances with minimal exertion (Berhold 2001). Designated by the state, the Western Maine Mountains biophysical region is an area of varied topography, with high peaks, plateaus, steep sided valleys, and foothills (McMahon 1990).

In coordination with the Maine Department of Inland Fisheries and Wildlife (MDIFW), Stantec designed and conducted fall diurnal raptor surveys at the Highland Wind Project to identify potential popular migration corridors and document species specific flight and behavioral patterns near the Project area. The surveys were conducted during the fall migration season for 15 days from early September to late October.

## 4.2 METHODS

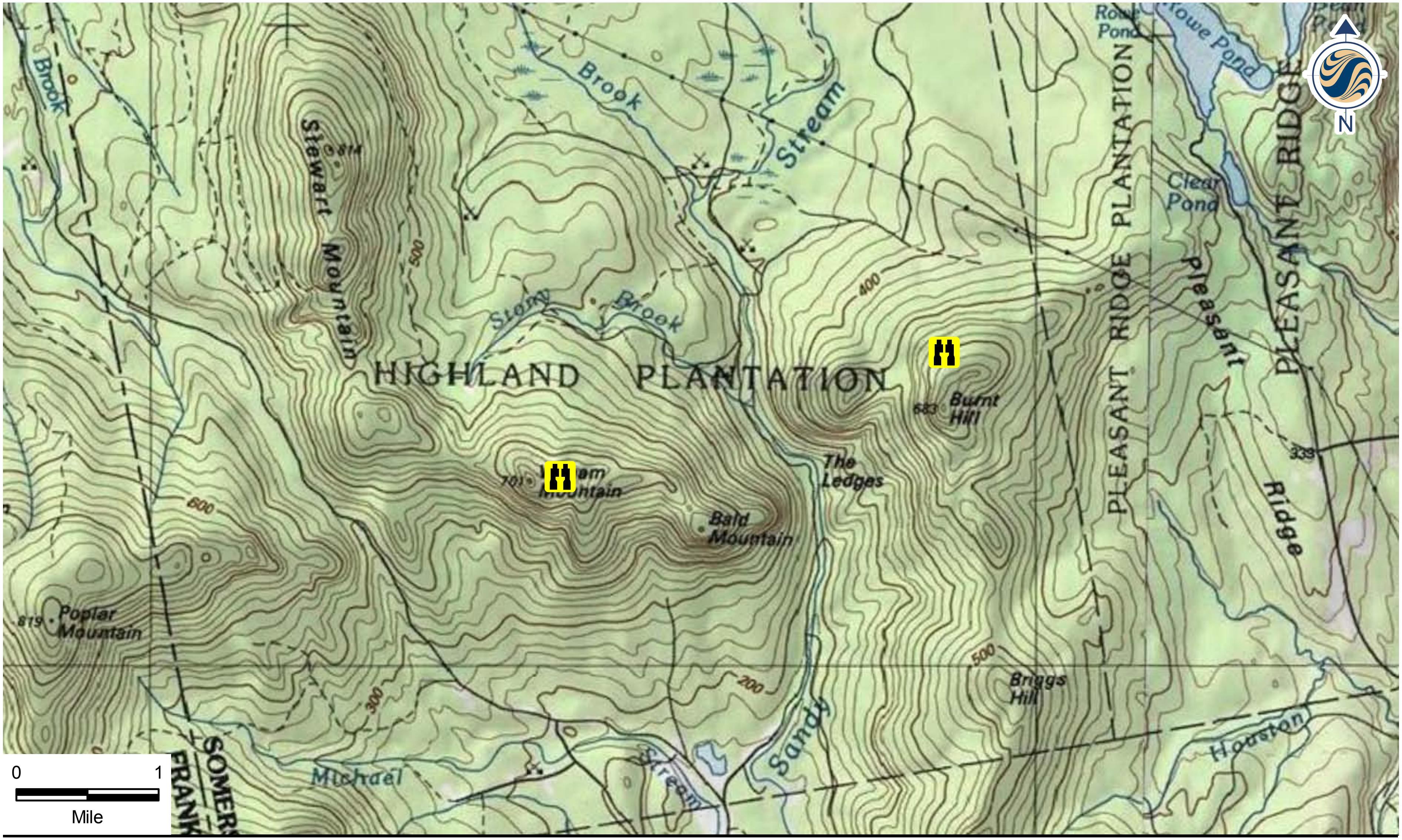
### 4.2.1 Field Surveys

Raptor surveys were conducted in two locations in the Project area. Two locations were discussed and chosen in coordination with MDIFW to provide adequate coverage the project area. The first was located in the clearing under the existing met tower on the summit of Witham Mountain and the other was located in the clearing under the existing met tower on Burnt Hill. Together these two locations afforded views of most of the Project area. Due to its topography and relatively low tree height, Witham Mountain location provided an excellent 360 degree view. The Burnt Hill location also afforded excellent views, although views to the south were slightly obstructed by trees and topography and views to the east were somewhat obstructed by trees (Figure 4-1). The majority of sampling occurred from the summit of Witham Mountain; however, 5 of the 15 survey days were sampled simultaneously with two observers

[5] The Eastern Continental Flyway includes the Maritime Provinces; New England; New York (south and east of a line from Jamestown to Utica to the north end of Lake Champlain); Pennsylvania (all except Erie County); Mid-Atlantic States through Georgia, West Virginia, Kentucky and Tennessee; Florida east of a line from Lake Seminole south to Apalachicola (Kellogg 2007).

(one at each survey location). Because views south from Burnt Hill were somewhat obstructed, there was limited overlap in birds that could be viewed from both locations. In addition, observers coordinated during the course of the simultaneous surveys using cell phone communication to reduce the likelihood that they were counting the same birds.

Surveys were conducted from 9 am to 4 pm, in order to include the time of day when the strongest thermal lift is produced and the majority of raptor migration activity typically occurs. Fall raptor surveys were generally conducted on days with favorable flight conditions, which typically occur on days following the passage of weather fronts or low-pressure systems causing northerly winds.

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**Legend**

Raptor Survey Location

**Client/Project**

**Highland Wind, LLC**
**Highland Wind Project**
**Highland Plantation, Maine**

Figure No.
4-1

Title
Raptor Survey Location Map
November 5, 2009

00385-F501-Raptor-Location-Map.mxd

Surveys were based on Hawk Migration Association of North America (HMANA) methods (HMANA 2007). During surveys, observers scanned the sky and surrounding landscape for raptors with binoculars and a spotting scope. Observations were recorded onto HMANA data sheets, which summarize the raptor count data by hour. Hourly weather observations, including wind speed and direction, temperature, percent cloud cover, and precipitation were recorded. Detailed notes for each observation were recorded on separate datasheets and Project area maps, including:

- The flight position(s) in relation to the ridge for each bird;
- The general flight path of each bird relative to topographic maps of the Project area;
- The minimum and maximum flight height for birds observed within 1 km-radius circle around the observer;
- An estimate of flight height for birds observed outside of 1 km-radius circle around the observer;
- The flight azimuth (in relation to true North); and
- Notes describing the general activity of the bird.

Flight positions were summarized into 4 categories: A) flight path directly over the ridge (A1-parallel to the ridge, A2-perpendicular to the ridge, or A3-over a saddle), B) flight path over upper slope of ridge, C) flight path over lower slope of ridge, and D) flight path over a valley (see Figure 3-2 below). As individual birds traveled through or in the vicinity of the Project, all position categories in which a bird occurred were recorded.

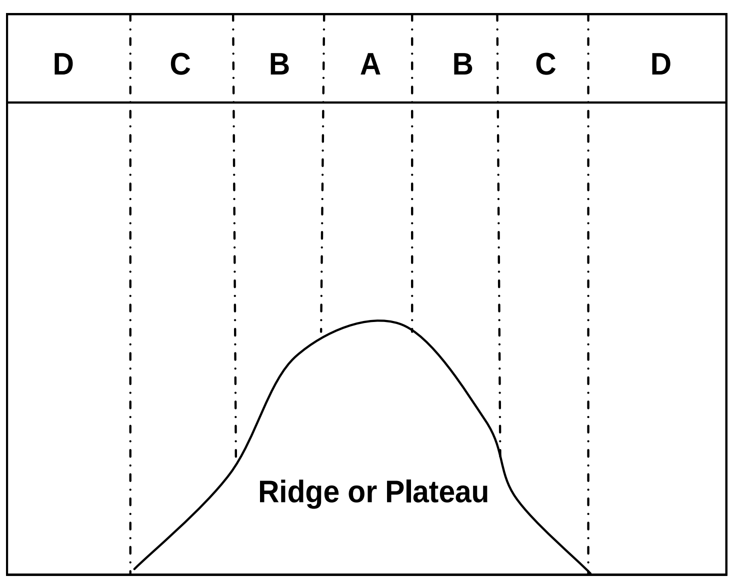


**Figure 3-2**. Raptor flight position categories within the Project area

Birds that flew too rapidly or were too far to accurately identify were recorded as unidentified to their genus or, if the identification of genus was not possible, unidentified raptor. Priority was given to raptor observations; however observers collected incidental data for other avian species observed including passerines and water birds.

### 4.2.2 Data Analysis

Results from raptor surveys were analyzed to derive the following summaries:

- Total number of individuals and species observed during each survey day and for the entire survey period;
- Total number of individuals observed flying above or below 130.5 m for each species observed within a 1 km-radius circle from the observer;
- Average flight height of birds observed outside of 1 km-radius circle from the observer;
- Number of birds suspected to be resident;
- The horizontal position of observed raptors with respect to the location of proposed turbines; and
- Hourly observation rate (birds per hour) for each survey day and for the entire survey period.

Flight height of each bird observed within 1 km was categorized as less than or greater than 130.5m (428') above ground level, which is the approximate height of the proposed wind turbines. The mapped flight paths and recorded flight positions were reviewed to identify any general patterns for migrants in the vicinity of the Project area.

Observations from the Project were compared to data from regional HMANA hawk watch sites (Appendix C, Table 4). The regional hawk watch sites included for comparison are: Cadillac Mountain, ME; Little Round Top, NH; Pack Monadnock, NH; Allegheny Front, PA; Hawk Mountain, PA; Barre Falls, MA; Shatterack Mountain, MA; and Montreal West Island, QC. Also provided for comparison are the results of available regional surveys conducted at proposed wind farms located in New York, Vermont, New Hampshire and Maine (Appendix C, Table 5).

## 4.3 RESULTS

Between September 3 and October 21, 2008, Stantec conducted raptor surveys on 15 days (five of which were performed simultaneously by observers in two different locations) for a total of135 survey hours. Most surveys were conducted on clear days allowing for optimal visibility. Temperatures ranged from 0 to 24°C (32 to 75°F) during the survey period. Wind speeds during the survey period ranged from 0 to 24 km/h (0 to 15 mph); the average wind speed was 19 km/h (12 mph). Wind direction was variable throughout the survey days; however, the majority of days had winds from a northerly direction which is favorable for fall migration. Wind direction did not appear to affect the number of raptors seen per day; however, the peak day (n=87) occurred on September 15 when very light winds were predominantly from the west-northwest (Figure 3-3; Appendix B, Table 1).

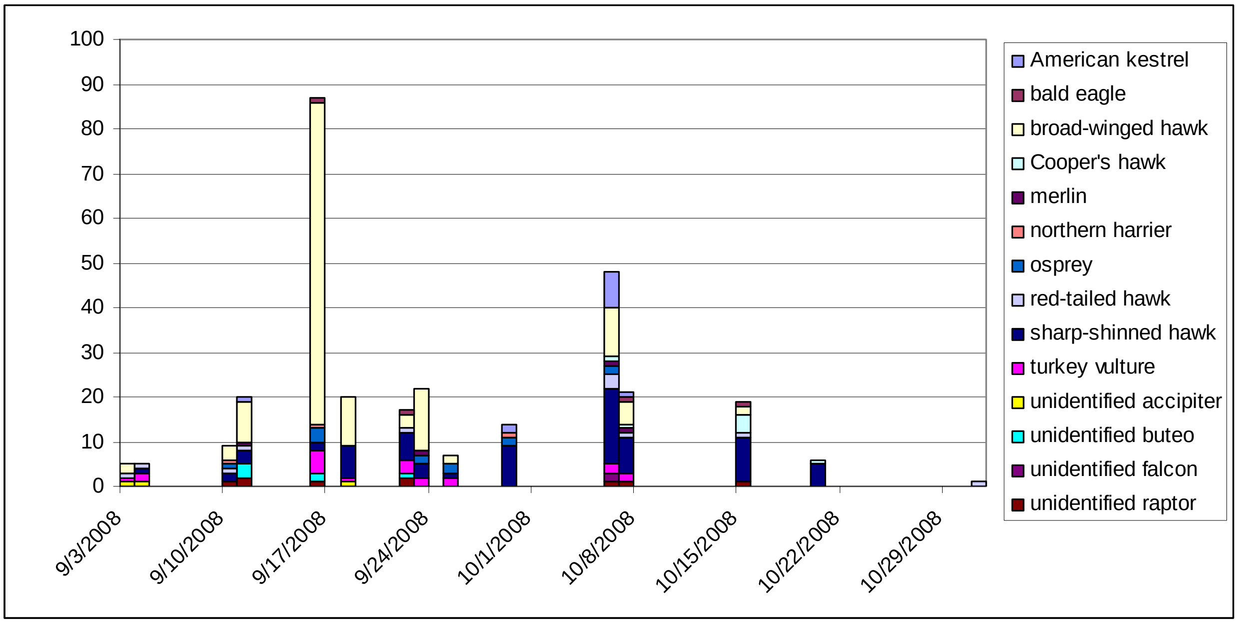


**Figure 4-3.** Total number of birds observed by species per survey day Fall 2008.

On a daily basis, the majority of observations occurred between 10:00 am and 4:00 pm; the peak activity hour was between 11:00 am and 12:00 pm, during the peak period of thermal development (Figure 4-4; Appendix B, Table 2).

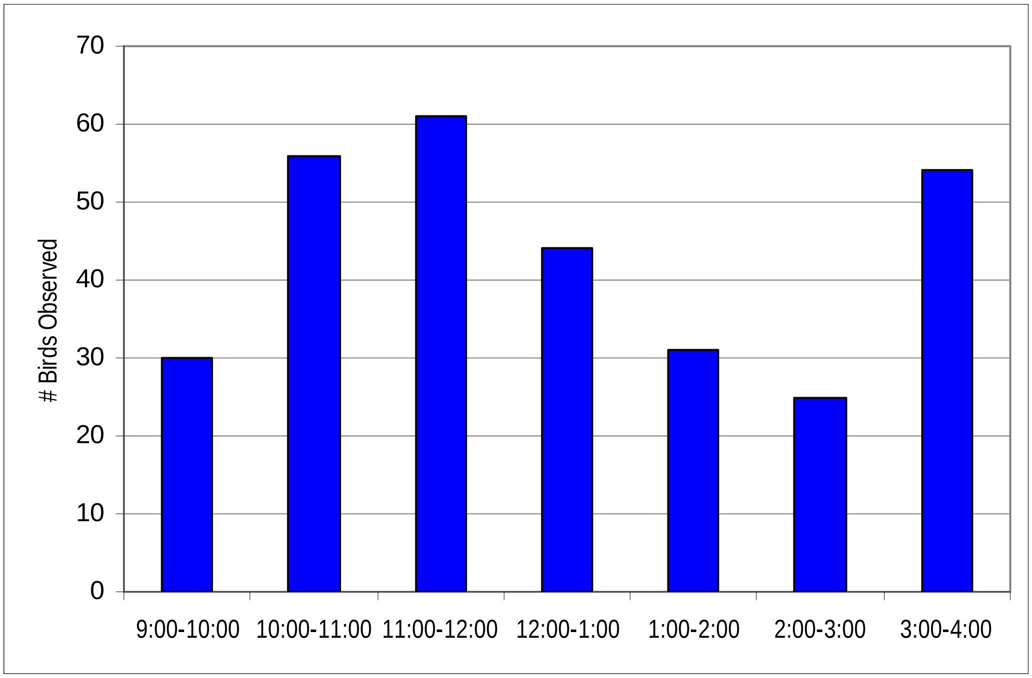


**Figure 4-4.** Number of individuals observed per survey hour - Fall 2008

During fall 2008 surveys, a total of 301 raptors representing 10 species plus individuals that could not be identified to species were observed. These results yielded an overall observation rate of 2.25 individuals/hour. Daily count totals ranged from 1 to 87 raptors (Appendix C, Table 1), and daily passage rates ranged from 0.2 to 6.2 birds/hour. Of the 301 total observations, 199 (65%) of those observations occurred during the 5 days of simultaneous surveys with two observers. Communication by the observers during the surveys limited the potential for "double-counting" birds.

Broad-winged hawks (*Buteo platypterus*) were the most commonly observed raptor (n=134, 45%; Figure 4-5). Approximately 53 percent of all observations of broad-winged hawks occurred on one day (September 16, 2008). Ninety-nine percent were believed to be migrants based on their direct flight paths and migratory behavior. Sharp-shinned hawks (*Accipiter striatus*) were the second most common species, representing 25 percent of all observations (n=74). Observers also documented the majority of these species as migratory (89%). Turkey vultures (*Cathartes aura*)[6] were the third most commonly observed species, accounting for 7 percent of all observations (n=20), and were almost equally documented to be migrant and resident individuals (40% and 55% respectively – 5% could not be determined to be either).

[6] While turkey vultures are not phylogenetically considered true raptors, they are diurnal migrants that exhibit flight characteristics similar to *Buteos, Accipiters* and other *Falconiformes* species, therefore vultures are typically included during hawk watch surveys.

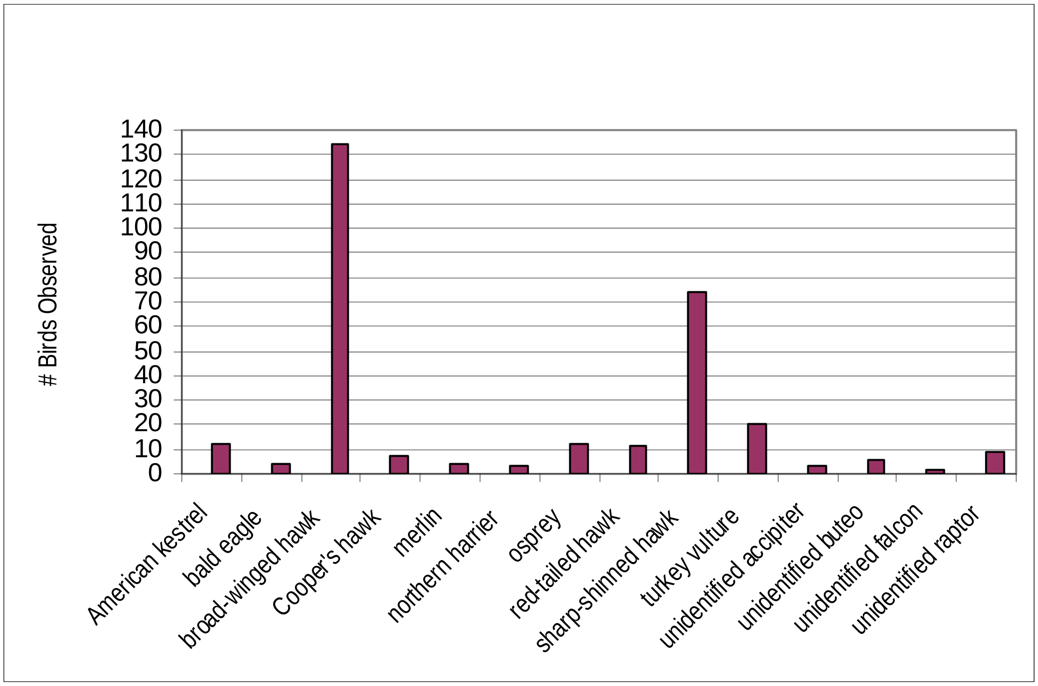


**Figure 4-5.** Number of individuals of species observed at Highland, ME - Fall 2008

Flight heights were categorized as above or below 130.5 m (428'), the maximum height of the proposed turbines. Of those raptors observed within the 1 km-radius circle from the observer (n=251), 43 percent were flying less than or equal to 130.5 m above the ground for at least a portion of their flight through the Project area (Figures 4-6 and 4-7; Table 4-1) and 40 percent were observed flying above 130.5 m. The remaining 17 percent of raptors were observed outside of the 1 km-radius circle with an average estimated flight height of 286 m (938') above ground.

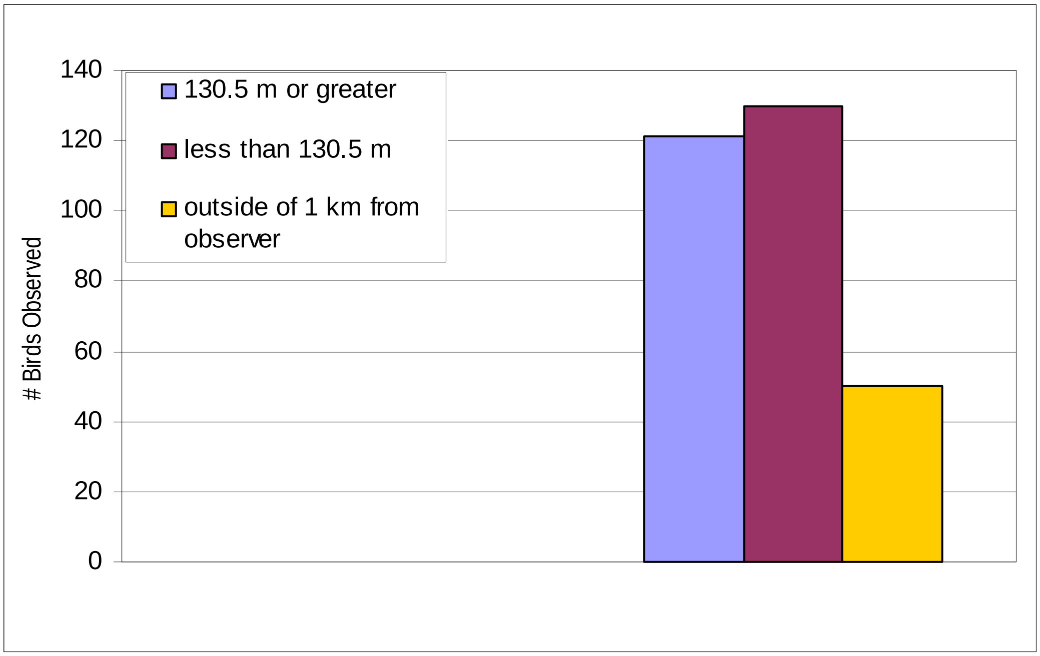


**Figure 4-6.** Number of individual species observed above or below 130.5 m (within 1 km from observer) and number of individuals observed beyond 1 km from observer at Highland, ME – Fall 2008

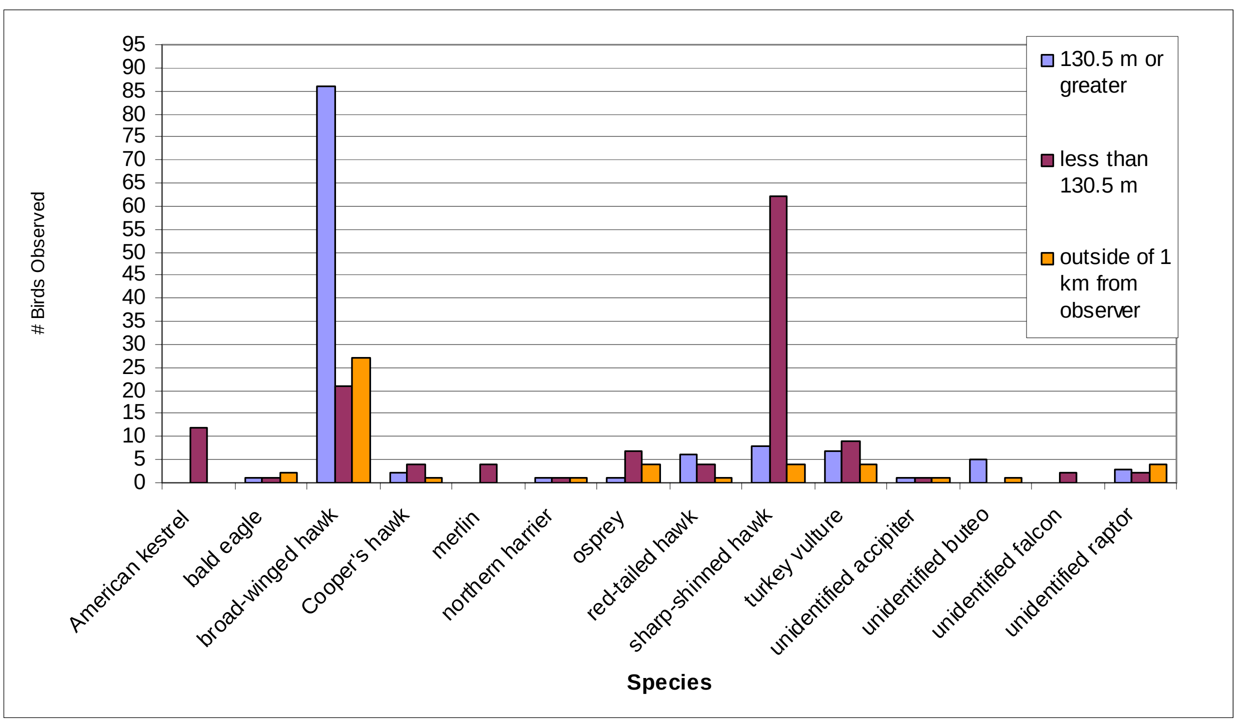


**Figure 4-7.** Raptor flight height distribution by species during Fall 2008 surveys at Highland, ME

**Table 4-1**. Number of observations and minimum flight heights within position categories relative to the Highland, ME Wind Project Area - Fall 2008

| **Total # Position Observations (n=**360**)** | **Position A) flight over ridge** | | | | **Position B - upper slope** | **Position C - lower slope** | **Position D - over valley** |
|---|---|---|---|---|---|---|---|
| | **A) flight over ridge** | **A1) flight along or parallel to ridge** | **A2) crossed ridge** | **A3) flight crossed depression or saddle** | | | |
| **No. of observations** | 30 | 121 | 73 | 55 | 38 | 19 | 24 |
| **Average minimum flight height (m)** | 178 | 150 | 108 | 87 | 80 | 153 | 288 |
| | **Combined number of observations and average min flight height for all positions over plateau (A, A1, A2, A3)** 279; 131 m | | | | | | |

As raptors traveled through or in the vicinity of the Project area, they often occurred in multiple horizontal flight positions (A-D) along the ridge or outside of the Project area. Of the 360 total recorded flight positions, the majority of raptor observations[7] (n=279, 78%) flew over the ridge at some point in their flight path, 34 percent flying parallel to the ridge (Table 4-1; Figure 4-8). There were 55 observations of birds crossing the saddle between Witham and South Stewart Mountains at an average minimum flight height of 87 m.

[7] The number of observations is greater than the number of individuals because individuals can be observed crossing multiple position categories.

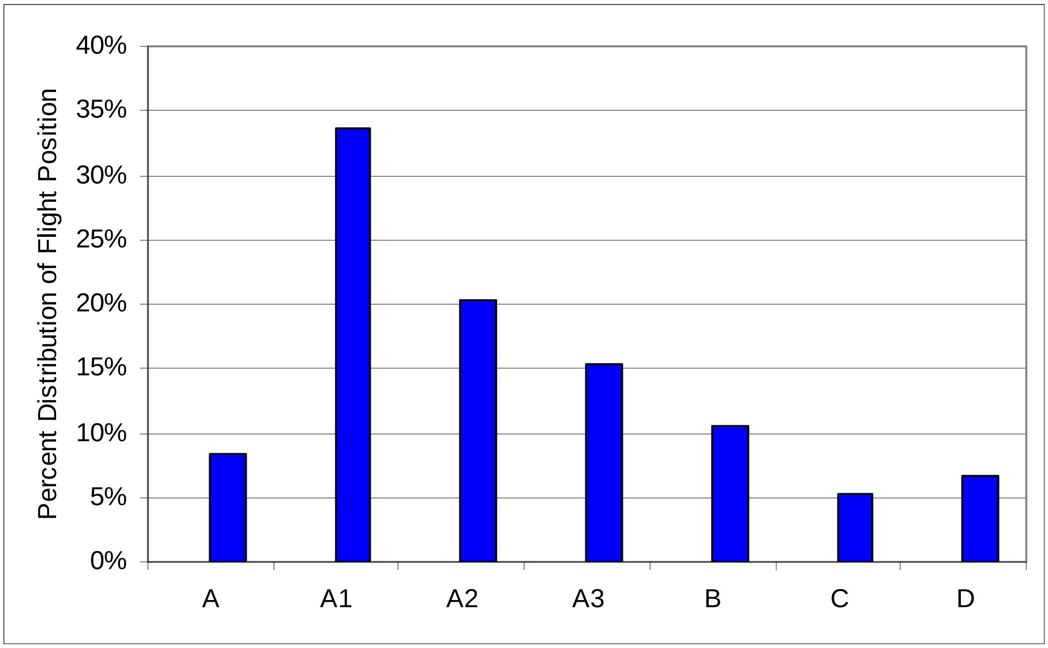


**Figure 4-8.** Raptor flight position distribution at Highland, Fall 2008. A = flight path directly over ridgeline, A1 = parallel to ridge, A2 = crosses ridge, A3 = crosses ridge in a gap or low area, B = over upper half of ridge but not on ridgeline, C = over lower half of ridge, D = not within Project boundary.

*Rare, Threatened and Endangered Species*

No state or federally listed threatened or endangered species were documented during the course of the raptor surveys. Observations during the fall surveys included, four bald eagles (*Haliaeetus leucocephalus*), a species currently listed as special concern in Maine[8]. These observations included one adult documented on September 16, a juvenile seen on September 22, a juvenile seen on October 7 and an adult bird recorded on October 15 (Figures 4-3 and 4-5). Observations occurred within the 1 km buffer zone as the individuals crossed the ridgeline (Figure 4-6; Appendix C, Table 2) and only one of the birds had a portion of its flight path below the proposed maximum turbine height. Three of the four individuals observed appeared to be residents based on their flight paths and behavior patterns. Three northern harriers (*Circus cyaneus*), also a Maine-listed species of special concern, were observed during these surveys.

[8] Effective September 12, 2009, the bald eagle was removed from Maine's list of Endangered and Threatened Species. It is currently listed as a species of special concern.

*Incidental bird observations*

During diurnal raptor surveys, other incidentally observed avian species also were documented (Table 4-2). These incidental observations were made while observers hiked to the designated survey points and during the course of the actual surveys. None of these species are state or federally listed as threatened or endangered. The white-throated sparrow (*Zonotrichia albicollis*) is a state listed species of special concern, but occurs commonly throughout much of the Project area.

| **Table 4-2.** Species of birds observed incidentally during raptor surveys at Highland, ME Fall 2008 |
|---|
| American crow |
| American goldfinch |
| black-capped chickadee |
| blue jay |
| boreal chickadee |
| brown creeper |
| Canada goose |
| common raven |
| dark-eyed junco |
| double-crested cormorant |
| downy woodpecker |
| golden-crowned kinglet |
| gray jay |
| hairy woodpecker |
| hermit thrush |
| yellow-rumped warbler |
| pileated woodpecker |
| red crossbill |
| snow bunting |
| unidentified waterfowl |
| white-throated sparrow |
| white-winged crossbill |

## 4.4 DISCUSSION

Over the course of 15 survey days between September 3 and October 21, 301 raptors were observed. A total of 10 species as well as birds for which the species could not be determined were documented during this time. Broad-winged hawks, sharp-shinned hawks, and turkey vultures were the most commonly observed species. Most individuals, particularly among the broad-winged hawks, were believed to be migrant birds. Migrating raptors were generally observed moving in a southerly direction.

The passage rate at the Project area for the fall 2008 survey period was 2.25 birds/hour. The passage rates at the fall 2008 HMANA hawk watch sites in the region varied between a low of 7.7 (Second Mountain; Ft. Indiantown Gap, PA) and 18.2 (Waggoner's Gap; Carlisle, PA) birds/hr (Appendix B, Table 3 and 4). Compared to the HMANA 2008 fall data, the passage rate at the Project area was relatively low. It should be noted that visibility and topographic features at the Project area generally vary from those at HMANA sites; these factors can influence the results of observed passage rates at hawk watch sites. It should also be noted that raptor surveys at the Project area were not conducted on every possible day of the raptor migration period; therefore, peak movement days in the area were potentially missed, or have a greater potential to skew results given a limited number of overall survey days. For example, during the fall survey, a priority was placed on surveying consecutive days after the passage of a frontal system when northerly winds are most common. Additionally, the HMANA survey methods differ to some extent from survey methods conducted at proposed wind sites in that 1) flight heights are not gauged during HMANA surveys; 2) HMANA surveyors often do not count birds believed to be resident; and 3) HMANA surveys generally include multiple observers per day resulting in increased observer effort and increased detection rates. These factors should be considered when interpreting the results of the fall data.

Also, available for comparison are the public results of fall surveys at other proposed wind sites in the region from 1999 to 2006. Seasonal passage rates among these sites ranged from 0.9 (Deerfield Vermont; forested ridge) to 25.6 (Westfield, New York; Great Lakes Shore) birds/hr (Appendix A, Table 4 and 5). Raptor activity at the Highland site during fall 2008 was similar to passage rates observed in the region in recent years. There would be some degree of annual variation in passage rates at any particular hawk watch site due to variable regional populations from year to year, as well as differences in daily weather conditions at a site among years. The fall 2008 raptor survey is representative of a typical fall migration season in the Project area. Although there may be some annual variation in the fall passage rates, there is no reason to suspect that annual variations would be significant.

Raptors observed in Project area were observed flying along the ridge and over the ridgeline itself, including low flights through a saddle. Birds also were documented over the valley beyond the Project area. Flight heights ranged from treetop to nearly 1 km above the observation site, with 43 percent of raptors estimated to be below 130.5 m, the maximum height of proposed turbines. Studies have documented that raptors employ a high level of collision avoidance behaviors at modern wind facilities (Whitfield and Madders 2006, Chamberlain *et al.* 2006). As most raptors are diurnal, they may be able to visually, as well as acoustically detect turbines during periods of fair weather. Foraging raptors that become distracted by prey, or migrant raptors flying during periods of reduced visibility, may be at increased risk of collision with wind turbines.

Flight height of raptors varied by survey day, individual raptor, and species across the survey period. Variations in the flight heights of raptors are due to a variety of factors, particular flight behaviors of raptor species and daily weather conditions. Typically, accipiters and falcons use up-drafts from side slopes to gain lift and, therefore, fly low over ridgelines. Buteos and accipitors tend to use lift from thermals that develop over side slopes and valleys and tend typically to fly higher during hours of peak thermal development. Raptors typically fly lower than usual during windy or inclement headwinds. Tailwinds, on the other hand, create deflective updrafts and push birds higher (Bildstein 2006).

Migration of raptors is a dynamic process due to various behavioral and environmental factors. As a result, flight pathways and movements along ridges, side slopes, and across valleys may vary seasonally, daily or hourly. Raptors may shift and use different ridge lines and cross different valleys from year to year or season to season. Weather and wind are major factors that influence migration pathways. Wind direction and strength, in particular, strongly affect the propensity of raptors to congregate along ‘leading lines’ or topographic features. The location of a raptor along a ‘leading line’ can be influenced by lateral drift caused by crosswinds (Richardson 1998).The flight paths of raptors observed at the Project area varied between survey dates and were likely influenced by varying wind direction and weather.

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# Appendix A

Radar Survey Results

| Appendix A Table 1. Survey dates, results, level of effort, and weather - Fall 2008 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Date** | **Passage rate** | **Flight Direction** | **Flight Height (m)** | **% below 130.5 m** | **Hours of Survey** | **Temperature (°C)** | **Wind Speed (m/s)** | **Wind Direction (degrees)** |
| 8/30 | 339 | 169 | 351 | 15% | 6 | 15 | 5 | 347 |
| 8/31 | 375 | 201 | 452 | 9% | 11 | 14 | 8 | 1 |
| 9/1 | 607 | 211 | 380 | 13% | 11 | 16 | 7 | 2 |
| 9/2 | 1196 | 275 | 264 | 25% | 11 | 15 | 2 | 63 |
| 9/7 | 451 | 199 | 271 | 20% | 11 | 10 | 6 | 330 |
| 9/10 | 684 | 220 | 355 | 9% | 11 | 6 | 4 | 356 |
| 9/11 | 504 | 265 | 268 | 27% | 12 | 10 | 3 | 275 |
| 9/15 | 1201 | 212 | 333 | 14% | 9 | 10 | 4 | 53 |
| 9/16 | 685 | 249 | 250 | 25% | 12 | 9 | 2 | 1 |
| 9/17 | 701 | 252 | 357 | 11% | 9 | 11 | 4 | 359 |
| 9/18 | 548 | 229 | 314 | 13% | 11 | 3 | 4 | 74 |
| 9/21 | 629 | 223 | 357 | 17% | 6 | 7 | 4 | 77 |
| 9/22 | 777 | 249 | 256 | 27% | 12 | 6 | 2 | 110 |
| 9/24 | 715 | 269 | 310 | 26% | 12 | 12 | 2 | 309 |
| 9/29 | 833 | 220 | 516 | 10% | 11 | 10 | 4 | 85 |
| 10/2 | 261 | 183 | 254 | 27% | 12 | 4 | 6 | 355 |
| 10/3 | 117 | 177 | 303 | 18% | 12 | 4 | 8 | 15 |
| 10/4 | 349 | 220 | 290 | 24% | 12 | 3 | 4 | 32 |
| 10/6 | 195 | 189 | 531 | 6% | 12 | 3 | 7 | 53 |
| 10/7 | 68 | 173 | 522 | 4% | 13 | 7 | 3 | 47 |
| **Entire Season** | **549** | **227** | **348** | **16%** | **216** | **9** | **4** | **25** |

**Appendix A Table 2. Summary of passage rates by hour, night, and for entire season.**

| Night of | Passage Rate (targets/km/hr) by hour after sunset | | | | | | | | | | | | | Entire Night | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | Mean | Median | Stdev | SE |
| 8/30 | 287 | 410 | 438 | 379 | -- | 180 | 343 | -- | -- | -- | -- | N/A | N/A | 339 | 361 | 94 | 38 |
| 8/31 | 171 | 493 | 659 | 660 | 664 | 510 | 434 | 268 | 177 | 86 | 7 | N/A | N/A | 375 | 434 | 243 | 73 |
| 9/1 | 231 | 557 | 654 | 977 | 1186 | 846 | 766 | 504 | 493 | 407 | 56 | N/A | N/A | 607 | 557 | 327 | 99 |
| 9/2 | 471 | 1321 | 1466 | 1664 | 1468 | 1468 | 1400 | 1221 | 1414 | 980 | 284 | N/A | N/A | 1196 | 1400 | 441 | 133 |
| 9/7 | 571 | 771 | 1063 | 573 | 439 | 418 | 285 | 236 | 188 | 332 | 82 | -- | N/A | 451 | 418 | 283 | 85 |
| 9/10 | 632 | 1275 | 1007 | 943 | 1043 | 868 | 626 | 439 | 343 | 236 | 114 | -- | N/A | 684 | 632 | 373 | 112 |
| 9/11 | 137 | 664 | 818 | 932 | 1093 | 696 | 506 | 321 | 246 | 188 | 386 | 64 | N/A | 504 | 446 | 335 | 97 |
| 9/15 | 817 | 948 | 1452 | 2480 | 1757 | -- | 1144 | 895 | 757 | 557 | -- | -- | N/A | 1201 | 948 | 605 | 202 |
| 9/16 | 411 | 693 | 943 | 1775 | 1720 | 1071 | 900 | 289 | 171 | 136 | 91 | 21 | N/A | 685 | 552 | 611 | 176 |
| 9/17 | 107 | 595 | 900 | 1302 | 1774 | -- | -- | 664 | 579 | -- | 321 | 64 | N/A | 701 | 595 | 557 | 186 |
| 9/18 | 875 | 1463 | -- | 1050 | 823 | 757 | 447 | 157 | 189 | 145 | 107 | 11 | N/A | 548 | 447 | 475 | 143 |
| 9/21 | 336 | 600 | 654 | 793 | 793 | 596 | -- | -- | -- | -- | -- | -- | N/A | 629 | 627 | 169 | 69 |
| 9/22 | 514 | 973 | 1043 | 943 | 882 | 887 | 1082 | 938 | 871 | 605 | 570 | 11 | N/A | 777 | 885 | 304 | 88 |
| 9/24 | 686 | 525 | 714 | 1039 | 960 | 807 | 804 | 789 | 607 | 686 | 701 | 257 | N/A | 715 | 708 | 201 | 58 |
| 9/29 | 807 | 1582 | 2202 | 1655 | 1425 | 321 | 354 | -- | 314 | 155 | 139 | 211 | -- | 833 | 354 | 745 | 225 |
| 10/2 | 225 | 373 | 375 | 329 | 257 | 236 | 424 | 268 | 379 | 214 | -- | 57 | 0 | 261 | 263 | 129 | 37 |
| 10/3 | 21 | 204 | 134 | 133 | 142 | 86 | 100 | 186 | 121 | 96 | 107 | 75 | -- | 117 | 114 | 49 | 14 |
| 10/4 | 69 | 123 | 230 | -- | 343 | 300 | 223 | 546 | 823 | 543 | 343 | 648 | 0 | 349 | 321 | 248 | 72 |
| 10/6 | 81 | 380 | 416 | 300 | 336 | 229 | 193 | 171 | 129 | 77 | 11 | 16 | -- | 195 | 182 | 139 | 40 |
| 10/7 | 51 | 91 | 99 | 107 | 70 | 79 | 69 | 98 | 70 | 64 | 43 | 48 | 0 | 68 | 70 | 29 | 8 |
| **Entire Season** | **375** | **702** | **803** | **949** | **904** | **575** | **561** | **470** | **437** | **324** | **210** | **124** | **0** | **549** | **421** | **468** | **32** |

-- indicates no data recorded for that hour; N/A indicates that sunrise occurred prior to that hour and no data was collected

| Appendix A Table 3. Mean Nightly Flight Direction | | |
|---|---|---|
| **Night of** | **Mean Flight Direction** | **Circular Stdev** |
| 8/30 | 169 | 34 |
| 8/31 | 201 | 22 |
| 9/1 | 211 | 30 |
| 9/2 | 275 | 39 |
| 9/7 | 199 | 35 |
| 9/10 | 220 | 29 |
| 9/11 | 265 | 99 |
| 9/15 | 212 | 34 |
| 9/16 | 249 | 50 |
| 9/17 | 252 | 61 |
| 9/18 | 229 | 26 |
| 9/21 | 223 | 38 |
| 9/22 | 249 | 35 |
| 9/24 | 269 | 71 |
| 9/29 | 220 | 27 |
| 10/2 | 183 | 61 |
| 10/3 | 177 | 41 |
| 10/4 | 220 | 37 |
| 10/6 | 189 | 20 |
| 10/7 | 173 | 30 |
| **Entire Season** | 227 | 51 |

**Appendix A Table 4. Summary of mean flight heights by hour, night, and for entire season.**

| Night of | Mean Flight Height (m) by hour after sunset | | | | | | | | | | | | | Entire Night | | | | % of targets below 130.5 meters |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | Mean | Median | STDV | SE | |
| 8/30 | 246 | 313 | 335 | 403 | 420 | 389 | -- | -- | -- | -- | -- | N/A | N/A | 351 | 362 | 66 | 27 | 15% |
| 8/31 | 173 | 531 | 421 | 413 | 465 | 515 | 499 | 506 | 534 | 489 | 424 | N/A | N/A | 452 | 489 | 102 | 31 | 9% |
| 9/1 | 301 | 511 | 506 | 473 | 401 | 347 | 370 | 364 | 361 | 266 | 280 | N/A | N/A | 380 | 364 | 86 | 26 | 13% |
| 9/2 | 203 | 300 | 268 | 272 | 257 | 282 | 260 | 303 | 297 | 200 | 265 | N/A | N/A | 264 | 268 | 35 | 11 | 25% |
| 9/7 | 304 | 335 | 343 | 377 | 271 | 282 | 275 | 202 | 317 | 148 | 206 | 195 | N/A | 271 | 278 | 70 | 20 | 20% |
| 9/10 | 363 | 420 | 367 | 338 | 339 | 337 | 357 | 425 | 334 | 355 | 323 | 298 | N/A | 355 | 347 | 37 | 11 | 9% |
| 9/11 | 328 | 442 | 340 | 282 | 274 | 235 | 257 | 215 | 173 | 200 | 165 | 308 | N/A | 268 | 266 | 79 | 23 | 27% |
| 9/15 | 328 | 329 | 394 | 331 | -- | 337 | 358 | 283 | 313 | 320 | -- | -- | N/A | 333 | 329 | 31 | 10 | 14% |
| 9/16 | 316 | 373 | 272 | 216 | 244 | 233 | 221 | 234 | 298 | 211 | 334 | 50 | N/A | 250 | 239 | 82 | 24 | 25% |
| 9/17 | 389 | 427 | 390 | 357 | 325 | 291 | -- | 271 | 360 | -- | 399 | -- | N/A | 357 | 360 | 52 | 17 | 11% |
| 9/18 | 271 | 351 | 274 | 249 | 354 | 369 | 384 | 371 | 361 | 286 | 367 | 129 | N/A | 314 | 352 | 75 | 22 | 13% |
| 9/21 | 259 | 443 | 424 | 360 | 338 | 319 | -- | -- | -- | -- | -- | -- | N/A | 357 | 349 | 68 | 28 | 17% |
| 9/22 | 272 | 246 | 231 | 296 | 287 | 238 | 275 | 295 | 295 | 250 | 221 | 169 | N/A | 256 | 261 | 38 | 11 | 27% |
| 9/24 | 238 | 269 | 311 | 335 | 324 | 396 | 334 | 319 | 344 | 247 | 292 | -- | N/A | 310 | 319 | 46 | 14 | 26% |
| 9/29 | 312 | 310 | 361 | 417 | 612 | 731 | 701 | 598 | 563 | 624 | 482 | 502 | 489 | 516 | 502 | 139 | 38 | 10% |
| 10/2 | 295 | 357 | 307 | 314 | 319 | 260 | 283 | 272 | 188 | 164 | 40 | -- | -- | 254 | 283 | 91 | 27 | 27% |
| 10/3 | 285 | 334 | 434 | 303 | 317 | 321 | 316 | 230 | 275 | 314 | 275 | 316 | 219 | 303 | 314 | 53 | 15 | 18% |
| 10/4 | 287 | 266 | 254 | 265 | 276 | 325 | 297 | 304 | 341 | 295 | 265 | 210 | 385 | 290 | 287 | 43 | 12 | 24% |
| 10/6 | 294 | 542 | 589 | 588 | 625 | 565 | 617 | 563 | 522 | 441 | 586 | 423 | 550 | 531 | 563 | 93 | 26 | 6% |
| 10/7 | 276 | 323 | 476 | 567 | 630 | 682 | 570 | 521 | 503 | 626 | 557 | 538 | -- | 522 | 547 | 119 | 34 | 4% |
| **Entire Season** | **287** | **371** | **365** | **358** | **372** | **373** | **375** | **349** | **354** | **320** | **322** | **285** | **411** | **348** | **321** | **119** | **8** | **16%** |

-- indicates no data recorded for that hour; N/A indicates that sunrise occurred prior to that hour and no data was collected

**Appendix A Table 5**. Summary of available avian fall radar survey results conducted at proposed (pre-construction) US wind power facilities in eastern US, using X-band mobile radar systems (2004-present)

| Year | Project Site | Number of Survey Nights | Number of Survey Hours | Landscape | Average Passage Rate (t/km/hr) | Range in Nightly Passage Rates | Average Flight Direction | Average Flight Height (m) | (Turbine Ht) % Targets Below Turbine Height | Reference |
|---|---|---|---|---|---|---|---|---|---|---|
| 2005 | Dairy Hills, Clinton Cty, NY | 57 | n/a | Agricultural plateau | 64 | n/a | 180 | 466 | (n/a) 10% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| 2005 | Perry, Wyoming Cty, NY | n/a | n/a | Agricultural plateau | 64 | n/a | 180 | 466 | (125 m) 10% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| 2005 | Alabama, Genesee Cty, NY | 59 | n/a | Agricultural plateau | 67 | n/a | 219 | 489 | (125 m) 11% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| 2004 | Sheffield, Caledonia Cty, VT | 18 | 176 | Forested ridge | 91 | 19-320 | 200 | 566 | (125 m) 1% | Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC. |
| 2005 | Alabama, Genesee Cty, NY | 40 | n/a | Agricultural plateau | 111 | n/a | 35 | 413 | (125 m) 14% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| 2007 | New Grange, Chautauqua Cty, NY | 57 | n/a | Great Lakes plain | 112 | n/a | 208 | 458 | (125 m) 10% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| 2005 | Churubusco, Clinton Cty, NY | 38 | 414 | Great Lakes plain/ADK foothills | 152 | 9-429 | 193 | 438 | (120 m) 5% | Woodlot Alternatives, Inc. 2005. A Fall Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Marble River Wind Project in Clinton and Ellenburg, New York. Prepared for AES Corporation. |
| 2005 | Maple Ridge, Lewis Cty, NY | 57 | n/a | Agricultural plateau | 158 | n/a | 195 | 415 | (125 m) 8% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| 2005 | Swallow Farm, PA | 58 | n/a | Forested ridge | 166 | n/a | n/a | 402 | (125 m) 5% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| 2004 | Casselman, PA | 30 | n/a | Forested ridge | 174 | n/a | n/a | 436 | (125 m) 7% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| 2004 | Dans Mountain, MD | 34 | 318 | Forested ridge | 188 | 2-633 | 193 | 542 | (125 m) 11% | Woodlot Alternatives, Inc. 2004. A Fall 2004 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Dan's Mountain Wind Project in Frostburg, Maryland. Prepared for US Wind Force. |
| 2006 | Villenova, Chautauqua Cty, NY | 36 | n/a | Great Lakes plain | 189 | 16-604 | 216 | 353 | (120 m) 9% | Stantec Consulting Services Inc. 2008. A Fall 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Ball Hill Windpark in Villenova and Hanover, New York. Prepared for Noble Environmental Power, LLC and Ecology and Environment. |
| 2004 | Prattsburgh, Steuben Cty, NY | 30 | 315 | Agricultural plateau | 193 | 12-474 | 188 | 516 | (125 m) 3% | Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windfarm Prattsburgh Project in Prattsburgh, New York. Prepared for UPC Wind Management, LLC. |
| 2005 | Sheldon, Wyoming Cty, NY | 36 | 347 | Agricultural plateau | 197 | 43-529 | 213 | 422 | (120 m) 3% | Woodlot Alternatives, Inc. 2006. A Fall 2005 Radar Survey of Bird Migration at the Proposed High Sheldon Wind Project in Sheldon, New York. Prepared for Invenergy. |

**Appendix A Table 5**. Summary of available avian fall radar survey results conducted at proposed (pre-construction) US wind power facilities in eastern US, using X-band mobile radar systems (2004-present)

| Year | Project Site | Number of Survey Nights | Number of Survey Hours | Landscape | Average Passage Rate (t/km/hr) | Range in Nightly Passage Rates | Average Flight Direction | Average Flight Height (m) | (Turbine Ht) % Targets Below Turbine Height | Reference |
|---|---|---|---|---|---|---|---|---|---|---|
| 2005 | Ellenberg, Clinton Cty, NY | 57 | n/a | Great Lakes plain/ADK foothills | 197 | n/a | 162 | 333 | (125 m) 12% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| 2005 | Prattsburgh-Italy, NY | 41 | n/a | Agricultural plateau | 200 | n/a | 177 | 365 | (125 m) 9% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| 2005 | Kibby, Franklin Cty, ME (Range 1) | 12 | 101 | Forested ridge | 201 | 12-783 | 196 | 352 | (125 m) 12% | Woodlot Alternatives, Inc. 2006. A Fall 2005 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine. |
| 2004 | Franklin, Pendleton Cty, WV | 34 | 349 | Forested ridge | 229 | 7-926 | 175 | 583 | (125 m) 8% | Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Liberty Gap Wind Project in Franklin, West Virginia. Prepared for US Wind Force, LLC. |
| 2006 | Wethersfield, Wyoming Cty, NY | 56 | n/a | Agricultural plateau | 256 | 31-701 | 208 | 344 | (125 m) 11% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| 2006 | Centerville, Allegany Cty, NY | 57 | n/a | Agricultural plateau | 259 | 12-877 | 208 | 350 | (125 m) 12% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| 2008 | Hounsfield, Jefferson Cty, NY | 60 | 674 | Great Lakes island | 281 | 64-835 | 207 | 298 | (125 m) 17% | Stantec Consulting Services Inc. 2008. A Fall 2008 Survey of Bird Migration at the Hounsfield Wind Project, New York. Prepared for American Consulting Professionals of New York, PLLC. |
| 2005 | Fayette Cty, PA | 26 | n/a | Forested ridge | 297 | n/a | n/a | 426 | (125 m) 5% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| 2005 | Stamford, Delaware Cty, NY | 48 | 418 | Forested ridge | 315 | 22-784 | 251 | 494 | (110 m) 3% | Woodlot Alternatives, Inc. 2007. A Spring and Fall 2005 Radar and Acoustic Survey of Bird Migration at the Proposed Moresville Energy Center in Stamford and Roxbury, New York. Prepared for Invenergy, LLC. Rockville, MD. |
| 2006 | Somerset Cty, PA | 29 | n/a | Forested ridge | 316 | n/a | n/a | 374 | (125 m) 8% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| 2007 | Laurel Mountain, Barbour Cty, WV | 20 | 212 | Forested ridge | 321 | 76-513 | 209 | 533 | (130 m) 6% | Stantec Consulting Services Inc. 2007. A Fall 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Laurel Mountain Wind Energy Project near Elkins, West Virginia. Prepared for AES Laurel Mountain, LLC. |
| 2008 | Georgia Mountain, VT | 21 | n/a | Forested ridge | 326 | 56-700 | 230 | 371 | (120 m) 7% | Stantec Consulting Services Inc. 2008. A Fall 2008 Survey of Bird Migration at the Georgia Mountain Wind Project, Vermont. Prepared for Georgia Mountain Community Wind. |
| 2006 | Cape Vincent, Jefferson Cty, NY | 63 | 508 | Great Lakes plain | 346 | n/a | 209 | 490 | (125 m) 8% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| 2007 | Errol, Coos County, NH | 29 | 232 | Forested ridge | 366 | 54 to 1234 | 223 | 343 | (125 m) 15% | Stantec Consulting Inc. 2007. Fall 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windpark in Coos County, New Hampshire by Granite Reliable Power, LLC. Prepared for Granite Reliable Power, LLC. |

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| Year | Project Site | Number of Survey Nights | Number of Survey Hours | Landscape | Average Passage Rate (t/km/hr) | Range in Nightly Passage Rates | Average Flight Direction | Average Flight Height (m) | (Turbine Ht) % Targets Below Turbine Height | Reference |
|---|---|---|---|---|---|---|---|---|---|---|
| 2007 | Lincoln, Penobscot Cty, ME | 22 | 231 | Forested ridge | 368 | 82-953 | 284 | 343 | (120 m) 13% | Woodlot Alternatives, Inc. 2008. A Fall 2007 Survey of Bird and Bat Migration at the Rollins Wind Project, Washington County, Maine. Prepared for Evergreen Wind, LLC. |
| 2005 | Preston Cty, WV | 26 | n/a | Forested ridge | 379 | n/a | n/a | 420 | (125 m) 10% | Plissner, J.H., T.J. Mabee, and B.A. Cooper. 2006 A radar and visual study of nocturnal bird and bat migration at the proposed Preston Wind Development project, Virginia, Fall 2005. Report to Highland New Wind Development, LLC. |
| 2005 | Jordanville, Herkimer Cty, NY | 38 | 404 | Agricultural plateau | 380 | 26-1019 | 208 | 440 | (125 m) 6% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| 2005 | Highland, VA | 58 | n/a | Forested ridge | 385 | n/a | n/a | 442 | (125 m) 12% | Plissner, J.H., T.J. Mabee, and B.A. Cooper. 2006 A radar and visual study of nocturnal bird and bat migration at the proposed Highland New Wind Development project, Virginia, Fall 2005. Report to Highland New Wind Development, LLC. |
| 2005 | Clayton, Jefferson Cty, NY | 37 | 385 | Agricultural plateau | 418 | 83-877 | 168 | 475 | (150 m) 10% | Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Clayton Wind Project in Clayton, New York. Prepared for PPM Atlantic Renewable. |
| 2007 | Roxbury, Oxford Cty, ME | 20 | 220 | Forested ridge | 420 | 88-1006 | 227 | 365 | (130 m) 14% | Woodlot Alternatives, Inc. 2007. A Fall 2007 Survey of Bird and Bat Migration at the Record Hill Wind Project, Roxbury, Maine. Prepared for Roxbury Hill Wind LLC. |
| 2006 | Bedford Cty, PA | 29 | n/a | Forested ridge | 438 | n/a | n/a | 379 | (125 m) 10% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| 2005 | Bliss, Wyoming Cty, NY | 8 | n/a | Agricultural plateau | 440 | 52-1392 | n/a | 411 | (125 m) 13% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| 2007 | Allegany, Cattaraugus Cty, NY | 46 | n/a | Forested ridge | 451 | n/a | 230 | 382 | (150 m) 14% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| 2005 | Kibby, Franklin Cty, ME (Valley) | 5 | 13 | Forested ridge | 452 | 52-995 | 193 | 391 | (125 m) 16% | Woodlot Alternatives, Inc. 2006. A Fall 2005 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine. |
| 2006 | Stetson, Washington Cty, ME | 12 | 77 | Forested ridge | 476 | 131-1192 | 227 | 378 | (125 m) 13% | Woodlot Alternatives, Inc. 2007. A Fall 2006 Survey of Bird and Bat Migration at the Stetson Wind Project, Washington County, Maine. Prepared for Evergreen Wind V, LLC. |
| 2005 | Howard, Steuben Cty, NY | 39 | 405 | Agricultural plateau | 481 | 18-1434 | 185 | 491 | (125 m) 5% | Woodlot Alternatives, Inc. 20065 A Fall 2005 Survey of Bird and Bat Migration at the Proposed Howard Wind Power Project in Howard, New York. Prepared for Everpower Global. |
| 2008 | Oakfield, Penobscot Cty, ME | 20 | n/a | Forested ridge | 501 | 116-945 | 200 | 309 | (125 m) 18% | Woodlot Alternatives, Inc. 2008. A Fall 2008 Survey of Bird and Bat Migration at the Oakfield Wind Project, Washington County, Maine. Prepared for Evergreen Wind, LLC. |
| 2005 | Mars Hill, Aroostook Cty, ME | 18 | 117 | Forested ridge | 512 | 60-1092 | 228 | 424 | (120 m) 8% | Woodlot Alternatives, Inc. 2006. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird Migration at the Mars Hill Wind Farm in Mars Hill, Maine. Prepared for Evergreen Windpower, LLC. |
| 2006 | Dutch Hill, Steuben Cty, NY | 21 | n/a | Agricultural plateau | 535 | n/a | 215 | 358 | (125 m) 11% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |

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| Year | Project Site | Number of Survey Nights | Number of Survey Hours | Landscape | Average Passage Rate (t/km/hr) | Range in Nightly Passage Rates | Average Flight Direction | Average Flight Height (m) | (Turbine Ht) % Targets Below Turbine Height | Reference |
|---|---|---|---|---|---|---|---|---|---|---|
| 2005 | Deerfield, Bennington Cty, VT | 32 | 324 | Forested ridge | 559 | 3-1736 | 221 | 395 | (100 m) 13% | Woodlot Alternatives, Inc. 2006. Fall 2005 Bird and Bat Migration Surveys at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy, Inc. |
| 2005 | Kibby, Franklin Cty, ME (Mountain) | 12 | 115 | Forested ridge | 565 | 109-1107 | 167 | 370 | (125 m) 16% | Woodlot Alternatives, Inc. 2006. A Fall 2005 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine. |
| 2006 | Lempster, Sullivan Cty, NH | 32 | 290 | Forested ridge | 620 | 133-1609 | 206 | 387 | (125 m) 8% | Woodlot Alternatives, Inc. 2007. A Fall 2007 Survey of Nocturnal Bird Migration,Breeding Birds, and Bicknell's Thrush at the Proposed Lempster Mountain Wind Power Project Lempster, New Hampshire. Prepared for Lempster Wind, LLC. |
| 2006 | Chateaugay, Franklin Cty, NY | 35 | 327 | Agricultural plateau | 643 | 38-1373 | 212 | 431 | (120 m) 8% | Woodlot Alternatives, Inc. 2006. Fall 2006 Radar Surveys at the Proposed Chateaugay Windpark in Chateaugay, New York. Prepared for Ecology and Environment, Inc. and Noble Power, LLC. |
| 2005 | Fairfield, Herkimer Cty, NY | 38 | 423 | Agricultural plateau | 691 | 116-1351 | 198 | 516 | (145 m) 6%[1] | Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar Survey of Bird and Bat Migration at the Proposed Top Notch Wind Project in Fairfield, New York. Prepared for PPM Atlantic Renewable. |
| 2005 | Munnsville, Madison Cty, NY | 31 | 292 | Agricultural plateau | 732 | 15-1671 | 223 | 644 | (118 m) 2% | Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Munnsville Wind Project in Munnsville, New York. Prepared for AES-EHN NY Wind, LLC. |
| 2007 | New Creek, Grant Cty, WV | 20 | n/a | Forested ridge | 811 | 263-1683 | 231 | 360 | (130 m) 17% | Stantec Consulting Services Inc. 2008. A Fall 2007 Survey of Bird and Bat Migration at the New Creek Wind Project,West Virginia. Prepared for AES New Creek, LLC. |
| 2007 | Wolfe Island, Ontario, Canada* | n/a | n/a | Great Lakes island | n/a | n/a | 95 | 233 | (125m) 23% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |

Note:
1 The percent targets below turbine height can be found in the addendum to the report "Effect of Top Notch (now Hardscrabble) Wind Project revision to turbine layout and model changes on the spring and fall 2005 nocturnal radar survey reports." Prepared August 26, 2009, by Stantec Consulting Services Inc.

# Appendix B

Acoustic Bat Survey Results

**Appendix B Table 1**. Summary of fall 2008 acoustic bat data and weather during each survey night at the Briggs Met High detector

| | | **BBSH** | | | **LACI** | **RBEP** | | | **MYSP** | **UNKN** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Night of** | **Operated Okay?** | **BBSH** | **big brown** | **silver-haired** | **hoary bat** | **eastern red** | **eastern pipistrelle** | **RBEP** | **MYSP** | **high-frequency** | **low-frequency** | **unknown** | **Total** | **Wind Speed (m/s)** | **Barometric Pressure** | **Relative Humidity (%)** | **Temperature (celsius)** |
| 08/28/08 | Yes | 1 | | | | | | | | 11 | | | **12** | 4.3 | 943 | | 15.6 |
| 08/29/08 | Yes | | | | 1 | | | | | | | | **1** | 10.1 | 942 | | 14.2 |
| 08/30/08 | Yes | | | | | 1 | | | | | | | **1** | 14.5 | 945 | | 13.6 |
| 08/31/08 | Yes | | | | | | | | | | | | **0** | | | | |
| 09/01/08 | Yes | | | | | | | | | | | | **0** | 9.5 | 931 | | 14.7 |
| 09/02/08 | Yes | | | | | | | | | | | | **0** | 3.6 | 929 | | 14.5 |
| 09/03/08 | Yes | | | | | | | | | | | | **0** | 5.3 | 924 | | 16.1 |
| 09/04/08 | Yes | | | | | | | | | | | | **0** | 4.5 | 930 | | 14.0 |
| 09/05/08 | Yes | | | | | | | | | 2 | 2 | | **4** | 9.0 | 928 | | 18.4 |
| 09/06/08 | Yes | | | | | | | | | | | | **0** | 5.3 | 921 | | 16.6 |
| 09/07/08 | Yes | | | | | | | | | | | | **0** | 10.9 | 925 | | 9.8 |
| 09/08/08 | Yes | | | | | | | | | | | | **0** | 6.8 | 929 | | 13.5 |
| 09/09/08 | Yes | | | | | | | | | | | | **0** | 10.2 | 925 | | 7.8 |
| 09/10/08 | Yes | | | | | | | | | | | | **0** | 4.0 | 936 | | 6.2 |
| 09/11/08 | Yes | | | | | | | | | | | | **0** | 5.6 | 933 | | 9.6 |
| 09/12/08 | Yes | | | | | | | | | | | | **0** | 5.6 | 924 | | 12.5 |
| 09/13/08 | Yes | | | | | | | | | | | | **0** | 10.0 | 924 | | 13.3 |
| 09/14/08 | Yes | | | | | | | | | | | | **0** | 15.5 | 912 | | 17.8 |
| 09/15/08 | Yes | | | | | | | | | | | | **0** | 7.4 | 926 | | 8.5 |
| 09/16/08 | Yes | | | 1 | | | | | | | | | **1** | 5.6 | 930 | | 7.9 |
| 09/17/08 | Yes | | | | | | | | | 1 | | | **1** | 8.0 | 928 | | 9.6 |
| 09/18/08 | Yes | | | | | | | | | | | | **0** | 4.4 | 938 | | 2.1 |
| 09/19/08 | Yes | | | | | | | | | | | | **0** | 7.8 | 937 | | 5.7 |
| 09/20/08 | Yes | | | | | | | | | | | | **0** | 8.4 | 931 | | 11.7 |
| 09/21/08 | Yes | | | | | | | | | | | | **0** | 3.6 | 938 | | 5.0 |
| 09/22/08 | Yes | | | | | | | | | | | | **0** | 2.6 | 941 | | 6.0 |
| 09/23/08 | Yes | | | | | | | | | | | | **0** | 7.2 | 940 | | 8.1 |
| 09/24/08 | Yes | | | | | | | | | 1 | | | **1** | 4.4 | 942 | | 13.7 |
| 09/25/08 | Yes | | | | | | | | | | | | **0** | 7.6 | 943 | | 12.3 |
| 09/26/08 | Yes | | | | | | | | | | | | **0** | 8.3 | 937 | | 11.5 |
| 09/27/08 | Yes | | | | | | | | | | | | **0** | 5.6 | 930 | | 15.8 |
| 09/28/08 | Yes | | | | | | | | | | | | **0** | 7.6 | 923 | | 12.5 |
| 09/29/08 | Yes | | | | | | | | | | | | **0** | 4.2 | 926 | | 8.8 |
| 09/30/08 | Yes | | | | | | | | | | | | **0** | 5.6 | 920 | | 9.4 |
| 10/01/08 | Yes | | | | | | | | | | | | **0** | 3.8 | 912 | | 9.4 |
| 10/02/08 | Yes | | | | | | | | | | | | **0** | 8.9 | 913 | | 3.0 |
| 10/03/08 | Yes | | | | | | | | | | | | **0** | 14.8 | 920 | | 3.7 |
| 10/04/08 | Yes | | | | | | | | | | | | **0** | 8.0 | 930 | | 2.9 |
| 10/05/08 | Yes | | | | | | | | | | | | **0** | 6.4 | 932 | | 2.2 |
| 10/06/08 | Yes | | | | | | | | | | | | **0** | 12.7 | 931 | | 1.9 |
| 10/07/08 | Yes | | | | | | | | | | | | **0** | 14.2 | 928 | | 5.8 |
| 10/08/08 | Yes | | | | | | | | | | | | **0** | 7.7 | 922 | | 9.7 |
| 10/09/08 | Yes | | | | | | | | | | | | **0** | 10.4 | 923 | | 9.2 |
| 10/10/08 | Yes | | | | | | | | | | | | **0** | 9.0 | 934 | | 6.2 |
| 10/11/08 | Yes | | | | | | | | | | | | **0** | 8.1 | 939 | | 5.1 |
| 10/12/08 | Yes | | | | | | | | | | | | **0** | 7.2 | 937 | | 8.2 |
| 10/13/08 | Yes | | | | | | | | | | | | **0** | 7.6 | 934 | | 7.5 |
| 10/14/08 | Yes | | | | | | | | | | | | **0** | 10.2 | 927 | | 5.4 |
| 10/15/08 | Yes | | | | | | | | | | | | **0** | 5.8 | 925 | | 8.5 |
| 10/16/08 | Yes | | | | | | | | | | | | **0** | 10.4 | 923 | | 3.7 |
| 10/17/08 | Yes | | | | | | | | | | | | **0** | 7.8 | 928 | | -0.8 |
| 10/18/08 | Yes | | | | | | | | | | | | **0** | 4.7 | 935 | | -1.7 |
| 10/19/08 | Yes | | | | | | | | | | | | **0** | 1.7 | 934 | | 2.5 |
| 10/20/08 | Yes | | | | | | | | | | | | **0** | 5.5 | 923 | | 4.0 |
| **By Species** | | **1** | **0** | **1** | **1** | **1** | **0** | **0** | **0** | **15** | **2** | **0** | **21** | | | | |
| **By Guild** | | **3** | | | **1** | **1** | | | **0** | **17** | | | | | | | |
| | | **BBSH** | | | **LACI** | **RBEP** | | | **MYSP** | **UNKN** | | | **Total** | | | | |

**Appendix B Table 2**. Summary of fall 2008 acoustic bat data and weather during each survey night at the Briggs Met Low detector

| | | BBSH | | | HB | RBEP | | | MYSP | UNKN | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Night of | Operated Okay? | BBSH | big brown | silver-hiared | hoary bat | eastern red | eastern pipistrelle | RBEP | MYSP | high-frequency | low-frequency | unknown | Total | Wind Speed (m/s) | Barometric Pressure | Relative Humidity (%) | Temperature (celsius) |
| 08/29/08 | Yes | | | | | | | | | | 1 | | **1** | 10.1 | 942 | | 14.2 |
| 08/30/08 | Yes | | | | | | | | | | | | **0** | 14.5 | 945 | | 13.6 |
| 08/31/08 | Yes | | | | | | | | | | | | **0** | | | | |
| 09/01/08 | Yes | 1 | | | | | | | | | | | **1** | 9.5 | 931 | | 14.7 |
| 09/02/08 | Yes | | | | | | | | | | | | **0** | 3.6 | 929 | | 14.5 |
| 09/03/08 | Yes | | | | | | | | | | | | **0** | 5.3 | 924 | | 16.1 |
| 09/04/08 | Yes | | | | | | | | | | | | **0** | 4.5 | 930 | | 14.0 |
| 09/05/08 | Yes | | | | | | | | | 1 | 1 | | **2** | 9.0 | 928 | | 18.4 |
| 09/06/08 | Yes | | | | 1 | | | | | | | | **1** | 5.3 | 921 | | 16.6 |
| 09/07/08 | Yes | | | | | | | | | | | | **0** | 10.9 | 925 | | 9.8 |
| 09/08/08 | Yes | | | | | | | | | | | | **0** | 6.8 | 929 | | 13.5 |
| 09/09/08 | Yes | | | | | | | | | | | | **0** | 10.2 | 925 | | 7.8 |
| 09/10/08 | Yes | | | | | | | | | | | | **0** | 4.0 | 936 | | 6.2 |
| 09/11/08 | Yes | | | | | | | | | | 1 | | **1** | 5.6 | 933 | | 9.6 |
| 09/12/08 | Yes | | | | 1 | | | | | | | | **1** | 5.6 | 924 | | 12.5 |
| 09/13/08 | Yes | | | | | | | | | | | | **0** | 10.0 | 924 | | 13.3 |
| 09/14/08 | Yes | | | | | | | | | | | | **0** | 15.5 | 912 | | 17.8 |
| 09/15/08 | Yes | | | | | | | | | | | | **0** | 7.4 | 926 | | 8.5 |
| 09/16/08 | Yes | | | | | | | | | | | | **0** | 5.6 | 930 | | 7.9 |
| 09/17/08 | Yes | | | | 1 | | | | | | | | **1** | 8.0 | 928 | | 9.6 |
| 09/18/08 | Yes | | | | | | | | | | | | **0** | 4.4 | 938 | | 2.1 |
| 09/19/08 | Yes | | | | | | | | | | | | **0** | 7.8 | 937 | | 5.7 |
| 09/20/08 | Yes | | | | | | | | | | | | **0** | 8.4 | 931 | | 11.7 |
| 09/21/08 | Yes | | | | | | | | | 1 | | | **1** | 3.6 | 938 | | 5.0 |
| 09/22/08 | Yes | | | | | | | | | | | | **0** | 2.6 | 941 | | 6.0 |
| 09/23/08 | Yes | | | | | | | | | | | | **0** | 7.2 | 940 | | 8.1 |
| 09/24/08 | Yes | | | | | | | | | | | | **0** | 4.4 | 942 | | 13.7 |
| 09/25/08 | Yes | | | | | | | | | | | | **0** | 7.6 | 943 | | 12.3 |
| 09/26/08 | Yes | | | | | | | | | | | | **0** | 8.3 | 937 | | 11.5 |
| 09/27/08 | Yes | | | | | | | | | | | | **0** | 5.6 | 930 | | 15.8 |
| 09/28/08 | Yes | | | | | | | | | | | | **0** | 7.6 | 923 | | 12.5 |
| 09/29/08 | Yes | | | | | | | | | | | | **0** | 4.2 | 926 | | 8.8 |
| 09/30/08 | Yes | | | | | | | | | | | | **0** | 5.6 | 920 | | 9.4 |
| 10/01/08 | Yes | | | | | | | | | | | | **0** | 3.8 | 912 | | 9.4 |
| 10/02/08 | Yes | | | | | | | | | | | | **0** | 8.9 | 913 | | 3.0 |
| 10/03/08 | Yes | | | | | | | | | | | | **0** | 14.8 | 920 | | 3.7 |
| 10/04/08 | Yes | | | | | | | | | | | | **0** | 8.0 | 930 | | 2.9 |
| 10/05/08 | Yes | | | | | | | | | | | | **0** | 6.4 | 932 | | 2.2 |
| 10/06/08 | Yes | | | | | | | | | | | | **0** | 12.7 | 931 | | 1.9 |
| 10/07/08 | Yes | | | | | | | | | 1 | | | **1** | 14.2 | 928 | | 5.8 |
| 10/08/08 | Yes | | | | | | | | | | | | **0** | 7.7 | 922 | | 9.7 |
| 10/09/08 | Yes | | | | | | | | | | | | **0** | 10.4 | 923 | | 9.2 |
| 10/10/08 | Yes | | | | | | | | | | | | **0** | 9.0 | 934 | | 6.2 |
| 10/11/08 | Yes | | | | | | | | | | | | **0** | 8.1 | 939 | | 5.1 |
| 10/12/08 | Yes | | | | | | | | | | | | **0** | 7.2 | 937 | | 8.2 |
| 10/13/08 | Yes | | | | | | | | | | | | **0** | 7.6 | 934 | | 7.5 |
| 10/14/08 | Yes | | | | | | | | | | | | **0** | 10.2 | 927 | | 5.4 |
| 10/15/08 | Yes | | | | | | | | | | | | **0** | 5.8 | 925 | | 8.5 |
| 10/16/08 | Yes | | | | | | | | | | | | **0** | 10.4 | 923 | | 3.7 |
| 10/17/08 | Yes | | | | | | | | | | | | **0** | 7.8 | 928 | | -0.8 |
| 10/18/08 | Yes | | | | | | | | | | | | **0** | 4.7 | 935 | | -1.7 |
| 10/19/08 | Yes | | | | | | | | | | | | **0** | 1.7 | 934 | | 2.5 |
| 10/20/08 | Yes | | | | | | | | | | | | **0** | 5.5 | 923 | | 4.0 |
| **By Species** | | **1** | **0** | **0** | **3** | **0** | **0** | **0** | **0** | **3** | **3** | **0** | **10** | | | | |
| **By Guild** | | **4** | | | **3** | **0** | | | **0** | **6** | | | | | | | |
| | | **BBSH** | | | **HB** | **RBEP** | | | **MYSP** | **UNKN** | | | **Total** | | | | |

**Appendix B Table 3**. Summary of fall 2008 acoustic bat data and weather during each survey night at the Briggs Met Tree detector

| | | BBSH | | | LACI | RBEP | | | MYSP | UNKN | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Night of | Operated Okay? | BBSH | big brown | silver-haired | hoary | eastern red | eastern pipistrelle | RBEP | MYSP | high-frequency | low-frequency | unknown | Total | Wind Speed (m/s) | Barometric Pressure | Relative Humidity (%) | Temperature (celsius) |
| 08/11/08 | No | | | | | | | | | | | | | 7.2 | 934 | | 12.4 |
| 08/12/08 | Yes | 2 | | | | 1 | | | 122 | 238 | | | **363** | 2.5 | 938 | | 15.3 |
| 08/13/08 | Yes | 9 | | 8 | | | | | 36 | 123 | 2 | | **178** | 5.5 | 941 | | 14.4 |
| 08/14/08 | Yes | | | | | | | 1 | | 1 | | | **2** | 3.5 | 944 | | 16.3 |
| 08/15/08 | Yes | 2 | 1 | 1 | | 1 | | 1 | 70 | 92 | 1 | | **169** | 7.8 | 937 | | 15.0 |
| 08/16/08 | Yes | 1 | | | | 3 | | 1 | 134 | 333 | | | **472** | 6.0 | 940 | | 15.2 |
| 08/17/08 | Yes | | 2 | | | | | | 71 | 160 | 1 | | **234** | 7.4 | 937 | | 15.3 |
| 08/18/08 | Yes | 2 | | 1 | | 1 | | | 61 | 204 | | | **269** | 11.7 | 942 | | 7.7 |
| 08/19/08 | Yes | 1 | | | | | | | 117 | 75 | | | **193** | 9.7 | 947 | | 11.6 |
| 08/20/08 | Yes | | | | | | | | 125 | 197 | | | **322** | 6.2 | 954 | | 17.2 |
| 08/21/08 | Yes | 2 | | | | 1 | | | 96 | 173 | 1 | | **273** | 3.3 | 955 | | 20.3 |
| 08/22/08 | Yes | 7 | 1 | 4 | 1 | | | | 56 | 91 | 3 | | **163** | 8.3 | 948 | | 16.5 |
| 08/23/08 | Yes | 1 | | | | | 1 | 1 | 74 | 137 | 1 | | **215** | 7.0 | 939 | | 15.9 |
| 08/24/08 | Yes | | | 1 | 1 | | | 1 | 59 | 96 | | | **158** | 11.2 | 939 | | 8.8 |
| 08/25/08 | Yes | 1 | | | | | | | 138 | 158 | | | **297** | 9.8 | 945 | | 10.5 |
| 08/26/08 | Yes | | | | | | | | 51 | 109 | | | **160** | 5.2 | 948 | | 15.6 |
| 08/27/08 | Yes | 46 | | | 1 | | | | 51 | 100 | 12 | | **210** | 5.6 | 946 | | 14.9 |
| 08/28/08 | Yes | | | | | | | | 12 | 40 | 1 | | **53** | 4.3 | 943 | | 15.6 |
| **By Species** | | **74** | **4** | **15** | **3** | **7** | **1** | **5** | **1273** | **2327** | **22** | **0** | **3731** | | | | |
| **By Guild** | | **96** | | | **3** | **13** | | | **1273** | **2349** | | | | | | | |
| | | **BBSH** | | | **LACI** | **RBEP** | | | **MYSP** | **UNKN** | | | **Total** | | | | |

**Appendix B Table 4**. Summary of fall 2008 acoustic bat data and weather during each survey night at the Burnt Hill Tree detector

| | | BBSH | | | LACI | RBEP | | | MYSP | UNKN | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Night of | Operated Okay? | BBSH | big brown | silver-haired bat | hoary | eastern red | eastern pipistrelle | RBEP | MYSP | high-frequency | low-frequency | unknown | Total | Wind Speed (m/s) | Barometric Pressure | Relative Humidity (%) | Temperature (celsius) |
| 08/11/08 | No | | | | | | | | | | | | | 7.2 | 934 | | 12.4 |
| 08/12/08 | Yes | | | | | | | | | | | | **0** | 2.5 | 938 | | 15.3 |
| 08/13/08 | Yes | 1 | | | | | | | | | 1 | | **2** | 5.5 | 941 | | 14.4 |
| 08/14/08 | Yes | | | | 1 | | | | 1 | 1 | | | **3** | 3.5 | 944 | | 16.3 |
| 08/15/08 | Yes | 1 | | | | | | | | 2 | 1 | | **4** | 7.8 | 937 | | 15.0 |
| 08/16/08 | Yes | | | | | | | | | | 2 | | **2** | 6.0 | 940 | | 15.2 |
| 08/17/08 | Yes | 1 | | | | | | | | 1 | | | **2** | 7.4 | 937 | | 15.3 |
| 08/18/08 | Yes | | | | | | | | | | | | **0** | 11.7 | 942 | | 7.7 |
| 08/19/08 | Yes | | | | | | | | | | | | **0** | 9.7 | 947 | | 11.6 |
| 08/20/08 | Yes | | | | | | | | | | | | **0** | 6.2 | 954 | | 17.2 |
| 08/21/08 | Yes | | | | 1 | | | | 1 | 5 | 2 | | **9** | 3.3 | 955 | | 20.3 |
| 08/22/08 | Yes | 1 | | | 1 | | | | | 4 | | | **6** | 8.3 | 948 | | 16.5 |
| 08/23/08 | Yes | | | | | | | | 2 | 3 | | | **5** | 7.0 | 939 | | 15.9 |
| 08/24/08 | Yes | | | | | | | | 1 | 2 | | | **3** | 11.2 | 939 | | 8.8 |
| 08/25/08 | Yes | 1 | | | | | | | | 1 | 2 | | **4** | 9.8 | 945 | | 10.5 |
| 08/26/08 | Yes | | | | | | | | 1 | | | | **1** | 5.2 | 948 | | 15.6 |
| 08/27/08 | Yes | 1 | | | | | | | 6 | 2 | 1 | | **10** | 5.6 | 946 | | 14.9 |
| 08/28/08 | Yes | | | | | | | | | | | | **0** | 4.3 | 943 | | 15.6 |
| 08/29/08 | Yes | | | | | | | | | | | | **0** | 10.1 | 942 | | 14.2 |
| 08/30/08 | Yes | | | | | | | | | | | | **0** | 14.5 | 945 | | 13.6 |
| 08/31/08 | Yes | | | | | | | | | | | | **0** | | | | |
| 09/01/08 | Yes | | | | | | | | | | | | **0** | 9.5 | 931 | | 14.7 |
| 09/02/08 | Yes | | | | | | | | 6 | 16 | | | **22** | 3.6 | 929 | | 14.5 |
| **By Species** | | **6** | **0** | **0** | **3** | **0** | **0** | **0** | **18** | **37** | **9** | **0** | **73** | | | | |
| **By Guild** | | **9** | | | **3** | **0** | | | **18** | **46** | | | | | | | |
| | | **BBSH** | | | **LACI** | **RBEP** | | | **MYSP** | **UNKN** | | | **Total** | | | | |

**Appendix B Table 5**. Summary of fall 2008 acoustic bat data and weather during each survey night at the Stewart N Met E Tree detector

| | | BBSH | | | LACI | RBEP | | | MYSP | UNKN | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Night of** | **Operated Okay?** | **BBSH** | **big brown** | **silver-haired bat** | **hoary** | **eastern red** | **eastern pipistrelle** | **RBEP** | **MYSP** | **high-frequency** | **low-frequency** | **unknown** | **Total** | **Wind Speed (m/s)** | **Barometric Pressure** | **Relative Humidity (%)** | **Temperature (celsius)** |
| 08/11/08 | Yes | | | | | | | | 341 | 262 | | | **603** | 7.2 | 934 | | 12.4 |
| 08/12/08 | Yes | | | | | | | | 5 | | | | **5** | 2.5 | 938 | | 15.3 |
| 08/13/08 | Yes | | | | | | | | 67 | 150 | | | **217** | 5.5 | 941 | | 14.4 |
| 08/14/08 | Yes | | | | | | | | | | | | **0** | 3.5 | 944 | | 16.3 |
| 08/15/08 | Yes | | | | | | | 1 | 720 | 187 | | | **908** | 7.8 | 937 | | 15.0 |
| 08/16/08 | Yes | | | | 1 | | | | 88 | 4 | | | **93** | 6.0 | 940 | | 15.2 |
| 08/17/08 | Yes | | | | | | | | 61 | 7 | | | **68** | 7.4 | 937 | | 15.3 |
| 08/18/08 | Yes | | | | | | | | | 3 | | | **3** | 11.7 | 942 | | 7.7 |
| 08/19/08 | Yes | | | | | | | | | 1 | | | **1** | 9.7 | 947 | | 11.6 |
| 08/20/08 | Yes | | | | | | | | | | | | **0** | 6.2 | 954 | | 17.2 |
| 08/21/08 | Yes | | | | | | | | 9 | 1 | | | **10** | 3.3 | 955 | | 20.3 |
| 08/22/08 | Yes | | | | | | | | 26 | 3 | | | **29** | 8.3 | 948 | | 16.5 |
| 08/23/08 | Yes | | | | | | | | 18 | | | | **18** | 7.0 | 939 | | 15.9 |
| 08/24/08 | Yes | | | | | | | | 7 | 3 | | | **10** | 11.2 | 939 | | 8.8 |
| 08/25/08 | Yes | | | | | | | | | | | | **0** | 9.8 | 945 | | 10.5 |
| 08/26/08 | Yes | | | | | | | | | | | | **0** | 5.2 | 948 | | 15.6 |
| 08/27/08 | Yes | | | | | | | | 68 | 100 | | | **168** | 5.6 | 946 | | 14.9 |
| 08/28/08 | Yes | | | | | | | | | 4 | | | **4** | 4.3 | 943 | | 15.6 |
| 08/29/08 | Yes | | | | | | | | 4 | 2 | | | **6** | 10.1 | 942 | | 14.2 |
| 08/30/08 | Yes | | | | | | | | | | | | **0** | 14.5 | 945 | | 13.6 |
| 08/31/08 | Yes | | | | | | | | | | | | **0** | | | | |
| 09/01/08 | Yes | | | | | | | | | 1 | | | **1** | 9.5 | 931 | | 14.7 |
| 09/02/08 | Yes | | | | | | | | | | | | **0** | 3.6 | 929 | | 14.5 |
| 09/03/08 | Yes | | | | | | | | 42 | 1 | 1 | | **44** | 5.3 | 924 | | 16.1 |
| 09/04/08 | Yes | | | | | | | | 7 | 1 | | | **8** | 4.5 | 930 | | 14.0 |
| 09/05/08 | Yes | | | | | | | | | | | | **0** | 9.0 | 928 | | 18.4 |
| 09/06/08 | Yes | | | | | | | | | | | | **0** | 5.3 | 921 | | 16.6 |
| 09/07/08 | Yes | | | | | | | | | | | | **0** | 10.9 | 925 | | 9.8 |
| 09/08/08 | Yes | | | | | | | | 1 | | | | **1** | 6.8 | 929 | | 13.5 |
| **By Species** | | **0** | **0** | **0** | **1** | **0** | **0** | **1** | **1464** | **730** | **1** | **0** | **2197** | | | | |
| **By Guild** | | **1** | | | **1** | **1** | | | **1464** | **731** | | | | | | | |
| | | **BBSH** | | | **LACI** | **RBEP** | | | **MYSP** | **UNKN** | | | **Total** | | | | |

**Appendix B Table 6**. Summary of fall 2008 acoustic bat data and weather during each survey night at the Stewart N Met W Tree detector

| | | BBSH | | | LACI | RBEP | | | MYSP | UNKN | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Night of | Operated Okay? | BBSH | big brown | silver-haired bat | hoary | eastern red | eastern pipistrelle | RBEP | MYSP | high-frequency | low-frequency | unknown | Total | Wind Speed (m/s) | Wind Direction (degrees) | Relative Humidity (%) | Temperature (celsius) |
| 08/11/08 | Yes | | | | | | | | | | | | **0** | | | | |
| 08/12/08 | Yes | | | | | | | | | | | | **0** | | | | |
| 08/13/08 | Yes | | | | | | | | | | | | **0** | | | | |
| 08/14/08 | Yes | | | | | | | | | | | | **0** | | | | |
| 08/15/08 | Yes | | | | | | | | | 1 | | | **1** | | | | |
| 08/16/08 | Yes | | | | | | | | | | | | **0** | | | | |
| 08/17/08 | Yes | | | | | | | | | | | | **0** | | | | |
| 08/18/08 | Yes | | | | | | | | | | | | **0** | | | | |
| 08/19/08 | Yes | | | | | | | | | | | | **0** | | | | |
| 08/20/08 | Yes | | | | | | | | | | | | **0** | | | | |
| 08/21/08 | Yes | | | | | | | | | 1 | | | **1** | | | | |
| 08/22/08 | Yes | | | | | | | | | 1 | | | **1** | | | | |
| 08/23/08 | Yes | | | | | | | | | 2 | | | **2** | | | | |
| 08/24/08 | Yes | | | | | | | | | 1 | | | **1** | | | | |
| 08/25/08 | Yes | | | | | | | | | | | | **0** | | | | |
| 08/26/08 | Yes | | | | | | | | | | | | **0** | | | | |
| 08/27/08 | Yes | | | | | | | | | 1 | 1 | | **2** | | | | |
| 08/28/08 | Yes | | | | | | | | | | | | **0** | | | | |
| 08/29/08 | Yes | | | | | | | | | | | | **0** | | | | |
| 08/30/08 | Yes | | | | | | | | | 1 | | | **1** | | | | |
| 08/31/08 | Yes | | | | | | | | | | | | **0** | | | | |
| 09/01/08 | Yes | | | | | | | | | | | | **0** | | | | |
| 09/02/08 | Yes | | | | | | | | | | | | **0** | | | | |
| 09/03/08 | Yes | | | | | | | | | | | | **0** | | | | |
| 09/04/08 | Yes | | | | | | | | | | | | **0** | | | | |
| 09/05/08 | Yes | | | | | | | | | 1 | | | **1** | | | | |
| 09/06/08 | Yes | | | | | | | | | | | | **0** | | | | |
| 09/07/08 | Yes | | | | | | | | | | | | **0** | | | | |
| 09/08/08 | Yes | | | | | | | | | | | | **0** | | | | |
| **By Species** | | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **9** | **1** | **0** | **10** | | | | |
| **By Guild** | | **0** | | | **0** | **0** | | | **0** | **10** | | | | | | | |
| | | **BBSH** | | | **LACI** | **RBEP** | | | **MYSP** | **UNKN** | | | **Total** | | | | |

**Appendix B Table 7**. Summary of fall 2008 acoustic bat data and weather during each survey night at the Stewart S Met High detector

| | | BBSH | | | LACI | RBEP | | | MYSP | UNKN | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Night of | Operated Okay? | BBSH | big brown | silver-haired bat | hoary | eastern red | eastern pipistrelle | RBEP | MYSP | high-frequency | low-frequency | unknown | Total | Wind Speed (m/s) | Barometric Pressure | Relative Humidity (%) | Temperature (celsius) |
| 09/03/08 | Yes | | | 1 | | | | | | | | | **1** | 5.3 | 924 | | 16.1 |
| 09/04/08 | Yes | | | 1 | | | | | | | | | **1** | 4.5 | 930 | | 14.0 |
| 09/05/08 | Yes | | | | | | | | | | | | **0** | 9.0 | 928 | | 18.4 |
| 09/06/08 | Yes | | | | | | | | | | | | **0** | 5.3 | 921 | | 16.6 |
| 09/07/08 | Yes | | | | | | | | | | | | **0** | 10.9 | 925 | | 9.8 |
| 09/08/08 | Yes | | | | | | | | | | | | **0** | 6.8 | 929 | | 13.5 |
| 09/09/08 | Yes | | | | | | | | | | | | **0** | 10.2 | 925 | | 7.8 |
| 09/10/08 | Yes | | | | | | | | | | | | **0** | 4.0 | 936 | | 6.2 |
| 09/11/08 | Yes | | | | | | | | | | | | **0** | 5.6 | 933 | | 9.6 |
| 09/12/08 | Yes | | | | | | | | | | | | **0** | 5.6 | 924 | | 12.5 |
| 09/13/08 | Yes | | | 1 | 1 | | | | | | | | **2** | 10.0 | 924 | | 13.3 |
| 09/14/08 | Yes | | | | | | | | | | | | **0** | 15.5 | 912 | | 17.8 |
| 09/15/08 | Yes | | | | | 1 | | | | 1 | 1 | | **3** | 7.4 | 926 | | 8.5 |
| 09/16/08 | Yes | | | | | | | | | 1 | | | **1** | 5.6 | 930 | | 7.9 |
| 09/17/08 | Yes | | | | | | | | | 1 | | | **1** | 8.0 | 928 | | 9.6 |
| 09/18/08 | Yes | | | | | | | | | | | | **0** | 4.4 | 938 | | 2.1 |
| 09/19/08 | Yes | | | | | | | | | | | | **0** | 7.8 | 937 | | 5.7 |
| 09/20/08 | Yes | | | | | | | | | | | | **0** | 8.4 | 931 | | 11.7 |
| 09/21/08 | Yes | | | | | | | | | | | | **0** | 3.6 | 938 | | 5.0 |
| 09/22/08 | Yes | | | | | | | | | | | | **0** | 2.6 | 941 | | 6.0 |
| 09/23/08 | Yes | | | | | | | | | | | | **0** | 7.2 | 940 | | 8.1 |
| 09/24/08 | Yes | | | 2 | | | | | | | | | **2** | 4.4 | 942 | | 13.7 |
| 09/25/08 | Yes | | | 1 | | | | | | | 1 | | **2** | 7.6 | 943 | | 12.3 |
| 09/26/08 | Yes | | | | | | | | | | | | **0** | 8.3 | 937 | | 11.5 |
| 09/27/08 | Yes | | | | | | | | | | | | **0** | 5.6 | 930 | | 15.8 |
| 09/28/08 | Yes | | | | | | | | | | | | **0** | 7.6 | 923 | | 12.5 |
| 09/29/08 | Yes | | | | | | | | | | | | **0** | 4.2 | 926 | | 8.8 |
| 09/30/08 | Yes | | | | | | | | | | | | **0** | 5.6 | 920 | | 9.4 |
| 10/01/08 | Yes | | | | | | | | | | | | **0** | 3.8 | 912 | | 9.4 |
| 10/02/08 | Yes | | | | | | | | | | | | **0** | 8.9 | 913 | | 3.0 |
| 10/03/08 | Yes | | | | | | | | | | | | **0** | 14.8 | 920 | | 3.7 |
| 10/04/08 | Yes | | | | | | | | | | | | **0** | 8.0 | 930 | | 2.9 |
| 10/05/08 | Yes | | | | | | | | | | | | **0** | 6.4 | 932 | | 2.2 |
| 10/06/08 | Yes | | | | | | | | | 1 | | | **1** | 12.7 | 931 | | 1.9 |
| 10/07/08 | Yes | | | | | | | | | | | | **0** | 14.2 | 928 | | 5.8 |
| 10/08/08 | Yes | | | | | | | | | | | | **0** | 7.7 | 922 | | 9.7 |
| 10/09/08 | Yes | | | | | | | | | | 1 | | **1** | 10.4 | 923 | | 9.2 |
| 10/10/08 | Yes | | | | | | | | | | | | **0** | 9.0 | 934 | | 6.2 |
| 10/11/08 | Yes | | | | | | | | | | | | **0** | 8.1 | 939 | | 5.1 |
| 10/12/08 | Yes | | | | | | | | | | | | **0** | 7.2 | 937 | | 8.2 |
| 10/13/08 | Yes | | | | | | | | | | | | **0** | 7.6 | 934 | | 7.5 |
| 10/14/08 | Yes | | | | | | | | | | | | **0** | 10.2 | 927 | | 5.4 |
| 10/15/08 | Yes | | | | | | | | | | | | **0** | 5.8 | 925 | | 8.5 |
| 10/16/08 | Yes | | | | | | | | | | | | **0** | 10.4 | 923 | | 3.7 |
| 10/17/08 | Yes | | | | | | | | | | | | **0** | 7.8 | 928 | | -0.8 |
| 10/18/08 | Yes | | | | | | | | | | | | **0** | 4.7 | 935 | | -1.7 |
| 10/19/08 | Yes | | | | | | | | | | | | **0** | 1.7 | 934 | | 2.5 |
| 10/20/08 | Yes | | | | | | | | | 2 | | | **2** | 5.5 | 923 | | 4.0 |
| **By Species** | | **0** | **0** | **6** | **1** | **1** | **0** | **0** | **0** | **6** | **3** | **0** | **17** | | | | |
| **By Guild** | | **7** | | | **1** | **1** | | | **0** | **9** | | | | | | | |
| | | **BBSH** | | | **LACI** | **RBEP** | | | **MYSP** | **UNKN** | | | **Total** | | | | |

**Appendix B Table 8**. Summary of fall 2008 acoustic bat data and weather during each survey night at the Stewart S Met Low detector

| | | BBSH | | | HB | RBEP | | | MYSP | UNKN | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Night of** | **Operated Okay?** | **BBSH** | **big brown** | **silver-hiared** | **hoary bat** | **eastern red** | **eastern pipistrelle** | **RBEP** | **MYSP** | **high-frequency** | **low-frequency** | **unknown** | **Total** | **Wind Speed (m/s)** | **Barometric Pressure** | **Relative Humidity (%)** | **Temperature (celsius)** |
| 08/28/08 | Yes | | | | | | | | | | | | **0** | 4.3 | 943 | | 15.6 |
| 08/29/08 | Yes | | | | | | | | | 1 | | | **1** | 10.1 | 942 | | 14.2 |
| 08/30/08 | Yes | | | | | | | | | 2 | | | **2** | 14.5 | 945 | | 13.6 |
| 08/31/08 | Yes | | | | | | | | | 1 | | | **1** | | | | |
| 09/01/08 | Yes | | | | | | | | | 1 | | | **1** | 9.5 | 931 | | 14.7 |
| 09/02/08 | Yes | | | | | | | | 1 | 1 | | | **2** | 3.6 | 929 | | 14.5 |
| 09/03/08 | Yes | 1 | | | | | | | | 1 | | | **2** | 5.3 | 924 | | 16.1 |
| 09/04/08 | Yes | 1 | | | | | | | | | | | **1** | 4.5 | 930 | | 14.0 |
| 09/05/08 | Yes | | | | | | | | | | | | **0** | 9.0 | 928 | | 18.4 |
| 09/06/08 | Yes | | | | | | | | | | | | **0** | 5.3 | 921 | | 16.6 |
| 09/07/08 | Yes | | | | | | | | | | | | **0** | 10.9 | 925 | | 9.8 |
| 09/08/08 | Yes | | | | | | | | | | | | **0** | 6.8 | 929 | | 13.5 |
| 09/09/08 | Yes | | | | | | | | | | | | **0** | 10.2 | 925 | | 7.8 |
| 09/10/08 | Yes | | | | | | | | | | | | **0** | 4.0 | 936 | | 6.2 |
| 09/11/08 | Yes | | | | | | | | | | | | **0** | 5.6 | 933 | | 9.6 |
| 09/12/08 | Yes | | | | | | | | | 1 | | | **1** | 5.6 | 924 | | 12.5 |
| 09/13/08 | Yes | | | 1 | | | | | | | | | **1** | 10.0 | 924 | | 13.3 |
| 09/14/08 | Yes | | | | | | | | | | | | **0** | 15.5 | 912 | | 17.8 |
| 09/15/08 | Yes | | | | | | | | | | 1 | | **1** | 7.4 | 926 | | 8.5 |
| 09/16/08 | Yes | | | | | | | | | 2 | | | **2** | 5.6 | 930 | | 7.9 |
| 09/17/08 | Yes | | | | | | | | | | | | **0** | 8.0 | 928 | | 9.6 |
| 09/18/08 | Yes | | | | | | | | | | | | **0** | 4.4 | 938 | | 2.1 |
| 09/19/08 | Yes | | | | | | | | | | | | **0** | 7.8 | 937 | | 5.7 |
| 09/20/08 | Yes | | | | | | | | | | | | **0** | 8.4 | 931 | | 11.7 |
| 09/21/08 | Yes | | | | | | | | | | | | **0** | 3.6 | 938 | | 5.0 |
| 09/22/08 | Yes | | | | | | | | | | | | **0** | 2.6 | 941 | | 6.0 |
| 09/23/08 | Yes | | | | | | | | | | | | **0** | 7.2 | 940 | | 8.1 |
| 09/24/08 | Yes | | | | | | | | | | | | **0** | 4.4 | 942 | | 13.7 |
| 09/25/08 | Yes | | | | | | | | | | | | **0** | 7.6 | 943 | | 12.3 |
| 09/26/08 | Yes | | | | | | | | | | | | **0** | 8.3 | 937 | | 11.5 |
| 09/27/08 | Yes | | | | | | | | | | | | **0** | 5.6 | 930 | | 15.8 |
| 09/28/08 | Yes | | | | | | | | | | | | **0** | 7.6 | 923 | | 12.5 |
| 09/29/08 | Yes | | | | | | | | | | | | **0** | 4.2 | 926 | | 8.8 |
| 09/30/08 | Yes | | | | | | | | | | | | **0** | 5.6 | 920 | | 9.4 |
| 10/01/08 | Yes | | | | | | | | | | | | **0** | 3.8 | 912 | | 9.4 |
| 10/02/08 | Yes | | | | | | | | | | | | **0** | 8.9 | 913 | | 3.0 |
| 10/03/08 | Yes | | | | | | | | | | | | **0** | 14.8 | 920 | | 3.7 |
| 10/04/08 | Yes | | | | | | | | | | | | **0** | 8.0 | 930 | | 2.9 |
| 10/05/08 | Yes | | | | | | | | | | | | **0** | 6.4 | 932 | | 2.2 |
| 10/06/08 | Yes | | | | | | | | | | | | **0** | 12.7 | 931 | | 1.9 |
| 10/07/08 | Yes | | | | | | | | | | | | **0** | 14.2 | 928 | | 5.8 |
| 10/08/08 | Yes | | | | | | | | | | | | **0** | 7.7 | 922 | | 9.7 |
| 10/09/08 | Yes | | | | | | | | | | | | **0** | 10.4 | 923 | | 9.2 |
| 10/10/08 | Yes | | | | | | | | | | | | **0** | 9.0 | 934 | | 6.2 |
| 10/11/08 | Yes | | | | | | | | | | | | **0** | 8.1 | 939 | | 5.1 |
| 10/12/08 | Yes | | | | | | | | | | | | **0** | 7.2 | 937 | | 8.2 |
| 10/13/08 | Yes | | | | | | | | | | | | **0** | 7.6 | 934 | | 7.5 |
| 10/14/08 | Yes | | | | | | | | | | | | **0** | 10.2 | 927 | | 5.4 |
| 10/15/08 | Yes | | | | | | | | | | | | **0** | 5.8 | 925 | | 8.5 |
| 10/16/08 | Yes | | | | | | | | | | | | **0** | 10.4 | 923 | | 3.7 |
| 10/17/08 | Yes | | | | | | | | | | | | **0** | 7.8 | 928 | | -0.8 |
| 10/18/08 | Yes | | | | | | | | | | | | **0** | 4.7 | 935 | | -1.7 |
| 10/19/08 | Yes | | | | | | | | | | | | **0** | 1.7 | 934 | | 2.5 |
| 10/20/08 | Yes | | | | | | | | | | | | **0** | 5.5 | 923 | | 4.0 |
| **By Species** | | **2** | **0** | **1** | **0** | **0** | **0** | **0** | **1** | **10** | **1** | **0** | **15** | | | | |
| **By Guild** | | **3** | | | **0** | **0** | | | **1** | **11** | | | | | | | |
| | | **BBSH** | | | **HB** | **RBEP** | | | **MYSP** | **UNKN** | | | **Total** | | | | |

**Appendix B Table 9**. Summary of fall 2008 acoustic bat data and weather during each survey night at the Stewart S Met Tree detector

| | | BBSH | | | HB | RBEP | | | MYSP | UNKN | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Night of** | **Operated Okay?** | **BBSH** | **big brown** | **silver-hiared** | **hoary bat** | **eastern red** | **eastern pipistrelle** | **RBEP** | **MYSP** | **high-frequency** | **low-frequency** | **unknown** | **Total** | **Wind Speed (m/s)** | **Barometric Pressure** | **Relative Humidity (%)** | **Temperature (celsius)** |
| 08/11/08 | Yes | | | | | | | | 1 | 1 | 1 | | **3** | 7.2 | 934 | | 12.4 |
| 08/12/08 | Yes | | | | | | | | | | | | **0** | 2.5 | 938 | | 15.3 |
| 08/13/08 | Yes | | | | | | | | | 1 | | | **1** | 5.5 | 941 | | 14.4 |
| 08/14/08 | Yes | | | | 1 | | | | | 1 | | | **2** | 3.5 | 944 | | 16.3 |
| 08/15/08 | Yes | | | | | | | | 1 | 4 | 1 | | **6** | 7.8 | 937 | | 15.0 |
| 08/16/08 | Yes | | | | | | | | | | | | **0** | 6.0 | 940 | | 15.2 |
| 08/17/08 | Yes | | | | | | | | 1 | | 1 | | **2** | 7.4 | 937 | | 15.3 |
| 08/18/08 | Yes | | | | | | | | | | | | **0** | 11.7 | 942 | | 7.7 |
| 08/19/08 | Yes | | | | | | | | | | | 2 | **2** | 9.7 | 947 | | 11.6 |
| 08/20/08 | Yes | | | | | | | | | 3 | | | **3** | 6.2 | 954 | | 17.2 |
| 08/21/08 | Yes | | | | | | | | 2 | 1 | | | **3** | 3.3 | 955 | | 20.3 |
| 08/22/08 | Yes | | | | | | | | 1 | 2 | | | **3** | 8.3 | 948 | | 16.5 |
| 08/23/08 | Yes | | | | | | | | | | 1 | | **1** | 7.0 | 939 | | 15.9 |
| 08/24/08 | Yes | | | | | | | | | 3 | | | **3** | 11.2 | 939 | | 8.8 |
| 08/25/08 | Yes | | | | | | | | | | | | **0** | 9.8 | 945 | | 10.5 |
| 08/26/08 | Yes | | | | | | | | | 1 | 1 | | **2** | 5.2 | 948 | | 15.6 |
| 08/27/08 | Yes | | | | | | | | | 2 | | | **2** | 5.6 | 946 | | 14.9 |
| 08/28/08 | Yes | | | | | | | | | | | | **0** | 4.3 | 943 | | 15.6 |
| 08/29/08 | Yes | | | | | | | | 1 | 1 | | | **2** | 10.1 | 942 | | 14.2 |
| 08/30/08 | Yes | | | | | | | | | | | | **0** | 14.5 | 945 | | 13.6 |
| 08/31/08 | Yes | | | | | | | | | | | | **0** | | | | |
| 09/01/08 | Yes | | | | | | | | | 1 | | | **1** | 9.5 | 931 | | 14.7 |
| 09/02/08 | Yes | | | | | | | | 1 | | | | **1** | 3.6 | 929 | | 14.5 |
| **By Species** | | **0** | **0** | **0** | **1** | **0** | **0** | **0** | **8** | **21** | **5** | **2** | **37** | | | | |
| **By Guild** | | **1** | | | **1** | **0** | | | **8** | **28** | | | | | | | |
| | | **BBSH** | | | **HB** | **RBEP** | | | **MYSP** | **UNKN** | | | **Total** | | | | |

**Appendix B Table 10**. Summary of fall 2008 acoustic bat data and weather during each survey night at the Stewart Valley Tree detector

| | | BBSH | | | HB | RBEP | | | MYSP | UNKN | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Night of | Operated Okay? | BBSH | big brown | silver-hiared | hoary bat | eastern red | eastern pipistrelle | RBEP | MYSP | high-frequency | low-frequency | unknown | Total | Wind Speed (m/s) | Barometric Pressure | Relative Humidity (%) | Temperature (celsius) |
| 08/11/08 | Yes | | | | | | | | 56 | 21 | | | **77** | 7.2 | 934 | | 12.4 |
| 08/12/08 | Yes | | | | | | | | 44 | 12 | | | **56** | 2.5 | 938 | | 15.3 |
| 08/13/08 | Yes | | | | | | | | 102 | 41 | | | **143** | 5.5 | 941 | | 14.4 |
| 08/14/08 | Yes | | | | | | | | 72 | 40 | | | **112** | 3.5 | 944 | | 16.3 |
| 08/15/08 | Yes | | | | | | | | 132 | 57 | | | **189** | 7.8 | 937 | | 15.0 |
| 08/16/08 | Yes | | | | | | | | 495 | 67 | | | **562** | 6.0 | 940 | | 15.2 |
| 08/17/08 | Yes | | | | | | | 1 | 275 | 79 | | | **355** | 7.4 | 937 | | 15.3 |
| 08/18/08 | Yes | | | | | | | 1 | 331 | 100 | | | **432** | 11.7 | 942 | | 7.7 |
| 08/19/08 | Yes | | | | | | | | 90 | 56 | | | **146** | 9.7 | 947 | | 11.6 |
| 08/20/08 | Yes | | | | | | | | 489 | 176 | | | **665** | 6.2 | 954 | | 17.2 |
| 08/21/08 | Yes | | | | | | | 3 | 287 | 157 | | | **447** | 3.3 | 955 | | 20.3 |
| 08/22/08 | Yes | | | | | | | 3 | 280 | 143 | | | **426** | 8.3 | 948 | | 16.5 |
| 08/23/08 | Yes | | | | | | | 3 | 400 | 255 | | | **658** | 7.0 | 939 | | 15.9 |
| 08/24/08 | Yes | | | | | | 1 | | 154 | 79 | | | **234** | 11.2 | 939 | | 8.8 |
| 08/25/08 | Yes | | | | | | | | 268 | 129 | 1 | | **398** | 9.8 | 945 | | 10.5 |
| 08/26/08 | Yes | | | | | | | | 79 | 109 | | | **188** | 5.2 | 948 | | 15.6 |
| 08/27/08 | Yes | | | | | | | | 203 | 187 | | | **390** | 5.6 | 946 | | 14.9 |
| **By Species** | | **0** | **0** | **0** | **0** | **0** | **1** | **11** | **3757** | **1708** | **1** | **0** | **5478** | | | | |
| **By Guild** | | **0** | | | **0** | **12** | | | **3757** | **1709** | | | | | | | |
| | | **BBSH** | | | **HB** | **RBEP** | | | **MYSP** | **UNKN** | | | **Total** | | | | |

**Appendix B Table 11**. Summary of fall 2008 acoustic bat data and weather during each survey night at the Witham Met High detector

| | | BBSH | | | HB | RBEP | | | MYSP | UNKN | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Night of | Operated Okay? | BBSH | big brown | silver-hiared | hoary bat | eastern red | eastern pipistrelle | RBEP | MYSP | high-frequency | low-frequency | unknown | Total | Wind Speed (m/s) | Barometric Pressure | Relative Humidity (%) | Temperature (celsius) |
| 09/09/08 | Yes | | | | | | | | | | | | **0** | 10.2 | 925 | | 7.8 |
| 09/10/08 | Yes | | | | | | | | | | 1 | | **1** | 4.0 | 936 | | 6.2 |
| 09/11/08 | Yes | | | | | | | | | | | | **0** | 5.6 | 933 | | 9.6 |
| 09/12/08 | Yes | | | | | | | | | | | | **0** | 5.6 | 924 | | 12.5 |
| 09/13/08 | Yes | | | | | | | | | | | | **0** | 10.0 | 924 | | 13.3 |
| 09/14/08 | Yes | | | | | | | | | | | | **0** | 15.5 | 912 | | 17.8 |
| 09/15/08 | Yes | | | | | | | | | | | | **0** | 7.4 | 926 | | 8.5 |
| 09/16/08 | Yes | | | | | | | | | 1 | | | **1** | 5.6 | 930 | | 7.9 |
| 09/17/08 | Yes | 1 | | | | | | | | | | | **1** | 8.0 | 928 | | 9.6 |
| 09/18/08 | Yes | | | | | | | | | | | | **0** | 4.4 | 938 | | 2.1 |
| 09/19/08 | Yes | | | | | | | | | | | | **0** | 7.8 | 937 | | 5.7 |
| 09/20/08 | Yes | | | | | | | | | | 1 | | **1** | 8.4 | 931 | | 11.7 |
| 09/21/08 | Yes | | | | | | | | | | | | **0** | 3.6 | 938 | | 5.0 |
| 09/22/08 | Yes | | | | | | | | | | | | **0** | 2.6 | 941 | | 6.0 |
| 09/23/08 | Yes | | | | | | | | | | | | **0** | 7.2 | 940 | | 8.1 |
| 09/24/08 | Yes | | | | | | | | | | | | **0** | 4.4 | 942 | | 13.7 |
| 09/25/08 | Yes | | | | | | | | | | | | **0** | 7.6 | 943 | | 12.3 |
| 09/26/08 | Yes | | | | | | | | | | | | **0** | 8.3 | 937 | | 11.5 |
| 09/27/08 | Yes | | | | | | | | | | | | **0** | 5.6 | 930 | | 15.8 |
| 09/28/08 | Yes | | | | | | | | | | | | **0** | 7.6 | 923 | | 12.5 |
| 09/29/08 | Yes | | | | | | | | | | | | **0** | 4.2 | 926 | | 8.8 |
| 09/30/08 | Yes | | | | | | | | | | | | **0** | 5.6 | 920 | | 9.4 |
| 10/01/08 | Yes | | | | | | | | | | | | **0** | 3.8 | 912 | | 9.4 |
| 10/02/08 | Yes | | | | | | | | | | | | **0** | 8.9 | 913 | | 3.0 |
| 10/03/08 | Yes | | | | | | | | | | | | **0** | 14.8 | 920 | | 3.7 |
| 10/04/08 | Yes | | | | | | | | | | | | **0** | 8.0 | 930 | | 2.9 |
| 10/05/08 | Yes | | | | | | | | | | | | **0** | 6.4 | 932 | | 2.2 |
| 10/06/08 | Yes | | | | | | | | | | | | **0** | 12.7 | 931 | | 1.9 |
| 10/07/08 | Yes | | | | | | | | | | | | **0** | 14.2 | 928 | | 5.8 |
| 10/08/08 | Yes | | | | | | | | | | | | **0** | 7.7 | 922 | | 9.7 |
| 10/09/08 | Yes | | | | | | | | | | | | **0** | 10.4 | 923 | | 9.2 |
| 10/10/08 | Yes | | | | | | | | | | | | **0** | 9.0 | 934 | | 6.2 |
| 10/11/08 | Yes | | | | | | | | | | | | **0** | 8.1 | 939 | | 5.1 |
| 10/12/08 | Yes | | | | | | | | | | | | **0** | 7.2 | 937 | | 8.2 |
| 10/13/08 | Yes | | | | | | | | | | | | **0** | 7.6 | 934 | | 7.5 |
| 10/14/08 | Yes | | | | | | | | | | | | **0** | 10.2 | 927 | | 5.4 |
| 10/15/08 | Yes | | | | | | | | | | | | **0** | 5.8 | 925 | | 8.5 |
| 10/16/08 | Yes | | | | | | | | | | | | **0** | 10.4 | 923 | | 3.7 |
| 10/17/08 | Yes | | | | | | | | | | | | **0** | 7.8 | 928 | | -0.8 |
| 10/18/08 | Yes | | | | | | | | | | | | **0** | 4.7 | 935 | | -1.7 |
| 10/19/08 | Yes | | | | | | | | | | | | **0** | 1.7 | 934 | | 2.5 |
| 10/20/08 | Yes | | | | | | | | | | | | **0** | 5.5 | 923 | | 4.0 |
| **By Species** | | **1** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **2** | **0** | **4** | | | | |
| **By Guild** | | **1** | | | **0** | **0** | | | **0** | **3** | | | | | | | |
| | | **BBSH** | | | **HB** | **RBEP** | | | **MYSP** | **UNKN** | | | **Total** | | | | |

**Appendix B Table 12**. Summary of fall 2008 acoustic bat data and weather during each survey night at the Whitham Met Low detector

| | | BBSH | | | HB | RBEP | | | MYSP | UNKN | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Night of | Operated Okay? | BBSH | big brown | silver-hiared | hoary bat | eastern red | eastern pipistrelle | RBEP | MYSP | high-frequency | low-frequency | unknown | Total | Wind Speed (m/s) | Wind Direction (degrees) | Relative Humidity (%) | Temperature (celsius) |
| 09/16/08 | No | | | | | | | | 1 | 1 | | | **2** | | | | |
| 09/17/08 | No | | | | | | | | | 1 | | | **1** | | | | |
| 09/18/08 | No | | | | | | | | | | | | **0** | | | | |
| 09/19/08 | No | | | | | | | | | 1 | | | **1** | | | | |
| 09/20/08 | No | | | | | | | | | | | | **0** | | | | |
| 09/21/08 | No | | | | | | | | | | | | **0** | | | | |
| 09/22/08 | No | | | | | | | | | | | | **0** | | | | |
| 09/23/08 | No | | | | | | | | | | | | **0** | | | | |
| 09/24/08 | No | | | | | | | | | | 1 | | **1** | | | | |
| 09/25/08 | No | | | | | | | | | | | | **0** | | | | |
| 09/26/08 | No | | | | | | | | | | | | **0** | | | | |
| 09/27/08 | No | | | | | | | | | | | | **0** | | | | |
| 09/28/08 | No | | | | | | | | | | | | **0** | | | | |
| 09/29/08 | No | | | | | | | | | | | | **0** | | | | |
| 09/30/08 | No | | | | | | | | | | | | **0** | | | | |
| 10/01/08 | No | | | | | | | | | | | | **0** | | | | |
| 10/02/08 | No | | | | | | | | | | | | **0** | | | | |
| 10/03/08 | No | | | | | | | | | | | | **0** | | | | |
| 10/04/08 | No | | | | | | | | | | | | **0** | | | | |
| 10/05/08 | No | | | | | | | | | | | | **0** | | | | |
| 10/06/08 | No | | | | | | | | | | | | **0** | | | | |
| 10/07/08 | No | | | | | | | | | | | | **0** | | | | |
| 10/08/08 | No | | | | | | | | | | | | **0** | | | | |
| 10/09/08 | No | | | | | | | | | | | | **0** | | | | |
| 10/10/08 | No | | | | | | | | | | | | **0** | | | | |
| 10/11/08 | No | | | | | | | | | | | | **0** | | | | |
| 10/12/08 | No | | | | | | | | | | | | **0** | | | | |
| 10/13/08 | No | | | | | | | | | | | | **0** | | | | |
| 10/14/08 | No | | | | | | | | | | | | **0** | | | | |
| 10/15/08 | No | | | | | | | | | | | | **0** | | | | |
| 10/16/08 | No | | | | | | | | | | | | **0** | | | | |
| 10/17/08 | No | | | | | | | | | | | | **0** | | | | |
| 10/18/08 | No | | | | | | | | | | | | **0** | | | | |
| 10/19/08 | No | | | | | | | | | | | | **0** | | | | |
| 10/20/08 | No | | | | | | | | | | | | **0** | | | | |
| **By Species** | | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **3** | **1** | **0** | **5** | | | | |
| **By Guild** | | **0** | | | **0** | **0** | | | **1** | **4** | | | | | | | |
| | | **BBSH** | | | **HB** | **RBEP** | | | **MYSP** | **UNKN** | | | **Total** | | | | |

**Appendix B Table 13**. Summary of fall 2008 acoustic bat data and weather during each survey night at the Whitham Met Tree detector

| | | BBSH | | | HB | RBEP | | | MYSP | UNKN | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Night of** | **Operated Okay?** | **BBSH** | **big brown** | **silver-hiared** | **hoary bat** | **eastern red** | **eastern pipistrelle** | **RBEP** | **MYSP** | **high-frequency** | **low-frequency** | **unknown** | **Total** | **Wind Speed (m/s)** | **Wind Direction (degrees)** | **Relative Humidity (%)** | **Temperature (celsius)** |
| 09/09/08 | Yes | | | | | | | | | | | | **0** | | | | |
| 09/10/08 | Yes | | | | | | | | | | 1 | | **1** | | | | |
| 09/11/08 | Yes | | | | | | | | | | | | **0** | | | | |
| 09/12/08 | Yes | | | | | | | | | | | | **0** | | | | |
| 09/13/08 | Yes | | | | | | | | | 1 | | | **1** | | | | |
| 09/14/08 | Yes | | | | | | | | | | | | **0** | | | | |
| 09/15/08 | Yes | | | | | | | | | | | | **0** | | | | |
| **By Species** | | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **1** | **0** | **2** | | | | |
| **By Guild** | | **0** | | | **0** | **0** | | | **0** | **2** | | | | | | | |
| | | **BBSH** | | | **HB** | **RBEP** | | | **MYSP** | **UNKN** | | | **Total** | | | | |

Appendix B Table 14. Summary of available fall bat detector surveys (results reported for individual detectors)

| Year | Project | Project Location | Habitat | Height (m) | Detector Nights | Start | End | Calls | Rate | Reference |
|---|---|---|---|---|---|---|---|---|---|---|
| **Tree or Low Tower detectors (10 m or below)** | | | | | | | | | | |
| 2007 | Rollins | Rollins, Penobscot Cty, ME | forest edge | 3 | 114 | 7/12 | 11/2 | 12291 | 107.8 | Stantec Consulting Services Inc. 2007. Fall 2007 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for FirstWind Management, LLC. |
| 2007 | Rollins | Rollins, Penobscot Cty, ME | forest edge | 3 | 53 | 8/2 | 10/16 | 5360 | 101.1 | Stantec Consulting Services Inc. 2007. Fall 2007 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for FirstWind Management, LLC. |
| 2007 | Rollins | Rollins, Penobscot Cty, ME | forest edge | 3 | 107 | 7/12 | 11/2 | 8996 | 84.1 | Stantec Consulting Services Inc. 2007. Fall 2007 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for FirstWind Management, LLC. |
| 2005 | Lempster | Lempster, Sullivan Cty, NH | forest edge | 7.5 | 34 | 9/20 | 10/31 | 27 | 0.8 | Woodlot Alternatives, Inc. 2005. Summary of fall 2005 Lempster bat survey. Memorandum to Jeff Keeler (CEI) from Bob Roy (Woodlot Alternatives, Inc.) dated November 18, 2005. |
| 2005 | Lempster | Lempster, Sullivan Cty, NH | forest edge | 2 | 42 | 9/20 | 10/31 | 2 | 0 | Woodlot Alternatives, Inc. 2005. Summary of fall 2005 Lempster bat survey. Memorandum to Jeff Keeler (CEI) from Bob Roy (Woodlot Alternatives, Inc.) dated November 18, 2005. |
| 2006 | Lempster | Lempster, Sullivan Cty, NH | forest edge | 10 | 29 | 9/9 | 10/24 | 2 | 0.1 | Woodlot Alternatives, Inc. 2007. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Lempster Mountain Wind Power Project in Lempster, New Hampshire. Prepared for Lempster Wind, LLC. |
| 2006 | Lempster | Lempster, Sullivan Cty, NH | forest edge | 3 | 44 | 9/9 | 10/24 | 384 | 8.7 | Woodlot Alternatives, Inc. 2007. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Lempster Mountain Wind Power Project in Lempster, New Hampshire. Prepared for Lempster Wind, LLC. |
| 2005 | High Sheldon | Sheldon, Wyoming Cty, NY | field | 2 | 49 | 8/1 | 10/4 | 5535 | 113 | Woodlot Alternatives, Inc. 2006. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed High Sheldon Wind Project in Sheldon, New York. Prepared for Invenergy. |
| 2005 | Howard | Howard, Steuben Cty, NY | field | 2 | 25 | 8/3 | 8/27 | 1493 | 51.5 | Woodlot Alternatives, Inc. 2005. A Fall 2005 Survey of Bird and Bat Migration at the Proposed Howard Wind Power Project in Howard, New York. Prepared for Everpower Global. |
| 2005 | Jordanville | Jordanville, Herkimer Cty, NY | field | 2 | 34 | 8/12 | 9/22 | 124 | 4.4 | Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Jordanville Wind Project in Jordanville, New York. Prepared for Community Energy, Inc. |
| 2005 | Marble River | Churubusco, Clinton Cty, NY | field | 10 | 34 | 8/1 | 10/11 | 150 | 4.4 | Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Marble River Wind Project in Clinton and Ellenburg, New York. Prepared for AES Corporation. |
| 2005 | Marble River | Churubusco, Clinton Cty, NY | field | 2 | 18 | 8/1 | 10/11 | 113 | 6.3 | Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Marble River Wind Project in Clinton and Ellenburg, New York. Prepared for AES Corporation. |
| 2005 | Top Notch | Fairfield, Herkimer Cty, NY | field | 2 | 34 | 8/19 | 9/21 | 44 | 1.3 | Woodlot Alternatives, Inc. 2005. A Summer and Fall 2005 Radar and Acoustic Surveys of Bird and Bat Migration at the Proposed Top Notch Wind Project in Fairfield, New York. Prepared for PPM Atlantic Renewable. |
| 2005 | West Hill | Munnsville, Madison Cty, NY | field | 2 | 30 | 8/1 | 10/21 | 10 | 0.3 | Woodlot Alternatives, Inc. 2005. Summer and Fall 2005 Bird and Bat Surveys at the Proposed Munnsville Wind Project in Munnsville, New York. Prepared for AES-EHN NY Wind, LLC. |
| 2005 | Horse Creek | Clayton, Jefferson Cty, NY | forest edge | 2 | 33 | 8/19 | 9/20 | 154 | 4.7 | Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Clayton Wind Project in Clayton, New York. Prepared for PPM Atlantic Renewable. |
| 2005 | Moresville | Stamford, Delaware Cty, NY | forest edge | 2 | 58 | 8/15 | 10/15 | 280 | 4.8 | Woodlot. 2007. A Spring and Fall 2005 Radar and Acoustic Survey of Bird Migration at the Proposed Moresville Energy Center in Stamford and Roxbury, New York. Prepared for Invenergy, LLC. Rockville, MD. |
| 2007 | Record Hill | Roxbury, Oxford Cty, ME | forest edge | 2 | 13 | 8/9 | 8/21 | 148 | 11.4 | Stantec Consulting Services Inc. 2007. Fall 2007 Migration Report: Visual, Acoustic and Radar Surveys of Bird and Bat Migration Conducted at the Proposed Record Hill Wind Project in Roxbury, Maine. Prepared for Independence Wind, LLC. |
| 2007 | Record Hill | Roxbury, Oxford Cty, ME | forest edge | 5 | 4 | 8/9 | 8/21 | 1 | 0.3 | Stantec Consulting Services Inc. 2007. Fall 2007 Migration Report: Visual, Acoustic and Radar Surveys of Bird and Bat Migration Conducted at the Proposed Record Hill Wind Project in Roxbury, Maine. Prepared for Independence Wind, LLC. |
| 2007 | Record Hill | Roxbury, Oxford Cty, ME | forest edge | 3 | 13 | 8/9 | 8/21 | 524 | 40.3 | Stantec Consulting Services Inc. 2007. Fall 2007 Migration Report: Visual, Acoustic and Radar Surveys of Bird and Bat Migration Conducted at the Proposed Record Hill Wind Project in Roxbury, Maine. Prepared for Independence Wind, LLC. |
| 2007 | Record Hill | Roxbury, Oxford Cty, ME | forest edge | 10 | 13 | 8/9 | 8/21 | 1576 | 121.2 | Stantec Consulting Services Inc. 2007. Fall 2007 Migration Report: Visual, Acoustic and Radar Surveys of Bird and Bat Migration Conducted at the Proposed Record Hill Wind Project in Roxbury, Maine. Prepared for Independence Wind, LLC. |
| **MET Tower Detectors** | | | | | | | | | | |
| 2007 | Ball Hill | Villenova, Chautauqua Cty, NY | field | 40 | 77 | 7/30 | 10/14 | 246 | 3.2 | Stantec Consulting Services Inc. 2008. A Fall 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Ball Hill Windpark in Villenova and Hanover, New York. Prepared for Noble Environmental Power, LLC and Ecology and Environment, Inc. |

Appendix B Table 14. Summary of available fall bat detector surveys (results reported for individual detectors)

| Year | Project | Project Location | Habitat | Height (m) | Detector Nights | Start | End | Calls | Rate | Reference |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| 2007 | Ball Hill | Villenova, Chautauqua Cty, NY | field | 20 | 77 | 7/30 | 10/14 | 295 | 3.8 | Stantec Consulting Services Inc. 2008. A Fall 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Ball Hill Windpark in Villenova and Hanover, New York. Prepared for Noble Environmental Power, LLC and Ecology and Environment, Inc. |
| 2007 | Record Hill | Roxbury, Oxford Cty, ME | forest edge | 45 | 46 | 8/22 | 10/18 | 7 | 0.2 | Stantec Consulting Services Inc. 2007. Fall 2007 Migration Report: Visual, Acoustic and Radar Surveys of Bird and Bat Migration Conducted at the Proposed Record Hill Wind Project in Roxbury, Maine. Prepared for Independence Wind, LLC. |
| 2007 | Record Hill | Roxbury, Oxford Cty, ME | forest edge | 20 | 58 | 8/22 | 10/18 | 93 | 1.6 | Stantec Consulting Services Inc. 2007. Fall 2007 Migration Report: Visual, Acoustic and Radar Surveys of Bird and Bat Migration Conducted at the Proposed Record Hill Wind Project in Roxbury, Maine. Prepared for Independence Wind, LLC. |
| 2007 | Record Hill | Roxbury, Oxford Cty, ME | forest edge | 45 | 59 | 8/22 | 10/19 | 18 | 0.4 | Stantec Consulting Services Inc. 2007. Fall 2007 Migration Report: Visual, Acoustic and Radar Surveys of Bird and Bat Migration Conducted at the Proposed Record Hill Wind Project in Roxbury, Maine. Prepared for Independence Wind, LLC. |
| 2007 | Record Hill | Roxbury, Oxford Cty, ME | forest edge | 20 | 59 | 8/22 | 10/19 | 252 | 5.1 | Stantec Consulting Services Inc. 2007. Fall 2007 Migration Report: Visual, Acoustic and Radar Surveys of Bird and Bat Migration Conducted at the Proposed Record Hill Wind Project in Roxbury, Maine. Prepared for Independence Wind, LLC. |
| 2005 | Dans Mountain | Loarville, Allegany Cty, MD | forest edge | 11 | 53 | 8/1 | 9/22 | 574 | 10.8 | Woodlot Alternatives, Inc. 2005. Fall 2005 Bat Echolocation Surveys at the Proposed Dan's Mountain Wind Project in Frostburg, Maryland. Prepared for US Wind Force. |
| 2005 | Dans Mountain | Loarville, Allegany Cty, MD | forest edge | 23 | 31 | 8/1 | 9/22 | 388 | 12.5 | Woodlot Alternatives, Inc. 2005. Fall 2005 Bat Echolocation Surveys at the Proposed Dan's Mountain Wind Project in Frostburg, Maryland. Prepared for US Wind Force. |
| 2007 | Rollins | Rollins, Penobscot Cty, ME | forest edge | 40 | 95 | 7/12 | 11/2 | 66 | 0.7 | Stantec Consulting Services Inc. 2007. Fall 2007 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for FirstWind Management, LLC. |
| 2007 | Rollins | Rollins, Penobscot Cty, ME | forest edge | 20 | 106 | 7/12 | 11/2 | 155 | 1.5 | Stantec Consulting Services Inc. 2007. Fall 2007 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for FirstWind Management, LLC. |
| 2006 | Kibby | Kibby, Franklin Cty, ME | forest edge | 45 | 72 | 6/20 | 10/25 | 18 | 0.3 | Woodlot Alternatives, Inc. 2006. Summer/Fall 2006 Survey of Bat Activity at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine Wind Development Inc. |
| 2006 | Kibby | Kibby, Franklin Cty, ME | forest edge | 45 | 76 | 6/20 | 10/25 | 0 | 0 | Woodlot Alternatives, Inc. 2006. Summer/Fall 2006 Survey of Bat Activity at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine Wind Development Inc. |
| 2006 | Kibby | Kibby, Franklin Cty, ME | forest edge | 20 | 44 | 6/20 | 10/25 | 4 | 0.1 | Woodlot Alternatives, Inc. 2006. Summer/Fall 2006 Survey of Bat Activity at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine Wind Development Inc. |
| 2006 | Kibby | Kibby, Franklin Cty, ME | forest edge | 45 | 20 | 6/20 | 10/25 | 0 | 0 | Woodlot Alternatives, Inc. 2006. Summer/Fall 2006 Survey of Bat Activity at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine Wind Development Inc. |
| 2006 | Redington | Redington, Franklin Cty, ME | forest edge | 15 | 21 | 8/10 | 10/24 | 0 | 0 | Woodlot Alternatives, Inc. 2006. Fall 2006 Bat Detector Surveys at the Proposed Redington Wind Project. Prepared for Maine Mountain Power. |
| 2006 | Redington | Redington, Franklin Cty, ME | forest edge | 15 | 48 | 8/10 | 10/24 | 0 | 0 | Woodlot Alternatives, Inc. 2006. Fall 2006 Bat Detector Surveys at the Proposed Redington Wind Project. Prepared for Maine Mountain Power. |
| 2006 | Redington | Redington, Franklin Cty, ME | forest edge | 30 | 29 | 8/10 | 10/24 | 0 | 0 | Woodlot Alternatives, Inc. 2006. Fall 2006 Bat Detector Surveys at the Proposed Redington Wind Project. Prepared for Maine Mountain Power. |
| 2006 | Redington | Redington, Franklin Cty, ME | forest edge | 30 | 37 | 8/10 | 10/24 | 0 | 0 | Woodlot Alternatives, Inc. 2006. Fall 2006 Bat Detector Surveys at the Proposed Redington Wind Project. Prepared for Maine Mountain Power. |
| 2006 | Stetson | Stetson, Penobscot Cty, ME | forest edge | 30 | 73 | 6/28 | 10/16 | 8 | 0.1 | Woodlot Alternatives, Inc. 2007. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Stetson Mountain Wind Power Project in Washington County, Maine. Prepared for Evergreen Wind V, LLC. |

Appendix B Table 14. Summary of available fall bat detector surveys (results reported for individual detectors)

| Year | Project | Project Location | Habitat | Height (m) | Detector Nights | Start | End | Calls | Rate | Reference |
|---|---|---|---|---|---|---|---|---|---|---|
| 2006 | Stetson | Stetson, Penobscot Cty, ME | forest edge | 30 | 76 | 6/28 | 10/16 | 170 | 2.2 | Woodlot Alternatives, Inc. 2007. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Stetson Mountain Wind Power Project in Washington County, Maine. Prepared for Evergreen Wind V, LLC. |
| 2006 | Stetson | Stetson, Penobscot Cty, ME | forest edge | 15 | 105 | 6/28 | 10/16 | 108 | 1 | Woodlot Alternatives, Inc. 2007. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Stetson Mountain Wind Power Project in Washington County, Maine. Prepared for Evergreen Wind V, LLC. |
| 2006 | Stetson | Stetson, Penobscot Cty, ME | forest edge | 15 | 107 | 6/28 | 10/16 | 651 | 6.1 | Woodlot Alternatives, Inc. 2007. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Stetson Mountain Wind Power Project in Washington County, Maine. Prepared for Evergreen Wind V, LLC. |
| 2005 | Lempster | Lempster, Sullivan Cty, NH | forest edge | 15 | 42 | 9/20 | 10/31 | 14 | 0.3 | Woodlot Alternatives, Inc. 2005. Summary of fall 2005 Lempster bat survey. Memorandum to Jeff Keeler (CEI) from Bob Roy (Woodlot Alternatives, Inc.) dated November 18, 2005. |
| 2006 | Lempster | Lempster, Sullivan Cty, NH | forest edge | 40 | 43 | 9/9 | 10/24 | 16 | 0.4 | Woodlot Alternatives, Inc. 2007. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Lempster Mountain Wind Power Project in Lempster, New Hampshire. Prepared for Lempster Wind, LLC. |
| 2006 | Brandon | Brandon, Franklin, Cty, NY | field | 12 | 62 | 7/25 | 10/4 | 1287 | 20.8 | Woodlot Alternatives, Inc. 2006. Fall 2006 Bat Detector Surveys at the Proposed Brandon and Chateaugay Windparks in Western New York. Prepared for Ecology and Environment, Inc. and Noble Power, LLC. |
| 2005 | High Sheldon | Sheldon, Wyoming Cty, NY | field | 15 | 65 | 8/1 | 10/4 | 335 | 5.2 | Woodlot Alternatives, Inc. 2006. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed High Sheldon Wind Project in Sheldon, New York. Prepared for Invenergy. |
| 2005 | High Sheldon | Sheldon, Wyoming Cty, NY | field | 30 | 58 | 8/1 | 10/4 | 137 | 2.4 | Woodlot Alternatives, Inc. 2006. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed High Sheldon Wind Project in Sheldon, New York. Prepared for Invenergy. |
| 2005 | Howard | Howard, Steuben Cty, NY | field | 30 | 13 | 8/3 | 8/19 | 30 | 2.3 | Woodlot Alternatives, Inc. 2005. A Fall 2005 Survey of Bird and Bat Migration at the Proposed Howard Wind Power Project in Howard, New York. Prepared for Everpower Global. |
| 2005 | Howard | Howard, Steuben Cty, NY | field | 27 | 15 | 8/3 | 8/14 | 30 | 2 | Woodlot Alternatives, Inc. 2005. A Fall 2005 Survey of Bird and Bat Migration at the Proposed Howard Wind Power Project in Howard, New York. Prepared for Everpower Global. |
| 2005 | Jordanville | Jordanville, Herkimer Cty, NY | field | 15 | 34 | 8/12 | 9/22 | 143 | 4.2 | Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Jordanville Wind Project in Jordanville, New York. Prepared for Community Energy, Inc. |
| 2005 | Jordanville | Jordanville, Herkimer Cty, NY | field | 30 | 41 | 8/12 | 9/22 | 255 | 6.2 | Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Jordanville Wind Project in Jordanville, New York. Prepared for Community Energy, Inc. |
| 2005 | Marble River | Churubusco, Clinton Cty, NY | field | 20 | 39 | 8/1 | 10/11 | 243 | 6.2 | Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Marble River Wind Project in Clinton and Ellenburg, New York. Prepared for AES Corporation. |
| 2005 | Top Notch | Fairfield, Herkimer Cty, NY | field | 15 | 34 | 8/19 | 9/21 | 30 | 0.9 | Woodlot Alternatives, Inc. 2005. A Summer and Fall 2005 Radar and Acoustic Surveys of Bird and Bat Migration at the Proposed Top Notch Wind Project in Fairfield, New York. Prepared for PPM Atlantic Renewable. |
| 2005 | Top Notch | Fairfield, Herkimer Cty, NY | field | 30 | 34 | 8/19 | 9/21 | 99 | 3 | Woodlot Alternatives, Inc. 2005. A Summer and Fall 2005 Radar and Acoustic Surveys of Bird and Bat Migration at the Proposed Top Notch Wind Project in Fairfield, New York. Prepared for PPM Atlantic Renewable. |
| 2005 | West Hill | Munnsville, Madison Cty, NY | field | 15 | 47 | 8/1 | 10/21 | 179 | 3.8 | Woodlot Alternatives, Inc. 2005. Summer and Fall 2005 Bird and Bat Surveys at the Proposed Munnsville Wind Project in Munnsville, New York. Prepared for AES-EHN NY Wind, LLC. |
| 2005 | West Hill | Munnsville, Madison Cty, NY | field | 30 | 52 | 8/1 | 10/21 | 106 | 2 | Woodlot Alternatives, Inc. 2005. Summer and Fall 2005 Bird and Bat Surveys at the Proposed Munnsville Wind Project in Munnsville, New York. Prepared for AES-EHN NY Wind, LLC. |
| 2006 | Steuben | Hartsville, Steuben Cty, NY | field | 15 | 76 | 7/26 | 10/10 | 119 | 1.6 | Environmental Design and Research (RD&R). 2006. Draft Environmental Impact Statement for the Cohocton Wind Power Project. Town of Cohocton, Steuben County, New York, Prepared for Canandaigua Wind Partners, LLC. |
| 2006 | Steuben | Hartsville, Steuben Cty, NY | field | 30 | 49 | 7/26 | 10/10 | 84 | 1.7 | Environmental Design and Research (RD&R). 2006. Draft Environmental Impact Statement for the Cohocton Wind Power Project. Town of Cohocton, Steuben County, New York, Prepared for Canandaigua Wind Partners, LLC. |
| 2006 | Wethersfield | Wethersfield, Wyoming Cty, NY | field | 15 | 54 | 7/25 | 10/9 | 0 | 0 | Woodlot Alternatives, Inc. 2006. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Centerville and Wethersfield Windparks in Centerville and Wethersfield, New York. Prepared for Ecology and Environment, Inc. and Noble Power, LLC. |
| 2006 | Wethersfield | Wethersfield, Wyoming Cty, NY | field | 30 | 26 | 7/25 | 10/9 | 22 | 0.8 | Woodlot Alternatives, Inc. 2006. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Centerville and Wethersfield Windparks in Centerville and Wethersfield, New York. Prepared for Ecology and Environment, Inc. and Noble Power, LLC. |

Appendix B Table 14. Summary of available fall bat detector surveys (results reported for individual detectors)

| Year | Project | Project Location | Habitat | Height (m) | Detector Nights | Start | End | Calls | Rate | Reference |
|---|---|---|---|---|---|---|---|---|---|---|
| 2006 | Brandon | Brandon, Franklin, Cty, NY | field | 25 | 72 | 7/25 | 10/4 | 464 | 6.4 | Woodlot Alternatives, Inc. 2006. Fall 2006 Bat Detector Surveys at the Proposed Brandon and Chateaugay Windparks in Western New York. Prepared for Ecology and Environment, Inc. and Noble Power, LLC. |
| 2006 | Centerville | Centerville, Allegany Cty, NY | field | 15 | 48 | 7/25 | 10/10 | 2 | 0 | Woodlot Alternatives, Inc. 2006. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Centerville and Wethersfield Windparks in Centerville and Wethersfield, New York. Prepared for Ecology and Environment, Inc. and Noble Power, LLC. |
| 2006 | Centerville | Centerville, Allegany Cty, NY | field | 35 | 41 | 7/25 | 10/10 | 3 | 0.1 | Woodlot Alternatives, Inc. 2006. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Centerville and Wethersfield Windparks in Centerville and Wethersfield, New York. Prepared for Ecology and Environment, Inc. and Noble Power, LLC. |
| 2006 | Chateaugay | Chateaugay, Franklin Cty, NY | field | 40 | 58 | 7/25 | 10/4 | 173 | 3 | Woodlot Alternatives, Inc. 2006. Fall 2006 Bat Detector Surveys at the Proposed Brandon and Chateaugay Windparks in Western New York. Prepared for Ecology and Environment, Inc. and Noble Power, LLC. |
| 2006 | Chateaugay | Chateaugay, Franklin Cty, NY | field | 20 | 44 | 7/25 | 10/4 | 345 | 7.8 | Woodlot Alternatives, Inc. 2006. Fall 2006 Bat Detector Surveys at the Proposed Brandon and Chateaugay Windparks in Western New York. Prepared for Ecology and Environment, Inc. and Noble Power, LLC. |
| 2006 | Cohocton/Dutch Hill | Cohocton, Steuben Cty, NY | field | 15 | 43 | 8/12 | 10/11 | 46 | 1.1 | Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Cohocton Wind Power Project in Cohocton, New York. Prepared for UPC Wind Management, LLC. |
| 2006 | Cohocton/Dutch Hill | Cohocton, Steuben Cty, NY | field | 30 | 47 | 8/12 | 10/11 | 57 | 1.2 | Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Cohocton Wind Power Project in Cohocton, New York. Prepared for UPC Wind Management, LLC. |
| 2005 | Clayton | Clayton, Jefferson Cty, NY | forest edge | 30 | 0 | 8/19 | 9/20 | 0 | 0 | Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Clayton Wind Project in Clayton, New York. Prepared for PPM Atlantic Renewable. |
| 2005 | Munnsville | Munnsville, Madison Cty, NY | field | 23 | 67 | 7/31 | 10/16 | 280 | 0.2 | Woodlot Alternatives, Inc. 2005. Summer and Fall 2005 Bird and Bat Surveys at the Proposed Munnsville Wind Project in Munnsville, New York. Prepared for AES-EHN NY Wind, LLC. |
| 2005 | Munnsville | Munnsville, Madison Cty, NY | field | 15 | 67 | 7/31 | 10/16 | 210 | 0.3 | Woodlot Alternatives, Inc. 2005. Summer and Fall 2005 Bird and Bat Surveys at the Proposed Munnsville Wind Project in Munnsville, New York. Prepared for AES-EHN NY Wind, LLC. |
| 2005 | Moresville | Stamford, Delaware Cty, NY | forest edge | 15 | 43 | 8/15 | 10/15 | 293 | 6.8 | Woodlot. 2007. A Spring and Fall 2005 Radar and Acoustic Survey of Bird Migration at the Proposed Moresville Energy Center in Stamford and Roxbury, New York. Prepared for Invenergy, LLC. Rockville, MD. |
| 2005 | Moresville | Stamford, Delaware Cty, NY | forest edge | 30 | 54 | 8/15 | 10/15 | 285 | 5.3 | Woodlot. 2007. A Spring and Fall 2005 Radar and Acoustic Survey of Bird Migration at the Proposed Moresville Energy Center in Stamford and Roxbury, New York. Prepared for Invenergy, LLC. Rockville, MD. |
| 2004 | Liberty Gap | Franklin, Pendleton Cty, WV | forest edge | 15 | 14 | Sep | Nov | 168 | 0.35 | Woodlot Alternatives, Inc. 2005. A Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Liberty Gap Wind Project in Franklin, West Virginia – Fall 2004. Prepared for US Wind Force, LLC. |
| 2004 | Liberty Gap | Franklin, Pendleton Cty, WV | forest edge | 30 | 14 | Sep | Nov | 165 | 0.19 | Woodlot Alternatives, Inc. 2005. A Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Liberty Gap Wind Project in Franklin, West Virginia – Fall 2004. Prepared for US Wind Force, LLC. |
| 2004 | Sheffield | Sheffield, Caledonia Cty, VT | forest edge | 15 | 6 | 9/10 | 9/15 | 30 | 0.23 | Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC. |
| 2004 | Sheffield | Sheffield, Caledonia Cty, VT | forest edge | 30 | 5 | 10/17 | 10/21 | 0 | 0 | Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC. |
| 2005 | Mars Hill | Mars Hill, Aroostook Cty, ME | forest edge | 20 | 22 | 8/31 | 9/21 | 25 | n/a | Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Mars Hill Wind Project in Mars Hill, Maine. Prepared for UPC Wind Management, LLC. |

| Appendix B Table 14. Summary of available fall bat detector surveys (results reported for individual detectors) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Year** | **Project** | **Project Location** | **Habitat** | **Height (m)** | **Detector Nights** | **Start** | **End** | **Calls** | **Rate** | **Reference** |
| 2005 | Mars Hill | Mars Hill, Aroostook Cty, ME | forest edge | 20 | 22 | 8/31 | 9/21 | 25 | n/a | Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Mars Hill Wind Project in Mars Hill, Maine. Prepared for UPC Wind Management, LLC. |

# Appendix C

Raptor Survey Results

**Appendix C Table 1.** Species composition of raptors observed during raptor surveys

| Species | 9/3/2008 | 9/4/2008 | 9/10/2008 | 9/11/2008 | 9/16/2008 | 9/18/2008 | 9/22/2008 | 9/23/2008 | 9/25/2008 | 9/29/2008 | 10/6/2008 | 10/7/2008 | 10/15/2008 | 10/20/2008 | 10/31/2008 | Grand Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| American kestrel | | | | 1 | | | | | | 2 | 8 | 1 | | | | 12 |
| bald eagle | | | | | 1 | | 1 | | | | | 1 | 1 | | | 4 |
| broad-winged hawk | 2 | | 3 | 9 | 72 | 11 | 3 | 14 | 2 | | 11 | 5 | 2 | | | 134 |
| Cooper's hawk | | | | | | | | | | | 1 | 1 | 4 | 1 | | 7 |
| merlin | | | | 1 | | | | 1 | | | 1 | 1 | | | | 4 |
| northern harrier | | | 1 | | 1 | | | | | 1 | | | | | | 3 |
| osprey | | | 1 | | 3 | | | 2 | 2 | 2 | 2 | | | | | 12 |
| red-tailed hawk | 1 | 1 | 1 | 1 | | | 1 | | | | 3 | 1 | 1 | | 1 | 11 |
| sharp-shinned hawk | | 1 | 2 | 3 | 2 | 7 | 6 | 3 | 1 | 9 | 17 | 8 | 10 | 5 | | 74 |
| turkey vulture | 1 | 2 | | | 5 | 1 | 3 | 2 | 2 | | 2 | 2 | | | | 20 |
| unidentified accipiter | 1 | 1 | | | | 1 | | | | | | | | | | 3 |
| unidentified buteo | | | | 3 | 2 | | 1 | | | | | | | | | 6 |
| unidentified falcon | | | | | | | | | | | 2 | | | | | 2 |
| unidentified raptor | | | 1 | 2 | 1 | | 2 | | | | 1 | 1 | 1 | | | 9 |
| Grand Total | 5 | 5 | 9 | 20 | 87 | 20 | 17 | 22 | 7 | 14 | 48 | 21 | 19 | 6 | 1 | 301 |

**Appendix C Table 2.** Observation totals of raptors by hour

| Species | 9:00-10:00 | 10:00-11:00 | 11:00-12:00 | 12:00-1:00 | 1:00-2:00 | 2:00-3:00 | 3:00-4:00 | Grand Total |
|---|---|---|---|---|---|---|---|---|
| American kestrel | 2 | 1 | 3 | 2 | 1 | 3 | 0 | 12 |
| bald eagle | 0 | 0 | 0 | 2 | 0 | 2 | 0 | 4 |
| broad-winged hawk | 12 | 27 | 28 | 16 | 8 | 1 | 42 | 134 |
| Cooper's hawk | 2 | 1 | 2 | 0 | 1 | 1 | 0 | 7 |
| merlin | 0 | 2 | 0 | 1 | 1 | 0 | 0 | 4 |
| northern harrier | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 3 |
| osprey | 1 | 4 | 3 | 2 | 0 | 1 | 1 | 12 |
| red-tailed hawk | 1 | 1 | 1 | 2 | 3 | 1 | 2 | 11 |
| sharp-shinned hawk | 10 | 14 | 11 | 13 | 8 | 9 | 9 | 74 |
| turkey vulture | 0 | 2 | 6 | 2 | 6 | 4 | 0 | 20 |
| unidentified accipiter | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 3 |
| unidentified buteo | 0 | 1 | 4 | 0 | 1 | 0 | 0 | 6 |
| unidentified falcon | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 2 |
| unidentified raptor | 1 | 1 | 3 | 2 | 1 | 1 | 0 | 9 |
| **Hourly totals** | 30 | 56 | 61 | 44 | 31 | 25 | 54 | 301 |

**Appendix C Table 3.** Raptor flight altitudes by species

| Species | 130.5 m or greater | less than 130.5 m | outside of 1 km from observer | Grand Total |
|---|---|---|---|---|
| American kestrel | 0 | 12 | 0 | 12 |
| bald eagle | 1 | 1 | 2 | 4 |
| broad-winged hawk | 86 | 21 | 27 | 134 |
| Cooper's hawk | 2 | 4 | 1 | 7 |
| merlin | 0 | 4 | 0 | 4 |
| northern harrier | 1 | 1 | 1 | 3 |
| osprey | 1 | 7 | 4 | 12 |
| red-tailed hawk | 6 | 4 | 1 | 11 |
| sharp-shinned hawk | 8 | 62 | 4 | 74 |
| turkey vulture | 7 | 9 | 4 | 20 |
| unidentified accipiter | 1 | 1 | 1 | 3 |
| unidentified buteo | 5 | 0 | 1 | 6 |
| unidentified falcon | 0 | 2 | 0 | 2 |
| unidentified raptor | 3 | 2 | 4 | 9 |
| **Grand Total** | 121 | 130 | 50 | 301 |

**Appendix C Table 4. Summary of Regional Fall (August to October) Migration Surveys***

| Location | Obs Hours | BV | TV | OS | BE | NH | SS | CH | NG | RS | BW | RT | RL | GE | AK | ML | PG | SW | UR | UB | UA | UF | UE | TOTAL | Birds /Hour |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Cadillac Mountain, ME *** | 242 | 0 | 40 | 230 | 21 | 145 | 1141 | 31 | 7 | 1 | 268 | 56 | 1 | 0 | 494 | 99 | 35 | 0 | 63 | 6 | 0 | 0 | 0 | 2,638 | 10.9 |
| **Little Round Top, NH*** | 84 | 0 | 18 | 41 | 32 | 1 | 34 | 12 | 0 | 0 | 3071 | 14 | 0 | 1 | 10 | 1 | 0 | 0 | 31 | 3 | 4 | 2 | 0 | 3,275 | 38.8 |
| **Pack Monadnock, NH*** | 338 | 0 | 21 | 255 | 48 | 66 | 1064 | 131 | 16 | 30 | 6835 | 74 | 0 | 0 | 180 | 51 | 17 | 0 | 15 | 6 | 3 | 2 | 0 | 8,814 | 26.1 |
| **Allegheny Front, PA *** | 476 | 15 | 92 | 108 | 56 | 36 | 899 | 136 | 5 | 10 | 3887 | 475 | 1 | 4 | 53 | 27 | 12 | 0 | 64 | 37 | 23 | 5 | 0 | 5,945 | 12.5 |
| **Hawk Mountain, PA *** | 610 | 19 | 108 | 449 | 181 | 174 | 2717 | 386 | 0 | 20 | 4289 | 176 | 0 | 10 | 286 | 95 | 58 | 0 | 44 | 13 | 15 | 10 | 0 | 9,050 | 14.8 |
| **Barre Falls, MA *** | 199 | 0 | 193 | 165 | 51 | 23 | 702 | 62 | 11 | 7 | 5235 | 40 | 0 | 0 | 135 | 30 | 19 | 0 | 12 | 1 | 0 | 0 | 0 | 6,686 | 33.6 |
| **Shatterack Mountain, MA *** | 116 | 0 | 21 | 70 | 15 | 18 | 391 | 15 | 0 | 5 | 5039 | 11 | 0 | 1 | 44 | 5 | 7 | 0 | 6 | 0 | 0 | 0 | 0 | 5,648 | 48.8 |
| **Montreal West Island, QC *** | 160 | 0 | 174 | 39 | 20 | 10 | 151 | 0 | 0 | 11 | 2142 | 157 | 0 | 0 | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,735 | 17.1 |

* Data obtained from HMANA website.

**Abbreviation Key:**
BV - Black Vulture
TV - Turkey Vulture
OS - Osprey
BE - Bald Eagle
NH - Northern Harrier
SS - Sharp-shinned Hawk
CH - Cooper's Hawk
NG - Northern Goshawk
RS - Red-shouldered Hawk
BW - Broad-winged Hawk
RT - Red-tailed Hawk
RL - Rough-legged Hawk
GE - Golden Eagle
AK - American Kestrel
ML - Merlin
PG - Peregrine Falcon
SW - Swainson's Hawk
UR - unidentified Raptor
UB - unidentified Buteo
UA - unidentified Accipiter
UF - unidentified Falcon
UE - unidentified Eagle

**Appendix C Table 5.** Summary of available fall raptor survey results at wind sites in the east

| Project Site | Landscape | Survey Period | # of Survey Days | # of Survey Hours | Total # Observed | # of Species Observed | Reference |
|---|---|---|---|---|---|---|---|
| **Fall 1996** | | | | | | | |
| Searsburg, Bennington County, VT | Forested ridge | Sept. 11 - Nov. 3 | 20 | 80 | 430 | 12 | Kerlinger, Paul. 1996. A Study of Hawk Migration at Green Mountain Power Corporation's Searsburg, Vermont, Wind Powewer Site: Autumn 1996. Prepared for the Vermont Public Service Board, Green Mountain Power, National Renewable Ener gy Laboratory, VERA. |
| **Fall 1998** | | | | | | | |
| Harrisburg, Lewis County, NY | Great Lakes plain/ADK foothills | Sept. 2 - Oct. 1 | 13 | 68 | 554 | 12 | Cooper, B.A., and T.J. Mabee. 1999. Bird migration near proposed wind turbine sites at Wethersfield and Harrisburg, New York. Unpublished report prepared for Niagara–Mohawk Power Corporation, Syracuse, NY, by ABR, Inc., Forest Grove, OR. 46 pp. |
| Wethersfield, Wyoming Cty, NY | Agricultural plateau | Sept. 2 - Oct. 1 | 24 | 107 | 256 | 12 | Cooper, B.A., and T.J. Mabee. 1999. Bird migration near proposed wind turbine sites at Wethersfield and Harrisburg, New York. Unpublished report prepared for Niagara–Mohawk Power Corporation, Syracuse, NY, by ABR, Inc., Forest Grove, OR. 46 pp. |
| **Fall 2004** | | | | | | | |
| Prattsburgh, Steuben Cty, NY | Agricultural plateau | Sept. 2 - Oct. 28 | 13 | 73 | 220 | 10 | Woodlot Alternatives, Inc. .2005b. A Fall 2004 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windfarm Prattsburgh Project in Prattsburgh, New York. Prepared for UPC Wind Management, LLC. |
| Cohocton, Stueben, Cty, NY | Agricultural plateau | Sept. 2 - Oct. 28 | 8 | 41.3 | 128 | 8 | Woodlot Alternatives, Inc. 2005. Avian and Bat Information Summary and Risk Assessment for the Proposed Cohocton Wind Power Project in Cohocton, New York. Prepared for UPC Wind Management, LLC. |
| Deerfield, Bennington Cty, VT (Existing Facility) | Forested ridge | Sept. 2 - Oct. 31 | 10 | 60 | 147 | 11 for both sites combined | Woodlot Alternatives, Inc. 2005c. Fall 2004 Avian Migration Surveys at the Proposed Deerfield Wind/Searsburg Expansion Project in Searsburg and Readsboro, Vermont. Prepared for Deerfield Wind, LLC and Vermont Environmental Research Associates. |
| Deerfield, Bennington Cty, VT (Western Expansion) | Forested ridge | Sept. 2 - Oct. 31 | 10 | 57 | 725 | 11 for both sites combined | Woodlot Alternatives, Inc. 2005c. Fall 2004 Avian Migration Surveys at the Proposed Deerfield Wind/Searsburg Expansion Project in Searsburg and Readsboro, Vermont. Prepared for Deerfield Wind, LLC and Vermont Environmental Research Associates. |
| Sheffield, Caledonia Cty, VT | Forested ridge | Sept. 11 - Oct. 14 | 10 | 60 | 193 | 10 | Woodlot Alternatives, Inc. 2006a. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC. |
| **Fall 2005** | | | | | | | |
| Alabama, Genesee Cty, NY | Great Lakes plain/ADK foothills | Sept. 11 - Oct. 10 | 5 | 19 | 148 | 4 | New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008. |
| High Sheldon, Wyoming Cty, NY | Agricultural and wooded plateau | Aug. 29 - Nov. 4 | 8 | 53.5 | 168 | 9 | New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008. |

**Appendix C Table 5.** Summary of available fall raptor survey results at wind sites in the east

| Project Site | Landscape | Survey Period | # of Survey Days | # of Survey Hours | Total # Observed | # of Species Observed | Reference |
|---|---|---|---|---|---|---|---|
| Wethersfield, Wyoming Cty, NY | Agricultural plateau | Sept. 13 - Sept. 18 | 3 | 21 | 0 | 0 | New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008. |
| Wethersfield, Wyoming Cty, NY | Agricultural plateau | Sept. 21 - Nov. 1 | 3 | 21 | 231 | 11 | New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008. |
| Bliss, Wyoming Cty, NY | Agricultural and wooded plateau | Sept. 12 - Sept. 17 | 2 | 21 | 0 | 0 | New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008. |
| Cohocton, Stueben, Cty, NY | Agricultural plateau | Sept. 7 - Oct. 1 | 7 | 40.12 | 131 | 10 | Woodlot Alternatives, Inc. 2005. Avian and Bat Information Summary and Risk Assessment for the Proposed Cohocton Wind Power Project in Cohocton, New York. Prepared for UPC Wind Management, LLC. |
| West Hill, Maidson Cty, NY | Agricultural plateau | Sept. 6 - Oct. 31 | 11 | 65 | 369 | 14 | New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008. |
| Clinton / Ellenburg, Clinton Cty, NY | Agricultural plateau | Sept. 23 - Sept. 28 | 3 | 21 | 0 | 0 | New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008. |
| Altona, Clinton Cty, NY | Great Lakes plain/ADK foothills | Sept. 24 - Sept. 30 | 3 | 21 | 0 | 0 | New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008. |
| Marble River, Clinton Cty, NY | Great Lakes plain/ADK foothills | Sept. 6 - Nov. 2 | 10 | 60 | 217 | 15 | New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008. |
| Clayton, Jefferson Cty, NY | Great Lakes plain/ADK foothills | Sept. 9 - Oct. 16 | 11 | 63.5 | 575 | 13 | New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008. |
| New Grange, Chautauqua Cty, NY | Forested ridge | Sept. 17 - Oct. 15* | 6 | 18 | 49 | 5 | New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008. |
| Moresville, Deleware Cty, NY | Forested ridge | Aug. 31 - Nov. 3 | 11 | 72 | 228 | 11 | New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008. |
| Churubusco, Clinton Cty, NY | Great Lakes plain/ADK foothills | Sept. 6 - Oct. 22 | 10 | 60 | 217 | 15 | Woodlot Alternatives, Inc. 2005l. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Marble River Wind Project in Clinton and Ellenburg, New York. Prepared for AES Corporation. |

**Appendix C Table 5.** Summary of available fall raptor survey results at wind sites in the east

| Project Site | Landscape | Survey Period | # of Survey Days | # of Survey Hours | Total # Observed | # of Species Observed | Reference |
|---|---|---|---|---|---|---|---|
| Dairy Hills, Wyoming Cty, NY | Agricultural plateau | Sept. 11 - Oct. 10 | 4 | 16 | 48 | 6 | New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008. |
| Howard, Steuben Cty, NY | Agricultural plateau | Sept. 1 - Oct. 28 | 10 | 57 | 206 | 12 | Woodlot Alternatives, Inc. 2005o. A Fall 2005 Survey of Bird and Bat Migration at the Proposed Howard Wind Power Project in Howard, New York. Prepared for Everpower Global. |
| Munnsville, Madison Cty, NY | Agricultural plateau | Sept. 6 - Oct. 31 | 11 | 65 | 369 | 14 | Woodlot Alternatives, Inc. 2005r. Summer and Fall 2005 Bird and Bat Surveys at the Proposed Munnsville Wind Project in Munnsville, New York. Prepared for AES-EHN NY Wind, LLC. |
| Mars Hill, Aroostook Cty, ME | Forested ridge | Sept. 9 - Oct. 13 | 8 | 42.5 | 115 | 13 | Woodlot Alternatives, Inc. 2005t. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Mars Hill Wind Project in Mars Hill, Maine. Prepared for UPC Wind Management, LLC. |
| Lempster, Sullivan County, NH | Forested ridge | Fall 2005 | 10 | 80 | 264 | 10 | Woodlot Alternatives, Inc. 2007c. Lempster Wind Farm Wildlife Habitat Summary and Assessment. Prepared for Lempster Wind, LLC. |
| Clayton, Jefferson Cty, NY | Agricultural plateau | Sept. 9 - Oct. 16 | 11 | 63.5 | 575 | 13 | Woodlot Alternatives, Inc. 2005m. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Clayton Wind Project in Clayton, New York. Prepared for PPM Atlantic Renewable. |
| **Fall 2006** | | | | | | | |
| Stetson, Penobscot Cty, ME | Forested ridge | Sept. 14 - Oct. 26 | 7 | 42 | 86 | 11 | Woodlot Alternatives, Inc. 2007b. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Stetson Mountain Wind Power Project in Washington County, Maine. Prepared for Evergreen Wind V, LLC. |
| Lincoln, Penobscot Cty, ME | Forested ridge | Sept. 13 - Oct. 16 | 12 | 89 | 144 | 12 | Woodlot Alternatives, Inc. 2007. Fall 2006 Survey of Bird and Bat Migration at the Proposed Stetson Wind Power Project in Washington County, Maine. Prepared for Evergreen Wind V. |
| Wethersfield, Wyoming Cty, NY | Agricultural plateau | Sept. 21 - Nov. 11 | 3 | 21? | 231 | 11 | New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008. |
| Chateaugay, Franklin Cty, NY | Great Lakes plain/ADK foothills | Sept. 6 - Oct. 26 | 2 | 24 | 42 | 5 | New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008. |
| St. Lawrence, Jefferson Cty, NY | Agricultural plateau | Sept. 23 - Nov. 11 | 10 | 30 | 288 | 10 | New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008. |

**Appendix C Table 5.** Summary of available fall raptor survey results at wind sites in the east

| Project Site | Landscape | Survey Period | # of Survey Days | # of Survey Hours | Total # Observed | # of Species Observed | Reference |
|---|---|---|---|---|---|---|---|
| Cape Vincent, Jefferson Cty, NY | Great Lakes plain/ADK foothills | Sept. 23 - Nov. 11 | 10 | 30 | 165 | 10 | New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008. |
| Jordanville, Herkimer Cty, NY | Agricultural plateau | Oct. 13 - Nov. 30 | 44 | 234.7 | 629 | 12 | New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008. |
| **Fall 2007** | | | | | | | |
| Roxbury, Oxford Cty, ME | Forested ridge | Sept. 3 - Oct. 15 | 14 | 86 | 96 | 12 | Stantec Consulting. 2008. Fall 2007 Migration Survey Report Visual, Acoustic, and Radar Surveys of Bird and Bat Migration conducted at the proposed Record Hill Wind Project In Roxbury, Maine. Prepared for Independence Wind, LLC. |
| Errol, Coos Cty, NH | Forested ridge | Sept. 5 - Oct. 16 | 11 | 68 | 44 | 9 | Stantec Consulting. 2007. Fall 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windpark in Coos County, New Hampshire by Granite Reliable Power, LLC. Prepared for Granite Reliable Power, LLC. |
| Laurel Mountain, Preston Cty, WV | Forested ridge | Sept. 12 - Dec. 1 | 24 | 147 | 769 | 12 | Stantec Consulting Services Inc. 2007. A Fall 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Laurel Mountain Wind Energy Project near Elkins, West Virginia. Prepared for AES Laurel Mountain, LLC. |
| Greenland, Grant Cty, WV | Forested ridge | Sept. 12 - Dec. 1 | 27 | | 858 | 13 | Stantec Consulting Services Inc. 2008. A Fall 2007 Survey of Bird and Bat Migration at the New Creek Wind Project,West Virginia. Prepared for AES New Creek, LLC. |
| New Grange, Chautauqua Cty, NY | Forested ridge | Sept. 21 - Oct. 28 | 6 | n/a | n/a | n/a | New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008. |
| Allegany, Cattaraugus Cty, NY | Forested ridge | Sept. 8 - Oct. 11 | 11 | 63.78 | 125 | 10 | New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008. |
| Jericho Rise, Franklin Cty, NY | Great Lakes plain/ADK foothills | Sept. 12 - Oct. 26 | 7 | 28 | 59 | 7 | New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008. |
| **Fall 2008** | | | | | | | |
| Oakfield, Aroostock Cty, ME | Agricultural plateau | Sept. 26 - Oct. 14 | 12 | 84 | 60 | 8 | Woodlot Alternatives, Inc. 2008. A Fall 2008 Survey of Bird and Bat Migration at the Oakfield Wind Project, Washington County, Maine. Prepared for Evergreen Wind, LLC. |

*Calculated for spring and fall combined.

**Calculated for spring and fall 2006 and 2007 combined.

***Non-migrants were not included in seasonal passage rates in NYSDEC 2008 table but were included in passage rates here.

# Spring 2009 Ecological Surveys

## for the Highland Wind Project
## in Highland Plantation, Maine

Prepared for

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**November 2009**

# Executive Summary

Highland Wind LLC (Highland) has proposed to construct a 128.6-megawatt (MW) wind energy project located in Highland Plantation and Pleasant Ridge Plantation, Somerset County, Maine (Figure 1-1). The Highland Wind Project (Project) includes 48 turbines, a 34.5-kilovolt (kV) electrical collector system, an electrical collection substation, a 115-kV generator lead, an Operations and Maintenance Building, and permanent meteorological (met) towers.

The turbines will be located in two distinct strings. The western string will include 26 turbines located on the ridgeline that connects Stewart Mountain, Witham Mountain and Bald Mountain. The meteorological data collected on this ridgeline suggests that weather conditions can be extreme and that the wind resource is excellent. These conditions require a Class I turbine and the Project has opted to use Vestas V90 3 MW turbines in most of the 26 turbine locations along the western string. The Vestas turbines have an 80-meter (m) hub height, a 90 m rotor diameter and a maximum tip-of-blade height of 125 m. The eastern string will include 22 turbines extending from the northeastern end of Burnt Hill south to Briggs Hill. Because of a more moderate wind capacity, Siemens SWT-2.3-101 turbines will be used along the eastern string to maximize energy output. These turbines have an 80 m hub height, a 101 m rotor diameter and a maximum tip-of-blade height of 130.5 m. Turbines will be located at elevations between 1550 and 2670 feet above sea level.

The electrical collector system will transfer power from the turbines to the proposed collector substation located north of Witham Mountain. These collector lines will be located underground along the ridgeline to reduce the project footprint and to reduce potential line maintenance costs along the exposed ridges. The approximately 11 mile long 115 kV generator lead will connect the on-site collector station to the existing Wyman Dam substation located in Moscow, Maine, where power will be transferred to the Central Maine Power system and ultimately distributed to the New England grid.

In preparation for this Project, Highland Wind contracted Stantec Consulting (Stantec) to perform a variety of environmental surveys within the Project area. In 2009, Stantec conducted surveys to document nocturnal and diurnal migration activity focusing on avian and bat populations. This work represented the first season of breeding bird surveys and the second season for each of the other surveys. The survey protocol and locations were discussed and chosen in coordination with the Maine Department of Inland Fisheries and Wildlife to provide adequate coverage of the Project area. A work plan describing methods and level of effort needed was approved by MDIFW on April 16, 2009.

***Nocturnal Radar Survey***

The spring 2009 radar survey targeted 20 nights between April 15 and May 31, 2009. Surveys were conducted using X-band radar, sampling from sunset to sunrise. Each hour of sampling included the recording of radar video files during horizontal and vertical operation at two different locations to provide adequate coverage of the Project area. The first radar unit was located on the summit of South Stewart Mountain, the same location as that used during the fall

2008 survey. Radar operations at this location completed one full survey year (fall and spring migration seasons) of sampling from a single local location. The second radar unit was situated just off a gravel road near Briggs Hill. This site was operated simultaneously with the radar on South Stewart on most nights. The radar at this second location supplied information on nocturnal migration activity from the eastern side of the Project area and provided views of the Sandy Stream Valley and the ridgeline saddle between Burnt Hill and Briggs Hill.

Radar surveys are intended to document several variables that characterize nocturnal migration within the Project area: passage rates, flight heights, and flight direction. The survey documented an overall passage rate for the entire survey period of 511 targets per kilometer per hour (t/km/hr) at Stewart and 496 t/km/hr at Briggs. Passage rates varied greatly between nights during the season, indicating migration occurred in pulses, with rates of migration likely influenced by weather patterns and conditions from night to night. In contrast, flight heights remained fairly consistent at both sites both throughout the survey period and in comparison with other seasons, suggesting a similar "use" of the airspace above the ridgeline by nocturnal migrants in fall and spring. The seasonal average flight height was 314 m ( 1035 feet [']) at Stewart and 287 m (946') at Briggs. When compared to the anticipated maximum turbine height of 130.5 m (428'), the seasonal average of targets flying below turbine height (using the adjusted flight heights) was 23 percent at Stewart and 26 percent at Briggs. Mean flight direction through the Project area was generally to the northeast for both radar sites.

Spring radar surveys at Highland documented patterns in nocturnal migration similar to those documented at most recent radar surveys. These include highly variable passage rates between nights, a generally northeastern flight direction, and flight heights primarily occurring between 200 and 600 m above ground. Within nights, migration activity was generally greatest 4-5 hours after sunset and declined steadily through the end of the night. While comparisons between radar studies are vague at best due to the variability of site circumstances, studies performed in similar regions, habitats, and at equivalent levels of effort to those at Highland do show a consistency in range of migratory activity.

***Bat Survey***

Six Anabat® acoustic bat detectors were deployed during the spring/summer 2009 survey between April 23 and August 17 to document the occurrence of bats near the rotor zone of the proposed turbines. Detectors were located within the same on-site met towers used during the second portion of the fall 2008 survey (South Stewart, Witham Mountain, and Briggs Hill). Data were summarized by guild and species and tallied per detector on a nightly and hourly basis. Data were also summarized by detector and detector groups according to height (e.g., high versus low detectors) and location (e.g., South Stewart vs. Witham Mountain met towers). Nightly acoustic activity levels were compared with nightly weather variables to identify any trends. Data recorded by the detectors were analyzed to provide the total number of detections per hour, per night, and per season by detector.

A total of 166 bat call sequences were recorded over 553 detector-nights ($\bar{x}$ =0.3 ± 0.05 SE recordings/detector/night [r/d/n]; range = 0 – 6). This detection rate is relatively low, but is comparable to the fall 2008 detection rate for those detectors deployed within the met towers. In 2009, extensive periods of rain during the deployment of the detectors may have contributed to the overall low activity levels that were documented. A total of 26.5 inches of rain fell in the nearby town of Bingham during the survey period with July experiencing the most rain during this period. In addition, the spring/summer survey period did not capture the peak in activity that typically occurs later in the season (mid-August to early September), but was captured during the 2008 surveys. Viewed seasonally, detection rates at detectors were generally very low, with activity level increasing through August. Those species that produce low frequency calls were detected most commonly, including the hoary bat (*Lasiurus cinereus*), silver-haired bat (*Lasionycteris noctivagans*), and big brown bat (*Eptesicus fuscus*). These species also were most commonly detected when the detectors were deployed in the met towers in 2008; however, these results contrasts sharply with the results for detectors deployed in trees during the earlier part of the fall 2008 season. Detectors placed in trees were closer to the ground (within 8 m) and more commonly recorded *Myotis* species; a genus that is more commonly detected at lower heights.

***Breeding Bird Surveys***

Breeding bird surveys were conducted during spring/summer 2009 to determine the species composition, abundance, diversity, and distribution of breeding birds in the Project area. Consistent with United States Geological Survey North American Breeding Bird Survey methods, Stantec biologists conducted breeding bird point count surveys during three separate visits to the Project area: the first visit was at the end of May, and consecutive visits took place in June 2009. The habitats in the Project area were grouped into four categories: coniferous forest, deciduous forest, mixed coniferous and deciduous forest, and disturbed (e.g., clearings for meteorological towers and early succession cuts). Habitat types for each point count location were assigned based on the dominant vegetation cover present at each survey location. Quantitative data collected during point counts were used to calculate the species richness, relative abundance, community diversity, and frequency of breeding birds within the available habitats of the Project area. Surveys were conducted during the peak of the nesting season, in the morning when detection of birds is greatest, and during optimal weather conditions for detection. It is likely, therefore, that the species richness detected during surveys is a suitable reflection of the species composition of breeding birds in the area.

There were a total of 35 breeding bird point count locations surveyed within the Project. Each point was surveyed during the three separate site visits. A total of 52 species plus an unidentified woodpecker and two unidentified ducks were observed during field surveys at point count locations. The composition of species detected during breeding bird surveys was representative of the habitats that occur in the Project area. The most birds were observed within the disturbed habitat, but this in large part reflects the greater number of survey points within this habitat category. The greatest species richness also was documented in disturbed habitat. The relative abundance was highest within the deciduous forest followed by the disturbed habitat. The Shannon Diversity Index was relatively similar across the four habitat categories, indicating a similar species diversity and distribution among points sampled. The species with the greatest relative abundances among all points sampled included, white-throated sparrow (*Zonotrichia albicollis*), chestnut-sided warbler (*Dendroica pensylvanica*), black-throated-blue warbler (*Dendroica caerulescens*), and dark-eyed junco (*Junco hyemalis* ).

In general, the species detected in the Project area are common and relatively abundant in the region. No state or federally threatened or endangered species were detected during the breeding bird surveys. Ten state-listed species of special concern were documented during these surveys; however many of these species including the white-throated sparrow and chestnut-sided warbler were commonly observed and are species that are typically associated with regenerating cuts and second-growth forests such as occur throughout the Project area.

### *Diurnal Raptor Survey*

Diurnal raptor surveys were conducted during the spring 2009 migration season. The purpose of the surveys was to document the species that occur in the vicinity of the Project, as well as the relative flights height, flight path locations, and other flight behaviors of observed raptors. These surveys were conducted from two different sites in the Project area: the summits of Witham Mountain and Briggs Hill. Surveys were based on Hawk Migration Association of North America methods and were typically conducted from 9 am to 4 pm.

Raptor surveys were conducted from March 25, 2009 to May 19, 2009, resulting in a total of 139 survey hours. Surveys included 12 days (83 hours) on Witham Mountain and 8 days (56 hours) on Briggs Hill. On four of these days, surveys were conducted simultaneously by observers at both survey locations.

A total of 260 raptors were observed resulting in an overall passage rate of 1.87 birds per hour. At Witham, a total of 153 raptors were observed for a passage rate of 1.84 birds per hour. At Briggs, a total of 107 raptors were observed resulting in a passage rate of 1.91 birds per hour. Ten different species plus unidentified raptors and buteos were recorded. The most commonly seen species were turkey vultures and red-tailed hawks (*Buteo jamaicensis*).

Of the 260 birds observed during the surveys, 236 occurred within the Project boundaries. The majority of the birds within the Project boundaries were seen over Witham Mountain (n=94; 39 percent) and Briggs Hill (n=83; 35 percent). Birds flying over the surrounding valleys (n=43; 18 percent) and Stewart Mountain (n=16; 7 percent) represented a relatively small percentage of the observations. Although observation sites provided views of the surrounding ridgelines and valleys, birds closer to the observer's location on Witham Mountain and Briggs Hill would have been more readily detected. As such, the higher percentage of observations over these sites may in part reflect the proximity of birds to the observers.

For those flight positions most likely associated with the proposed turbine locations within the Project boundaries, flight heights were categorized as above or below the proposed maximum turbine height of 130.5 m (428'). Eighty percent of the raptors observed from Witham occurred below the proposed maximum rotor height (n=116) (Figure 5-6a, Appendix D Table 3). Similarly 86 percent of the raptors observed from Briggs Hill occurred below the proposed maximum rotor height (n=78).

No federally-listed threatened or endangered species were observed during the raptor surveys. A single peregrine falcon (*Falco peregrinus*), the breeding population of which is a state-listed endangered species, was observed flying through the Project area on April 10. Eight state-listed species of conservation concern also were identified during raptor surveys, including bald eagle (*Haliaeetus leucocephalus*), northern harrier (*Circus cyaneus*), chimney swift (*Chaetura pelagica*), tree swallow (*Tachycineta bicolor)*, American redstart (*Setophaga ruticilla)*, chestnut-sided warbler (*Dendroica pensylvanica*), white-throated sparrow and black-and-white warbler (*Mniotilta varia*).

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* *This report was prepared by Stantec Consulting Services Inc. for Highland Wind LLC. The material in it reflects Stantec's judgment in light of the information available to it at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions made based on it, are the responsibility of such third parties. Stantec accepts no responsibility for damages, if any suffered by any third party as a result of decisions made or actions based on this report.*

# 1.0 Introduction

Highland Wind LLC (Highland) has proposed to construct a 128.6-megawatt (MW) wind energy project located in Highland Plantation and Pleasant Ridge Plantation, Somerset County, Maine (Figure 1-1). The Highland Wind Project (Project) includes 48 turbines, a 34.5-kilovolt (kV) electrical collector system, an electrical collection substation, a 115 kV generator lead, an Operations and Maintenance Building, and permanent meteorological (met) towers.

The turbines will be located in two distinct strings. The western string will include 26 turbines located on the ridgeline that connects Stewart Mountain, Witham Mountain and Bald Mountain. The meteorological data collected on this ridgeline suggests that weather conditions can be extreme and that the wind resource is excellent. These conditions require a Class I turbine and the Project has opted to use Vestas V90 3 MW turbines in most of the 26 turbine locations along the western string. The Vestas turbines have an 80 meter (m) hub height, a 90 m rotor diameter and a maximum tip-of-blade height of 125 m. The eastern string will include 22 turbines extending from the northeastern end of Burnt Hill south to Briggs Hill. Because of a more moderate wind capacity, Siemens SWT-2.3-101 turbines will be used along the eastern string to maximize energy output. These turbines have an 80 m hub height, a 101 m rotor diameter and a maximum tip-of-blade height of 130.5 m. Turbines will be located at elevations between 1550 and 2670 feet above sea level.

The electrical collector system will transfer power from the turbines to the proposed collector substation located north of Witham Mountain. These collector lines will be located underground along the ridgeline to reduce the project footprint and to reduce potential line maintenance costs along the exposed ridges. The approximately 11 mile long 115 kV generator lead will connect the on-site collector station to the existing Wyman Dam substation located in Moscow, Maine, where power will be transferred to the Central Maine Power system and ultimately distributed to the New England grid.

## 1.1 PROJECT BACKGROUND

In 2008, Stantec Consulting (Stantec) conducted a variety of environmental surveys as part of the continued planning for this Project, including surveys to characterize bird and bat activity within the Project area. Surveys conducted in 2008 included:

- Nocturnal radar surveys;
- Acoustic bat surveys;
- Raptor migration surveys; and
- Wetland delineation and vernal pool reconnaissance.

The scope of these surveys was based on a combination of developing standard methods within the wind power industry for pre-construction surveys, guidelines outlined by U.S. Fish and Wildlife Service (USFWS) and Maine Department of Inland Fisheries and Wildlife (MDIFW), and is consistent with other studies conducted recently in the state and the Northeast.

Surveys conducted in 2009 represent the first season of breeding bird surveys and the second season for each of the other surveys. During winter 2009, Stantec worked with MDIFW to finalize the methods and level of effort needed for spring 2009 field surveys. A work plan describing methods and level of effort needed was approved by MDIFW on April 16, 2009. In addition to the bird and bat surveys described in this report a separate report summarizes surveys for northern bog lemming (*Synaptomys borealis*), northern spring salamander (*Gyrinophilus porphyriticus*), and Roaring Brook mayfly (*Epeorus frisoni*).

## 1.2 KEY QUESTIONS AND RESEARCH PRIORITIES

Surveys in the Project area are intended to provide baseline biological use information, which can be used to help make Project design decisions. In coordination and through consultations with state agencies, Stantec developed a work plan which addresses several Project specific ecological concerns using the following survey methods.

1) Nocturnal radar surveys were used to document nocturnal migration patterns within the Project area and in relation to area ridgelines, especially during migration periods. Spring surveys were conducted to supplement the fall 2008 radar surveys.

2) Passive acoustic bat surveys helped characterize presence and species composition of bats in the Project area and specifically within the blade-swept area of the proposed turbines. The surveys also should provide information from lower heights within the tree canopy to document activity of different species that utilize various heights. Spring and summer 2009 surveys were conducted to supplement the fall 2008 acoustic surveys.

3) Breeding bird surveys were conducted in order to document and characterize the breeding bird assemblage of the Project area, in a quantitative, repeatable way. The data collected will provide baseline information on the breeding bird species and abundance that are currently present within the Project area for later comparison with post-construction surveys.

4) Diurnal raptor surveys were used to develop baseline information regarding use of the Project area by migrating raptors. These surveys help characterize the occurrence and flight patterns of diurnally migrating raptors (hawks, falcons, harriers, and eagles) and turkey vultures (*Cathartes aura*) in the Project area. Data collected during the surveys include number and species, general flight direction, and approximate flight altitude. Spring 2009 surveys were conducted to supplement the fall 2008 raptor surveys.

Following is a brief description of the Project; a review of the methods used to conduct scientific surveys and the results of those surveys; a discussion of results; and the conclusions reached based on those results.

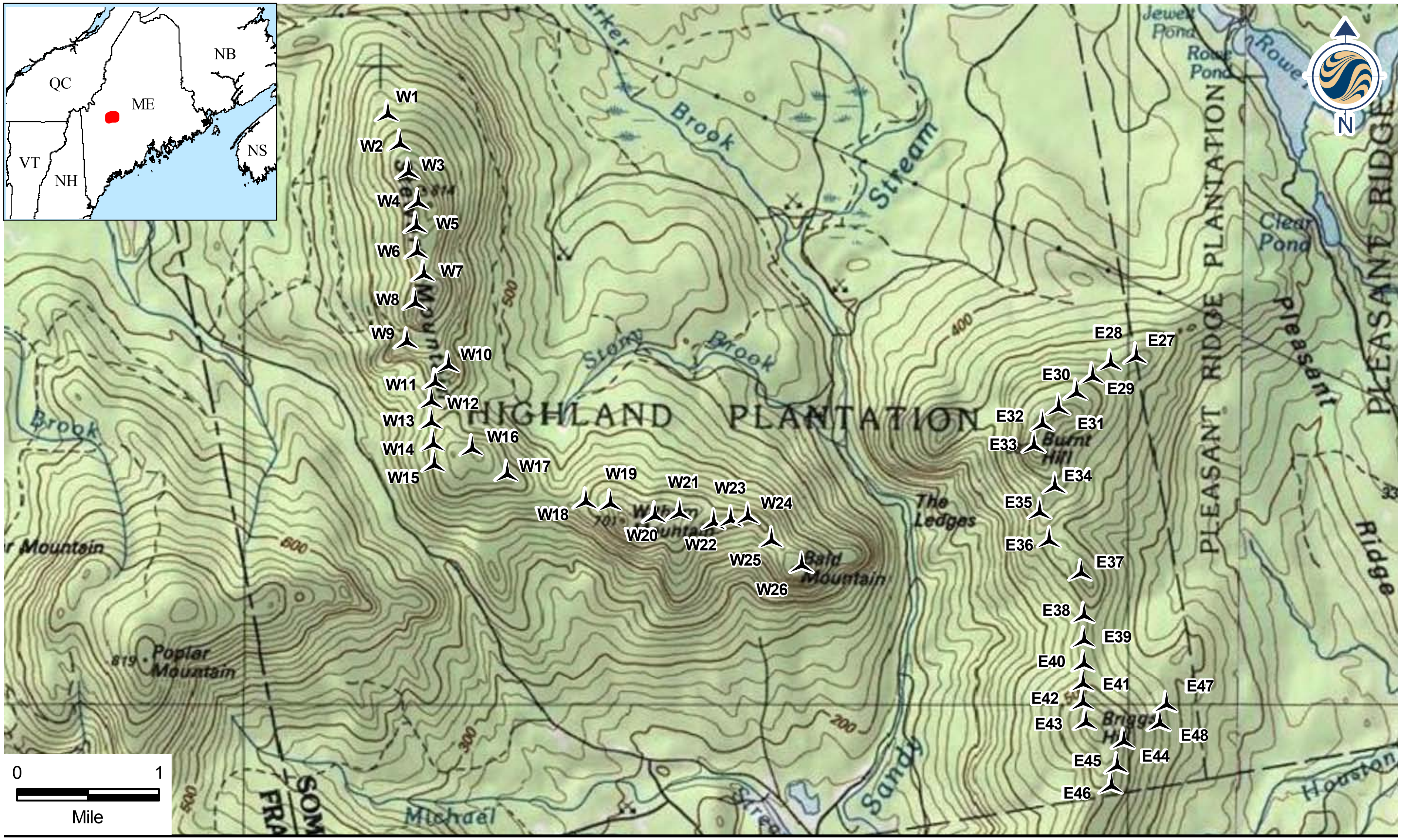
## 1.3 PROJECT AREA DESCRIPTION

The Project area is located within the Central and Western Mountains Ecoregion as defined in *Maine's Comprehensive Wildlife Conservation Strategy* (MDIFW 2005). This ecoregion is a consolidation of the Western Mountains and Central Mountains biophysical regions originally described by McMahon (1990). The Central and Western Mountains Ecoregion extends from the New Hampshire boarder south the White Mountains National Forest, north to Aroostook

County and east to the western foothills. The average elevation within the western portion of the ecoregion (former Western Mountain Biophysical Region) is between approximately 305 m to 610 m (1,000' to 2,000') with several peaks exceeding 823 m (2,700'). The northern portion of this ecoregion includes some of the highest peaks in the state and has elevations that range from 183 m to 1,603 m (600' to 5,258'). The climate of this ecoregion is characterized by relatively low annual precipitation and cool temperatures. Heavy snow fall prolongs the winter resulting in a relatively short growing season (McMahon 1990). In general, ridge tops within this ecoregion are dominated by red spruce (*Picea rubens*) and balsam fir (*Abies balsamea*) with lower elevations supporting deciduous species such as sugar maple (*Acer saccharum*), yellow birch (*Betula alleghaniensis*) and American beech (*Fagus grandifolia*).

The Project area is located primarily within land managed by Wagner Forest Management, Ltd on a series of ridgelines that do not exceed 732 m (2,680') in elevation. These include Stewart, Witham, and Bald Mountains; and Briggs and Burnt Hill. Stewart Mountain represents the western boundary of the project and Briggs and Burnt Hill represent the eastern boundary. These two ridgelines are separated by the Sandy Stream Valley. The northern end of Stewart Mountain is the highest in elevation reaching 817 m (2,680') and decreases southward to 671 m (2,200'). Witham Mountain is the next highest in elevation reaching nearly 701 m (2,300'); the remaining ridgelines heights are approximately 671 m (2,200') and lower.

Due to its relatively low elevation, the vegetation in the Project area is dominantly northern hardwood species and includes: sugar maple, yellow birch, and American beech. Due to its relatively low elevation, the vegetation in the Project area is dominantly northern hardwood species and includes: sugar maple, yellow birch, and American beech. Red spruce and balsam fir are present primarily on those ridge tops that exceed approximately 610 m (2,000'). Historically and presently, the land within and surrounding the Project area, including the summits of the ridgelines, have been used for commercial timber management. This is evident by the recent and past cuts as well as the presence of the network of haul roads that extend through the Project area. These forest management operations have resulted in a variation of forest age classes.

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**Legend**

Turbine

Client/Project

**Highland Wind, LLC**
**Highland Wind Project**
**Highland Plantation, Maine**

Figure No.
1-1

Title
Project Location Map
November 4, 2009

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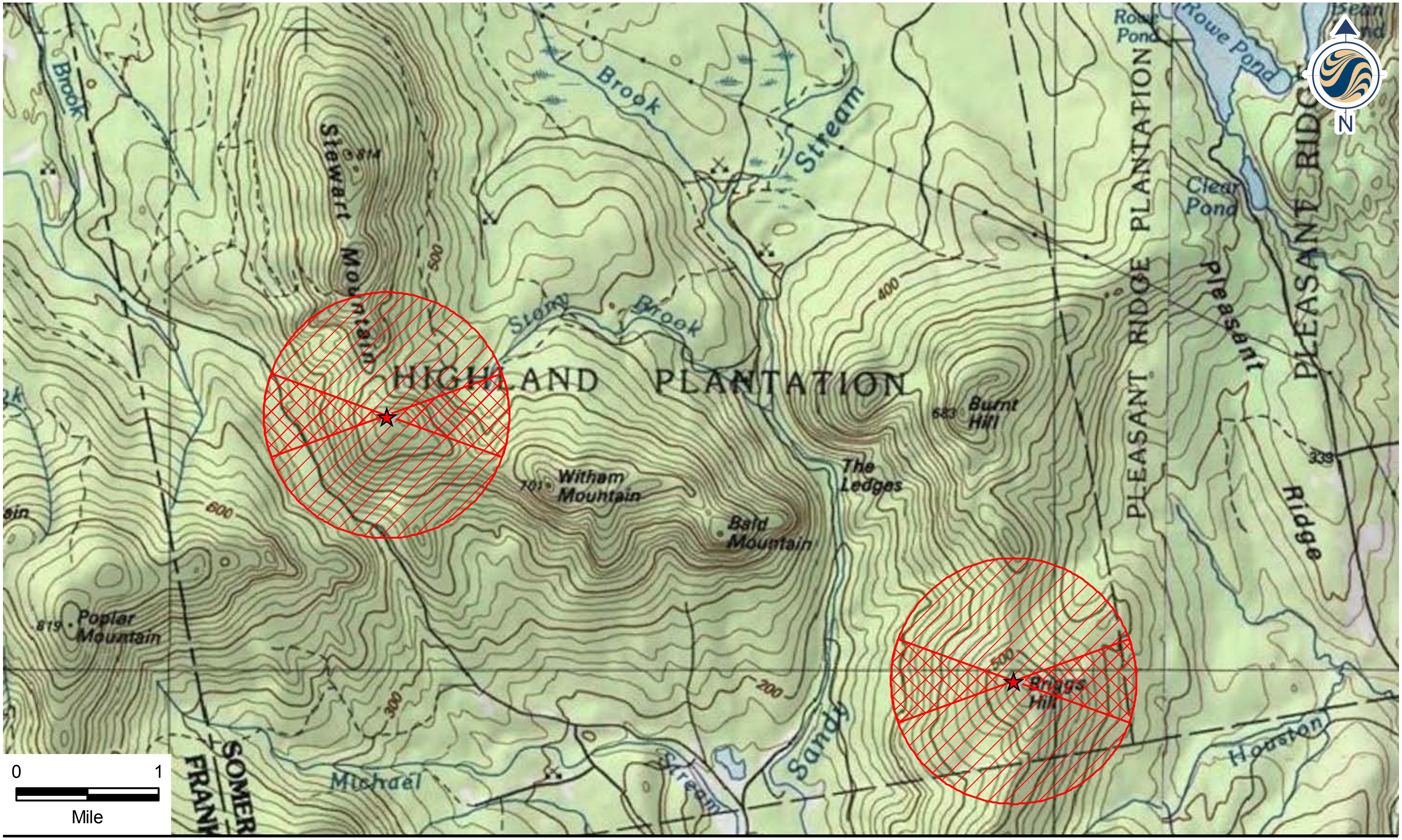
# 2.0 Nocturnal Radar Survey

## 2.1 INTRODUCTION

Nocturnal radar surveys were conducted in the Project area to characterize spring 2009 nocturnal migration patterns of passerine birds (songbirds) and bats. Unlike raptors, which migrate during the day using thermals resulting from rising warm air, the majority of North American passerines migrate at night. Raptors soaring flight uses the laminar flow of air over the landscape, which creates updrafts along hillsides and ridgelines; whereas, passerines may have evolved the strategy of migrating at night to take advantage of more stable atmospheric conditions for their flapping flight (Kerlinger 1995). Waiting to migrate during the cooler nighttime temperatures may have also provided passerines the extra benefits of a more efficient method of regulating body temperature during more active, flapping flight and the reduction of predation risk while in flight (Alerstam 1990, Kerlinger 1995). Therefore, while raptor migration can be documented by visual daytime (diurnal) surveys, documenting the patterns of nocturnal migrants requires the use of radar or other non-visual technologies. This approach also captures migrating bats, which are typically active at night. The goal of the surveys was to document the overall passage rates for nocturnal migration in the vicinity of the Project area, including the number of migrants, their flight direction, and their flight altitude.

## 2.2 SURVEY DESIGN

The spring 2009 radar study was conducted from two sites to provide more complete coverage of the Project area. One radar unit was located on the southern end of Stewart Mountain, the same location as that used during the fall 2008 survey. Radar operations at this location completed one full survey year (fall and spring migration seasons) of sampling from a single local location. The second radar unit was situated just off a gravel road near Briggs Hill. This site was operated simultaneously with the radar on South Stewart on most nights. The radar at this second location supplied information on nocturnal migration activity from the eastern side of the Project area and provided views of the Sandy Stream Valley and the ridgeline saddle between Burnt Hill and Briggs Hill. The radar sites (Figure 2 -1), provided excellent sampling of the airspace within 1.4 kilometers (km; approximately 4,500‘) of the site. Most of the quadrants were visible on the radar screen for both sites. Efforts were made to maximize the airspace sampled by elevating the antennae to approximately 3 m (10’), thus reducing the amount of the radar beam reflected back by surrounding vegetation (Figure 2-2). Marine surveillance radar, similar to that described by Cooper *et al.* (1991), was used during field data collection. The radar has a peak power output of 12 kilowatts and has the ability to track small animals, including birds, bats, and even insects, based on settings selected for the radar functions. It cannot, however, readily distinguish between different types of animals being detected. Consequently, all animals observed on the radar screen were identified as “targets.” The radar has an “echo trail” function which captures past echoes of flight trails, enabling determination of flight direction. During all operations, the radar’s echo trail was set to 30 seconds. The radar was equipped with a 2 m (6.5’) waveguide antenna. The antenna has a vertical beam width of 20º (10º above and below horizontal).

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**Legend**

- Radar Location
- Horizontal Radar Detection Range
- Alignment Vertical Radar Sweep

**Client/Project**
**Highland Wind, LLC**
**Highland Wind Project**
**Highland Plantation, Maine**

Figure No.
2-1

Title
Radar Location Map
August 12, 2009

00385-F201-Radar-Location-Map.mxd

Objects on the ground detected by the radar cause returns on the radar screen (echoes) that appear as blotches called ground clutter. Large amounts of ground clutter reduce the ability of the radar to track birds and bats flying over those areas (Figure 2-2).

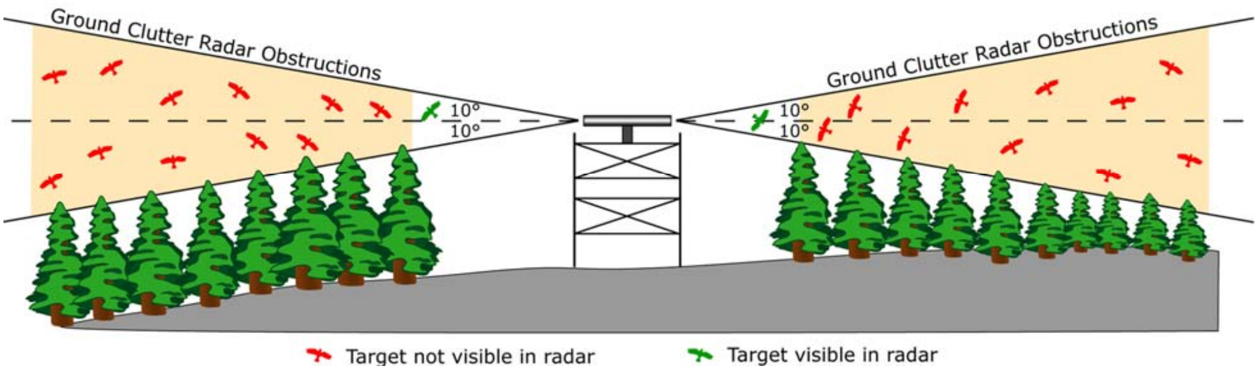
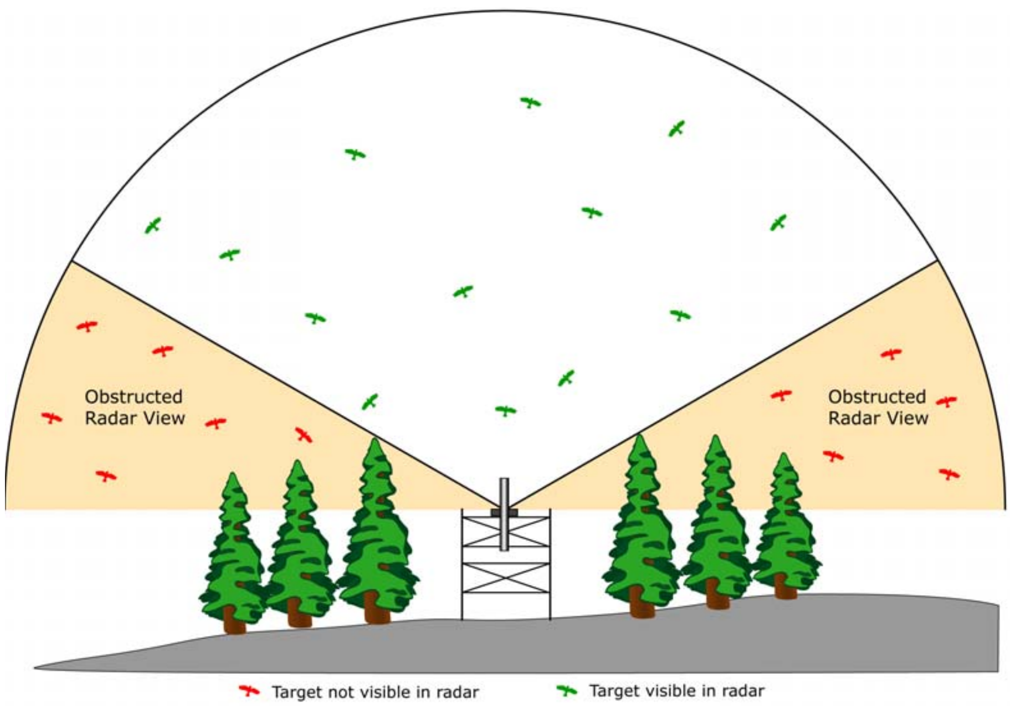



**Figure 2-2.** Ground clutter in horizontal mode (top) and vertical mode (bottom). Although the radar records three-dimensional space, it is translated by the radar screen into a two dimensional representation, which can cause targets to be obscured from view.



However, vegetation and hilltops near the radar can be used to reduce or eliminate ground clutter by "hiding" clutter-causing objects from the radar (Figure 2-3). These nearby features also cause ground clutter, but their proximity to the radar antenna generally limits the ground clutter to the center of the radar screen – targets are indistinguishable from the "clutter" as represented on the radar screen (Figure 2-4). The presence or reduction of potential clutter producing objects was carefully considered during site selection and radar station configuration.

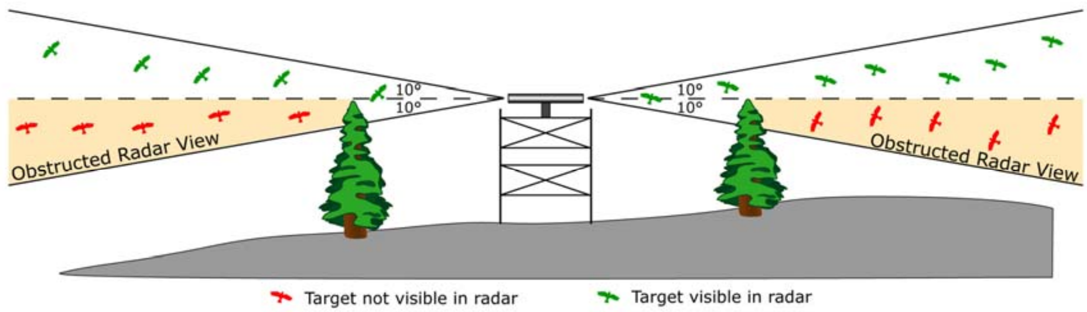



**Figure 2-3.** Proper site selection can reduce ground clutter to the center of the radar screen (top), so that the majority of the two-dimensional radar screen remains relatively uncluttered, allowing targets to be tracked as they both enter and leave the cluttered area (bottom).

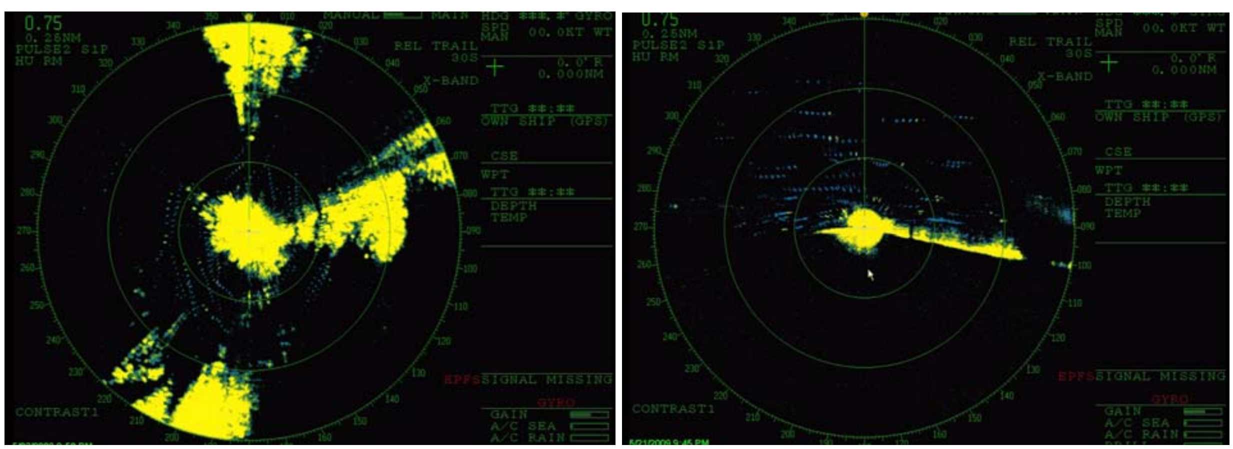


**Figure 2-4** (top) Briggs Hill Radar Screen Shots (left = horizontal mode and right = vertical mode) (bottom) South Stewart Radar Screenshots (left = horizontal mode and right = vertical mode)

Radar surveys were conducted from sunset to sunrise, and were scheduled to occur on 20 nights between April 15 and June 1, 2009. Because the anti-rain function of the radar must be turned down to detect small songbirds and bats, surveys could not be conducted during active rainfall. Therefore, surveys were planned largely for nights without rain. However, in order to characterize migration patterns during nights without optimal conditions, some nights with weather forecasts including occasional showers, mist, or fog were sampled.

The radar was operated in two modes throughout the course of each night. In surveillance mode, the antenna spins horizontally to survey the airspace around the radar and detects the number of targets and their flight direction as they pass through the Project Site (Figures 2-3 and 2-4). By analyzing the echo trail, the flight direction and flight speed of targets can be determined.

In vertical mode, the radar unit is tilted 90º to vertically survey the airspace above the radar (Harmata *et al.* 1999). In vertical mode, target echoes do not provide directional data, but do provide information on the altitude of targets passing through the vertical, 20º radar beam (Figure 2-5). Both modes of operation were used during each hour of sampling.

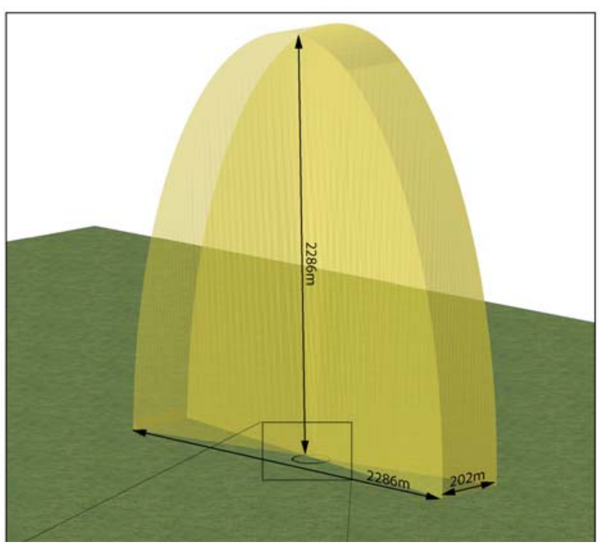



**Figure 2-5**. Detection Range of the radar in vertical mode

The radar was operated at a range of 1.4 km (4500'). At this range, the echoes of small birds can be easily detected, observed, and tracked. At greater ranges, larger birds can be detected but the echoes of small birds are reduced in size and restricted to a smaller portion of the radar screen, thus limiting the ability to observe the movement pattern of individual targets.

## 2.3 DATA COLLECTION METHODS

### 2.3.1 Radar Data

The radar display was connected to the video recording software of a computer enabling digital archiving of the radar data for subsequent analysis. This software recorded and archived video samples continuously every hour from sunset to sunrise of each survey night. By alternating the radar antenna every 10 minutes from vertical mode to horizontal mode, a total of 30 minutes of vertical samples and 30 minutes of horizontal samples were collected within each hour. Video recordings were subsequently analyzed based on a random schedule for each night. This sampling schedule allowed for randomization of sample collection and prevented double-counting of targets due to the 30-second echo trail used to determine the flight path vector.

## 2.4 DATA ANALYSIS METHODS

### 2.4.1 Radar Data

Video samples were analyzed using a digital analysis software tool developed by Stantec. For horizontal samples, targets (either birds or bats) were differentiated from insects based on their flight speed. Following adjustment for wind speed and direction, targets traveling faster than approximately 6 m (20') per second were identified as a bird or bat target (Larkin 1991, Bruderer and Boldt 2001). The software tool recorded the time, location, and flight vector for each target traveling fast enough to be a bird or bat within each horizontal sample, and these results were output to a spreadsheet. For vertical samples, the software tool recorded the entry point of targets passing through the vertical radar beam, the time, and flight altitude above the radar location, and then subsequently outputs the data to a spreadsheet. These datasets were then used to calculate passage rate (reported as targets per kilometer of migratory front per hour), flight direction, and flight altitude of targets.

Mean target flight directions (± 1 circular standard deviation) were summarized using software designed specifically to analyze directional data (Oriana2© Kovach Computing Services). The statistics used for this analysis are based on those used by Batschelet (1965), because they take into account the circular nature of the data. Nightly wind direction, which was collected from the met tower next to the radar site, was also summarized using this method.

Flight altitude data were summarized using linear statistics. Mean flight altitudes (± 1 standard error [SE]) were calculated by hour, night, and overall season. The percent of targets flying below 130.5 m, the approximate maximum height of the proposed wind turbines with blades, was also calculated hourly, for each night, and for the entire survey period.

### 2.4.2 Weather Data

Temperature, wind speed, and wind direction were recorded on an hourly basis by the south Stewart met tower for the duration of the radar survey period (April 29 to May 31). The mean, maximum, and minimum temperature, mean and maximum wind speed, relative humidity, barometric pressure, and dew point were calculated for each night.

## 2.5 RESULTS

Radar surveys were conducted during 21 nights at the Briggs Hill radar site (April 29 to May 31, 2009); and 19 nights at the South Stewart Mountain radar site (April 29 to May 26, 2009). Of those nights, 16 were performed simultaneously at both radar sites (Appendix A, Table 1A & B).

### 2.5.1 Passage Rates

The mean passage rate for the entire survey period was 496 ± 31 targets per kilometer per hour (t/km/hr) at Briggs Hill and 511± 46 t/km/hr at South Stewart (Figure 2-6; also Appendix A, Table 1A & B). Nightly passage rates at Briggs Hill varied from 10 ± 4 t/km/hr on May 5 to 1,262 ± 173 t/km/h on May 19. At South Stewart, nightly passage rates ranged from 8 ± 5 t/km/hr on May 10 to 1735 ± 235 t/km/hr May 20. Individual hourly passage rates varied from 0 to 1757 t/km/hr at Briggs Hill and 0 to 2268 t/km/hr at South Stewart (Appendix A, Table 1A & B). The days with the highest mean passage rates for the two sites were different, but both sites had their lowest mean passage rates on the same days, May 5 and May 10. Hourly passage rates varied between and within nights throughout the season. For the entire season, passage rates were highest during the fourth or fifth hour after sunset (Figure 2-7).

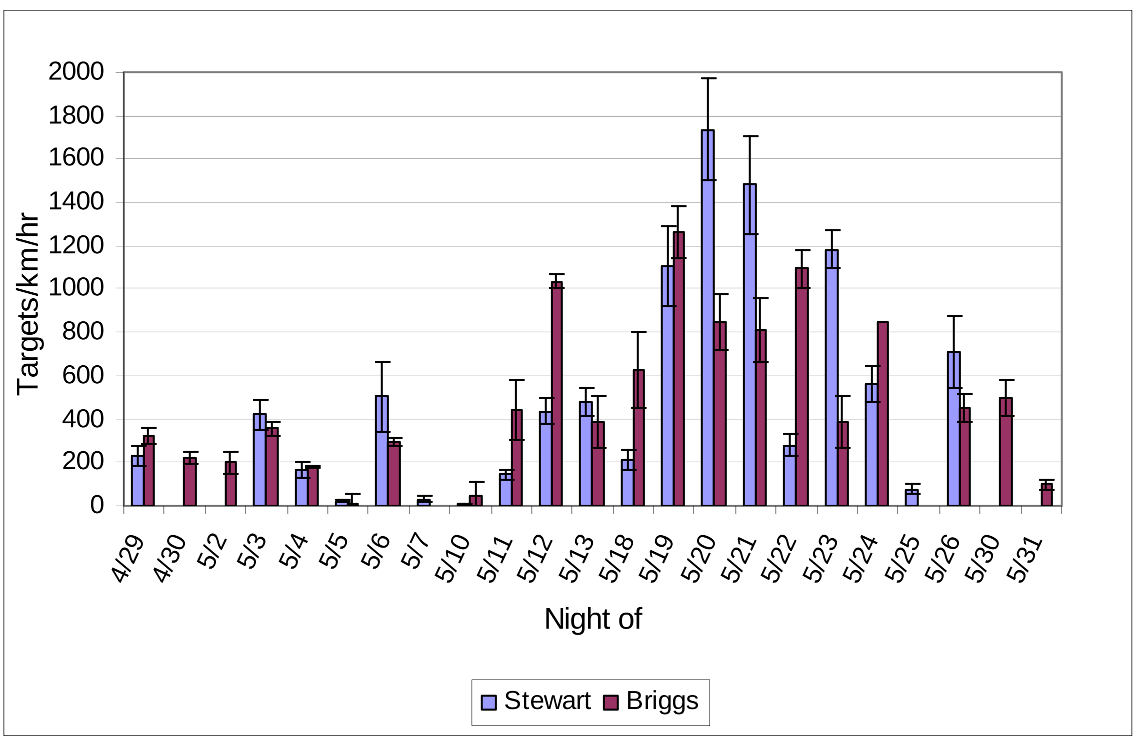



**Figure 2-6.** Nightly passage rates observed (error bars ± 1 SE)

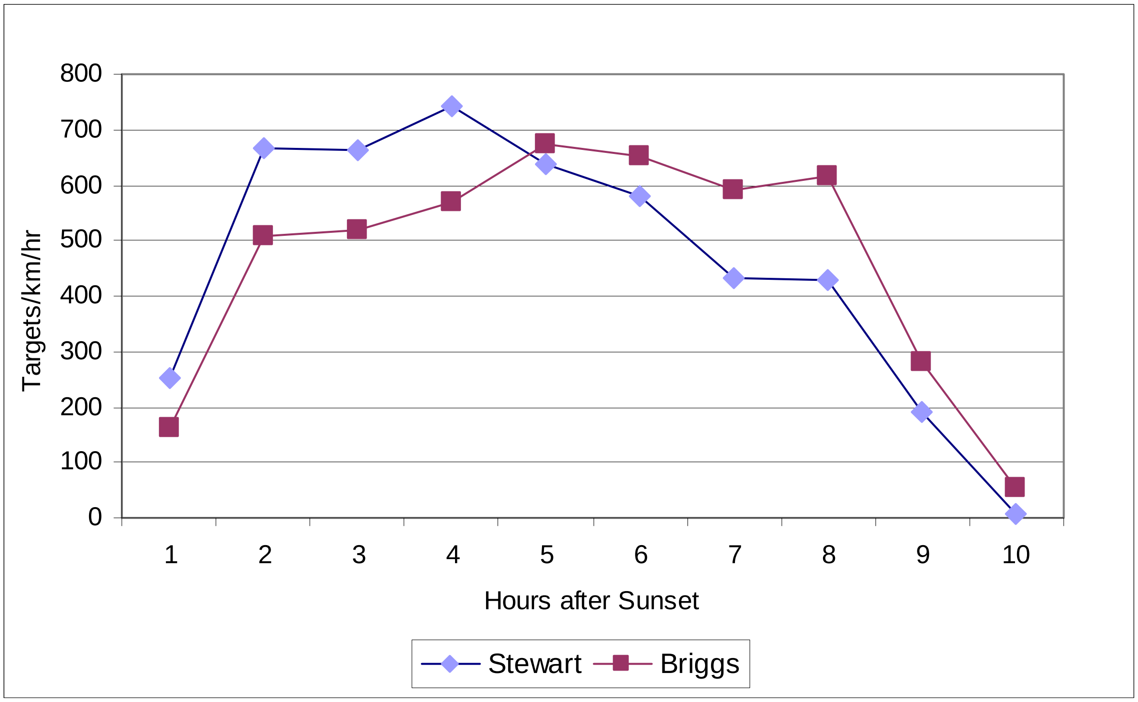



**Figure 2-7.** Hourly passage rates for entire season

### 2.5.2 Flight Direction

Mean flight direction through the Project area was 47°± 39° at Briggs Hill and 53° ± 48° at South Stewart (Figure 2-8). There was some variation between nights in mean flight direction although most nights at both sites included flight directions generally to the northeast, as is typical for the spring migration period (Appendix A, Table 2A & B).

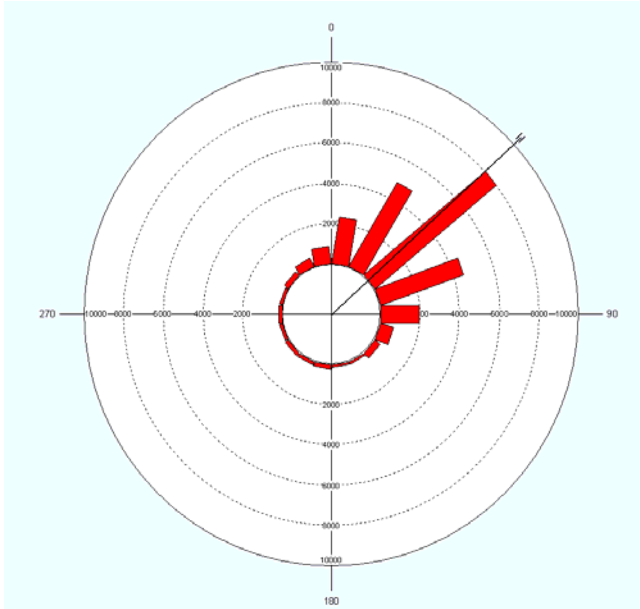
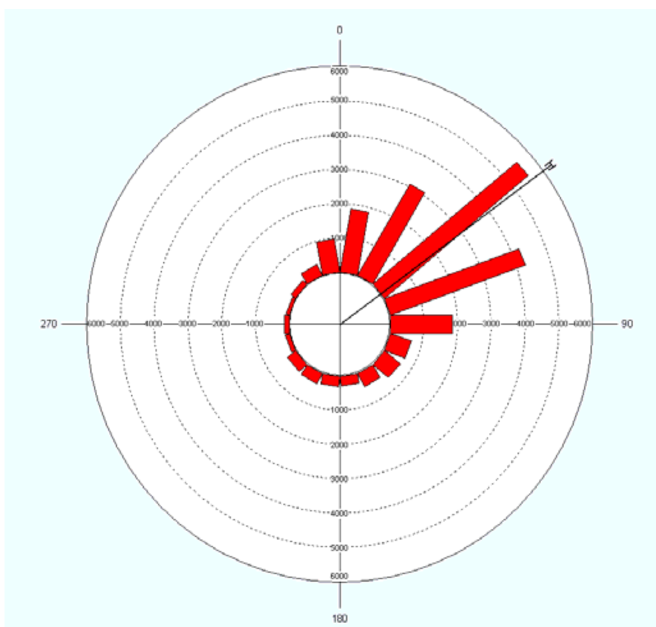



**Figure 2-8.** Stewart (top) and Briggs (bottom) mean flight directions for the entire season (the bracket along the margin of the histogram is the 95% confidence interval)




### 2.5.3 Flight Altitude

The seasonal mean flight height of all targets at Briggs Hill was 287 ± 8 m above the radar site and at South Stewart it was 314 ± 10 m. At Briggs Hill the average nightly flight height ranged from 115 ± 12 m on May 18 to 451 ± 33 m on April 30 and at South Stewart the average flight height ranged from168 ± 14 m April 29 to 514 ± 39 m on May 12 on South Stewart (Figure 2-9; Appendix A, Table 3A & B). The percent of targets observed flying below 130.5 m averaged 26 percent at Briggs Hill for the season and 23 percent at South Stewart for the season (Figure 2-

10). In general, those nights with the lowest mean flight heights corresponded to the nights with the highest percentage of targets below the maximum turbine height of 130.5 m. The mean hourly flight height for the entire season was relatively constant throughout the night at both sites (Figure 2-11).

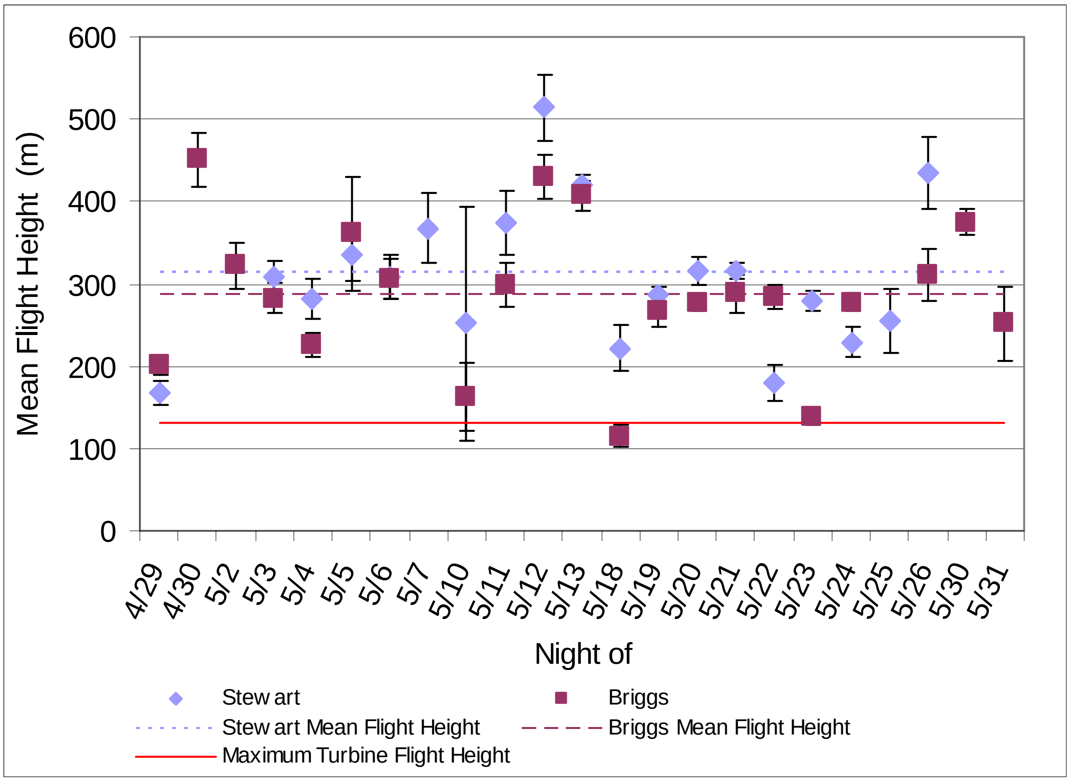
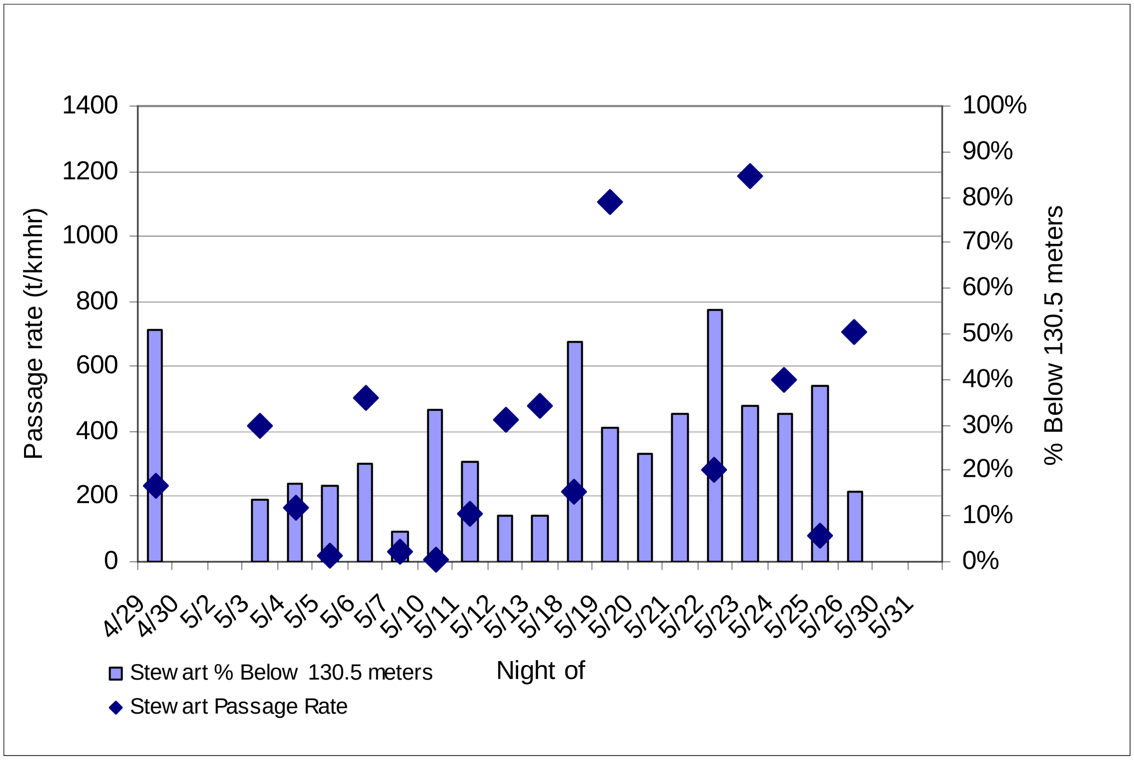



**Figure 2-9.** Mean nightly flight height of targets (error bars ± 1 SE)



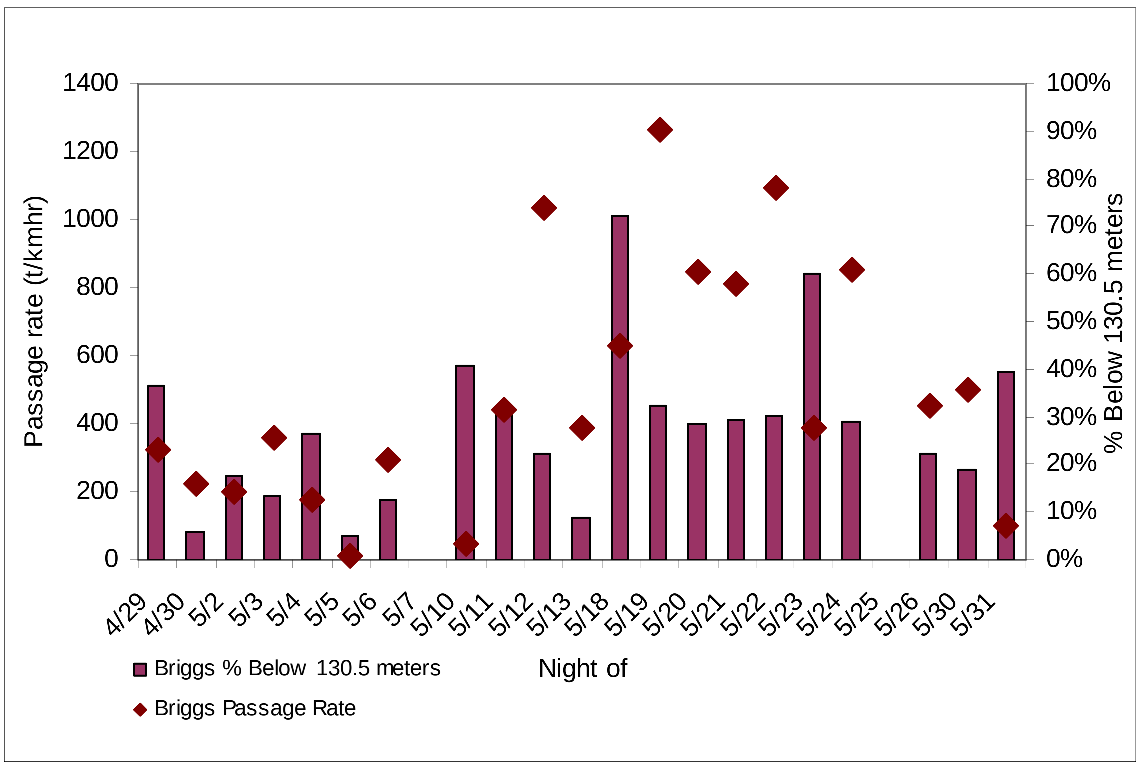




**Figure 2-10.** Stewart (top) and Briggs (bottom) percent of targets observed flying below a height of 130.5 m (428')

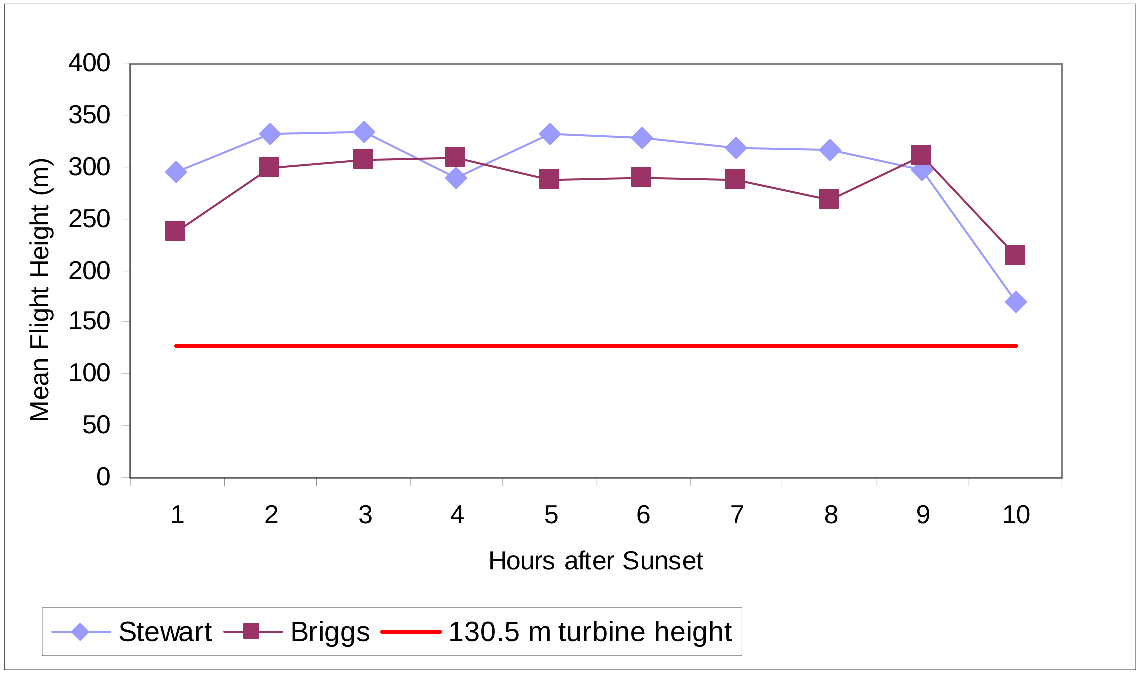



**Figure 2-11.** Hourly target flight height distribution

### 2.5.4 Weather Data

Mean nightly wind speeds in the Project area from April 29 to May 31 varied between 3.5 and 14.9 meters per second (m/s), with an overall mean of 7.7 m/s. Mean nightly temperatures varied between 1.5ºC and 19.8ºC, with an overall mean of 7.8ºC.

## 2.6 DISCUSSION

The results of this field survey provide useful information about site-specific migration activity and patterns in the Project area, especially when the results of the two sites are compared with each other and when results are compared with results of previous surveys conducted in Fall 2008.

The mean nightly passage rates at Stewart and Briggs were similar on most nights. On three nights in late May, the passage rate at Stewart was noticeably higher than at Briggs and on two nights in mid May and late May, the passage rate at Briggs was noticeably higher than at Briggs. This variation may be due to a general migration pattern where migrants, although moving in a broad front will occasionally pass in random concentrated pulses over the landscape. The overall trend of mean hourly passage rate was very similar at both sites. The mean nightly flight heights were also similar on most nights. The hourly mean flight height was relatively consistent throughout the night at both sites and ranged between 200 and 350 m above the radar.

Within the last several years, data from nocturnal radar surveys using similar methods and equipment as those used at this Project area rapidly becoming available. These other studies provide an opportunity to compare the results of this project to others in Maine and the northeastern United States. However, it is important to note that there are limitations in comparing data from previous years with data from 2009, as year-to-year variation in continental bird populations may influence how many birds migrate through an area. Additionally, differences in site characteristics, particularly the topography, local landscape conditions, and vegetation surrounding a radar survey location, can play a large role in any radar's ability to detect targets and the subsequent calculation of passage rate. These differences should be recognized as one of the most significant limiting factors in making direct site-to-site comparisons of passage rates. Regardless of potential differences between radar survey locations, the results at the Project are within the typical range of results at projects on forested ridges in the northeast (Appendix A Table 5).

Nightly variation in the magnitude and flight characteristics of nocturnally-migrating songbirds is not uncommon and is often attributed to weather patterns, such as cold fronts and winds aloft (Hassler *et al.* 1963, Gauthreaux and Able 1970, Richardson 1972, Able 1973, Bingman *et al.* 1982, Gauthreaux 1991). Nights with the highest passage rates appeared to have had moderate to light winds (2 to 4 m/s) from the northeast. Temperature does not seem to have an affect on passage rate at this site.

Some research suggests that bird migration may be affected by landscape features, such as coastlines, large river valleys, and mountain ranges. This has been documented for diurnally migrating birds, such as raptors, but is not as well established for nocturnally migrating birds (Sielman *et al*. 1981; Bingman 1980; Bingman *et al*. 1982; Bruderer and Jenni 1990; Richardson 1998; Fortin *et al*. 1999; Williams *et al.* 2001; Diehl *et al*. 2003). Those studies that suggest night-migrating birds are influenced by topography typically have been conducted in areas of steep and abrupt topography, such as the most rugged areas of the northern Appalachians and the Alps. Topography at the project site did not appear to influence migration patterns through the area.

Emerging evidence from other studies conducted by Stantec and other consultants, and academic research, suggests that flight height seems to be more important in determining potential collision risk than passage rate or flight direction (Cooper and Mabee 2000; Cooper *et al*. 2004; Gauthreaux and Livingston 2006; Mizrahi *et al*. 2008). Comparison of flight height between survey sites as measured by radar is generally less influenced by site characteristics as the main portion of the radar beam is directed skyward, and the potential effects of surrounding vegetation on the radar's view can be more easily controlled. The radars were centrally located within openings at this Project site, which allowed for unobstructed views in vertical mode and targets were observed flying in all areas of the vertical detection range. The radar views in horizontal mode were comparable to other regional studies conducted by Stantec in the state. The emerging body of studies characterizing nocturnal migrants shows a relatively consistent pattern in flight altitude, with most targets appearing to fly at altitudes of several hundred meters or more above the ground (Appendix A, Table 5). This pattern applies to this site, as targets appeared to fly at fairly consistent heights near 300 m above the ground nightly and throughout the survey period. The flight heights at the Project are well above the proposed turbine height of 130.5 m, indicating a limited mortality risk during migration.

There is currently no accurate quantitative method of directly correlating pre-construction passage rates at wind farms to operational impacts to birds and bats. Until radar surveys are conducted at a constructed site followed by mortality surveys the morning after, no direct correlations to collision risk can be made. This radar survey is designed to sample migration activity over a given point of time to provide baseline data pre-construction.

# 3.0 Acoustic Bat Survey

## 3.1 INTRODUCTION

Acoustic monitoring of bat activity has become a standard element of pre-construction surveys for proposed wind-energy developments (Kunz *et al*. 2007a,b). Acoustic surveys are associated with several major assumptions (Hayes 2000) and results should not be used to determine the number of bats inhabiting an area or to determine the number of bats that may collide with the proposed turbines. However, acoustic surveys can provide insight into seasonal patterns in activity levels and examine how weather conditions influence bat activity. This data may be useful in predicting trends in post-construction mortality rates. The objectives of acoustic surveys at the Project were (1) to document bat activity patterns from August through October in airspace near the rotor zone of the proposed turbines and at an intermediate height and (2) to document bat activity patterns in relation to weather factors including wind speed, temperature, and barometric pressure.

Eight species of bats occur in Maine, based upon their normal geographical range. These are the big brown bat (*Eptesicus fuscus*), silver-haired bat (*Lasionycteris noctivagans*), eastern red bat (*Lasiurus borealis*), hoary bat (*L. cinereus*), eastern small-footed myotis (*Myotis leibii*), little brown myotis (*M. lucifugus*), northern myotis, (*M. septentrionalis*), and tri-colored bat (*Perimyotis subflavus*) (BCI 2001). Of these, the eastern small-footed myotis, eastern red bat, hoary bat, and silver-haired bat are listed in Maine as species of special concern

An initial season of acoustic surveys was conducted in the Project area between mid August and late October 2008. Detectors first were deployed in trees along access road corridors. Once the met towers were constructed in early September, the detectors were moved to guy wires at each of the three met towers. The second season of acoustic surveys began in April 2009, and continued through mid August 2009. The detectors were located in met towers for the duration of this survey period. This section summarizes results of 2009 surveys, making comparison to acoustic data collected in 2008 where appropriate.

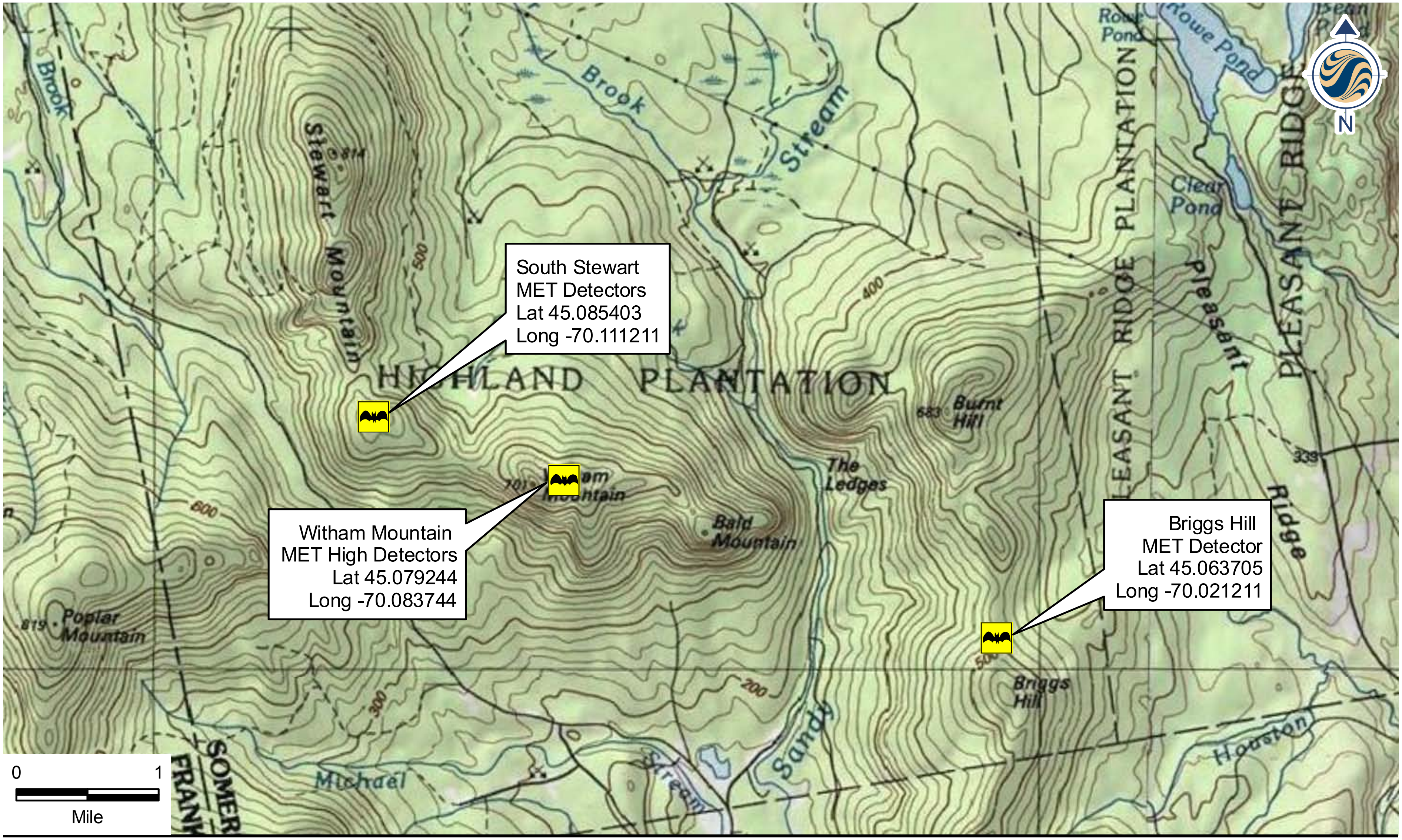
## 3.2 SURVEY DESIGN

### 3.2.1 Data Collection Methods

Anabat SD1 detectors (Titley Electronics Pty Ltd.) were used for the duration of the spring/summer 2009 acoustic bat survey. Each detector was programmed to sample continuously between 1900 and 0800 on a nightly basis, storing data from each night on removable compact flash cards. Anabat detectors operate by dividing the frequency of ultrasonic calls by an adjustable factor (set to 16 for North American species) so that they are audible to humans. The detectors also record frequency profiles of each detected bat call sequence for analysis and species identification, as described below. Anabat detectors were selected for use in this study based on their widespread use for this type of survey, their ability to be deployed for long periods of time, and their ability to detect a broad frequency range, which allows detection of all species of bats that could occur in the Project area.

The audio sensitivity setting of each Anabat system was set between 6 and 7 (on a scale of 1 to 10) to maximize sensitivity while limiting ambient background noise and interference. The sensitivity of individual detectors was then tested using an ultrasonic Bat Chirp (Reno, NV) to ensure that the detectors would be able to detect bats up to a distance of at least 10 m (33'). Detectors were powered by 12-volt batteries, charged by solar panels, and housed within waterproof boxes. Bat calls are directed to the microphone on the bat detectors using a 1.5 inch diameter PVC elbow, which protects the microphone from rain and weather while maximizing the volume of air sampled.

A total of six detectors were deployed between mid April and mid August 2009. Two detectors were deployed in each of the three met towers: South Stewart, Witham Mountain, and Briggs Hill (Figure 3-1). One detector was suspended at a height of approximately 20 m (66') and the other at a height of approximately 40 m (131') in each tower (Figure 3-2). Table 3-1 in section 3.3 lists deployment dates for each detector.

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**Legend**

Bat Detector Location

**Client/Project**

**Highland Wind, LLC**
**Highland Wind Project**
**Highland Plantation, Maine**

Figure No.
3-1

Title
Bat Survey Location Map
August 12, 2009

00385-F301-Bat-Survey-Location-Map.mxd

**Figure 3-2.** Typical view of acoustic bat detectors deployed from met tower guy wires.

### 3.2.2 Data Analysis Methods

Ultrasound recordings of bat echolocation may be broken into recordings of a single bat call or recordings of bat call sequences. A call is a single pulse of sound produced by a bat, while a call sequence is a combination of two or more pulses recorded in an Anabat file. Recordings containing less than two calls were eliminated from analysis as has been done in similar studies (Arnett *et al*. 2006).

Potential call files were extracted from data files using CFCread© software. The default settings for CFCread© were used during this file extraction process, as these settings are recommended for the calls that are characteristic of Maine bats. This software screens all data recorded by the bat detector and extracts call files using a filter. Using the default settings for this initial screen also ensures comparability between data sets. Settings used by the filter include a max TBC (time between calls) of 5 seconds, a minimum line length of 5 milliseconds, and a smoothing factor of 50. The smoothing factor refers to whether or not adjacent pixels can be connected with a smooth line. The higher the smoothing factor, the less restrictive the filter is and the more noise files and poor quality call sequences are retained within the data set.

Following extraction of call files, each file was visually inspected for species identification and to ensure that only bat calls were included in the data set. Insect activity, wind, and interference can also sometimes produce Anabat files that pass through the initial filter and need to be visually inspected and removed from the data set. Call sequences are easily differentiated from other recordings, which typically form a diffuse band of dots at either a constant frequency or widely varying frequency.

Because bat activity levels are highly variable among individual nights and individual hours (Hayes 1997, Arnett *et al*. 2006), detection rates are summarized on both of these temporal scales. Nightly detection rates were summarized by month as well as for the entire sampling period. Hourly detection rates were summarized by hour after sunset, as recommended by Kunz *et al*. (2007a, b). Quantitative comparisons among these temporal periods was not attempted because the high amount of variability associated with bat detection would required much larger sample sizes (Arnett *et al*. 2006, Hayes 1997).

Bat call sequences were individually marked and categorized by species group, or “guild” based on visual comparison to reference calls. Qualitative visual comparison of recorded call sequences of sufficient length to reference libraries of bat calls allows for relatively accurate identification of bat species (O’Farrell *et al*. 1999, O’Farrell and Gannon 1999). Call sequences were classified to species whenever possible, based on criteria developed from review of reference calls collected by Chris Corben, the developer of the Anabat system, as well as other bat researchers. However, due to similarity of call signatures between several species, all classified calls have been categorized into five guilds[2] reflecting the bat community in the region of the Project area and is as follows:

- **Unknown (UNKN)** – All call sequences with less than five calls, or poor quality sequences (those with indistinct call characteristics or background static). These sequences were further identified as either “high frequency unknown” (HFUN) for sequences with a minimum frequency above 30 to 35 kHz, or “low frequency unknown” (LFUN) for sequences with a minimum frequency below 30 to 35 kHz. The unknown calls are separated into these specific high frequency and low frequency groups because some inferences can be made as to the possible guilds based upon bats known to occur in this area. For this area, HFUN most likely represents eastern red bats, tri-colored bats and *Myotis* species since these species typically produce ultrasound sequences of more than 30 kHz. Big brown, silver-haired and hoary bats would be the species in this area typically producing ultrasound sequences of less than 30 kHz.

- **Myotis (MYSP)** – All bats of the genus *Myotis*. While there are some general characteristics believed to be distinctive for several of the species in this genus, these characteristics do not occur consistently enough for any one species to be relied upon at all times when using Anabat recordings.

[2] Gannon *et al.* 2003 categorized bats into guilds based upon similar minimum frequency and call shape. These guilds were: Unidentified, Myotis, LABO-PISU and EPFU-LANO-LACI. We broke hoary bats out into a separate guild due to the importance of reporting activity patterns of migratory species in the context of wind energy development.

- **Eastern red bat/tri-colored bat[3] (RBTB)** – Eastern red bats and tri-colored bats. These two species can produce calls distinctive only to each species. However, significant overlap in the call pulse shape, frequency range, and slope can also occur.

- **Big brown/silver-haired bat (BBSH)** – Big brown and silver-haired bats. These species' call signatures commonly overlap and have therefore been included as one guild in this report.

- **Hoary bat (HB)** – Hoary bats. Calls of hoary bats can usually be distinguished from those of big brown and silver-haired bats by minimum frequency extending below 20 kHz or by calls varying widely in minimum frequency across a sequence.

This method of guild identification represents a conservative approach to bat call identification. Since some species sometimes produce calls unique only to that species, all calls were identified to the lowest possible taxonomic level before being grouped into the listed guilds. Tables and figures in the body of this report will reflect those guilds. However, since species-specific identification did occur in some cases, each guild will also be briefly discussed with respect to potential species composition of recorded call sequences.

Once all of the call files were identified and categorized in appropriate guilds, nightly tallies of detected calls were compiled. Mean detection rates (number of recordings/detector-night) for the entire sampling period were calculated for each detector and for all detectors combined.

#### 3.2.2.1 Weather Data

Temperature (°C), wind speed (m/s), and barometric pressure (mbar) were collected from a 50 meter met tower at South Stewart and provided by Highland Wind for the duration of the survey period (April 23-August 17). Mean nightly temperature, barometric pressure, and wind speed were calculated for each night, and nightly averages were plotted against nightly detections.

## 3.3 RESULTS

### 3.3.1 Detector Call Analysis

Detectors were deployed for a total of 117 calendar-nights (692 detector-nights) between April 23 and August 17. Detectors were operational during 553, or approximately 80%, of these nights. At least one detector was operational at each met tower during every night of the survey period with the exception of a 6-night period at the Witham tower in early May, during which both detectors malfunctioned. Table 3-1 summarizes the ranges of dates each detector was deployed and overall results per detector.

[3] The scientific and common name of the eastern pipistrelle (*Pipistrellus subflavus*) has been changed to the tri-colored bat (*Perimyotis subflavus*).

| Table 3-1. Summary of bat detector field survey effort and results, spring/summer 2009 surveys | | | | | | |
|---|---|---|---|---|---|---|
| **Location** | **Dates Deployed** | **Calendar Nights** | **Detector-Nights*** | **Recorded Sequences** | **Detection Rate **** | **Maximum Sequences recorded ***** |
| Briggs High | April 23-August 13 | 113 | 73 | 19 | 0.3 | 3 |
| Briggs Low | April 23-August 13 | 113 | 112 | 57 | 0.5 | 6 |
| Stewart High | April 23-August 17 | 117 | 117 | 31 | 0.3 | 3 |
| Stewart Low | April 23-August 17 | 117 | 74 | 22 | 0.3 | 3 |
| Witham High | April 24-August 17 | 116 | 110 | 19 | 0.2 | 3 |
| Witham Low | April 24-August 17 | 116 | 67 | 18 | 0.3 | 4 |
| ***Overall Results*** | | ***692*** | ***553*** | ***166*** | ***0.3*** | -- |
| * One detector-night is equal to a one detector successfully operating throughout the night. | | | | | | |
| ** Number of bat echolocation sequences recorded per detector-night. | | | | | | |
| *** Maximum number of bat passes recorded from any single detector for a detector-night. | | | | | | |

A total of 166 bat call sequences were recorded during the survey period, resulting in an overall detection rate of 0.3 ± 0.05 (standard error [SE]) recordings/detector/night (r/d/n) among detectors. Detection rates were similar between detectors, with individual detectors accounting for between 11% and 34% of the total number of recordings. Detection rates were higher in August than during any other month of the survey period, overall and by individual detector, although the mean number of recordings per detector-night remained below 1 even during August (Tables 3-2 and 3-3; Figure 3-3).

| Table 3-2. Monthly combined detection rates for six acoustic detectors during 2009 surveys | | | |
|---|---|---|---|
| Month | # Detector-nights | # Recordings | Rate |
| April | 22 | 1 | 0.05 |
| May | 121 | 24 | 0.20 |
| June | 135 | 36 | 0.27 |
| July | 181 | 36 | 0.20 |
| August | 94 | 69 | 0.73 |
| **Overall** | **553** | **166** | **0.30** |

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| Table 3-3. Monthly summary of 2009 acoustic survey results by detector | | | | | | |
|---|---|---|---|---|---|---|
| **Detector / Month** | **Dates** | **Calendar Nights** | **Detector-Nights*** | **Recorded Sequences** | **Detection Rate **** | **Maximum Sequences recorded ***** |
| Briggs High | | | | | | |
| April | April 23-30 | 8 | 0 | 0 | - | - |
| May | May 1-31 | 31 | 20 | 3 | 0.2 | 1 |
| June | June 1-30 | 30 | 11 | 0 | 0.0 | 0 |
| July | July 1-31 | 31 | 29 | 5 | 0.2 | 3 |
| August | August 1-13 | 13 | 13 | 11 | 0.8 | 3 |
| Briggs Low | | | | | | |
| April | April 23-30 | 8 | 7 | 0 | 0.0 | 0 |
| May | May 1-31 | 31 | 31 | 12 | 0.4 | 2 |
| June | June 1-30 | 30 | 30 | 17 | 0.6 | 6 |
| July | July 1-31 | 31 | 31 | 13 | 0.4 | 5 |
| August | August 1-13 | 13 | 13 | 15 | 1.2 | 4 |
| Stewart High | | | | | | |
| April | April 23-30 | 8 | 8 | 0 | 0.0 | 0 |
| May | May 1-31 | 31 | 31 | 9 | 0.3 | 1 |
| June | June 1-30 | 30 | 30 | 11 | 0.4 | 3 |
| July | July 1-31 | 31 | 31 | 1 | 0.0 | 1 |
| August | August 1-17 | 17 | 17 | 10 | 0.6 | 2 |
| Stewart Low | | | | | | |
| April | April 23-30 | 8 | 1 | 1 | 1.0 | 1 |
| May | May 1-31 | 31 | 7 | 0 | 0.0 | 0 |
| June | June 1-30 | 30 | 18 | 4 | 0.2 | 3 |
| July | July 1-31 | 31 | 31 | 2 | 0.1 | 1 |
| August | August 1-17 | 17 | 17 | 15 | 1.0 | 2 |
| Witham High | | | | | | |
| April | April 24-30 | 7 | 6 | 0 | 0.0 | 0 |
| May | May 1-31 | 31 | 26 | 0 | 0.0 | 0 |
| June | June 1-30 | 30 | 30 | 1 | 0.0 | 1 |
| July | July 1-31 | 31 | 31 | 7 | 0.2 | 3 |
| August | August 1-17 | 17 | 17 | 11 | 0.9 | 2 |
| Witham Low | | | | | | |
| April | April 24-30 | 7 | 0 | 0 | - | - |
| May | May 1-31 | 31 | 6 | 0 | 0.0 | 0 |
| June | June 1-30 | 30 | 16 | 3 | 0.2 | 1 |
| July | July 1-31 | 31 | 28 | 8 | 0.3 | 4 |
| August | August 1-17 | 17 | 17 | 7 | 0.4 | 3 |
| **Overall Results** | | **692** | **546** | **166** | **0.3** | -- |
| * One detector-night is equal to a one detector successfully operating throughout the night. | | | | | | |
| ** Number of bat echolocation sequences recorded per detector-night. | | | | | | |
| *** Maximum number of bat passes recorded from any single detector for a detector-night. | | | | | | |

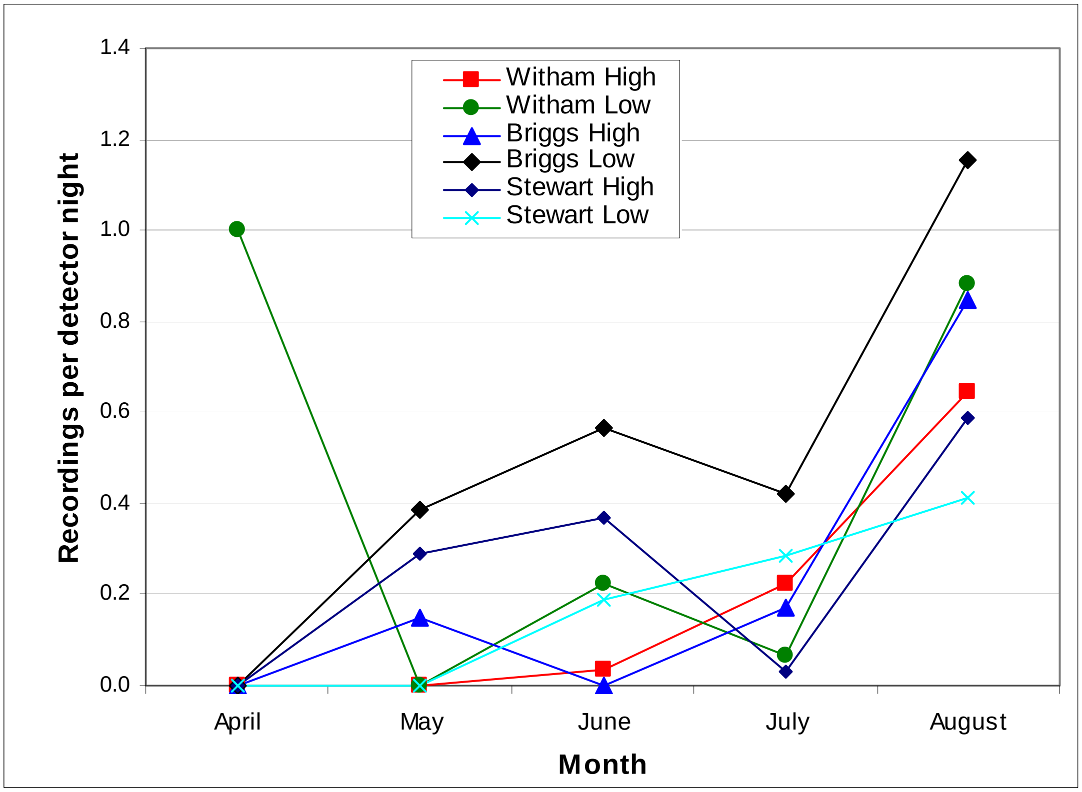



**Figure 3-3.** Total nightly bat call sequence detections by detector. The Witham Low detector was the only detector to record a bat call during April and it recorded only a single call sequence and as such this value for April is artificially high.

Figures 3-4 through 3-9 display nightly acoustic activity by guild at each acoustic detector deployed within the Project area during 2009 surveys. Generally, high and low detectors at each met tower documented similar acoustic activity patterns, with peaks in activity often coordinated between detectors. Levels of acoustic activity were also similar between high and low detectors, with no clear trend of greater activity at either the high or the low detectors (Figures 3-4 through 3-9).

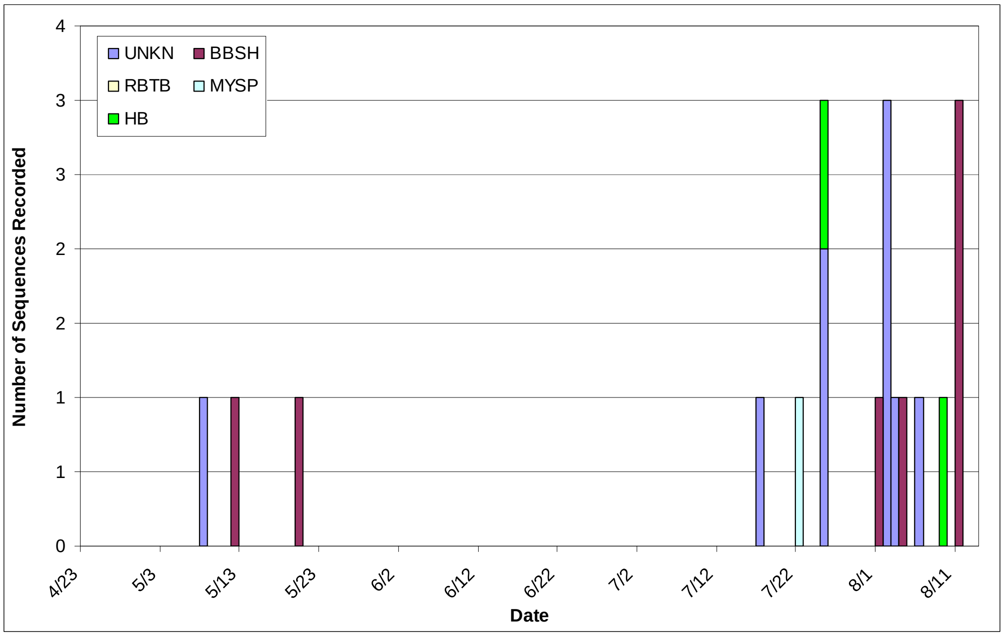



**Figure 3-4a**. Nightly detections at the Briggs Hill High detector from April through August, 2009. UNKN (*unknown guild*); RBTB (*red bat/tri-colored bat)*; BBSH (*big brown/silver haired*); HB (*hoary bat*); MYSP (*myotis*).

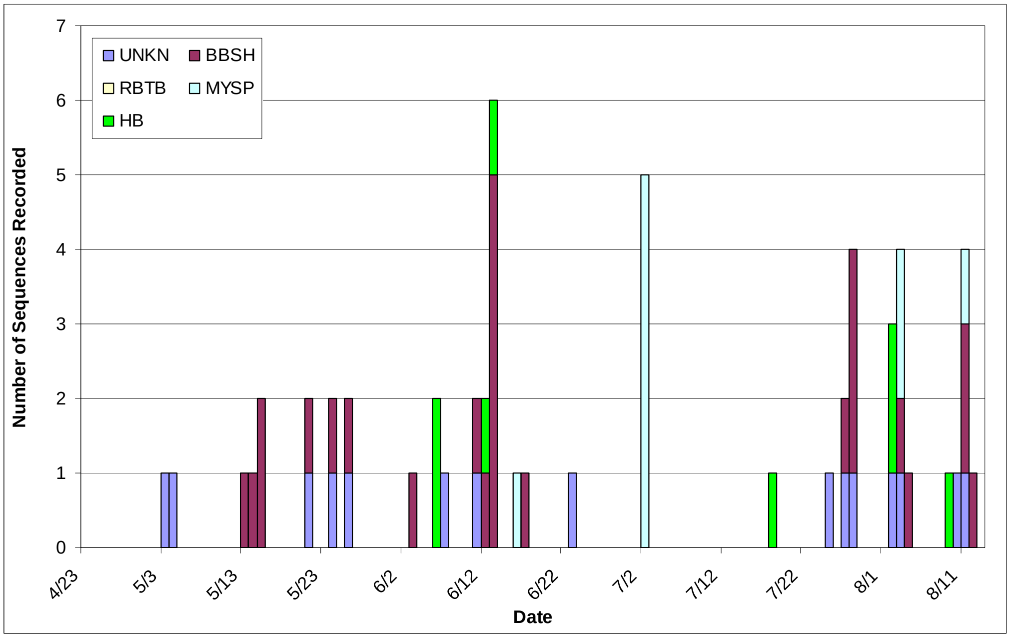



**Figure 3-4b**. Nightly detections at the Briggs Hill Low detector from April through August, 2009. UNKN (*unknown guild*); RBTB (*red bat/tri-colored bat/evening bat*); BBSH (*big brown/silver haired*); HB (*hoary bat*); MYSP (*myotis*).

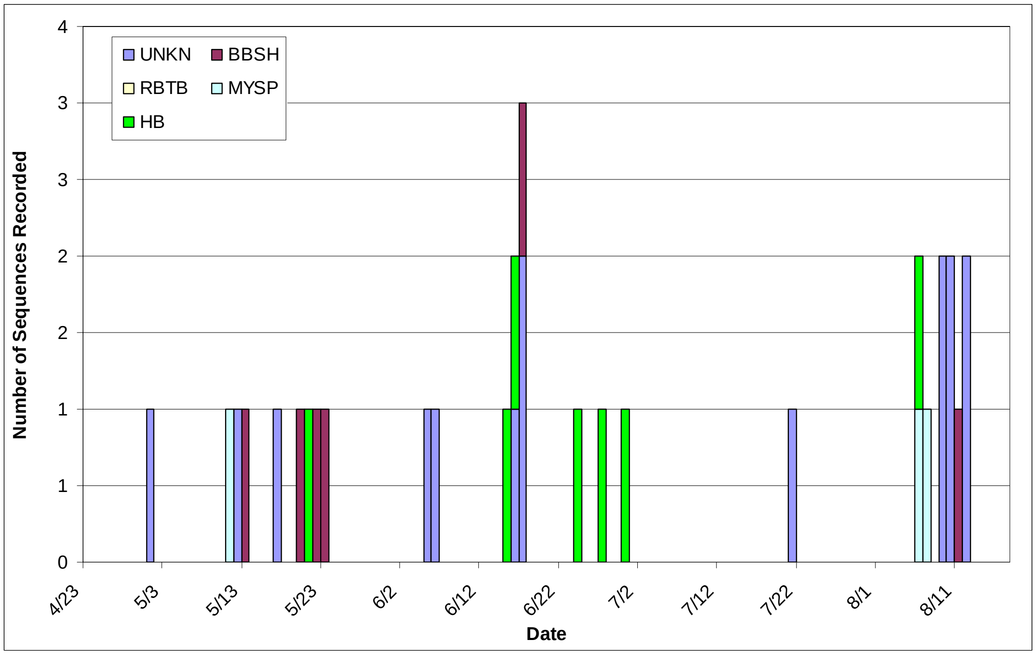



**Figure 3-4c**. Nightly detections at the Stewart High detector from April through August, 2009. UNKN (*unknown guild*); RBTB (*red bat/tri-colored bat)*; BBSH (*big brown/silver haired*); HB (*hoary bat*); MYSP (*myotis*).

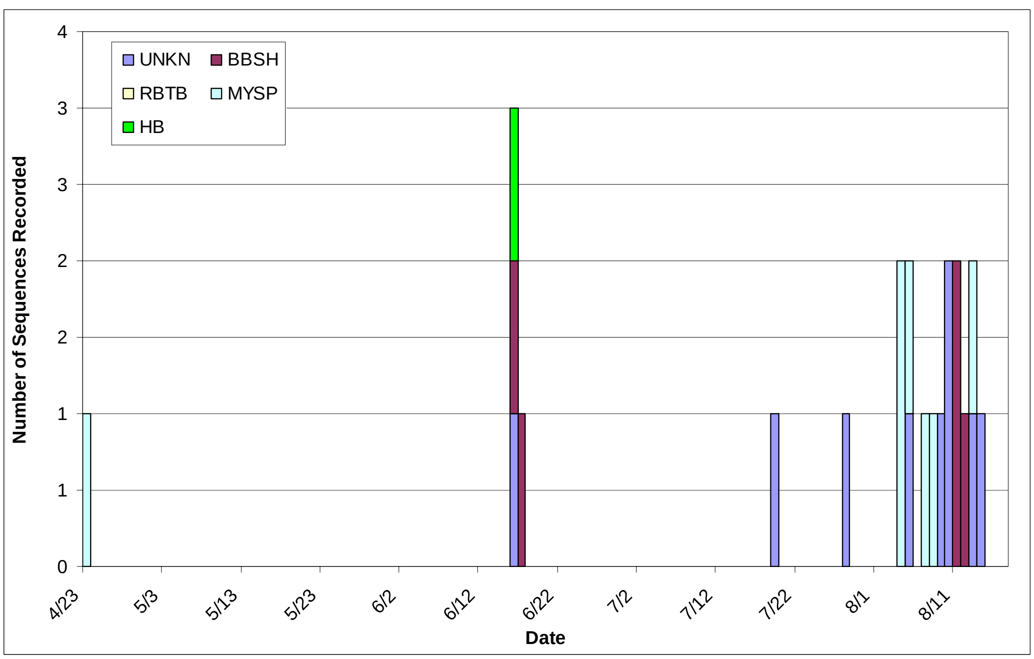



**Figure 3-4d**. Nightly detections at the Stewart Low detector from April through August, 2009. UNKN (*unknown guild*); RBTB (*red bat/tri-colored bat)*; BBSH (*big brown/silver haired*); HB (*hoary bat*); MYSP (*myotis*).

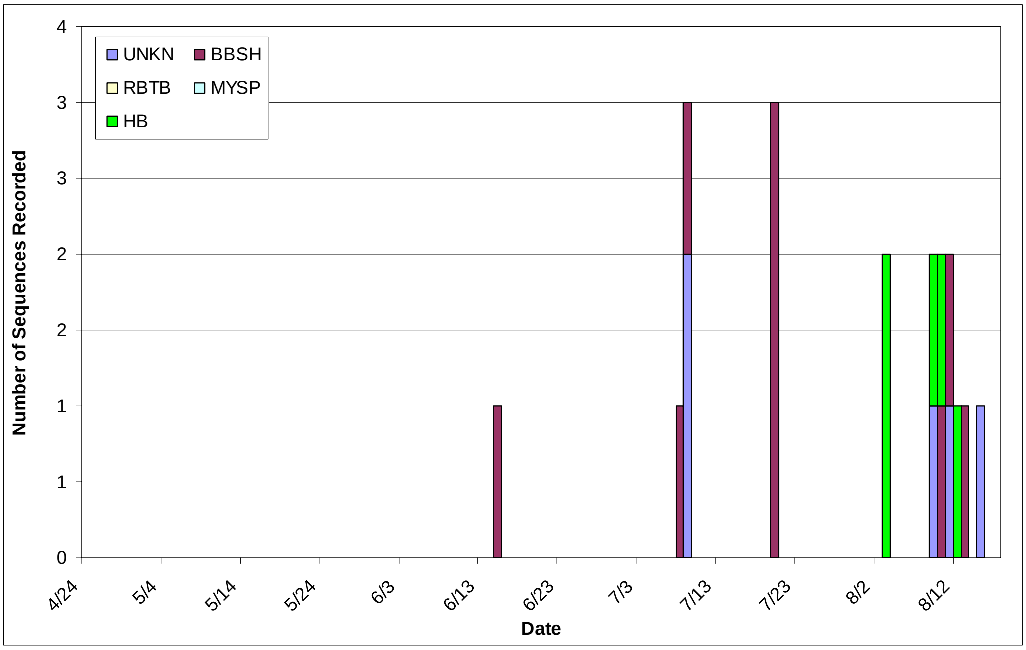



**Figure 3-4e**. Nightly detections at the Witham High detector from April through August, 2009. UNKN (*unknown guild*); RBTB (*red bat/tri-colored bat)*; BBSH (*big brown/silver haired*); HB (*hoary bat*); MYSP (*myotis*).

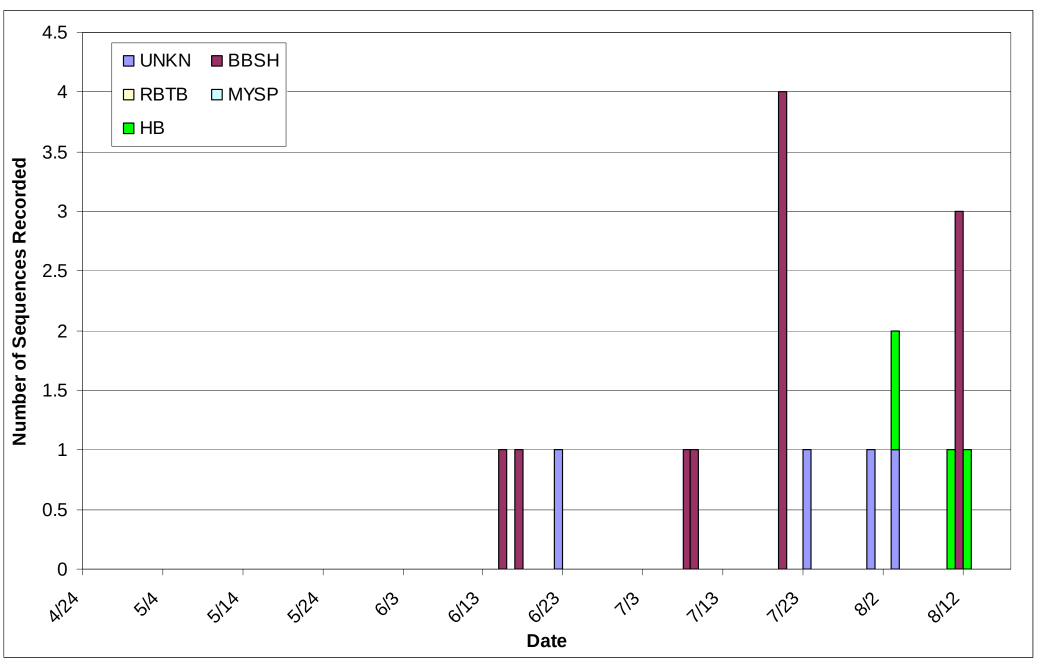



**Figure 3-4f**. Nightly detections at the Witham Low detector from April through August, 2009. UNKN (*unknown guild*); RBTB (*red bat/tri-colored bat)*; BBSH (*big brown/silver haired*); HB (*hoary bat*); MYSP (*myotis*).

Most recorded call sequences were classified as BBSH (*n* = 63; 38.0%), followed by UNKN (*n* = 57; 34.3%). Remaining sequences were split roughly evenly between HB (*n* = 26; 15.7%) and MYSP (*n* = 20; 12.0%). No call sequences were identified as RBTB (Table 3-4). Within the BBSH guild, 23 (37%) were identified as silver-haired bats, 3 (5%) were identified as big brown bats, and 37 (58%) could not be identified between the species. Within the UNKN category, the majority (*n* = 39; 68%) of call sequences were low frequency. Of those species documented within the Project area, the hoary bat (HB), silver-haired bat (SH) and big brown bat (BB) typically produce low frequency calls. As a single species, hoary bats (HB) accounted for a relatively high percentage of the total number of recorded sequences (*n* = 26; 16%).

**Table 3-4.** Distribution of detections by guild for detectors during spring/summer 2009 surveys

| **Detector** | **Guild** | | | | | **Total** |
|---|---|---|---|---|---|---|
| | **BBSH** | **HB** | **MYSP** | **RBTB** | **UNKN** | |
| Briggs High | 7 | 2 | 1 | 0 | 9 | 19 |
| Briggs Low | 25 | 8 | 9 | 0 | 15 | 57 |
| Stewart High | 6 | 7 | 3 | 0 | 15 | 31 |
| Stewart Low | 5 | 1 | 7 | 0 | 9 | 22 |
| Witham High | 9 | 5 | 0 | 0 | 5 | 19 |
| Witham Low | 11 | 3 | 0 | 0 | 4 | 18 |
| **Total** | **63** | **26** | **20** | **0** | **57** | **166** |
| **Guild Composition %** | **38.0%** | **15.7%** | **12.0%** | **0.0%** | **34.3%** | |

Among detectors, species composition varied slightly, although overall numbers of recorded call sequences were too low to characterize patterns. Figure 3-5 summarizes species composition of acoustic activity by detector for the entire survey period.

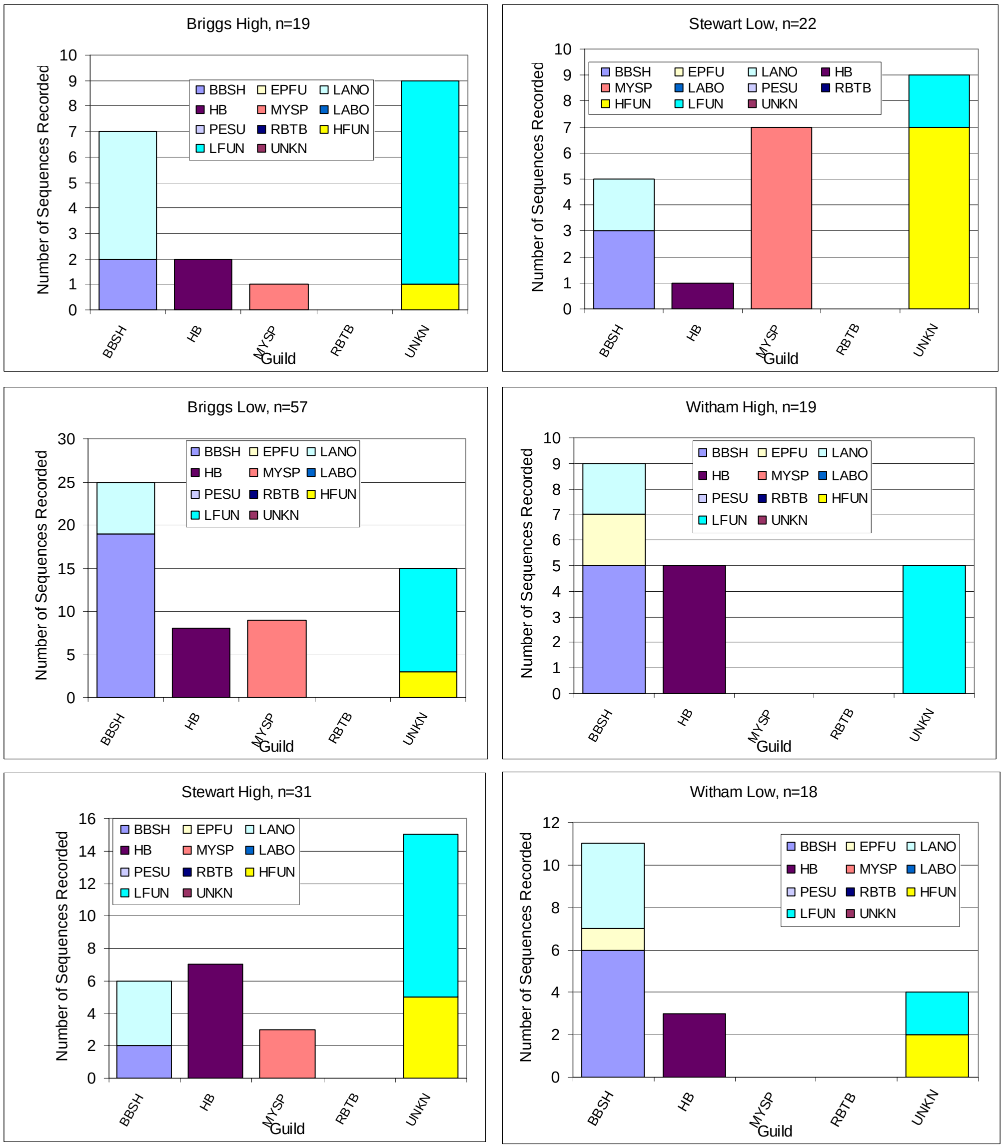



**Figure 3-5**. Guild and species composition of recorded bat call sequences at Highland met detectors from April through August, 2009. UNKN (*unknown guild*); RBTB (*red bat/tri-colored bat)*; BBSH (*big brown/silver haired*); HB (*hoary bat*); MYSP (*myotis*).

Timing of acoustic activity varied between detectors and nights, but exhibited a gradual peak between the second and fourth hour past sunset when data were combined for all detectors and all nights. Activity levels then dropped gradually between the fourth and tenth hour past sunset (Figure 3-6).

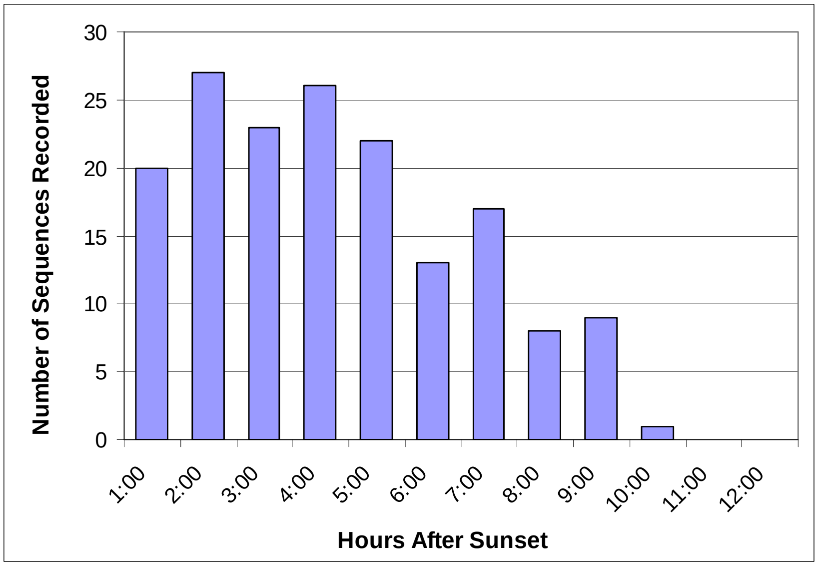



**Figure 3-6**. Timing of acoustic activity during 2009 surveys relative to sunset for six detectors combined.

### 3.3.2 Weather Data

Mean nightly wind speeds in the Project area from April 23 through August 17 varied between 2.0 and 16.6 m/s, with an overall mean of 6.8 m/s (Figure 3-7). Mean nightly temperatures varied between1.5ºC and 22.0ºC, with an overall mean of 12.0ºC (Figure 3-8). Mean nightly barometric pressure varied from 920 mm Hg to 952 mm Hg with a mean value of 940 mm Hg (Figure 3-9). Whereas wind speed and barometric pressure were variable throughout the survey period, mean nightly temperatures trended higher throughout the survey period. Generally speaking, bat activity levels were higher on nights with lower mean wind speeds and higher mean temperatures. Rainfall totaled 26.5 inches during the survey period and bats were seldom detected on nights with rainfall (Figure 3-10).

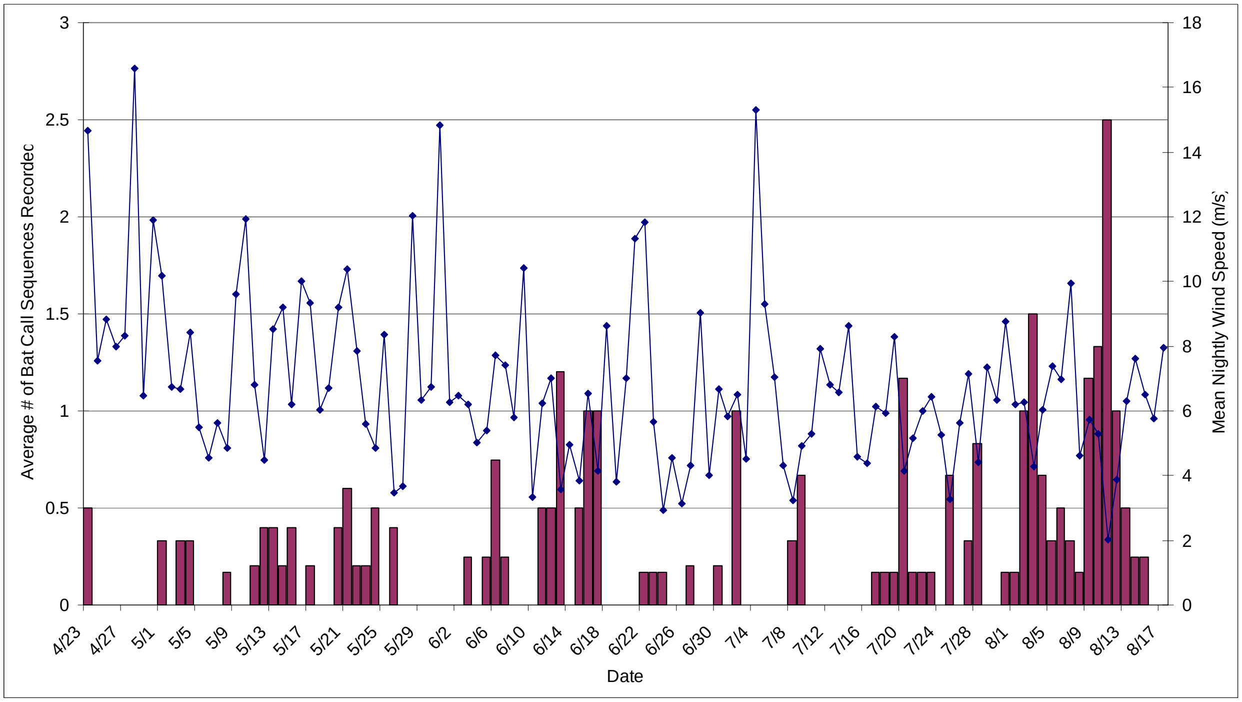



**Figure 3-7.** Nightly mean wind speed (m/s) (blue line) and bat call detections averaged across the six detectors

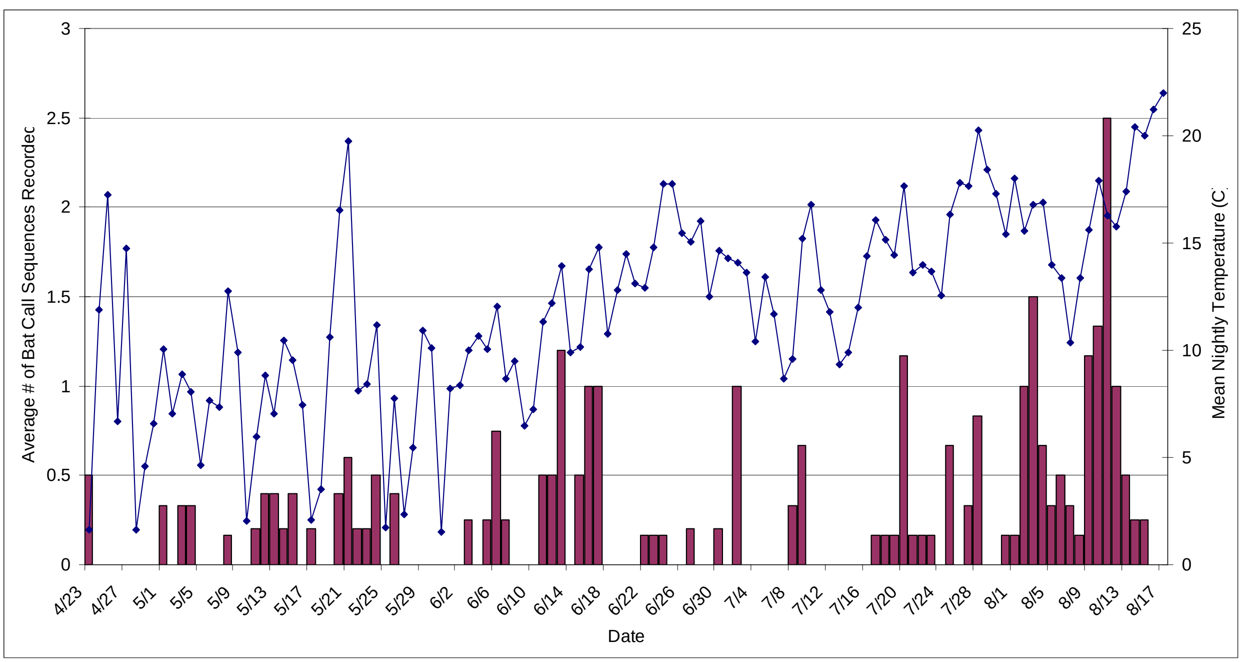



**Figure 3-8.** Nightly mean temperature (Celsius) (blue line) and bat call detections averaged across the six detectors

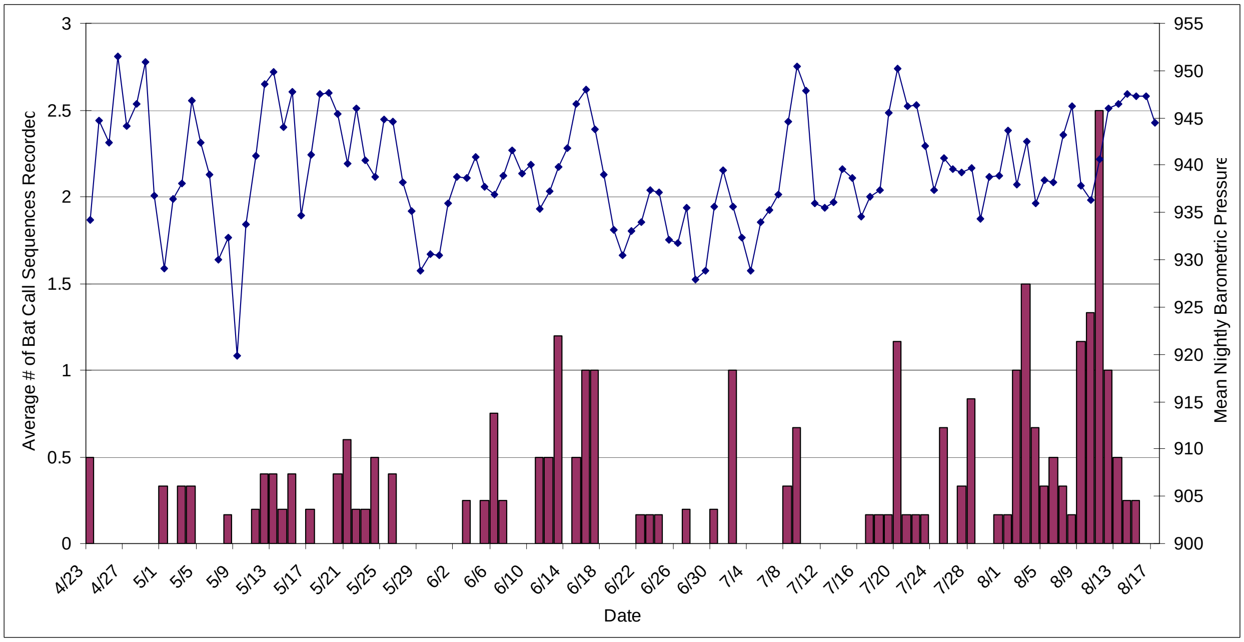



**Figure 3-9.** Nightly mean barometric pressure (mm Hg) (blue line) and bat call detections averaged across the six detectors

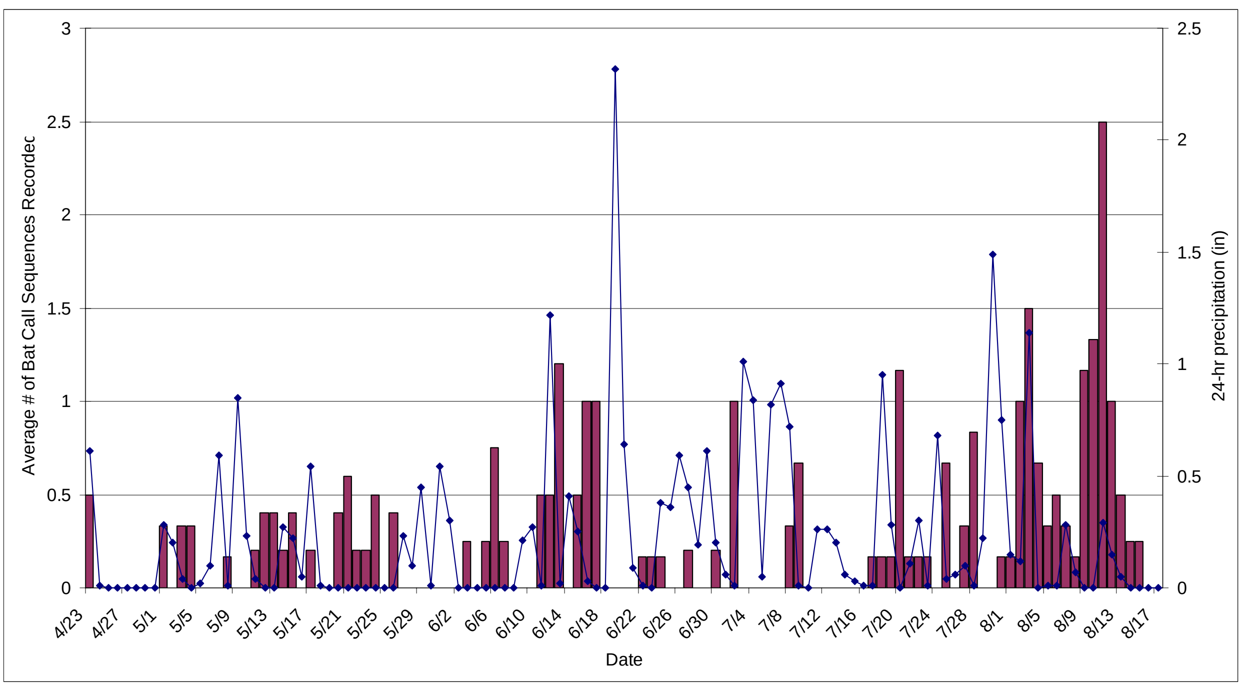



**Figure 3-10.** 24-hr total precipitation (inches; blue line) and bat call detections averaged across the six detectors. Because data on timing of rainfall were not available, rainfall data are reported as 24-hour totals, including daytime rain.

## 3.4 DISCUSSION

Bat echolocation surveys provide some insight into possible activity patterns, species composition, and timing of movements of bats in the Project area. Between 2008 and 2009 acoustic surveys, Stantec conducted nearly eight months of acoustic monitoring at three different met towers and several near-ground locations (in 2008) within the Project area. Together, these two seasons of monitoring provide information on the activity patterns of bats in the Project area. Acoustic surveys in 2009 documented low levels of acoustic activity among all six detectors. No detector recorded more than six call sequences during any single night, which is very low for this type of survey work, particularly in mid summer. Weather conditions during this time period, particularly high rainfall amounts, may have significantly influenced bat activity and resulting detection rates. In addition, the 2009 spring/summer survey period did not capture the peak in activity that typically occurs later in the season (mid-August to early September) because this time was cover during the 2008 surveys.

Comparison of the 2008 and 2009 survey results, using only the data collected at the met tower locations, indicates that the overall mean detection rate was the same (0.3 r/d/n). In 2008, detectors were originally deployed in trees along forested corridors and were placed at a height of 8 m or less. These lower detectors picked up a high number of call sequences (n=11,516) many of which were determined to be either *Myotis* sp. or high frequency unknown calls.

Species composition of recorded bat activity suggests that most bats flying above the canopy within the Project area are larger species, with hoary bats and silver-haired bats appearing to be the most commonly detected species, followed by big brown bats. Very few *Myotis* sp. bats were recorded above the tree canopy. These trends were true for both 2008 and 2009 acoustic surveys, and have also been observed at other regional studies. The *Myotis* sp. bats are detected most frequently near the ground and larger bats, which are presumably more capable fliers, are detected more frequently by detectors mounted high in met towers.

Differences in detection rates between guilds at the various detector locations may reflect varying vertical distribution and habitat preferences of bat species (Arnett *et al*. 2006, Hayes 2000). Recent research using Anabat detectors recorded *Myotis* species more frequently at lower heights and larger species such as big brown and hoary bats were more frequently at higher heights (Arnett *et al*. 2006). This general trend matches the guild compositions reported in Figure 3-5. However, interpretation of guild composition is confounded by the high number of UNKN call sequences. Unknown call sequences could not be identified to guild or species due to short call sequences (less than five pulses) or poor call signature formation, often a result of bats flying at the edge of the detection zone of the detector or flying away from the microphone. The relatively small area sampled by bat detectors makes scenarios leading to un-identifiable call sequences common, but some information can still be gleaned from these poor recordings. Specifically, 68 percent of UNKN sequences recorded in the Project area during 2009 surveys were identified as being LFUN, which include the hoary bat, silver-haired bat, and big brown bat, the three most commonly identified species during 2009 surveys. These species also were most commonly detected when the detectors were deployed in the met towers in 2008; however, these results contrasts sharply with the results for detectors deployed in trees during the earlier part of the fall 2008 season. Detectors placed in trees were closer to the ground (within 8 m) and more commonly recorded *Myotis* species; a genus that is more commonly detected at lower heights.

When met tower acoustic data from 2008 and 2009 are considered together, August stands out as the month with the highest acoustic activity levels. Although only half of the month was sampled during each year, activity levels peaked in August and gradually declined in September and October during 2008 surveys, and peaked in August after a gradual increase during 2009 surveys.

Comparison of acoustic bat activity levels and weather variables suggest that bats are most active during mild nights with no precipitation and low wind speeds. The large amount of rain between April and August, 2009, may have contributed to the overall low levels of acoustic activity documented in the Project area. July was the rainiest month, and a corresponding drop in activity levels was observed during this month. Because weather variables are not independent of one another, activity levels of bats are likely determined by the combination of variables rather than one single variable. Visual comparison of Figures 3-7 through 3-10 above show that during certain periods with low or no bat activity (example May 29 through June 2) wind speeds were high, temperatures were low, barometric pressure dropped, and considerable rain fell. While the weather was clearly not favorable for bats during certain intervals in the survey period, it is difficult to isolate which weather variable influenced bat activity most.

Qualitatively speaking, acoustic surveys at the Project area mirror similar surveys conducted in the Northeast Specifically, detection rates at detectors suspended from met towers were low (less than 1 r/d/n), and detectors operating at ground-level exhibited tremendous variation, ranging from less than 10 to over 300 r/d/n. This type of variation reflects differing conditions (habitat, microclimates, etc.) and differing timing of operation among detectors. The results of these Project specific surveys, including variability in bat activity and generally low detection rates above canopy height, are consistent with other publicly available acoustic surveys conducted at proposed wind developments in the Northeast. This Project area does appear to have activity levels that are consistently below those from similar surveys conducted in the region (Appendix B Table 1).

# 4.0 Breeding Bird Survey

## 4.1 INTRODUCTION

Stantec conducted a breeding bird survey during the spring and summer of 2009. The goal of the surveys was to determine the species composition, abundance, diversity, and distribution of breeding birds in the Project area. The surveys focused effort on documenting the occurrence of species of conservation concern, but considered all avian species visually or acoustically detected. Survey methods were conducted in accordance with the United States Geological Survey (USGS) North American Breeding Bird Survey methods (Sauer *et al.* 2003). The survey provides baseline data of the species present in the Project area, their abundance, as well as the community structures among the different habitats present on-site.

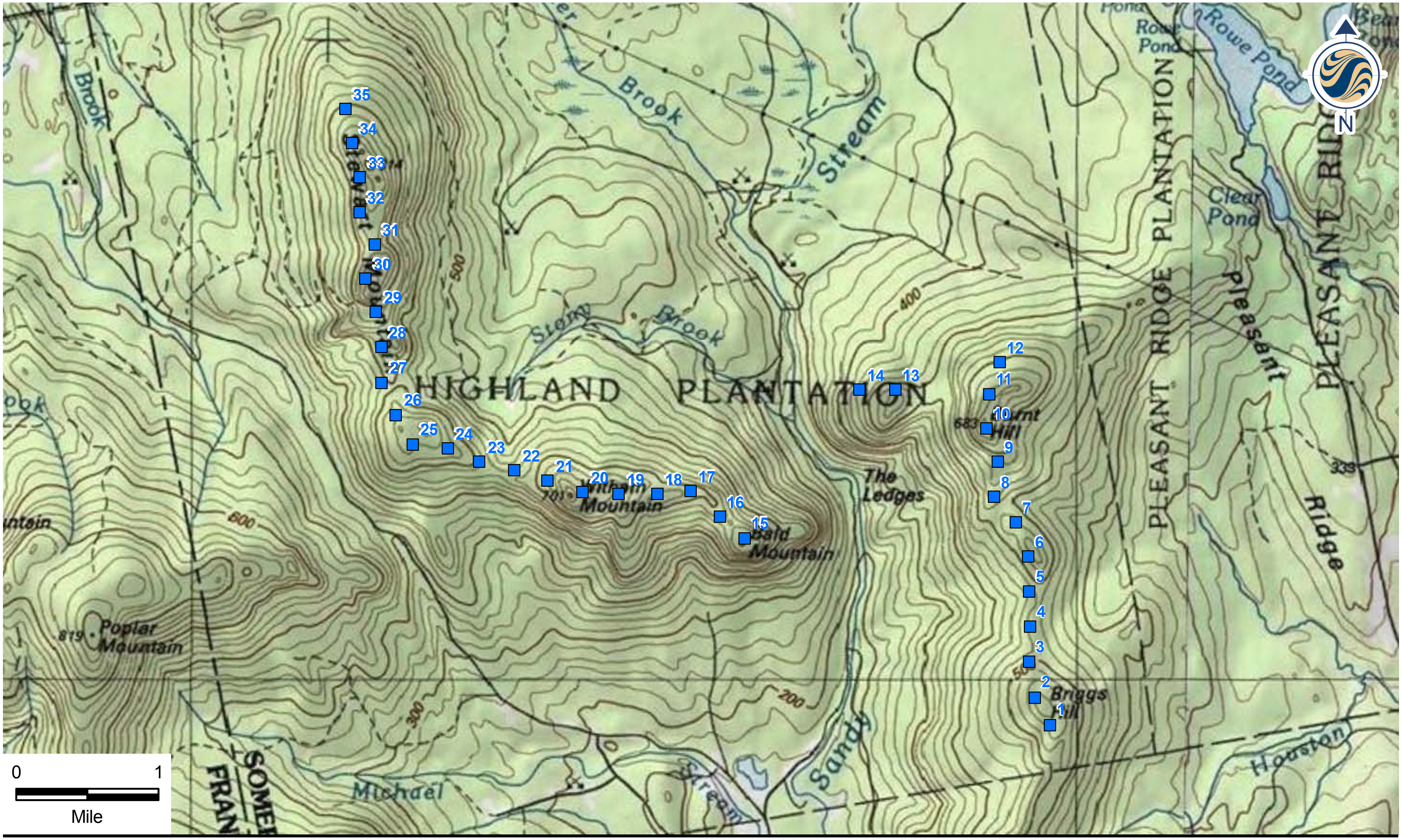
## 4.2 METHODS

### 4.2.1 Breeding Bird Survey Point Counts

Consistent with USGS North American Breeding Bird Survey methods, Stantec biologists conducted breeding bird point count surveys during three separate visits to the Project area: the first visit occurred at the end of May, and the other visits took place in June 2009.

The timing of surveys targeted the timeframe starting 15 minutes before sunrise to 6 hours after sunrise on days with suitably clear weather, mild temperatures, and when rain or wind would not inhibit the detection of birds. Point count locations were established over the proposed Project area using Global Positioning System (GPS) equipment (Figure 4-1), and were positioned to sample all habitats representative of the Project area. These included points along the ridgelines in proximity to the proposed turbine locations or access roads. At each survey point, GPS location, time, weather, habitat, species, number of individuals, and other behavioral notes were recorded.

During surveys, observers oriented themselves toward the north and record the general location of birds onto the directional quadrants of a count circle. Point count sample periods were broken into three periods: the first three minutes, the following two minutes, and the final five minutes. For the duration of the 10-minute count period, the species and the number of individuals occurring at distances of 0-50 m, 50-100 m, or greater than 100 m from the observer, or flying overhead, were recorded on datasheets for the period during which they were first heard. During each consecutive time period, observers would determine the location of previously recorded birds and track any movements within the count circle to avoid recounting birds. When possible, observers made digital recordings of rare or unusual birds. Observations of birds made before and after the point count timeframes were recorded separately as incidental observations.

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00385-F401-BBS-Points.mxd

**Legend**

■ BBS Point Location

**Client/Project**

**Highland Wind, LLC**
**Highland Wind Project**
**Highland Plantation, Maine**

Figure No.
4-1

Title
Breeding Bird Survey Location Map
October 15, 2009

The habitats in the Project area were summarized into four categories: coniferous forest, deciduous forest, mixed coniferous and deciduous forest, and disturbed. Habitat types for each point count location were assigned based on the dominant vegetation cover present at each survey location. The disturbed habitat category included clearings created for meteorological (met) towers as well as early successional cuts created by timber harvesting. Habitats that share similar characteristics were grouped wherever possible for statistical analysis purposes. For example, coniferous forest habitats included second-growth stands as well as coniferous stands that had undergone more recent harvesting, but were beyond the initial early successional stage of regeneration.

Quantitative data collected during point counts were used to calculate the species richness, relative abundance, community diversity, and frequency of breeding birds within the available habitats of the Project area.

- Species richness (SR) is the total number of species that are detected at a specific point, within a habitat classification, or across the Project area.
- Relative abundance (RA) measures the number of individuals of a species within a habitat classification or across the Project area, and takes into account the number of times each point is surveyed and the number of points per habitat, or per Project area.
- Frequency (Fr) of occurrence, expressed as a percentage, measures the number of points within a habitat type, or across the Project area, where a particular species is detected.
- The Shannon Diversity Index (SDI) is a measure of species diversity in a community or habitat. SDI can provide more information about community composition than species richness alone because it takes into account relative abundance and evenness of species. It indicates not only the number of species, but also how abundance is distributed among all the species in the community or habitat.

Species recorded as beyond 100 m from the observer, as flyovers, or birds detected incidentally were not included in the statistical analysis for relative abundance, species frequency, or community diversity due to the probability that they were not breeding within the direct vicinity of the point count location; however, these data were used to determine overall species richness and the total number of birds observed.

## 4.3 RESULTS

One round of surveys was conducted in May (May 21 to 22), and two were conducted in June (June 9 and 10, and June 21, 25, and 26). Breeding bird surveys were conducted when wind or rain conditions had no adverse effect on bird detection. Wind conditions were predominantly calm to 4 to 7 kph (2 to 4 mph); wind speeds did not typically exceed 19 kph (12 mph) during the surveys except for brief periods on May 21 and 22, June 9, and June 21. Weather conditions generally ranged from clear to overcast skies, although there were periods of fog or mist, drizzle, and showers during surveys on June 10, 21, and 26. Temperatures during the surveys ranged from -18 to 23º C (-0.4º to 73.4º F).

There were a total of 35 breeding bird point count locations surveyed within the Project area. Each point was surveyed during the three separate site visits. Fifty-two species and an unidentified woodpecker and two unidentified ducks were observed during point count surveys (Appendix C Table 1). Three additional species were detected incidentally between point count surveys: American kestrel (*Falco sparverius*), American woodcock (*Scolopax minor*), and eastern phoebe (*Sayornis phoebe*) (Appendix C Table 2).

### 4.3.1 BBS Point Counts

Including birds detected beyond 100 m from the observer and birds seen flying over head, a total of 1,057 individual birds representing 52 species were documented during the point count surveys. Fifty-two percent of birds (n=553) were detected within 50 meters of the observer, 37 percent (n=390) were detected 50 to 100 m, 7 percent (n=77) were detected at greater than 100 m from the observer, and 4 percent (n=37) were observed as flyovers (Appendix C Table 1). The species with the greatest relative abundance among the 35 point counts included white-throated sparrow (*Zonotrichia albicollis*; RA=1.02), chestnut-sided warbler (*Dendroica pensylvanica*; RA=0.68), black-throated-blue warbler (*Dendroica caerulescens*; RA=0.67), and dark-eyed junco (*Junco hyemalis*; RA=0.60).

Point count data were analyzed to determine species richness, relative abundances, and diversity for each habitat type (Table 4-1). Excluding birds detected greater than 100 m from the observer and birds seen flying over head (n=943), the species richness was 47 and the relative abundance of all birds among the 35 point count locations was 8.98. The SDI for all points surveyed was 3.25.

The ridgeline portion of the Project area is dominated by two habitat categories, and these were the most frequently surveyed habitats: disturbed areas (n=17 points) and coniferous forest (n=15 points). The most birds were observed within the disturbed habitat (n=517), but this in large part reflects the greater number of survey points within this habitat category. The greatest species richness also was documented in disturbed habitat (SR=38). The relative abundance was highest within the deciduous forest (RA=11.33) followed by the disturbed habitat (RA=10.14). The SDI was relatively similar across the four habitat categories, indicating a similar species diversity and distribution among points sampled.

**Table 4-1.** Summary of breeding bird point count results by habitat type

| Habitat Type | # BBS Points | Total Birds Observed | Relative Abundance | Species Richness | Shannon Diversity Index |
|---|---|---|---|---|---|
| Coniferous forest | 15 | 341 | 7.58 | 32 | 2.95 |
| Deciduous forest | 1 | 34 | 11.33 | 19 | 2.80 |
| Mixed forest | 2 | 51 | 8.50 | 20 | 2.82 |
| Disturbed | 17 | 517 | 10.14 | 38 | 2.98 |
| **All points** | **35** | **943** | **8.98** | **47** | **3.25** |

### 4.3.2 Species relative abundances and frequencies among habitats

Following is a summary of the relative abundance and frequency of occurrence for the most commonly detected species in the four surveyed habitats (Appendix C, Tables 3).

#### 4.3.2.1 Coniferous forest

The species with the greatest relative abundance among the coniferous forest points were Nashville warbler (*Vermivora ruficapilla*; RA=0.89), yellow-rumped warbler (*Dendroica coronata*; RA=0.76), and golden-crowned kinglet (*Regulus satrapa*); RA=0.67). The species occurring most frequently among the coniferous forest points were dark-eyed junco (Fr=100%), yellow-rumped warbler (Fr=93%), golden-crowned kinglet (Fr=87%), and Nashville warbler (Fr=87%).

#### 4.3.2.2 Deciduous forest

Species with the greatest relative abundances among deciduous forest points were dark-eyed junco (RA=1.33), black-throated blue warbler (RA=1.33), American redstart (*Setophaga ruticilla*); RA=1.00), and mourning warbler (*Oporornis philadelphia*); RA=1.00). Because only one point was surveyed in this habitat, the frequency of occurrence yields little information; all detected birds had a value of 100 percent.

#### 4.3.2.3 Mixed forest

Species with the greatest relative abundances among mixed forest points were black-throated blue warbler (RA=2.67), yellow-rumped warbler (RA=1.67), hermit thrush (*Catharus guttatus*); RA=1.33) and bay-breasted warbler (*Dendroica castanea*); RA=1.33). Because only two points were surveyed in this habitat, species either had a frequency of occurrence of 50 percent (n=12) or 100 percent (n=8).

#### 4.3.2.4 Disturbed

Species with the greatest relative abundances among disturbed habitat points were white-throated sparrow (RA=1.55), chestnut-sided warbler (RA=1.24), common yellowthroat (RA=1.10), and black-throated blue warbler (RA=0.78). The species observed most frequently were white-throated sparrow (Fr=100%), chestnut-sided warbler (Fr=94%), and common yellowthroat (Fr=88%).

## 4.4 DISCUSSION

During the 2009 breeding bird surveys, a total of 55 species were documented in the Project area. Surveys were conducted during the peak nesting period, and were initiated in the early morning when birds are typically the most vocal. Surveys were generally conducted during optimal weather conditions for detection of vocalizations. Certain species of bird vocalize less frequently and are, therefore, often under-represented during breeding bird surveys (Farnsworth *et al.* 2002). The 2009 surveys used standard methods that are comparable to other breeding bird surveys conducted in the region; therefore, the results of the surveys provide a suitable reflection of the breeding bird community in the Project area. The 2009 data represents baseline data that can be compared to similar studies conducted in the region, as well as future studies conducted on-site. .

The ridgeline portion of the Project area consists primarily of disturbed habitat and coniferous forests and as a result more of the point count locations fell within these two habitats. Largely as a result of number of survey points, most of the birds were observed within these two habitats. These two habitats also had comparatively higher species richness when compared to the deciduous and mixed habitat categories. The SDI for the four habitats was similar indicating a relatively even distribution of species among the surveyed points.

The species detected during breeding bird surveys were those that would typically be associated with the available habitats in the Project area. Those stands of more mature coniferous and deciduous forests provided habitat for interior forest species such as the golden-crowned kinglet and bay-breasted warbler. In contrast generalist species such as the Nashville warbler and edge-associated species (i.e., mourning warbler and white-throated sparrow) occurred more commonly in less mature stands and in the very early successional cuts and clearings.

No state- or federally-listed endangered or threatened species were observed during the 2009 breeding bird surveys, but 10 state-listed species of special concern were documented (Table 4-2). Although these species are listed as species of special concern in Maine, several of them are considered globally and regionally secure (NatureServe Explorer 2009). For example, the chestnut-sided warbler has shown no statistically significant decline and no clear population trends across its range. White-throated sparrow and chestnut-sided warbler, two species that respond well to regeneration following timber harvesting, had the highest RA during the point count surveys. With the possible exception of the black-throated blue warbler, which is more typically associated with interior forest habitats, the species with the greatest relative abundances among all points sampled are forest edge dwelling species and will inhabit areas with past forest disturbances such as timber harvesting. In general, the species that were detected on-site are common and regionally abundant species and they are representative of the habitats in which they were detected.

| **Table 4-2.** Maine species of special concern detected during the 2009 breeding bird surveys | |
|---|---|
| **Species** | **Relative abundance among all points** |
| least flycatcher | 0.01 |
| yellow warbler | 0.01 |
| Tennessee warbler | 0.03 |
| Canada warbler | 0.04 |
| American redstart | 0.24 |
| black-and-white warbler | 0.28 |
| chestnut-sided warbler | 0.68 |
| white-throated sparrow | 1.02 |
| olive-sided flycatcher | * |
| eastern wood-pewee | * |
| *Observed greater than 100 m from observer. | |

# 5.0 Diurnal Raptor Surveys

## 5.1 INTRODUCTION

The Project area is within the "Eastern Continental Hawk Flyway"[4], which extends from the Canadian Maritimes south to eastern Florida. Within this large area, raptors tend to concentrate along linear mountain ridgelines which provide 'leading lines' for migrants (Kellogg 2007). Updrafts are formed along the side slopes of ridges which raptors use in order to fly long distances with minimal exertion (Berthold 2001). Raptors also use thermals, pockets of warm, air that rise from the ground's surface as it is heated by the sun, to minimize energy expenditure during migration movements (Bildstein 2006). Because many raptor species avoid crossing large bodies of water, raptor migration in the Eastern Continental Hawk Flyway also tends to be concentrated along the shores of large bodies of water including lakes and the Atlantic Coast (Kellogg 2007).

It was the purpose of the raptor surveys to sample migration activity at central and prominent locations within the Project area, to document the species that occur in the vicinity of the Project, and the general flights height, flight path locations, and other flight behaviors of raptors within or in the vicinity of the Project.

[4] The Eastern Continental Flyway includes the Maritime Provinces; New England; New York (south and east of a line from Jamestown to Utica to the north end of Lake Champlain); Pennsylvania (all except Erie County); Mid-Atlantic States through Georgia, West Virginia, Kentucky and Tennessee; Florida east of a line from Lake Seminole south to Apalachicola (Kellogg 2007).

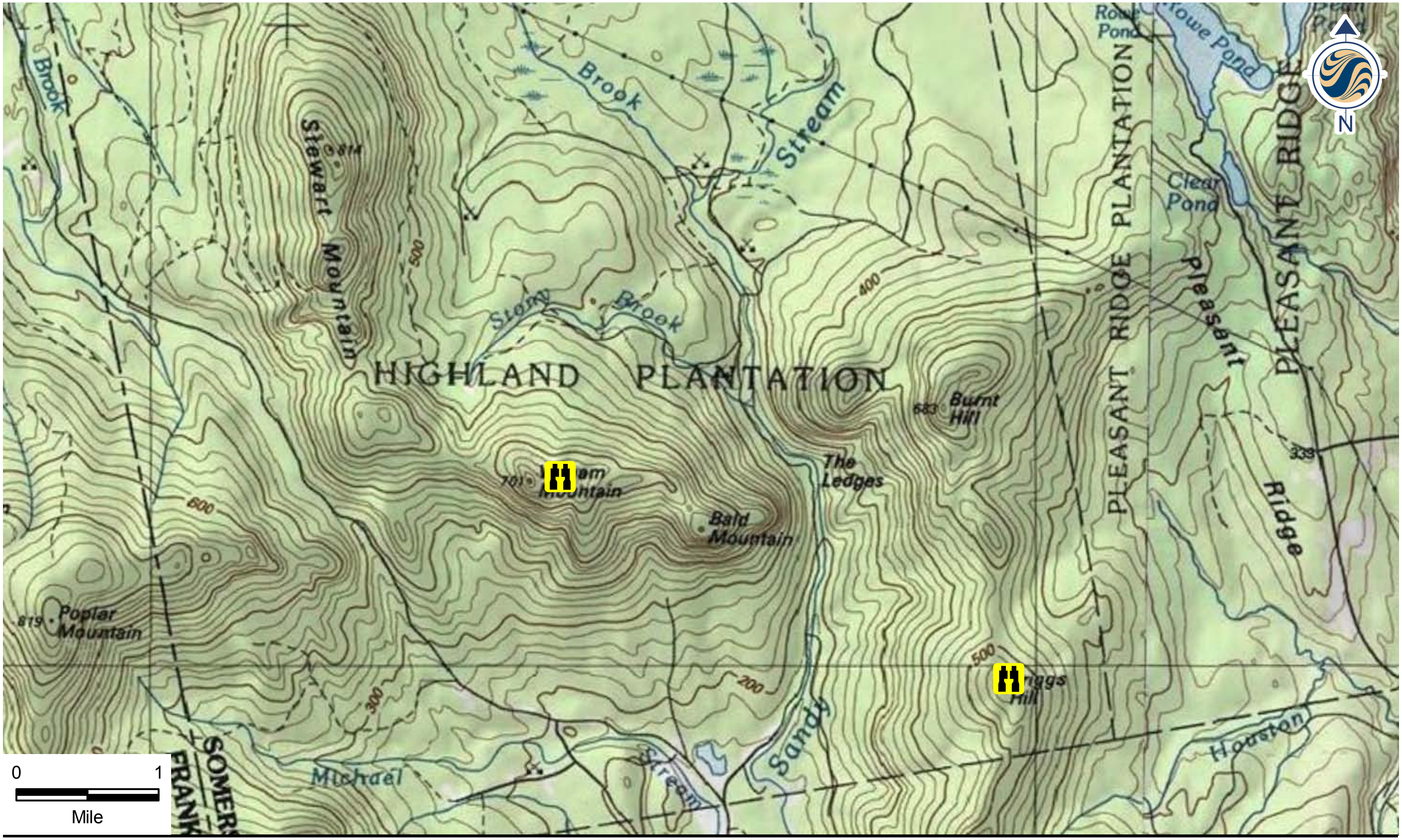
## 5.2 DATA COLLECTION METHODS

### 5.2.1 Field Surveys

Diurnal raptor surveys were conducted on days with favorable flight conditions. Days following the passage of weather fronts bringing favorable weather, good visibility, and days with southerly winds were targeted. Raptor migration is facilitated by tail winds (winds aligned with the preferred direction of travel), which "push" migrating raptors forward (Bildstien 2006); however, some raptors will fly in light or moderate headwinds. Days with headwinds also were sampled as some flight behaviors differ in moderate to strong headwinds.

Raptor surveys were conducted from two different sites in the Project area (see Figure 5-1). These two locations were chosen in coordination with MDIFW because they provided adequate coverage of the Project area. The primary raptor observation site was located on the exposed-bedrock summit of Witham Mountain, where unobstructed 360-degree views of the Project area are available. The summit of Briggs Hill located at the southern edge of the Project area was chosen as the second survey site[5]. Briggs offers good views to the south of approaching raptors as well as sweeping vistas across Bald, Witham, and Stewart Mountains.

[5] Burnt Hill, which is located at the northern end of the Project area, was used as the second survey site during the fall migration. This more northerly location provided a better opportunity to observe birds migrating south.





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**Legend**

Raptor Survey Location

195600385

**Client/Project**

**Highland Wind, LLC**
**Highland Wind Project**
**Highland Plantation, Maine**

Figure No.
5-1

Title
Raptor Survey Location Map
August 12, 2009

00385-F501-Raptor-Location-Map.mxd

Surveys were based on Hawk Migration Association of North America (HMANA) methods (HMANA 2007). Surveys were generally conducted from 9 am to 4 pm, during the peak hours of thermal development and raptor movement. During surveys, observers scanned the sky and surrounding landscape for raptors with binoculars or a spotting scope. Hourly weather observations, including wind speed and direction, temperature, sky conditions, percent cloud cover, and relative cloud height and type were recorded. Detailed information for each observation was recorded on datasheets and Project area maps, including:

- Observation date and time;
- Species, number of individuals, and age (if possible);
- If the raptor occurred within the Project boundary (as depicted in Figure 5-1);
- The flight positions of each bird in relation to topography of the area;
- The flight height (above ground) of each bird (within each different topographical flight position);
- The specific flight behaviors of each bird;
- The general flight direction of each bird; and
- If the bird was actively migrating as well as other notes describing the general activity of each bird.

Topographical flight positions were summarized into categories that describe the landscape surrounding the observation site (these positions apply to birds observed both within as well as outside of the Project boundary): A1) parallel to ridge, A2) perpendicular to ridge, A3) over saddle, B) flight path over upper slope of ridge, C) flight path over lower slope of ridge, and D) flight path over a valley (see Figure 5-2 below). As individual birds traveled through or in the vicinity of the Project, all position categories in which a bird occurred were recorded.

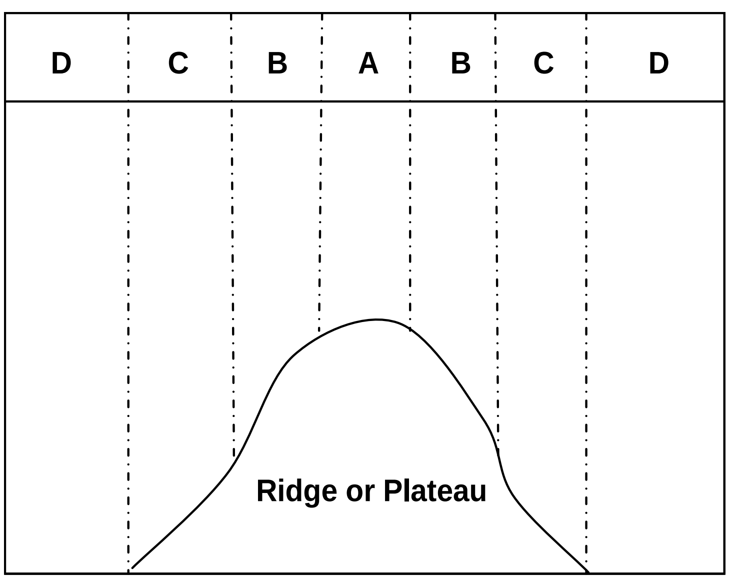


**Figure 5-2**. Raptor flight position categories in relation to the topography of the Project area.

Nearby objects with known heights, such as the met towers located on the ridges of Witham Mountain and Briggs Hill, were used to gauge flight height.

Flight behaviors where categorized as: circle soaring, linear soaring (straight-line soaring or slow gliding in a 'thermal street' formed between updrafts), gliding (with wings partially closed and bent wrists), powered flight (flapping wings), banking (breaking with fully extended wings and tail fanned), diving (wings partially to mostly closed while in descent), kiting (using wind current to kite with partially closed wings and tail), hovering (maintaining a stationary altitude with some flapping and fanned tail while hunting and looking downward), aerial feeding (eating prey in flight while in a soar or slow glide), aerial hunting low over the ground, aerial display (territorial or courtship aerial display), or perched. These behaviors in association with flight direction, species, and seasonality, were used to describe birds as actively migrating or not-actively migrating.

Birds that flew too rapidly or were too far to accurately identify were recorded as unidentified to their genus or, if the identification of genus was not possible, unidentified raptor. Although priority was given to raptor observations, incidental observations for other avian species, including passerines and water birds also were recorded.

## 5.3 DATA ANALYSIS METHODS

The raptor observation data was summarized by survey day and for the entire survey period for surveys conducted from both observation sites. Analysis included a summary of:

- The total number of individuals per species observed each survey day, and for the entire survey period;
- Daily passage rates (birds per hour [birds/hr]) calculated for each survey day, as well as for the entire survey period;
- Hourly observation totals per species;
- The percentage of birds within each topographical flight position category;
- The average minimum flight height of birds within each topographical flight position category;
- The percentage of all birds that occurred within the Project boundary;
- For all birds observed within the Project boundary, and within topographical positions where the turbines are to be located, flight heights were categorized as less than or greater than 130.5 m (428') above ground;
- A summary of the flight behaviors of all birds observed.

Observations from the Project survey were compared to Spring 2009 data from the following hawk watch sites: Barre Falls, Barre, Massachusetts; Poquonock, Poquonock, Connecticut; Plum Island, Newburyport, Massachusetts; Pilgrim Heights, North Truro, Massachusetts; and Bradbury Mountain, Pownal, Maine (HMANA 2009). Also provided for comparison were the results of available surveys conducted at proposed wind farms located primarily in New York, Vermont, New Hampshire, and Maine.

## 5.4 RESULTS

Raptor surveys were conducted from March 25, 2009 to May 19, 2009, resulting in a total of 139 survey hours. Surveys included 12 days (83 hours) on Witham Mountain and 8 days (56 hours) on Briggs Hill. On four of these days, surveys were conducted simultaneously observers at both survey locations. During the simultaneous surveys, observers used cell phones to communicate observations and limit potentially double-counting birds. Surveys were generally conducted from 9:00 am to 4:00 pm, and also included some extended morning and/or evening hours on days when flight conditions were favorable.

Survey days were dominated by high pressure atmospheric conditions and good visibility. Clouds heights were generally mid- to high-elevation, with cumulus and cirrus being the predominant cloud type. Temperatures ranged from -4° C, with a three foot snow-pack early season, to 24°C in mid-May (25 - 75°F). A few surveys were conducted on days with marginal flight conditions. Weather on two days included stratus clouds, drizzle, and passing low pressure, and two days had strong, gusty winds. The majority of days had winds from a westerly direction, which is normal for spring migration, but wind direction was variable throughout the survey period. Wind direction did not appear to affect the number of raptors seen per day; however, migration on April 29 may have been hampered by strong northerly winds (Figure 5-3; Appendix D Table 1).

During the spring 2009 surveys, a total of 260 raptors representing 10 species[6] plus unidentified raptors and unidentified buteos were observed. This included birds within the 1 kilometer Project boundary as well as birds observed beyond this boundary. The overall passage rate was 1.87 birds/hr. At Witham, a total of 153 raptors were observed for a passage rate of 1.84 birds/hr. At Briggs, a total of 107 raptors were observed resulting in a passage rate of 1.91 birds/hr. At Witham, daily counts ranged from 0 to 13 birds with daily passage rates ranging from 0 to 3.28 birds/hr. At Briggs, daily counts ranged from 4 to 30 birds with daily passage rates ranging from 0.57 to 4.29 birds/hr (Appendix D, Table 1).

Turkey vultures (*Cathartes aura*) were the most commonly observed species (Witham, n=57; Briggs, n=75), representing 37 percent and 70 percent of all observations at Witham and Briggs, respectively. At Witham, red-tailed hawks (*Buteo jamaicensis*; n=46; 30 percent) and sharp-shinned hawk (*Accipiter striatus*; n=15; 10 percent) were the next most commonly observed species. Similarly, at Briggs red-tailed hawks (n=14; 13 percent) were the most commonly observed species after turkey vultures. Ten or few observations were documented for each of the remaining species.

[6] While turkey vultures are not phylogenetically considered true raptors, they are diurnal migrants that exhibit flight characteristics similar to *Buteos, Accipiters* and other *Falconiformes* species, therefore vultures are typically included during hawk watch surveys.

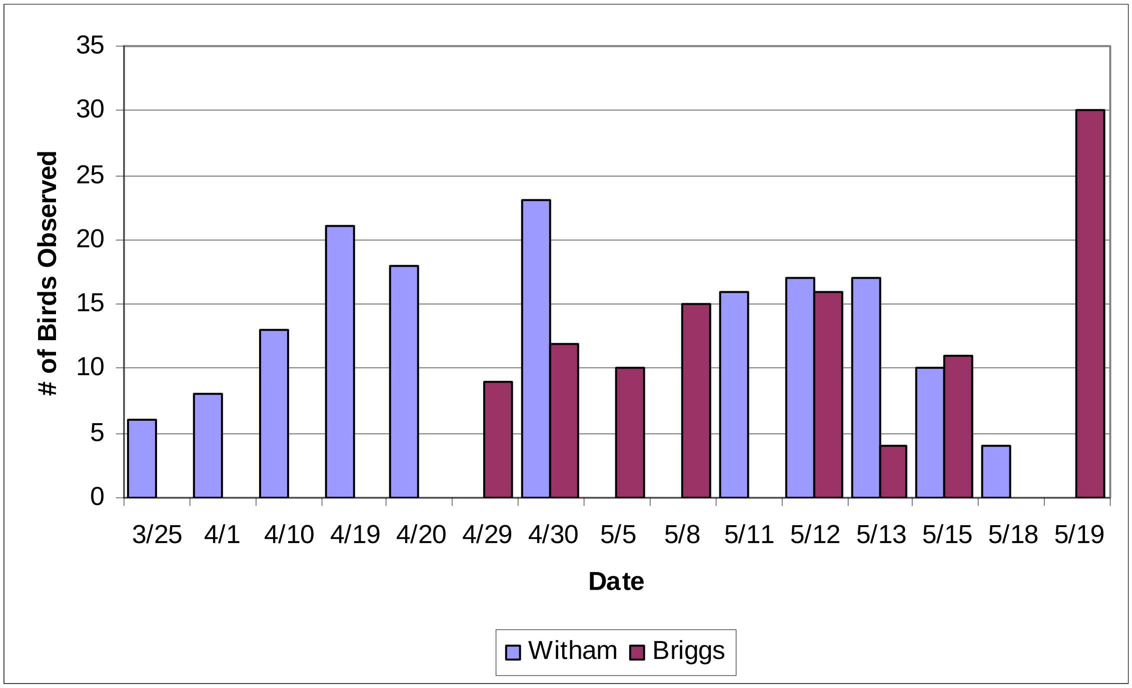


**Figure 5-3.** Total number of birds observed per survey day at Highland Wind Project – Spring 2009

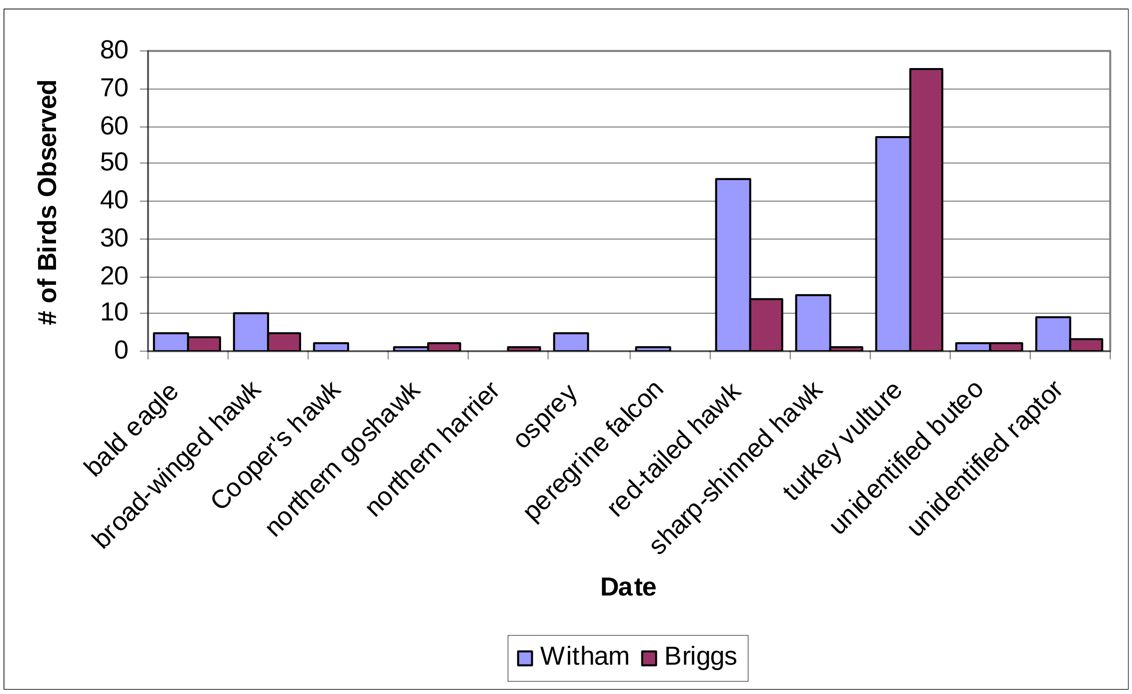


**Figure 5-4.** Number of individuals of species observed at Highland Wind Project – Spring 2009

On a daily basis, most observations occurred between 11:00 am and 1:00 pm, when thermal development is strong. A second, weaker peak occurred between 3:00 pm and 4:00 pm (Figure 5-5; Appendix D, Table 2).

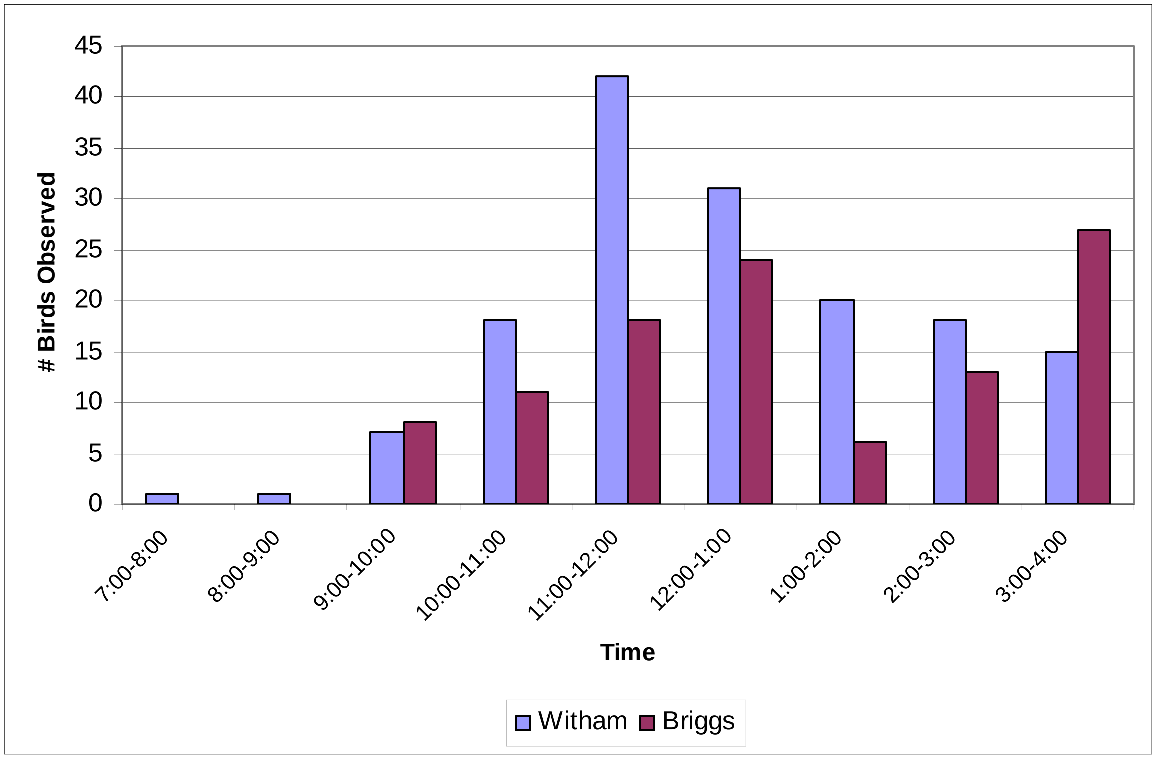


**Figure 5-5.** Number of individuals observed per survey hour at Highland Wind Project – Spring 2009

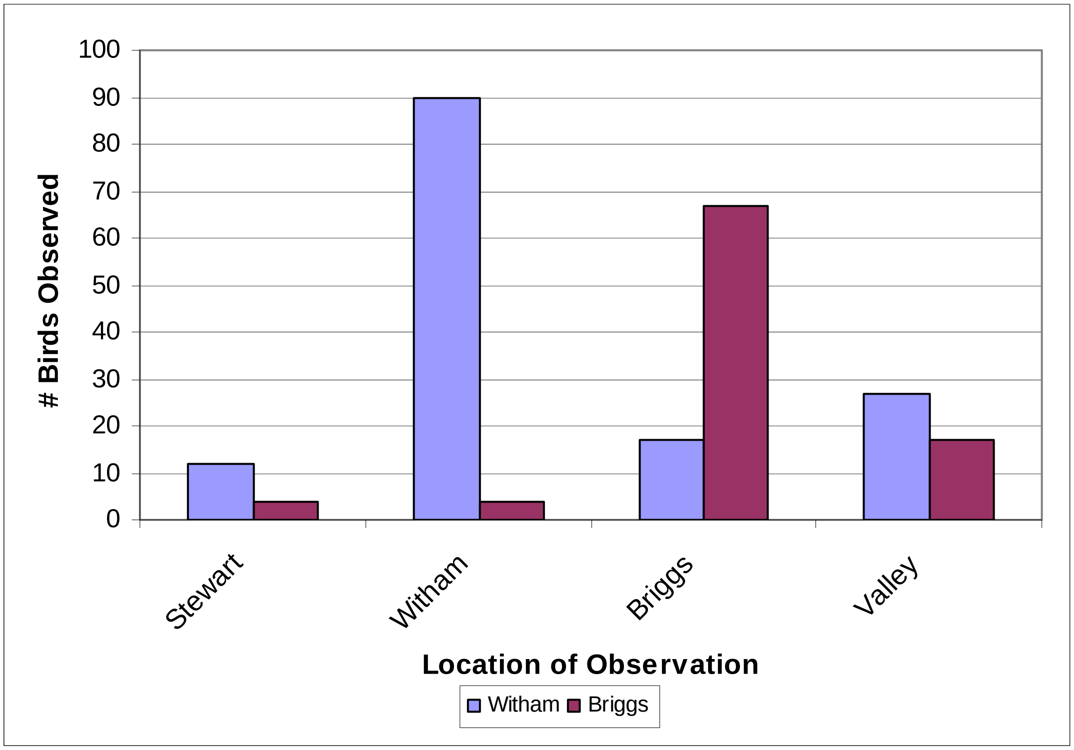


**Figure 5-6.** Number of individuals observed over topographical features of the Highland Wind Project as observed from Witham Mountain or Briggs Hill – Spring 2009

Raptors observed within the Project area were categorized as occurring over Stewart Mountain, Witham Mountain, Briggs Hill, and over the valleys surrounding the ridges (Figure 5-6). Of the 260 birds observed during the survey, 236 occurred within the Project boundary. Of these 236 birds, the majority were seen over Witham Mountain (n=94; 39 percent) and Briggs Hill (n=83; 35 percent). Birds flying over the surrounding valleys (n=43; 18 percent) and Stewart Mountain (n=16; 7 percent) represented a relatively small percentage of the observations. Although observation sites provided views of the surrounding ridgelines and valleys, birds closer to the observer's location on Witham Mountain and Briggs Hill would have been more readily detected. As such, the higher percentage of observations over these sites may in part reflect the proximity of birds to the observers.

**Table 5-1**. Number of observations and average flight heights for each position category for birds observed at, Highland - Spring 2009

| Location | Flight Position Characteristic | A1) flight along or parallel to ridge | A2) crossed ridge | A3) flight crossed depression or saddle | B) upper slope | C) lower slope | D) over valley |
|---|---|---|---|---|---|---|---|
| Witham | No. of position observations (n=339) | 44 | 47 | 36 | 99 | 66 | 47 |
| | Average minimum flight height (m) | 79.2 | 104.2 | 79.6 | 123.8 | 201.5 | 280.7 |
| Briggs | No. of position observations (n=133) | 37 | 16 | 5 | 19 | 18 | 38 |
| | Average minimum flight height (m) | 80.1 | 113.0 | 117.2 | 99.9 | 272.3 | 356.7 |

As raptors passed through the area they were typically observed in multiple flight positions (A-D) either within or beyond the Project boundary. Because birds occurred in more than one flight position, the following analysis includes more flight positions than total individuals observed within the Project boundary. At Witham, 339 total flight positions were documented. Twenty-nine percent of flight positions occurred along the upper slope (n=99) and 19 percent occurring along the lower slope (n=66) (Table 5-1). Each of the other flight positions represented 14 percent or less of the observations. At Briggs, 133 total fight positions were documented. Twenty-nine percent (n=38) of these flight position occurred over the valley and 28 percent occurred along/parallel (n=37) to the ridge (Table 5-1). Each of the other flight positions represented 14 percent or less of the observations.

For those flight positions within the Project boundary most likely associated with the proposed turbine locations (positions A1, A2, A3, and B), flight heights were categorized as above or below the proposed maximum turbine height of 130.5 m (428'). Eighty percent of the raptors observed from Witham in these four flight positions occurred below the proposed maximum rotor height (n=116) (Figure 5-7a, Appendix D Table 3). Similarly 86 percent of the raptors observed from Briggs Hill in these flight positions occurred below the proposed maximum rotor height (n=78) (Figure 5-7 b, Appendix D Table 3).

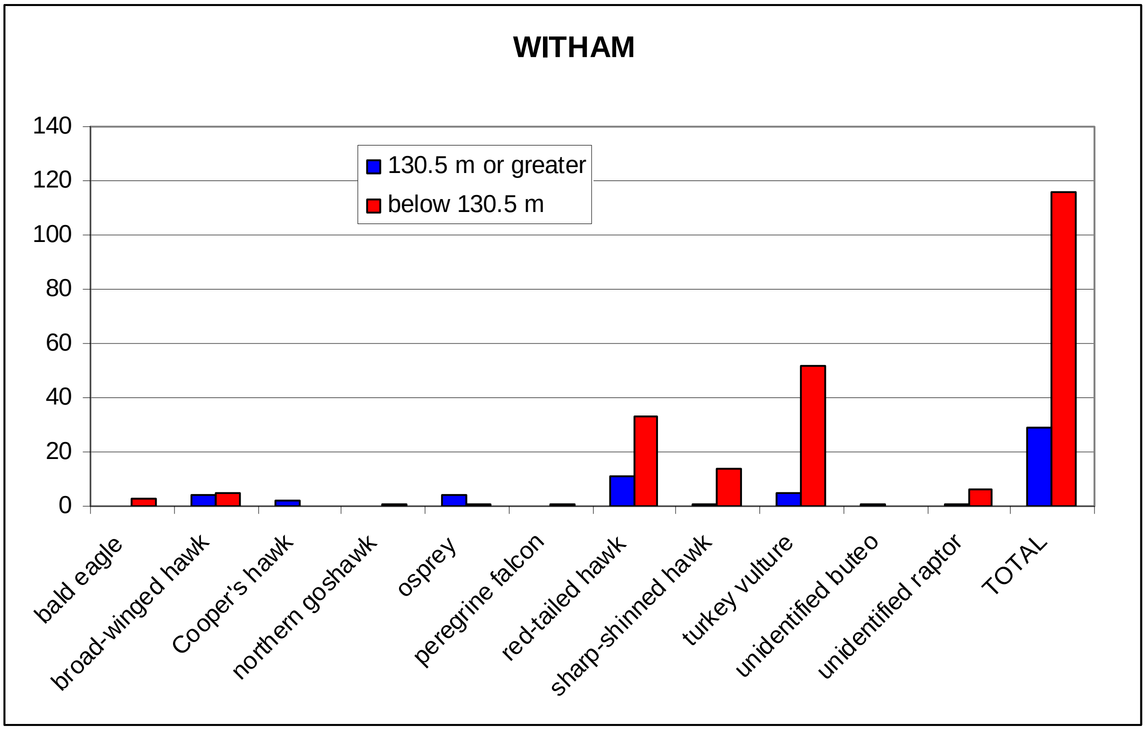


**Figure 5-7a.** Number of individuals by species observed within Highland Wind Project boundary in proposed turbine areas (A1, A2, A3, and B) below 130.5 m – Spring 2009

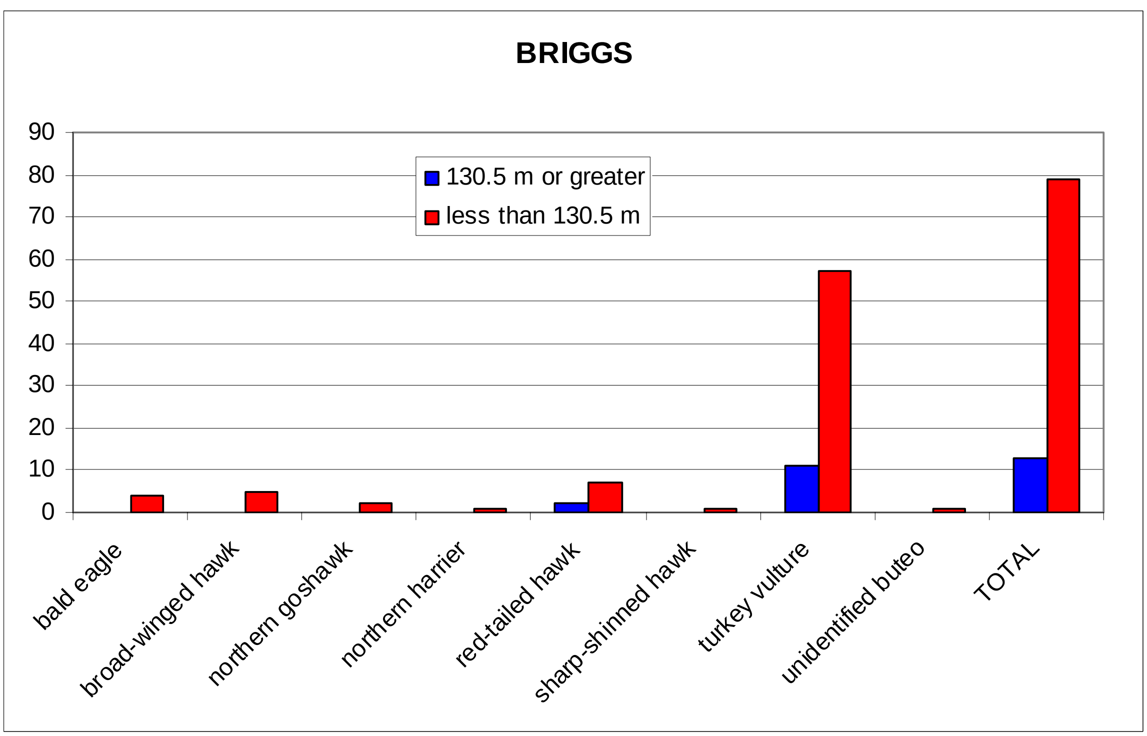


**Figure 5-7b.** Number of individuals by species observed within Highland Wind Project boundary in proposed turbine areas (A1, A2, A3, and B) below 130.5 m – Spring 2009

As raptors traveled within or beyond the Project boundary, they often exhibited multiple flight behaviors. As a result, the summary of flight behaviors includes more flight behaviors than total number of birds observed. Of the 207 flight behaviors documented from Witham Mountain, the majority of raptors were gliding (n=77; 37 percent) or circle soaring (n=69; 33 percent) (Figure 5-8; Appendix D Table 4). Of the 103 flight behaviors documented from Briggs Hill, the majority of birds were circle soaring (n=43; 42 percent) and linear soaring (n=36; 35 percent) (Figure 5-8; Appendix D Table 4).

Based on their flight behaviors and direction of travel, raptors were categorized as either migrants or non-migrants (seasonally local or stop-over birds). Birds that were traveling in a non-migration direction, were perched, engaged in aerial display, or appeared to be foraging were generally considered non-migrants. Sixty-three percent (n=165) of all raptors observed during the 2009 spring surveys were considered to be non-migrants, 33 percent (n=85) were considered to be migrants, and 4 percent (n=10) could not be categorized based on observed behavior.

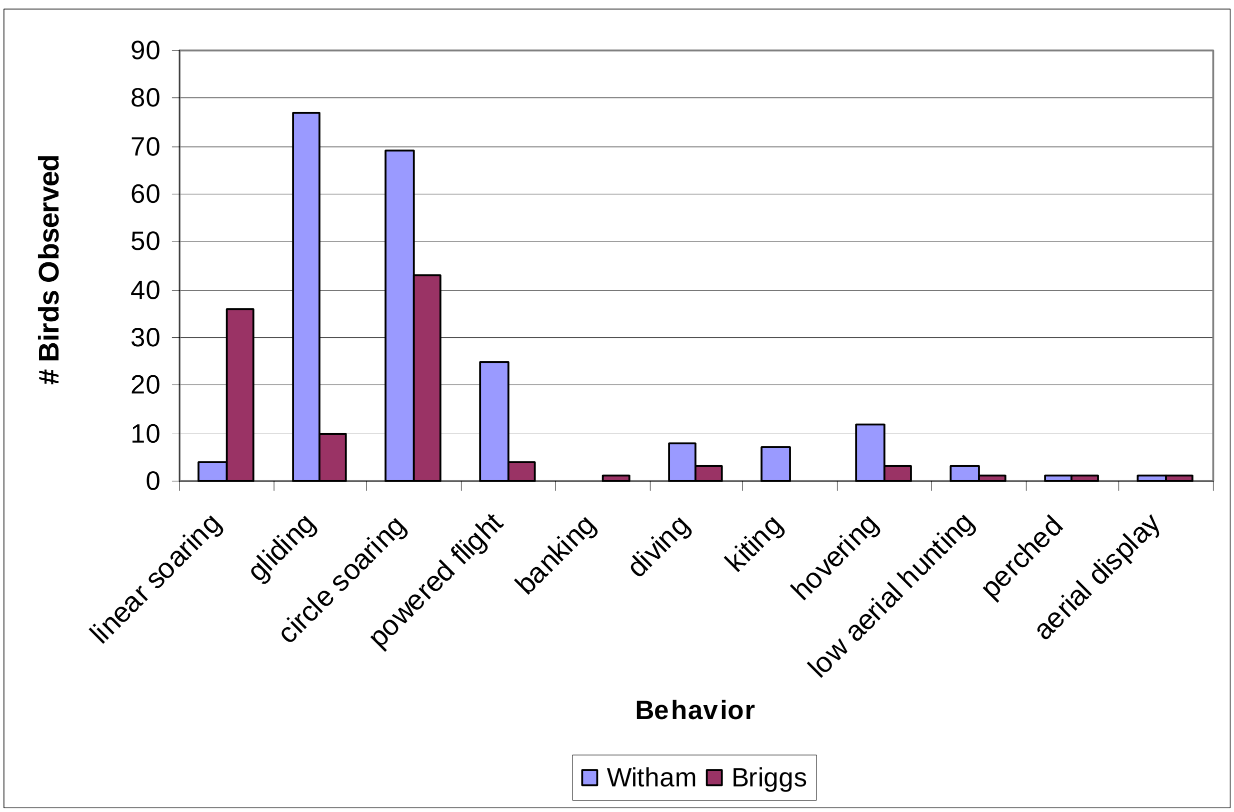


**Figure 5-8.** Number of observations by flight behaviors at Highland Wind Project – Spring 2009

### 5.4.1 Rare, Threatened and Endangered Species

No federally-listed threatened or endangered species were observed during the raptor surveys. Surveys documented one state-listed threatened species[7], peregrine falcon (*Falco peregrinus*; n=1). A single juvenile peregrine falcon was observed flying over Witham Mountain on April 7, at approximately 40 m above ground level. The bird continued north through the saddle between Witham and Stewart mountains. Two state-listed species of special concern, bald eagle (*Haliaeetus leucocephalus*; n=7) and northern harrier (*Circus cyaneus*; n=1) also were identified during the raptors surveys. The adult northern harrier was observed on April 30 at approximately 38 m above ground level. Seven bald eagles were documented in the Project area including four adults, one sub-adult, one juvenile, and one eagle of indeterminate age.[8] Four of the bald eagles crossed over the ridge and three of these were below the maximum turbine height for a portion of their flight. Six observations included flight paths along the slope, three of which included portions below maximum turbine height. One additional bald eagle was observed during the surveys, but it occurred outside of the 1 km Project boundary.

### 5.4.2 Incidental bird observations

During the 2009 raptor surveys, observers documented other avian species seen incidental to the targeted surveys (Table 5-2). These incidental observations were made while observers hiked to the designated survey points, or during the course of the raptor surveys. In total, 51 non-raptor avian species were observed.

Six of these incidentally observed species—tree swallow (*Tachycineta bicolor*), chimney swift (*Chaetura pelagica*), American redstart, black-and-white warbler, chestnut-sided warbler, white-throated sparrow—are state species of special concern. No breeding habitat exists within the Project area for the chimney swift so the single bird that was observed was migrating through the area. The two tree swallows also may have been migrating through the Project area. The other four species were documented during the 2009 breeding bird survey and two of the species, white-throated sparrow and chestnut-sided warbler, were the most commonly observed species based upon relative abundance calculations (Refer to Section 4 for additional discussion).

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[7] The state status of endangered species only applies to breeding populations of peregrine falcons.

[8] The nearest documented bald eagle nests and are located on the Kennebec River approximately 6 miles from the nearest turbine. The nearest peregrine nest is located on the Kennebec River approximately 8 miles from the nearest turbine.

**Table 5-2.** Incidental observation of non-raptor avian species made during raptor surveys - Highland Wind Project, Spring 2009

| | |
|---|---|
| American crow | golden-crowned kinglet |
| American goldfinch | hairy woodpecker |
| American redstart | hermit thrush |
| American robin | killdeer |
| black-and-white warbler | magnolia warbler |
| black-capped chickadee | mourning dove |
| black-backed gull | Nashville warbler |
| blue-headed vireo | northern flicker |
| blue jay | ovenbird |
| boreal chickadee | pine siskin |
| bohemian waxwing | pileated woodpecker |
| brown creeper | rose-breasted grosbeak |
| black-throated blue warbler | ruby-crowned kinglet |
| black-throated green warbler | ruffed grouse |
| Canada goose | sandhill crane |
| chipping sparrow | tree swallow |
| chimney swift | unidentified duck |
| cliff swallow | unidentified gull |
| common loon | unidentified finch |
| common merganser | unknown passerine |
| common raven | white-breasted nuthatch |
| common yellowthroat | winter wren |
| chestnut-sided warbler | white-throated sparrow |
| dark-eyed junco | white-winged crossbill |
| downy woodpecker | yellow-bellied sapsucker |
| European starling | yellow-rumped warbler |

## 5.5 DISCUSSION

A total of 260 individual raptors were documented during the 2009 spring raptor surveys. These observations included birds from 10 different species. Turkey vultures and red-tailed hawks were the most commonly observed species. Based upon flight behavior, the majority of individuals (65%) were believed to be non-migratory birds. During the fall 2008 raptor surveys, a total of 301 individual raptors were documented. These observations also included birds from 10 different species. The most commonly observed species were broad-winged hawks (*Buteo platypterus*) and sharp-shinned hawks (*Accipiter striatus*) and in contrast to the spring 2009 survey the majority of all birds (89%) were believed to be migratory based upon flight behavior. .

During the spring 2009 survey period, the passage rates for the two observations sites were similar with 1.84 birds/hr at Witham and 1.91 birds/hr at Briggs. For those birds seen flying in the proposed turbine areas, 80 percent of those observed from Witham occurred below the maximum turbine height and 86 percent of the birds observed from Briggs occurred below the maximum turbine height. More of the birds observed from Witham occurred over the upper and lower slopes than the other flight positions. In contrast, more of the birds observed from Briggs occurred over the valleys or flying parallel to the ridgelines. Annual variation in passage rates at any hawk watch site is expected as a result of regional population fluctuations and differences in daily weather conditions. Despite this expected variation, the results of the spring 2009 raptor survey appears to be representative of a typical spring migration for the Project area.

The 2009 spring passage rates at other regional HMANA hawk watch sites ranged from 3.78 (Poquonock, CT) to 9.3 (Bradbury Mountain, ME) birds/hr (Appendix D Table 4). Compared to these HMANA survey results, the passage rates at the Project area were relatively low. It should be noted that visibility and topographic features at the Project area generally vary from those at HMANA sites, which can influence the results of observed passage rates. Additionally, the HMANA survey methods differ to some extent from survey methods employed for this Project: 1) flight heights are not gauged during HMANA surveys; 2) HMANA surveyors often do not count birds believed to be non-migrants; and 3) multiple observers used during HMANA surveys have the potential to increase detection rates. These factors should be considered when interpreting the results of the spring data.

In addition to the results of HMANA surveys, data from spring surveys conducted at other proposed wind sites in the region were compared to the Project area surveys. Seasonal passage rates at these other sites ranged from 0.1 (Clinton/Ellenburg, NY and Whethersfield, NY) to 25.6 (Westfield, New York)) birds/hr (Appendix D Table 5). The results of the Project area surveys fell within this range, although at the lower end of the range. The percentage of raptors observed below the maximum turbine height also fell within the range of 3 to 94.7 percent observed at other regional Project sites (Appendix D Table 5).

Despite the relatively low flight heights of raptors, studies have documented high turbine collision avoidance behaviors at modern wind facilities (Whitfield and Madders 2006, Chamberlain *et al.* 2006). Raptor flight heights vary due to a variety of factors; particularly fight behaviors and daily weather conditions. Typically, *accipiters* and falcons use up-drafts from side slopes to gain lift and, therefore, usually fly low over ridgelines. *Buteos* tend to use lift from thermals that develop over side slopes and valleys and tend to fly high during hours of peak thermal development. Raptors, particularly *accipiters*, typically fly lower during windy or inclement conditions. Local birds also may fly at lower altitudes while making small scale movements between foraging locations (Barrios and Rodriguez, 2004).

Although the occurrence of some raptors within the zone of the proposed rotor blades increases the potential for migrating raptors to come into the vicinity of the turbines, raptor mortality in the United States, outside of California, has been documented to be relatively low. With some exceptions, mortality rates found at wind developments have ranged from 0 to 0.07 fatalities/turbine/year from 2000-2004 (GAO 2005). Several recent studies have documented relatively low raptor mortality with less than 50 total raptor and owl fatalities documented by 25 studies at 20 different locations throughout the United States (Osborn *et al.* 2000, Johnson *et al*. 2002, Kerlinger 2002, Young *et al.* 2003, Erickson *et al.* 2000, Erickson *et al.* 2004, Kerlinger

2006, Erickson *et al.* 2003, Johnson *et al*. 2003, Kerns and Kerlinger 2004, Arnett *et al* 2005, Koford *et al*. 2005, Fiedler *et al*. 2007, Howe *et al.* 2002, Jain *et al*. 2007, Jain *et al*. 2008, Jain *et al.* 2009a, Stantec 2008, Stantec 2009, Young *et al*. 2009, Tidhar 2009, Jain *et al.* 2009b, Jain *et al.* 2009c, Jain *et al.* 2009d). In general, these results suggest that there is a relatively low collision risk of raptors with wind turbines. As most raptors are diurnal, they may be able to visually, as well as acoustically detect turbines during periods of fair weather. Foraging raptors that may become distracted by prey, or migrant raptors flying during periods of reduced visibility, may be at increased risk of collision with wind turbines.

During the spring 2009 surveys, raptors were observed in multiple flight positions along the ridgelines as well as over the valley beyond the Project area boundary. Raptor migration is a dynamic process due to behavioral and environmental factors. As a result, flight pathways and movements along ridges, side slopes, and across valleys may vary seasonally, daily or hourly. Raptors may shift and use different ridge lines and cross different valleys from year to year or season to season. Weather and wind are major factors that influence migration pathways. Wind direction and strength, in particular, affect the propensity of raptors to congregate along ‘leading lines’ or topographic features. The location of a raptor along a ‘leading line’ can be influenced by lateral drift caused by crosswinds (Richardson 1998). The flight paths of raptors observed in the Project area varied between survey dates and were likely influenced by varying wind direction and weather.

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# Appendix A

Radar Survey Data Tables

| Appendix A Table 1A. Survey dates, results, level of effort, and weather - Briggs Hill site Spring 2009 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Date** | **Passage rate** | **Flight Direction** | **Flight Height (m)** | **% below 130.5 m** | **Hours of Survey** | **Temperature (C)** | **Wind Speed (m/s)** | **Wind Direction (degrees)** |
| 29-Apr | 324 | 40.469° | 201 | 37% | 10 | 4 | 7 | 282 |
| 30-Apr | 221 | 19.687° | 451 | 6% | 7 | 6 | 12 | 180 |
| 2-May | 199 | 45.219° | 322 | 18% | 10 | 7 | 7 | 245 |
| 3-May | 357 | 35.304° | 283 | 13% | 10 | 9 | 7 | 237 |
| 4-May | 178 | 199.738° | 226 | 26% | 9 | 8 | 9 | 25 |
| 5-May | 10 | 250.939° | 361 | 5% | 9 | 5 | 6 | 64 |
| 6-May | 297 | 32.055° | 307 | 13% | 9 | 8 | 4 | 191 |
| 10-May | 45 | 92.601° | 163 | 41% | 10 | 2 | 12 | 312 |
| 11-May | 440 | 68.612° | 298 | 31% | 10 | 6 | 7 | 343 |
| 12-May | 1037 | 55.882° | 430 | 22% | 9 | 9 | 5 | 310 |
| 13-May | 388 | 37.448° | 407 | 9% | 9 | 7 | 8 | 183 |
| 18-May | 628 | 49.614° | 115 | 72% | 9 | 3 | 6 | 306 |
| 19-May | 1262 | 53.196° | 267 | 32% | 9 | 11 | 7 | 296 |
| 20-May | 848 | 38.093° | 276 | 29% | 9 | 16 | 9 | 257 |
| 21-May | 813 | 48.561° | 288 | 30% | 9 | 20 | 11 | 273 |
| 22-May | 1094 | 50.214° | 284 | 30% | 9 | 8 | 8 | 356 |
| 23-May | 389 | 51.264° | 138 | 60% | 9 | 8 | 6 | 205 |
| 24-May | 850 | 39.667° | 278 | 29% | 9 | 11 | 5 | 316 |
| 26-May | 453 | 34.716° | 311 | 22% | 9 | 8 | 3 | 147 |
| 30-May | 500 | 48.421° | 375 | 19% | 9 | 10 | 7 | 247 |
| 31-May | 97 | 46.564° | 252 | 39% | 9 | 1 | 15 | 294 |
| **Entire Season** | **496** | **47.443°** | **287** | **26%** | **9** | **8** | **8** | |

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| Appendix A Table 1B. Survey dates, results, level of effort, and weather - South Stewart Mtn site Spring 2009 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Date** | **Passage rate** | **Flight Direction** | **Flight Height (m)** | **% below 130.5 m** | **Hours of Survey** | **Temperature (C)** | **Wind Speed (m/s)** | **Wind Direction (degrees)** |
| 29-Apr | 233 | 51 | 168 | 51% | 9 | 4 | 7 | 282 |
| 3-May | 421 | 38 | 308 | 14% | 10 | 9 | 7 | 237 |
| 4-May | 167 | 222 | 282 | 17% | 10 | 8 | 9 | 25 |
| 5-May | 21 | 290 | 336 | 17% | 10 | 5 | 6 | 64 |
| 6-May | 506 | 28 | 308 | 22% | 8 | 8 | 4 | 191 |
| 7-May | 32 | 65 | 367 | 6% | 10 | 7 | 5 | 270 |
| 10-May | 8 | 151 | 252 | 33% | 7 | 2 | 12 | 312 |
| 11-May | 147 | 133 | 374 | 22% | 9 | 6 | 7 | 343 |
| 12-May | 438 | 65 | 514 | 10% | 9 | 9 | 5 | 310 |
| 13-May | 481 | 33 | 420 | 10% | 9 | 7 | 8 | 183 |
| 18-May | 214 | 71 | 221 | 48% | 6 | 3 | 6 | 306 |
| 19-May | 1103 | 60 | 287 | 29% | 9 | 11 | 7 | 296 |
| 20-May | 1735 | 53 | 316 | 24% | 8 | 16 | 9 | 257 |
| 21-May | 1482 | 60 | 315 | 33% | 9 | 20 | 11 | 273 |
| 22-May | 280 | 77 | 179 | 55% | 6 | 8 | 8 | 356 |
| 23-May | 1184 | 60 | 279 | 34% | 8 | 8 | 6 | 205 |
| 24-May | 560 | 86 | 229 | 32% | 6 | 11 | 5 | 316 |
| 25-May | 77 | 184 | 255 | 39% | 9 | 2 | 9 | 338 |
| 26-May | 709 | 34 | 434 | 15% | 9 | 8 | 3 | 147 |
| **Entire Season** | **511** | **53** | **314** | **23%** | **8** | **8** | **7** | |

| Appendix A Table 2A. Summary of passage rates by hour, night, and for entire season at Briggs Hill site. | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Night of** | **Passage Rate (targets/km/hr) by hour after sunset** | | | | | | | | | | **Entire Night** | | | |
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **Mean** | **Median** | **Stdev** | **SE** |
| 29-Apr | 18 | 69 | 304 | 450 | 480 | 536 | 525 | 354 | 286 | 223 | 324 | 329 | 182 | 61 |
| 30-Apr | 225 | 361 | 246 | 207 | 225 | 221 | 64 | N/A | N/A | N/A | 221 | 225 | 87 | 35 |
| 2-May | 289 | 100 | 175 | 230 | 318 | 317 | 198 | 193 | 146 | 21 | 199 | 196 | 95 | 32 |
| 3-May | 282 | 579 | 504 | 343 | 437 | 437 | 389 | 296 | 296 | 11 | 357 | 366 | 156 | 52 |
| 4-May | 214 | 264 | 244 | 240 | 261 | 146 | 124 | 64 | 43 | N/A | 178 | 214 | 86 | 30 |
| 5-May | 11 | 4 | 17 | 5 | 4 | 0 | 25 | 25 | 0 | N/A | 10 | 5 | 10 | 4 |
| 6-May | 111 | 186 | 300 | 357 | 313 | 475 | 497 | 296 | 136 | N/A | 297 | 300 | 136 | 48 |
| 10-May | 4 | 30 | 71 | 110 | 111 | 64 | 11 | N/A | 5 | 0 | 45 | 30 | 45 | 16 |
| 11-May | 89 | 496 | 568 | 532 | 579 | 549 | 546 | 568 | 464 | 11 | 440 | 539 | 209 | 70 |
| 12-May | 175 | 925 | 1071 | 1396 | 1493 | 1282 | 1104 | 1132 | 750 | N/A | 1037 | 1104 | 395 | 140 |
| 13-May | 236 | 518 | 404 | 479 | 418 | 411 | 357 | 418 | 254 | N/A | 388 | 411 | 93 | 33 |
| 18-May | 29 | 525 | 546 | 857 | 1018 | 961 | 789 | 693 | 232 | N/A | 628 | 693 | 331 | 117 |
| 19-May | 279 | 1254 | 1007 | 1004 | 1589 | 1714 | 1757 | 1711 | 1043 | N/A | 1262 | 1254 | 488 | 173 |
| 20-May | 157 | 849 | 800 | 957 | 1189 | 1057 | 914 | 1186 | 525 | N/A | 848 | 914 | 331 | 117 |
| 21-May | 171 | 1071 | 943 | 900 | 1111 | 1046 | 971 | 864 | 236 | N/A | 813 | 943 | 355 | 125 |
| 22-May | 296 | 954 | 954 | 1079 | 1346 | 1582 | 1443 | 1507 | 689 | N/A | 1094 | 1079 | 423 | 150 |
| 23-May | 29 | 271 | 357 | 518 | 630 | 670 | 536 | 471 | 16 | N/A | 389 | 471 | 241 | 85 |
| 24-May | 197 | 891 | 939 | 1082 | 1264 | 844 | 956 | 1086 | 393 | N/A | 850 | 939 | 342 | 121 |
| 26-May | 321 | 629 | 671 | 618 | 514 | 425 | 446 | 375 | 81 | N/A | 453 | 446 | 184 | 65 |
| 30-May | 282 | 500 | 614 | 571 | 711 | 786 | 614 | 414 | 11 | N/A | 500 | 571 | 238 | 84 |
| 31-May | 18 | 164 | 171 | 14 | 118 | 186 | 118 | 82 | 5 | N/A | 97 | 118 | 71 | 25 |
| **Entire Season** | **164** | **507** | **519** | **569** | **673** | **653** | **590** | **618** | **281** | **53** | **496** | **393** | **424** | **31** |
| N/A indicates no data for that hour | | | | | | | | | | | | | | |

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| Appendix A Table 2B. Summary of passage rates by hour, night, and for entire season - South Stewart Mtn site. | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Night of** | **Passage Rate (targets/km/hr) by hour after sunset** | | | | | | | | | | **Entire Night** | | | |
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **Mean** | **Median** | **Stdev** | **SE** |
| 29-Apr | 0 | 89 | 155 | 356 | 343 | 351 | 270 | 300 | 232 | N/A | 233 | 270 | 126 | 45 |
| 3-May | 243 | 738 | 664 | 539 | 419 | 462 | 463 | 377 | 289 | 11 | 421 | 441 | 210 | 70 |
| 4-May | 171 | 300 | 246 | 364 | 150 | 157 | 77 | 96 | 94 | 14 | 167 | 154 | 108 | 36 |
| 5-May | 46 | 39 | 18 | 4 | 7 | 11 | 11 | 64 | 14 | 0 | 21 | 13 | 21 | 7 |
| 6-May | 129 | 227 | 381 | 681 | 531 | 1461 | 418 | 218 | N/A | N/A | 506 | 400 | 426 | 161 |
| 7-May | 21 | 11 | 21 | 14 | 21 | 27 | 21 | 57 | 114 | 7 | 32 | 21 | 32 | 11 |
| 10-May | 4 | 4 | 4 | N/A | 0 | 11 | 0 | N/A | 32 | N/A | 8 | 4 | 11 | 5 |
| 11-May | 13 | 113 | 236 | 157 | 159 | 167 | 211 | 167 | 104 | N/A | 147 | 159 | 65 | 23 |
| 12-May | 46 | 514 | 596 | 604 | 544 | 400 | 400 | 467 | 368 | N/A | 438 | 467 | 170 | 60 |
| 13-May | 507 | 796 | 661 | 532 | 521 | 404 | 375 | 339 | 193 | N/A | 481 | 507 | 179 | 63 |
| 18-May | N/A | N/A | 182 | 143 | 396 | 254 | 164 | 146 | N/A | N/A | 214 | 173 | 103 | 46 |
| 19-May | 514 | 1436 | 1569 | 1918 | 1371 | 1068 | 1046 | 670 | 339 | N/A | 1103 | 1068 | 523 | 185 |
| 20-May | 421 | 1775 | 2264 | 2268 | 2132 | 1871 | 1268 | 1879 | N/A | N/A | 1735 | 1875 | 622 | 235 |
| 21-May | 1100 | 1821 | 1929 | 2189 | 2146 | 1596 | 1311 | 1029 | 214 | N/A | 1482 | 1596 | 638 | 226 |
| 22-May | N/A | N/A | 193 | 218 | 457 | 393 | 214 | 207 | N/A | N/A | 280 | 216 | 121 | 54 |
| 23-May | N/A | 1311 | 1251 | 1543 | 1538 | 1247 | 1152 | 893 | 536 | N/A | 1184 | 1249 | 225 | 85 |
| 24-May | 218 | 736 | 550 | 529 | 604 | 725 | N/A | N/A | N/A | N/A | 560 | 577 | 189 | 84 |
| 25-May | 25 | 182 | 193 | 82 | 100 | 54 | 32 | 26 | 0 | N/A | 77 | 54 | 70 | 25 |
| 26-May | 561 | 1221 | 1504 | 1196 | 679 | 370 | 360 | 336 | 155 | N/A | 709 | 561 | 479 | 169 |
| **Entire Season** | **251** | **666** | **664** | **741** | **638** | **580** | **433** | **428** | **192** | **8** | **511** | **336** | **578** | **46** |
| N/A indicates no data for that hour | | | | | | | | | | | | | | |

| Appendix A Table 3A. Mean Nightly Flight Direction from Briggs Hill. | | |
|---|---|---|
| **Night of** | **Mean Flight Direction** | **Circular Stdev** |
| 29-Apr | 40.469° | 34.064° |
| 30-Apr | 19.687° | 31.699° |
| 2-May | 45.219° | 42.603° |
| 3-May | 35.304° | 32.346° |
| 4-May | 199.738° | 51.776° |
| 5-May | 250.939° | 38.526° |
| 6-May | 32.055° | 44.064° |
| 10-May | 92.601° | 45.203° |
| 11-May | 68.612° | 44.826° |
| 12-May | 55.882° | 28.011° |
| 13-May | 37.448° | 39.733° |
| 18-May | 49.614° | 30.811° |
| 19-May | 53.196° | 37.15° |
| 20-May | 38.093° | 43.047° |
| 21-May | 48.561° | 27.029° |
| 22-May | 50.214° | 38.473° |
| 23-May | 51.264° | 27.349° |
| 24-May | 39.667° | 34.082° |
| 26-May | 34.716° | 44.037° |
| 30-May | 48.421° | 33.914° |
| 31-May | 46.564° | 36.095° |
| **Entire Season** | **47.443°** | **39.763°** |

| Appendix A Table 3B. Mean Nightly Flight Direction from South Stewart Mtn. site | | |
|---|---|---|
| **Night of** | **Mean Flight Direction** | **Circular Stdev** |
| 29-Apr | 51.367° | 24.104° |
| 3-May | 37.54° | 39.847° |
| 4-May | 222.197° | 37.885° |
| 5-May | 290.413° | 56.854° |
| 6-May | 27.765° | 38.06° |
| 7-May | 65.214° | 66.757° |
| 10-May | 150.854° | 28.316° |
| 11-May | 132.933° | 76.27° |
| 12-May | 64.549° | 37.557° |
| 13-May | 32.964° | 44.698° |
| 18-May | 70.987° | 42.594° |
| 19-May | 60.42° | 38.08° |
| 20-May | 53.127° | 32.76° |
| 21-May | 60.461° | 41.557° |
| 22-May | 77.38° | 50.779° |
| 23-May | 60.246° | 40.667° |
| 24-May | 86.487° | 106.944° |
| 25-May | 183.947° | 83.204° |
| 26-May | 33.763° | 39.506° |
| **Entire Season** | 53.415° | 48.666° |

| Appendix A Table 4A. Summary of mean flight heights by hour, night, and for entire season at Briggs Hill site. | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Night of | Mean Flight Height (m) by hour after sunset | | | | | | | | | | Entire Night | | | | % of targets below 130.5 meters |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Mean | Median | STDV | SE | |
| 29-Apr | 226 | 221 | 205 | 191 | 184 | 234 | 190 | 220 | 212 | 122 | 201 | 209 | 32 | 10 | 37% |
| 30-Apr | 282 | 479 | 464 | 497 | 458 | 413 | 565 | N/A | N/A | N/A | 451 | 464 | 88 | 33 | 6% |
| 2-May | 387 | 355 | 384 | 475 | 364 | 261 | 299 | 171 | 212 | 317 | 322 | 336 | 90 | 29 | 18% |
| 3-May | 253 | 312 | 348 | 337 | 350 | 305 | 313 | 206 | 198 | 208 | 283 | 309 | 61 | 19 | 13% |
| 4-May | 162 | 200 | 229 | 230 | 175 | 272 | 294 | 263 | 213 | N/A | 226 | 229 | 44 | 15 | 26% |
| 5-May | -- | -- | -- | 500 | 227 | -- | 256 | 461 | -- | N/A | 361 | 359 | 140 | 70 | 5% |
| 6-May | 222 | 246 | 262 | 333 | 441 | 333 | 286 | 330 | -- | N/A | 307 | 308 | 69 | 24 | 13% |
| 10-May | 81 | 241 | 213 | 43 | 236 | -- | -- | -- | -- | -- | 163 | 213 | 93 | 42 | 41% |
| 11-May | 210 | 373 | 446 | 310 | 214 | 332 | 289 | 214 | 293 | -- | 298 | 293 | 80 | 27 | 31% |
| 12-May | 223 | 443 | 502 | 460 | 444 | 480 | 412 | 445 | 460 | N/A | 430 | 445 | 81 | 27 | 22% |
| 13-May | 299 | 488 | 454 | 444 | 416 | 397 | 379 | 385 | 404 | N/A | 407 | 404 | 54 | 18 | 9% |
| 18-May | 174 | 125 | 131 | 79 | 76 | 101 | 96 | 86 | 169 | N/A | 115 | 101 | 37 | 12 | 72% |
| 19-May | 206 | 315 | 278 | 364 | 321 | 220 | 216 | 234 | 252 | N/A | 267 | 252 | 55 | 18 | 32% |
| 20-May | 262 | 323 | 308 | 277 | 270 | 250 | 270 | 246 | -- | N/A | 276 | 270 | 27 | 9 | 29% |
| 21-May | 266 | 317 | 347 | 278 | 311 | 248 | 209 | 189 | 425 | N/A | 288 | 278 | 72 | 24 | 30% |
| 22-May | 216 | 289 | 290 | 372 | 301 | 258 | 249 | 304 | 279 | N/A | 284 | 289 | 43 | 14 | 30% |
| 23-May | 177 | 179 | 122 | 105 | 133 | 119 | 121 | 144 | -- | N/A | 138 | 128 | 27 | 10 | 60% |
| 24-May | 242 | 324 | 324 | 284 | 284 | 288 | 257 | 253 | 245 | N/A | 278 | 284 | 31 | 10 | 29% |
| 26-May | 217 | 211 | 214 | 235 | 313 | 400 | 431 | 407 | 368 | N/A | 311 | 313 | 93 | 31 | 22% |
| 30-May | 275 | 384 | 442 | 364 | 338 | 379 | 402 | 364 | 429 | N/A | 375 | 379 | 50 | 17 | 19% |
| 31-May | 384 | 166 | 169 | -- | 184 | 202 | 216 | 179 | 512 | N/A | 252 | 193 | 127 | 45 | 39% |
| **Entire Season** | **238** | **300** | **307** | **309** | **288** | **289** | **287** | **268** | **311** | **215** | **287** | **277** | **107** | **8** | **26%** |

-- indicates no targets for that hour

N/A indicates no data for that hour

**Appendix A Table 4B. Summary of mean flight heights by hour, night, and for entire season - South Stewart Mtn site.**

| Night of | Mean Flight Height (m) by hour after sunset | | | | | | | | | | Entire Night | | | | % of targets below 130.5 meters |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Mean | Median | STDV | SE | |
| 29-Apr | 171 | 204 | 260 | 124 | 173 | 165 | 136 | 102 | 151 | 195 | 168 | 168 | 45 | 14 | 51% |
| 3-May | 269 | 357 | 355 | 368 | 382 | 372 | 298 | 250 | 229 | 197 | 308 | 327 | 68 | 21 | 14% |
| 4-May | 203 | 341 | 375 | 282 | 248 | 315 | 292 | 360 | 287 | 120 | 282 | 289 | 77 | 24 | 17% |
| 5-May | -- | 451 | -- | -- | 258 | 348 | -- | 292 | 332 | -- | 336 | 332 | 73 | 33 | 17% |
| 6-May | 263 | 210 | 237 | 346 | 431 | 354 | 256 | 370 | N/A | N/A | 308 | 304 | 77 | 27 | 22% |
| 7-May | 399 | 524 | 548 | 448 | 369 | 334 | 291 | 180 | 210 | N/A | 367 | 369 | 128 | 43 | 6% |
| 10-May | N/A | -- | N/A | 60 | 529 | -- | -- | N/A | 167 | N/A | 252 | 167 | 246 | 142 | 33% |
| 11-May | 308 | 476 | 578 | 334 | 406 | 256 | 428 | 401 | 183 | N/A | 374 | 401 | 119 | 40 | 22% |
| 12-May | 231 | 452 | 587 | 593 | 562 | 593 | 477 | 578 | 555 | N/A | 514 | 562 | 118 | 39 | 10% |
| 13-May | 356 | 465 | 481 | 453 | 419 | 407 | 381 | 394 | 419 | N/A | 420 | 419 | 41 | 14 | 10% |
| 18-May | N/A | 200 | 135 | 167 | 265 | 322 | 238 | N/A | N/A | N/A | 221 | 219 | 68 | 28 | 48% |
| 19-May | 251 | 275 | 289 | 268 | 282 | 336 | 327 | 299 | 260 | N/A | 287 | 282 | 29 | 10 | 29% |
| 20-May | 325 | 362 | 366 | 347 | 329 | 302 | 256 | 238 | N/A | N/A | 316 | 327 | 47 | 17 | 24% |
| 21-May | 305 | 365 | 325 | 316 | 343 | 298 | 266 | 296 | 324 | N/A | 315 | 316 | 29 | 10 | 33% |
| 22-May | N/A | 174 | 102 | 131 | 212 | 203 | 254 | N/A | N/A | N/A | 179 | 189 | 56 | 23 | 55% |
| 23-May | N/A | 218 | 306 | 253 | 274 | 312 | 287 | 270 | 315 | N/A | 279 | 280 | 33 | 12 | 34% |
| 24-May | 252 | 307 | 213 | 209 | 207 | 186 | N/A | N/A | N/A | N/A | 229 | 211 | 44 | 18 | 32% |
| 25-May | 523 | 265 | 215 | 193 | 119 | 195 | 351 | 252 | 180 | N/A | 255 | 215 | 120 | 40 | 39% |
| 26-May | 293 | 318 | 296 | 310 | 507 | 617 | 560 | 458 | 548 | N/A | 434 | 458 | 130 | 43 | 15% |
| **Entire Season** | **296** | **331** | **333** | **289** | **332** | **329** | **319** | **316** | **297** | **171** | **314** | **299** | **119** | **10** | **23%** |

-- indicates no targets for that hour  N/A indicates no data for that hour

**Appendix A Table 5**. Summary of available avian spring radar survey results conducted at proposed (pre-construction) US wind power facilities in eastern US, using X-band mobile radar systems (2004-present)

| Year | Project Site | Number of Survey Nights | Number of Survey Hours | Landscape | Average Passage Rate (t/km/hr) | Range in Nightly Passage Rates | Average Flight Direction | Average Flight Height (m) | (Turbine Ht) % Targets Below Turbine Height | Citation |
|---|---|---|---|---|---|---|---|---|---|---|
| 2005 | Ellenberg, Clinton Cty, NY | 40 | n/a | Great Lakes plain/ADK foothills | 110 | n/a | 30 | 338 | (125 m) 20% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| 2005 | Sheldon, Wyoming Cty, NY | 38 | 272 | Agricultural plateau | 112 | 6-558 | 25 | 422 | (120 m) 6% | Woodlot Alternatives, Inc. 2006. A Spring 2005 Radar Survey of Bird Migration at the Proposed High Sheldon Wind Project in Sheldon, New York. Prepared for Invenergy. |
| 2005 | Munnsville, Madison Cty, NY | 41 | 388 | Agricultural plateau | 160 | 6-1065 | 31 | 291 | (118 m) 25% | Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Munnsville Wind Project in Munnsville, New York. Prepared for AES-EHN NY Wind, LLC. |
| 2005 | Sheffield, Caledonia Cty, VT | 20 | 180 | Forested ridge | 166 | 12-440 | 40 | 552 | (125 m) 6% | Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC. |
| 2005 | Stamford, Delaware Cty, NY | 35 | 301 | Forested ridge | 210 | 10-785 | 46 | 431 | (110 m) 8% | Woodlot Alternatives, Inc. 2007. A Spring and Fall 2005 Radar and Acoustic Survey of Bird Migration at the Proposed Moresville Energy Center in Stamford and Roxbury, New York. Prepared for Invenergy, LLC. Rockville, MD. |
| 2005 | Churubusco, Clinton Cty, NY | 39 | 310 | Great Lakes plain/ADK foothills | 254 | 3-728 | 40 | 422 | (120 m) 11% | Woodlot Alternatives, Inc. 2005. A Spring Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Marble River Wind Project in Clinton and Ellenburg, New York. Prepared for AES Corporation. |
| 2005 | Prattsburgh, Steuben Cty, NY | 20 | 183 | Agricultural plateau | 277 | 70-621 | 22 | 370 | (125 m) 16% | Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windfarm Prattsburgh Project in Prattsburgh, New York. Prepared for UPC Wind Management, LLC. |
| 2005 | Deerfield, Bennington Cty, VT | 20 | 183 | Forested ridge | 404 | 74-973 | 69 | 523 | (100 m) 4% | Woodlot Alternatives, Inc. 2005. Spring 2005 Bird and Bat Migration Surveys at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy, Inc. |
| 2005 | Jordanville, Herkimer Cty, NY | 40 | 364 | Agricultural plateau | 409 | 26-1410 | 40 | 371 | (125 m) 21% | Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Jordanville Wind Project in Jordanville, New York. Prepared for Community Energy, Inc. |
| 2005 | Franklin, Pendleton Cty, NY | 21 | 204 | Forested ridge | 457 | 34-1240 | 53 | 492 | (125 m) 11% | Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Liberty Gap Wind Project in Franklin, West Virginia. Prepared for US Wind Force, LLC. |
| 2005 | Clayton, Jefferson Cty, NY | 36 | 303 | Agricultural plateau | 460 | 71-1769 | 30 | 443 | (150 m) 14% | Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Clayton Wind Project in Clayton, New York. Prepared for PPM Atlantic Renewable. |
| 2005 | Dans Mountain, MD | 23 | 189 | Forested ridge | 493 | 63-1388 | 38 | 541 | (125 m) 15% | Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Dan's Mountain Wind Project in Frostburg, Maryland. Prepared for US Wind Force. |
| 2005 | Fairfield, Herkimer Cty, NY | 40 | 369 | Agricultural plateau | 509 | 80-1175 | 44 | 419 | (145 m) 16%[1] | Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar Survey of Bird and Bat Migration at the Proposed Top Notch Wind Project in Fairfield, New York. Prepared for PPM Atlantic Renewable. |
| 2006 | Kibby, Franklin Cty, ME (Range 1) | 10 | 80 | Forested ridge | 197 | 6-471 | 50 | 412 | (120 m) 22% | Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine. |
| 2006 | Deerfield, Bennington Cty, VT | 26 | 236 | Forested ridge | 263 | 5-934 | 58 | 435 | (100 m) 11% | Woodlot Alternatives, Inc. 2006. Spring 2006 Bird and Bat Migration Surveys at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy, Inc. |

**Appendix A Table 5**. Summary of available avian spring radar survey results conducted at proposed (pre-construction) US wind power facilities in eastern US, using X-band mobile radar systems (2004-present)

| Year | Project Site | Number of Survey Nights | Number of Survey Hours | Landscape | Average Passage Rate (t/km/hr) | Range in Nightly Passage Rates | Average Flight Direction | Average Flight Height (m) | (Turbine Ht) % Targets Below Turbine Height | Citation |
|---|---|---|---|---|---|---|---|---|---|---|
| 2006 | Centerville, Allegany Cty, NY | 42 | n/a | Agricultural plateau | 290 | 25-1140 | 22 | 351 | (125 m) 16% | Mabee, T.J., J.H. Plissner, and B.A. Cooper. 2006a. A Radar and Visual Study of Nocturnal Bird and Bat Migration at the Proposed Centerville and Wethersfield Windparks, New York, Spring 2006. Report prepared for Ecology and Environment, LLC and Noble Environmental Power, LLC. July 2006. |
| 2006 | Wethersfield, Wyoming Cty, NY | 44 | n/a | Agricultural plateau | 324 | 41-907 | 12 | 355 | (125 m) 19% | Mabee, T.J., J.H. Plissner, and B.A. Cooper. 2006a. A Radar and Visual Study of Nocturnal Bird and Bat Migration at the Proposed Centerville and Wethersfield Windparks, New York, Spring 2006. Report prepared for Ecology and Environment, LLC and Noble Environmental Power, LLC. July 2006. |
| 2006 | Mars Hill, Aroostook Cty, ME | 15 | 85 | Forested ridge | 338 | 76-674 | 58 | 384 | (120 m) 14% | Woodlot Alternatives, Inc. 2006. A Spring 2006 Radar, Visual, and Acoustic Survey of Bird Migration at the Mars Hill Wind Farm in Mars Hill, Maine. Prepared for Evergreen Windpower, LLC. |
| 2006 | Chateaugay, Franklin Cty, NY | 35 | 300 | Agricultural plateau | 360 | 54-892 | 48 | 409 | (120 m) 18% | Woodlot Alternatives, Inc. 2006. Spring 2006 Radar Surveys at the Proposed Chateaugay Windpark in Chateaugay, New York. Prepared for Ecology and Environment, Inc. and Noble Power, LLC. |
| 2006 | Howard, Steuben Cty, NY | 42 | 440 | Agricultural plateau | 440 | 35-2270 | 27 | 426 | (125 m) 13% | Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Howard Wind Power Project in Howard, New York. Prepared for Everpower Global. |
| 2006 | Kibby, Franklin Cty, ME (Valley) | 2 | 14 | Forested ridge | 443 | 45-1242 | 61 | 334 | (120 m) n/a | Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine. |
| 2006 | Kibby, Franklin Cty, ME (Mountain) | 6 | 33 | Forested ridge | 456 | 88-1500 | 67 | 368 | (120 m) 14% | Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine. |
| 2006 | Kibby, Franklin Cty, ME (Range 2) | 7 | 57 | Forested ridge | 512 | 18-757 | 86 | 378 | (120 m) 25% | Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine. |
| 2007 | Stetson, Washington Cty, ME | 21 | 138 | Forested ridge | 147 | 3-434 | 55 | 210 | (120 m) 22% | Woodlot Alternatives, Inc. 2007. A Spring 2007 Survey of Bird and Bat Migration at the Stetson Wind Project, Washington County, Maine. Prepared for Evergreen Wind V, LLC. |
| 2007 | Cape Vincent, Jefferson Cty, NY | 50 | 300 | Great Lakes plain | 166 | n/a | 34 | 441 | (125 m) 14% | Western EcoSystems Technology, Inc. (WEST). 2007. Avian and Bat Studies for the Proposed Cape Vincent Wind Power Project, Jefferson County, NY. Prepared for BP Alternative Energy North America. |
| 2007 | New Grange, Chautauqua Cty, NY | 41 | n/a | Great Lakes plain | 175 | n/a | 18 | 450 | (125 m) 13% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| 2007 | Laurel Mountain, Barbour Cty, WV | 20 | 197 | Forested ridge | 277 | 13-646 | 27 | 533 | (130 m) 3% | Stantec Consulting Services Inc. 2007. A Spring 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Laurel Mountain Wind Energy Project near Elkins, West Virginia. Prepared for AES Laurel Mountain, LLC. |
| 2007 | Errol, Coos County, NH | 30 | 212 | Forested ridge | 342 | 2 to 870 | 76 | 332 | (125 m) 14% | Stantec Consulting Inc. 2007. Spring 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windpark in Coos County, New Hampshire by Granite Reliable Power, LLC. Prepared for Granite Reliable Power, LLC. |
| 2007 | Villenova, Chautauqua Cty, NY | 40 | n/a | Great Lakes plain | 419 | 22-1190 | 10 | 493 | (120 m) 3% | Stantec Consulting Services Inc. 2008. A Spring 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Ball Hill Windpark in Villenova and Hanover, New York. Prepared for Noble Environmental Power, LLC and Ecology and Environment. |

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**Appendix A Table 5**. Summary of available avian spring radar survey results conducted at proposed (pre-construction) US wind power facilities in eastern US, using X-band mobile radar systems (2004-present)

| Year | Project Site | Number of Survey Nights | Number of Survey Hours | Landscape | Average Passage Rate (t/km/hr) | Range in Nightly Passage Rates | Average Flight Direction | Average Flight Height (m) | (Turbine Ht) % Targets Below Turbine Height | Citation |
|---|---|---|---|---|---|---|---|---|---|---|
| 2007 | Roxbury, Oxford Cty, ME | 20 | n/a | Forested ridge | 539 | 137-1256 | 52 | 312 | (130) 18% | Woodlot Alternatives, Inc. 2007. A Spring 2007 Survey of Bird and Bat Migration at the Record Hill Wind Project, Roxbury, Maine. Prepared for Roxbury Hill Wind LLC. |
| 2007 | Lempster, Sullivan Cty, NH | 30 | 277 | Forested ridge | 542 | 49-1094 | 49 | 358 | (125 m) 18% | Woodlot Alternatives, Inc. 2007.A Spring 2007 Survey of Nocturnal Bird Migration,Breeding Birds, and Bicknell's Thrush at the Proposed Lempster Mountain Wind Power Project Lempster, New Hampshire. Prepared for Lempster Wind, LLC. |
| 2008 | Lincoln, Penobscot Cty, ME | 20 | 189 | Forested ridge | 247 | 40-766 | 75 | 316 | (120 m) 13% | Stantec Consulting Services Inc. 2008.A Spring 2008 Survey of Bird and Bat Migration at the Rollins Wind Project, Washington County, Maine. Prepared for Evergreen Wind, LLC. |
| 2008 | Allegany, Cattaraugus Cty, NY | 30 | 275 | Forested ridge | 268 | 53-755 | 18 | 316 | (150 m) 19% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| 2008 | Oakfield, Penobscot Cty, ME | 20 | 194 | Forested ridge | 498 | 132-899 | 33 | 276 | (120 m) 21% | Stantec Consulting Services Inc. 2008.A Spring 2008 Survey of Bird and Bat Migration at the Oakfield Wind Project, Washington County, Maine. Prepared for Evergreen Wind, LLC. |
| 2008 | Hounsfield, Jefferson Cty, NY | 42 | 379 | Great Lakes island | 624 | 74-1630 | 51 | 319 | (125 m) 19% | Stantec Consulting Services Inc. 2008. A Spring 2008 Survey of Bird Migration at the Hounsfield Wind Project, New York. Prepared for American Consulting Professionals of New York, PLLC. |
| 2008 | New Creek, Grant Cty, WV | 20 | n/a | Forested ridge | 1020 | 289-2610 | 30 | 354 | (130 m) 13% | Stantec Consulting Services Inc. 2008. A Spring 2008 Survey of Bird Migration at the New Creek Wind Project,West Virginia. Prepared for AES New Creek, LLC. |

Note:
[1] The percent targets below turbine height can be found in the addendum to the report "Effect of Top Notch (now Hardscrabble) Wind Project revision to turbine layout and model changes on the spring and fall 2005 nocturnal radar survey reports." Prepared August 26, 2009, by Stantec Consulting Services Inc.

# Appendix B

Publicly Available Bat Survey Results

**Appendix B Table 1.** Summary of available spring bat detector surveys (results reported for individual detectors)

| Year | Project | Project Location | Habitat | Height (m) | Detector Nights | Start | End | Calls | Rate | Reference |
|---|---|---|---|---|---|---|---|---|---|---|
| **Tree or low tower detectors (10 m or below)** | | | | | | | | | | |
| 2006 | Lempster | Lempster, Sullivan Cty, NH | forest edge | 5 | 21 | 4/5 | 6/12 | 16 | 0.8 | Woodlot Alternatives, Inc. 2006. Summary of spring 2006 Lempster bat survey. Memorandum to Jeff Keeler (CEI) from Bob Roy (Woodlot Alternatives, Inc.) dated July 26, 2006. |
| 2006 | Howard | Howard, Steuben Cty, NY | field | 8 | 35 | 4/15 | 6/3 | 29 | 0.8 | Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Howard Wind Power Project in Howard, New York. Prepared for Everpower Global. |
| 2005 | Sheffield | Sheffield, Caledonia Cty, VT | forest edge | 10 | 4 | 5/12 | 5/29 | 0 | 0 | Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC. |
| 2006 | Sheffield | Sheffield, Caledonia Cty, VT | forest edge | 8 | 38 | 4/24 | 6/13 | 840 | 22.1 | Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC. |
| 2006 | Sheffield | Sheffield, Caledonia Cty, VT | forest edge | 9 | 37 | 4/24 | 6/13 | 90 | 2.4 | Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC. |
| 2006 | Sheffield | Sheffield, Caledonia Cty, VT | forest edge | 8 | 34 | 4/24 | 6/13 | 178 | 5.2 | Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC. |
| 2006 | Deerfield | Deerfield, Bennington Cty, VT | forest edge | 2 | 37 | 4/14 | 6/11 | 4 | 0.1 | Woodlot Alternatives, Inc. 2006. Spring 2006 Bird and Bat Migration Surveys at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy, Inc. |
| 2008 | Rollins | Rollins, Penobscot Cty, ME | forest edge | 3 | 21 | 4/23 | 5/22 | 34 | 1.6 | Stantec Consulting Inc. 2008. Spring 2008 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for FirstWind Management, LLC. |
| 2008 | Rollins | Rollins, Penobscot Cty, ME | forest edge | 3 | 29 | 4/23 | 5/22 | 16 | 0.6 | Stantec Consulting Inc. 2008. Spring 2008 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for FirstWind Management, LLC. |
| **Met tower detectors** | | | | | | | | | | |
| 2008 | Rollins | Rollins, Penobscot Cty, ME | forest edge | 40 | 52 | 4/23 | 6/14 | 29 | 0.6 | Stantec Consulting Inc. 2008. Spring 2008 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for FirstWind Management, LLC. |
| 2008 | Rollins | Rollins, Penobscot Cty, ME | forest edge | 20 | 23 | 4/23 | 6/14 | 40 | 1.7 | Stantec Consulting Inc. 2008. Spring 2008 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for FirstWind Management, LLC. |
| 2008 | Rollins | Rollins, Penobscot Cty, ME | forest edge | 40 | 23 | 5/22 | 6/14 | 3 | 0.1 | Stantec Consulting Inc. 2008. Spring 2008 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for FirstWind Management, LLC. |
| 2008 | Rollins | Rollins, Penobscot Cty, ME | forest edge | 20 | 23 | 5/22 | 6/14 | 3 | 0.1 | Stantec Consulting Inc. 2008. Spring 2008 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for FirstWind Management, LLC. |
| 2008 | Rollins | Rollins, Penobscot Cty, ME | forest edge | 40 | 53 | 4/22 | 6/14 | 166 | 3.1 | Stantec Consulting Inc. 2008. Spring 2008 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for FirstWind Management, LLC. |
| 2008 | Rollins | Rollins, Penobscot Cty, ME | forest edge | 20 | 53 | 4/22 | 6/14 | 106 | 2.0 | Stantec Consulting Inc. 2008. Spring 2008 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for FirstWind Management, LLC. |
| 2007 | Ball Hill | Villenova, Chautauqua Cty, NY | field | 40 | 32 | 3/28 | 5/30 | 4 | 0.1 | Stantec Consulting Inc. 2007. A Spring 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Ball Hill Windpark in Villenova and Hanover, NY. Prepared for Nobel Environmental Power, LLC and Ecology and Environment, Inc. |
| 2007 | Ball Hill | Villenova, Chautauqua Cty, NY | field | 20 | 54 | 3/28 | 5/30 | 74 | 1.4 | Stantec Consulting Inc. 2007. A Spring 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Ball Hill Windpark in Villenova and Hanover, NY. Prepared for Nobel Environmental Power, LLC and Ecology and Environment, Inc. |
| 2007 | Stetson | Stetson, Penobscot Cty, ME | forest edge | 30 | 47 | 4/24 | 6/18 | 52 | 1.1 | Woodlot Alternatives, Inc. 2007. A Spring 2007 Survey of Bird and Bat Migration at the Stetson Wind Project, Washington County, Maine. Prepared for Evergreen Wind V, LLC. |
| 2007 | Stetson | Stetson, Penobscot Cty, ME | forest edge | 30 | 56 | 4/24 | 6/18 | 235 | 4.2 | Woodlot Alternatives, Inc. 2007. A Spring 2007 Survey of Bird and Bat Migration at the Stetson Wind Project, Washington County, Maine. Prepared for Evergreen Wind V, LLC. |
| 2007 | Stetson | Stetson, Penobscot Cty, ME | forest edge | 30 | 56 | 4/24 | 6/18 | 36 | 0.6 | Woodlot Alternatives, Inc. 2007. A Spring 2007 Survey of Bird and Bat Migration at the Stetson Wind Project, Washington County, Maine. Prepared for Evergreen Wind V, LLC. |
| 2006 | Kibby | Kibby, Franklin Cty, ME | forest edge | 50 | 14 | 5/4 | 6/19 | 0 | 0 | Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine Wind Development, Inc. |
| 2006 | Kibby | Kibby, Franklin Cty, ME | forest edge | 50 | 24 | 5/4 | 6/19 | 0 | 0 | Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine Wind Development, Inc. |
| 2006 | Kibby | Kibby, Franklin Cty, ME | forest edge | 20 | 35 | 5/4 | 6/19 | 31 | 0.7 | Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine Wind Development, Inc. |
| 2006 | Kibby | Kibby, Franklin Cty, ME | forest edge | 50 | 35 | 5/4 | 6/19 | 0 | 0 | Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine Wind Development, Inc. |
| 2006 | Lempster | Lempster, Sullivan Cty, NH | forest edge | 40 | 60 | 4/5 | 6/12 | 7 | 0.1 | Woodlot Alternatives, Inc. 2006. Summary of spring 2006 Lempster bat survey. Memorandum to Jeff Keeler (CEI) from Bob Roy (Woodlot Alternatives, Inc.) dated July 26, 2006. |
| 2006 | Lempster | Lempster, Sullivan Cty, NH | forest edge | 20 | 50 | 4/5 | 6/12 | 3 | 0.1 | Woodlot Alternatives, Inc. 2006. Summary of spring 2006 Lempster bat survey. Memorandum to Jeff Keeler (CEI) from Bob Roy (Woodlot Alternatives, Inc.) dated July 26, 2006. |
| 2005 | Cohocton/Dutch Hill | Cohocton, Steuben Cty, NY | field | 30 | 29 | 5/2 | 5/30 | 21 | 0.7 | Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Cohocton Wind Power Project in Cohocton, New York. Prepared for UPC Wind Management, LLC |
| 2005 | High Sheldon | Sheldon, Wyoming Cty, NY | field | 30 | 36 | 4/21 | 5/30 | 6 | 0.2 | Woodlot Alternatives, Inc. 2006. A Spring 2005 Radar Survey of Bird Migration at the Proposed High Sheldon Wind Project in Sheldon, New York. Prepared for Invenergy. |
| 2005 | Jordanville | Jordanville, Herkimer Cty, NY | field | 30 | 29 | 4/14 | 5/13 | 15 | 0.5 | Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Jordanville Wind Project in Jordanville, New York. Prepared for Community Energy, Inc. |
| 2005 | Marble River | Churubusco, Clinton Cty, NY | field | 30 | 46 | 4/14 | 5/30 | 12 | 0.3 | Woodlot Alternatives, Inc. 2005. A Spring Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Marble River Wind Project in Clinton and Ellenburg, New York. Prepared for AES Corporation. |

**Appendix B Table 1.** Summary of available spring bat detector surveys (results reported for individual detectors)

| Year | Project | Project Location | Habitat | Height (m) | Detector Nights | Start | End | Calls | Rate | Reference |
|---|---|---|---|---|---|---|---|---|---|---|
| 2005 | Prattsburgh | Prattsburgh, Steuben Cty , NY | field | 30 | 17 | 4/15 | 5/10 | 8 | 0.5 | Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windfarm Prattsburgh Project in Prattsburgh, New York. Prepared for UPC Wind Management, LLC. |
| 2005 | Prattsburgh | Prattsburgh, Steuben Cty , NY | field | 15 | 20 | 4/11 | 5/30 | 8 | 0.4 | Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windfarm Prattsburgh Project in Prattsburgh, New York. Prepared for UPC Wind Management, LLC. |
| 2006 | Chateaugay | Chateaugay, Franklin Cty, NY | field | 40 | 54 | 4/16 | 6/8 | 117 | 2.2 | Woodlot Alternatives, Inc. 2006. Spring 2006 Bat Surveys at the Proposed Brandon and Chateaugay Wind Farms in Northern New York. Prepared for Nobel Environmental Power, LLC and Ecology & Environment, Inc. |
| 2006 | Chateaugay | Chateaugay, Franklin Cty, NY | field | 20 | 54 | 4/16 | 6/8 | 103 | 1.9 | Woodlot Alternatives, Inc. 2006. Spring 2006 Bat Surveys at the Proposed Brandon and Chateaugay Wind Farms in Northern New York. Prepared for Nobel Environmental Power, LLC and Ecology & Environment, Inc. |
| 2006 | Brandon | Brandon, Franklin Cty, NY | field | 15 | 38 | 4/7 | 6/4 | 848 | 22 | Woodlot Alternatives, Inc. 2006. Spring 2006 Bat Surveys at the Proposed Brandon and Chateaugay Wind Farms in Northern New York. Prepared for Nobel Environmental Power, LLC and Ecology & Environment, Inc. |
| 2006 | Brandon | Brandon, Franklin Cty, NY | field | 30 | 36 | 4/7 | 6/4 | 114 | 3.2 | Woodlot Alternatives, Inc. 2006. Spring 2006 Bat Surveys at the Proposed Brandon and Chateaugay Wind Farms in Northern New York. Prepared for Nobel Environmental Power, LLC and Ecology & Environment, Inc. |
| 2006 | Howard | Howard, Steuben Cty, NY | field | 50 | 36 | 4/15 | 6/4 | 5 | 0.1 | Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Howard Wind Power Project in Howard, New York. Prepared for Everpower Global. |
| 2006 | Howard | Howard, Steuben Cty, NY | field | 20 | 45 | 4/15 | 6/7 | 16 | 0.4 | Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Howard Wind Power Project in Howard, New York. Prepared for Everpower Global. |
| 2005 | Horse Creek | Clayton, Jefferson Cty, NY | forest edge | 20 | 42 | 4/20 | 5/31 | 55 | 1.3 | Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Clayton Wind Project in Clayton, New York. Prepared for PPM Atlantic Renewable. |
| 2005 | Horse Creek | Clayton, Jefferson Cty, NY | forest edge | 15 | 36 | 4/20 | 5/31 | 12 | 0.3 | Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Clayton Wind Project in Clayton, New York. Prepared for PPM Atlantic Renewable. |
| 2005 | Moresville | Stamford, Delaware Cty, NY | forest edge | 30 | 27 | 4/12 | 5/8 | 8 | 0.3 | Woodlot. 2007. A Spring and Fall 2005 Radar and Acoustic Survey of Bird Migration at the Proposed Moresville Energy Center in Stamford and Roxbury, New York. Prepared for Invenergy, LLC. Rockville, MD. |
| 2005 | Deerfield | Deerfield, Bennington Cty, VT | forest edge | 15 | 40 | 4/19 | 6/15 | 4 | 0.1 | Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy/Deerfield Wind, LLC. |
| 2005 | Sheffield | Sheffield, Caledonia Cty, VT | forest edge | 20 | 31 | 5/1 | 5/31 | 6 | 0.2 | Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC. |
| 2006 | Deerfield | Deerfield, Bennington Cty, VT | forest edge | 35 | 60 | 4/14 | 6/13 | 4 | 0.1 | Woodlot Alternatives, Inc. 2006. Spring 2006 Bird and Bat Migration Surveys at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy, Inc. |
| 2006 | Deerfield | Deerfield, Bennington Cty, VT | forest edge | 15 | 47 | 4/14 | 5/31 | 0 | 0 | Woodlot Alternatives, Inc. 2006. Spring 2006 Bird and Bat Migration Surveys at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy, Inc. |
| 2006 | Deerfield | Deerfield, Bennington Cty, VT | forest edge | 30 | 29 | 4/14 | 5/20 | 0 | 0 | Woodlot Alternatives, Inc. 2006. Spring 2006 Bird and Bat Migration Surveys at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy, Inc. |
| 2006 | Deerfield | Deerfield, Bennington Cty, VT | forest edge | 15 | 21 | 4/14 | 5/16 | 7 | 0.3 | Woodlot Alternatives, Inc. 2006. Spring 2006 Bird and Bat Migration Surveys at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy, Inc. |
| 2006 | Sheffield | Sheffield, Caledonia Cty, VT | forest edge | 31 | 36 | 4/24 | 6/13 | 5 | 0.14 | Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC. |
| 2005 | Liberty Gap | Franklin, Pendleton Cty, WV | forest edge | 30 | 21 | 4/17 | 6/7 | 2 | 0.1 | Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Liberty Gap Wind Project in Franklin, West Virginia. Prepared for US Wind Force, LLC. |
| 2005 | Liberty Gap | Franklin, Pendleton Cty, WV | forest edge | 15 | 21 | 4/17 | 6/7 | 19 | 0.9 | Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Liberty Gap Wind Project in Franklin, West Virginia. Prepared for US Wind Force, LLC. |
| 2006 | Wethersfield | Wethersfield, Wyoming Cty, NY | field | 21 | 63 | 4/6 | 6/7 | 60 | 1.0 | Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bat Migration at the Proposed Centerville and Wethersfield Windparks in Centerville and Wethersfield, New York. Prepared for Ecology and Environment, Inc. and Noble Power, LLC. |
| 2006 | Wethersfield | Wethersfield, Wyoming Cty, NY | field | 10 | 63 | 4/6 | 6/7 | 132 | 2.1 | Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bat Migration at the Proposed Centerville and Wethersfield Windparks in Centerville and Wethersfield, New York. Prepared for Ecology and Environment, Inc. and Noble Power, LLC. |
| 2006 | Centerville | Centerville, Allegany Cty, NY | field | 25 | 63 | 4/6 | 6/8 | 139 | 2.2 | Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bat Migration at the Proposed Centerville and Wethersfield Windparks in Centerville and Wethersfield, New York. Prepared for Ecology and Environment, Inc. and Noble Power, LLC |
| 2006 | Centerville | Centerville, Allegany Cty, NY | field | 10 | 63 | 4/6 | 6/8 | 131 | 2.1 | Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bat Migration at the Proposed Centerville and Wethersfield Windparks in Centerville and Wethersfield, New York. Prepared for Ecology and Environment, Inc. and Noble Power, LLC |
| 2007 | Coos | Coos Cty, NH | forest edge | 50 | 37 | 4/26 | 6/1 | 8 | 0.2 | Stantec Consulting Inc. 2007. Spring 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windpark in Coos County, New Hampshire by Granite Reliable Power, LLC. Prepared for Granite Reliable Power, LLC. |
| 2007 | Coos | Coos Cty, NH | forest edge | 20 | 19 | 4/30 | 6/1 | 5 | 0.3 | Stantec Consulting Inc. 2007. Spring 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windpark in Coos County, New Hampshire by Granite Reliable Power, LLC. Prepared for Granite Reliable Power, LLC. |
| 2007 | Coos | Coos Cty, NH | forest edge | 30 | 35 | 4/28 | 6/1 | 8 | 0.2 | Stantec Consulting Inc. 2007. Spring 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windpark in Coos County, New Hampshire by Granite Reliable Power, LLC. Prepared for Granite Reliable Power, LLC. |
| 2007 | Coos | Coos Cty, NH | forest edge | 15 | 35 | 4/28 | 6/1 | 12 | 0.3 | Stantec Consulting Inc. 2007. Spring 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windpark in Coos County, New Hampshire by Granite Reliable Power, LLC. Prepared for Granite Reliable Power, LLC. |

# Appendix C

Breeding Bird Survey Data Tables

**Appendix C Table 1.** Total number of species and individuals detected, and distance from observer at 35 point count locations during three survey periods - Spring 2009*

| Common name | Scientific name | 0-50 m | 50-100 m | > 100 m | Flyovers | Grand Total |
|---|---|---|---|---|---|---|
| alder flycatcher | *Empidonax alnorum* | 8 | 4 | 1 | | 13 |
| American crow | *Corvus brachyrhynchos* | | | 1 | | 1 |
| American goldfinch | *Carduelis tristis* | 4 | | | 6 | 10 |
| American redstart | *Setophaga ruticilla* | 16 | 9 | | | 25 |
| American robin | *Turdus migratorius* | 3 | 2 | 1 | | 6 |
| black-and-white warbler | *Mniotilta varia* | 25 | 4 | | | 29 |
| bay-breasted warbler | *Dendroica castanea* | 13 | 3 | | | 16 |
| black-capped chickadee | *Poecile atricapilla* | 4 | 1 | | | 5 |
| blue headed vireo | *Vireo solitarius* | 9 | 5 | 1 | | 15 |
| blackburnian warbler | *Dendroica fusca* | 22 | 4 | | | 26 |
| blue jay | *Cyanocitta cristata* | 5 | 1 | 3 | 5 | 14 |
| blackpoll warbler | *Dendroica striata* | 11 | 9 | | | 20 |
| boreal chickadee | *Poecile hudsonicus* | 9 | | | | 9 |
| brown creeper | *Certhia americana* | 1 | | | | 1 |
| black-throated blue warbler | *Dendroica caerulescens* | 40 | 30 | 3 | | 73 |
| black-throated green warbler | *Dendroica virens* | 8 | 12 | 5 | | 25 |
| Canada warbler | *Wilsonia canadensis* | 4 | | | | 4 |
| cedar waxwing | *Bombycilla cedrorum* | 7 | | | 8 | 15 |
| common raven | *Corvus corax* | | | | 6 | 6 |
| common yellowthroat | *Geothlypis trichas* | 34 | 24 | 3 | 1 | 62 |
| chestnut-sided warbler | *Dendroica pensylvanica* | 46 | 25 | 4 | | 75 |
| dark-eyed junco | *Junco hyemalis* | 38 | 25 | 4 | | 67 |
| eastern wood-pewee | *Contopus virens* | | | 2 | | 2 |
| golden-crowned kinglet | *Regulus satrapa* | 26 | 11 | | | 37 |
| hairy woodpecker | *Picoides villosus* | 3 | 2 | | 1 | 6 |
| hermit thrush | *Catharus guttatus* | 11 | 32 | 7 | | 50 |
| least flycatcher | *Empidonax minimus* | 1 | | | | 1 |
| magnolia warbler | *Dendroica magnolia* | 28 | 9 | | 1 | 38 |
| mourning dove | *Zenaida macroura* | 1 | | 1 | | 2 |
| mourning warbler | *Oporornis philadelphia* | 7 | 4 | | | 11 |
| Nashville warbler | *Vermivora ruficapilla* | 27 | 22 | 1 | | 50 |
| northern flicker | *Colaptes auratus* | 1 | 1 | 1 | 1 | 4 |
| northern parula | *Parula americana* | | 1 | | | 1 |
| olive-sided flycatcher | *Contopus cooperi* | | | 1 | | 1 |
| ovenbird | *Seiurus aurocapillus* | 10 | 12 | 5 | | 27 |
| purple finch | *Carpodacus purpureus* | 2 | | 1 | | 3 |
| rose-breasted grosbeak | *Pheucticus ludovicianus* | 3 | 7 | 2 | | 12 |
| red-breasted nuthatch | *Sitta canadensis* | 8 | 5 | | | 13 |
| ruby-crowned kinglet | *Regulus calendula* | 2 | | | | 2 |
| red-eyed vireo | *Vireo olivaceus* | 9 | 12 | 1 | | 22 |
| red-tailed hawk | *Buteo jamaicensis* | | | 1 | 3 | 4 |
| ruffed grouse | *Bonasa umbellus* | 1 | 1 | 1 | | 3 |
| scarlet tanager | *Piranga olivacea* | | 1 | | | 1 |
| sharp-shinned hawk | *Accipiter striatus* | | | | 1 | 1 |
| Swainson's thrush | *Catharus ustulatus* | 3 | 2 | | | 5 |
| Tennessee warbler | *Vermivora peregrina* | 2 | 1 | | | 3 |
| unidentified duck | *n/a* | | | | 2 | 2 |
| unidentified woodpecker | *n/a* | | 1 | | | 1 |
| winter wren | *Troglodytes troglodytes* | 14 | 34 | 5 | | 53 |
| white-throated sparrow | *Zonotrichia albicollis* | 45 | 62 | 21 | 1 | 129 |
| yellow-bellied flycatcher | *Empidonax flaviventris* | 2 | 2 | | | 4 |
| yellow-bellied sapsucker | *Sphyrapicus varius* | 1 | 1 | | | 2 |
| yellow-rumped warbler | *Dendroica coronata* | 38 | 9 | 1 | 1 | 49 |
| yellow warbler | *Dendroica petechia* | 1 | | | | 1 |
| **Total birds observed** | | **553** | **390** | **77** | **37** | **1057** |

*Numbers largely represent singing males but also include male and some female individuals that were visually detected.

| **Appendix C Table 2**. Species detected incidentally between point count survey locations |
|---|
| American kestrel |
| American redstart |
| American robin |
| American woodcock |
| black-and-white warbler |
| blue-headed vireo |
| blackburnian warbler |
| black-throated blue warbler |
| black-throated green warbler |
| common yellowthroat |
| chestnut-sided warbler |
| dark-eyed junco |
| eastern phoebe |
| least flycatcher |
| magnolia warbler |
| mourning dove |
| Nashville warbler |
| Northern parula |
| olive-sided flycatcher |
| ovenbird |
| rose-breasted grosbeak |
| ruffed grouse |
| scarlet tanager |
| winter wren |
| white-throated sparrow |
| yellow-bellied sapsucker |
| yellow-rumped warbler |

**Appendix C Table 3.** Total number of observations, relative abundance, and frequency of species at coniferous forest and deciduous forest point count locations during three survey periods - Spring 2009

| Species | Coniferous forest (16 points) | | | Deciduous forest (9 points) | | |
|---|---|---|---|---|---|---|
| | Total[a] | Relative abundance[b] | Frequency[c] | Total[a] | Relative abundance[b] | Frequency[c] |
| alder flycatcher | | 0.00 | 0 | 5 | 0.19 | 33 |
| American goldfinch | | 0.00 | 0 | 1 | 0.04 | 11 |
| American redstart | | 0.00 | 0 | 15 | 0.56 | 67 |
| American robin | 1 | 0.02 | 6 | 4 | 0.15 | 33 |
| bay-breasted warbler | 12 | 0.25 | 56 | | 0.00 | 0 |
| black-and-white warbler | 2 | 0.04 | 13 | 13 | 0.48 | 78 |
| blackburnian warbler | 18 | 0.38 | 75 | 2 | 0.07 | 11 |
| black-capped chickadee | 2 | 0.04 | 13 | 1 | 0.04 | 11 |
| blackpoll warbler | 16 | 0.33 | 50 | | 0.00 | 0 |
| black-throated blue warbler | 18 | 0.38 | 63 | 26 | 0.96 | 100 |
| black-throated green warbler | 5 | 0.10 | 25 | 2 | 0.07 | 11 |
| blue jay | 2 | 0.04 | 13 | 1 | 0.04 | 11 |
| blue-headed vireo | 7 | 0.15 | 31 | 4 | 0.15 | 44 |
| boreal chickadee | 9 | 0.19 | 25 | | 0.00 | 0 |
| brown creeper | 1 | 0.02 | 6 | | 0.00 | 0 |
| Canada warbler | | 0.00 | 0 | 3 | 0.11 | 22 |
| cedar waxwing | | 0.00 | 0 | 6 | 0.22 | 22 |
| chestnut-sided warbler | 7 | 0.15 | 25 | 31 | 1.15 | 100 |
| common yellowthroat | 2 | 0.04 | 13 | 25 | 0.93 | 89 |
| dark-eyed junco | 28 | 0.58 | 94 | 9 | 0.33 | 44 |
| golden-crowned kinglet | 32 | 0.67 | 88 | | 0.00 | 0 |
| hairy woodpecker | 1 | 0.02 | 6 | 2 | 0.07 | 22 |
| hermit thrush | 11 | 0.23 | 50 | 20 | 0.74 | 89 |
| least flycatcher | | 0.00 | 0 | 1 | 0.04 | 11 |
| magnolia warbler | 24 | 0.50 | 69 | 4 | 0.15 | 44 |
| mourning dove | | 0.00 | 0 | | 0.00 | 0 |
| mourning warbler | | 0.00 | 0 | 10 | 0.37 | 33 |
| Nashville warbler | 42 | 0.88 | 88 | 1 | 0.04 | 11 |
| northern flicker | | 0.00 | 0 | 1 | 0.04 | 11 |
| northern parula | | 0.00 | 0 | 1 | 0.04 | 11 |
| ovenbird | 2 | 0.04 | 13 | 15 | 0.56 | 89 |
| purple finch | 2 | 0.04 | 13 | | 0.00 | 0 |
| red-breasted nuthatch | 10 | 0.21 | 50 | | 0.00 | 0 |
| red-eyed vireo | 2 | 0.04 | 6 | 13 | 0.48 | 78 |
| rose-breasted grosbeak | | 0.00 | 0 | 10 | 0.37 | 78 |
| ruby-crowned kinglet | | 0.00 | 0 | | 0.00 | 0 |
| ruffed grouse | | 0.00 | 0 | 2 | 0.07 | 22 |
| scarlet tanager | | 0.00 | 0 | | 0.00 | 0 |
| Swainson's thrush | 3 | 0.06 | 19 | 2 | 0.07 | 22 |
| Tennessee warbler | 3 | 0.06 | 13 | | 0.00 | 0 |
| unidentified woodpecker | 1 | 0.02 | 6 | | 0.00 | 0 |
| white-throated sparrow | 26 | 0.54 | 75 | 33 | 1.22 | 100 |
| winter wren | 27 | 0.56 | 69 | 7 | 0.26 | 44 |
| yellow-bellied flycatcher | 4 | 0.08 | 25 | | 0.00 | 0 |
| yellow-bellied sapsucker | 1 | 0.02 | 6 | 1 | 0.04 | 11 |
| yellow-rumped warbler | 34 | 0.71 | 88 | 3 | 0.11 | 22 |
| yellow warbler | | 0.00 | 0 | 1 | 0.04 | 11 |
| **Total birds observed** | **355** | | | **275** | | |
| **Relative abundance** | **7.40** | | | **10.19** | | |
| **Species richness** | **32** | | | **34** | | |
| **Shannon Diversity Index** | **2.95** | | | **2.99** | | |

a Total number of individuals detected (mainly singing males, also males and females that were visually observed).
b Mean number of birds observed.
c Percentage of survey points at which the species was observed.

**Appendix C Table 4.** Total number of observations, relative abundance, and frequency of species at mixed forest and regenerating clearcut point count locations during three survey periods - Spring 2009

| | Mixed forest (7 points) | | | Regenerating clearcut (3 points) | | |
|---|---|---|---|---|---|---|
| **Species** | **Total[a]** | **Relative abundance[b]** | **Frequency[c]** | **Total[a]** | **Relative abundance[b]** | **Frequency[c]** |
| alder flycatcher | 4 | 0.19 | 14 | 3 | 0.33 | 67 |
| American goldfinch | 3 | 0.14 | 14 | | 0.00 | 0 |
| American redstart | 7 | 0.33 | 57 | 3 | 0.33 | 67 |
| American robin | | 0.00 | 0 | | 0.00 | 0 |
| bay-breasted warbler | 4 | 0.19 | 29 | | 0.00 | 0 |
| black-and-white warbler | 8 | 0.38 | 86 | 6 | 0.67 | 100 |
| blackburnian warbler | 6 | 0.29 | 43 | | 0.00 | 0 |
| black-capped chickadee | 2 | 0.10 | 14 | | 0.00 | 0 |
| blackpoll warbler | 4 | 0.19 | 29 | | 0.00 | 0 |
| black-throated blue warbler | 19 | 0.90 | 71 | 7 | 0.78 | 67 |
| black-throated green warbler | 13 | 0.62 | 71 | | 0.00 | 0 |
| blue jay | 3 | 0.14 | 29 | | 0.00 | 0 |
| blue-headed vireo | 3 | 0.14 | 43 | | 0.00 | 0 |
| boreal chickadee | | 0.00 | 0 | | 0.00 | 0 |
| brown creeper | | 0.00 | 0 | | 0.00 | 0 |
| Canada warbler | 1 | 0.05 | 14 | | 0.00 | 0 |
| cedar waxwing | 1 | 0.05 | 14 | | 0.00 | 0 |
| chestnut-sided warbler | 21 | 1.00 | 71 | 12 | 1.33 | 100 |
| common yellowthroat | 16 | 0.76 | 57 | 15 | 1.67 | 100 |
| dark-eyed junco | 19 | 0.90 | 100 | 7 | 0.78 | 67 |
| golden-crowned kinglet | 4 | 0.19 | 29 | 1 | 0.11 | 33 |
| hairy woodpecker | | 0.00 | 0 | 2 | 0.22 | 33 |
| hermit thrush | 9 | 0.43 | 57 | 3 | 0.33 | 33 |
| least flycatcher | | 0.00 | 0 | | 0.00 | 0 |
| magnolia warbler | 5 | 0.24 | 71 | 4 | 0.44 | 67 |
| mourning dove | 1 | 0.05 | 14 | | 0.00 | 0 |
| mourning warbler | | 0.00 | 0 | 1 | 0.11 | 33 |
| Nashville warbler | 6 | 0.29 | 57 | | 0.00 | 0 |
| northern flicker | 1 | 0.05 | 14 | | 0.00 | 0 |
| northern parula | | 0.00 | 0 | | 0.00 | 0 |
| ovenbird | 4 | 0.19 | 29 | 1 | 0.11 | 33 |
| purple finch | | 0.00 | 0 | | 0.00 | 0 |
| red-breasted nuthatch | 3 | 0.14 | 29 | | 0.00 | 67 |
| red-eyed vireo | 3 | 0.14 | 14 | 3 | 0.33 | 67 |
| rose-breasted grosbeak | | 0.00 | 0 | | 0.00 | 0 |
| ruby-crowned kinglet | 2 | 0.10 | 29 | | 0.00 | 0 |
| ruffed grouse | | 0.00 | 0 | | 0.00 | 0 |
| scarlet tanager | | 0.00 | 0 | 1 | 0.11 | 33 |
| Swainson's thrush | | 0.00 | 0 | | 0.00 | 0 |
| Tennessee warbler | | 0.00 | 0 | | 0.00 | 0 |
| unidentified woodpecker | | 0.00 | 0 | | 0.00 | 0 |
| white-throated sparrow | 32 | 1.52 | 100 | 16 | 1.78 | 100 |
| winter wren | 10 | 0.48 | 71 | 4 | 0.44 | 67 |
| yellow-bellied flycatcher | | 0.00 | 0 | | 0.00 | 0 |
| yellow-bellied sapsucker | | 0.00 | 0 | | 0.00 | 0 |
| yellow-rumped warbler | 9 | 0.43 | 86 | 1 | 0.11 | 33 |
| yellow warbler | | 0.00 | 0 | | 0.00 | 0 |
| **Total birds observed** | **223** | | | **90** | | |
| **Relative abundance** | **10.62** | | | **10.00** | | |
| **Species richness** | **30** | | | **18** | | |
| **Shannon Diversity Index** | **3.01** | | | **2.52** | | |

a Total number of individuals detected (mainly singing males, also males and females that were visually observed).

b Mean number of birds observed.

c Percentage of survey points at which the species was observed.

# Appendix D

Raptor Survey Data Tables

**Appendix D Table 1.** Daily totals of raptor species observed at Highland Spring 2009

| Site | Species | 3/25/2009 | 4/1/2009 | 4/10/2009 | 4/19/2009 | 4/20/2009 | 4/29/2009 | 4/30/2009 | 5/5/2009 | 5/8/2009 | 5/11/2009 | 5/12/2009 | 5/13/2009 | 5/15/2009 | 5/18/2009 | 5/19/2009 | Grand Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Briggs** | bald eagle | | | | | | 1 | | | 1 | | | | | | 2 | 4 |
| | broad-winged hawk | | | | | | | | 2 | | | 1 | | 1 | | 1 | 5 |
| | northern goshawk | | | | | | | | | | | | 1 | | | 1 | 2 |
| | northern harrier | | | | | | | 1 | | | | | | | | | 1 |
| | red-tailed hawk | | | | | | 1 | 1 | 2 | 3 | | 3 | | 1 | | 3 | 14 |
| | sharp-shinned hawk | | | | | | | | 1 | | | | | | | | 1 |
| | turkey vulture | | | | | | 6 | 10 | 5 | 10 | | 12 | 3 | 8 | | 21 | 75 |
| | unidentified buteo | | | | | | 1 | | | | | | | 1 | | | 2 |
| | unidentified raptor | | | | | | | | | 1 | | | | | | 2 | 3 |
| | **Total birds observed** | **--** | **--** | **--** | **--** | **--** | **9** | **12** | **10** | **15** | **--** | **16** | **4** | **11** | **--** | **30** | **107** |
| **Witham** | bald eagle | 1 | 1 | | | | | | | | 1 | 1 | | 1 | | | 5 |
| | broad-winged hawk | | | | | 3 | | | | | 5 | 1 | | 1 | | | 10 |
| | Cooper's hawk | | | 1 | | | | 1 | | | | | | | | | 2 |
| | northern goshawk | | | | | | | | | | | | | 1 | | | 1 |
| | osprey | | | | 1 | 3 | | | | | | 1 | | | | | 5 |
| | peregrine falcon | | | 1 | | | | | | | | | | | | | 1 |
| | red-tailed hawk | 2 | 7 | 5 | 3 | 4 | | 3 | | | 6 | 4 | 10 | 2 | | | 46 |
| | sharp-shinned hawk | | | 2 | 5 | 4 | | | | | | 3 | 1 | | | | 15 |
| | turkey vulture | | | 3 | 11 | 3 | | 18 | | | 2 | 6 | 6 | 4 | 4 | | 57 |
| | unidentified buteo | | | | | 1 | | 1 | | | | | | | | | 2 |
| | unidentified raptor | 3 | | 1 | 1 | | | | | | 2 | 1 | | 1 | | | 9 |
| | **Total birds observed** | **6** | **8** | **13** | **21** | **18** | **--** | **23** | **--** | **--** | **16** | **17** | **17** | **10** | **4** | **--** | **153** |
| | **Project Total** | **6** | **8** | **13** | **21** | **18** | **9** | **35** | **10** | **15** | **16** | **33** | **21** | **21** | **4** | **30** | **260** |

**Appendix D Table 2.** Hourly summary of raptor observations at Highland Spring 2009

| Site | Species | 7:00-8:00 | 8:00-9:00 | 9:00-10:00 | 10:00-11:00 | 11:00-12:00 | 12:00-1:00 | 1:00-2:00 | 2:00-3:00 | 3:00-4:00 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Briggs** | bald eagle | | | 1 | | 3 | | | | | 4 |
| | broad-winged hawk | | | 1 | | 1 | 2 | 1 | | | 5 |
| | northern goshawk | | | 1 | | | 1 | | | | 2 |
| | northern harrier | | | 1 | | | | | | | 1 |
| | red-tailed hawk | | | | 3 | 2 | 5 | | 3 | 1 | 14 |
| | sharp-shinned hawk | | | | | | | | 1 | | 1 |
| | turkey vulture | | | 3 | 8 | 10 | 15 | 5 | 9 | 25 | 75 |
| | unidentified buteo | | | 1 | | | | | | 1 | 2 |
| | unidentified raptor | | | | | 2 | 1 | | | | 3 |
| | **TOTAL** | | | 8 | 11 | 18 | 24 | 6 | 13 | 27 | 107 |
| **Witham** | bald eagle | | | | | 2 | 1 | | 2 | | 5 |
| | broad-winged hawk | | | | 2 | 4 | 1 | 1 | | 2 | 10 |
| | Cooper's hawk | | | | | | | | 2 | | 2 |
| | northern goshawk | | | | | 1 | | | | | 1 |
| | osprey | | | | 2 | 1 | 1 | 1 | | | 5 |
| | peregrine falcon | | | | 1 | | | | | | 1 |
| | red-tailed hawk | | | 2 | 3 | 4 | 13 | 11 | 5 | 8 | 46 |
| | sharp-shinned hawk | | 1 | 3 | 3 | 3 | 2 | 2 | 1 | | 15 |
| | turkey vulture | | | 1 | 6 | 25 | 12 | 4 | 5 | 4 | 57 |
| | unidentified buteo | | | 1 | | | | | 1 | | 2 |
| | unidentified raptor | 1 | | | 1 | 2 | 1 | 1 | 2 | 1 | 9 |
| | **TOTAL** | 1 | 1 | 7 | 18 | 42 | 31 | 20 | 18 | 15 | 153 |
| | **Project Total** | 1 | 1 | 15 | 29 | 60 | 55 | 26 | 31 | 42 | 260 |

**Appendix D Table 3.** Number of individuals of species observed within Project boundary in proposed turbine areas (flight positions A1, A2, A3, B) above or below 130.5 m

| WITHAM | | | |
|---|---|---|---|
| **Species** | **130.5 m or greater** | **below 130.5 m** | **TOTAL** |
| bald eagle | | 3 | 3 |
| broad-winged hawk | 4 | 5 | 9 |
| Cooper's hawk | 2 | | 2 |
| northern goshawk | | 1 | 1 |
| osprey | 4 | 1 | 5 |
| peregrine falcon | | 1 | 1 |
| red-tailed hawk | 11 | 33 | 44 |
| sharp-shinned hawk | 1 | 14 | 15 |
| turkey vulture | 5 | 52 | 57 |
| unidentified buteo | 1 | | 1 |
| unidentified raptor | 1 | 6 | 7 |
| **TOTAL** | **29** | **116** | **145** |
| **BRIGGS** | | | |
| **Species** | **130.5 m or greater** | **less than 130.5 m** | **TOTAL** |
| bald eagle | | 4 | 4 |
| broad-winged hawk | | 5 | 5 |
| northern goshawk | | 2 | 2 |
| northern harrier | | 1 | 1 |
| red-tailed hawk | 2 | 7 | 9 |
| sharp-shinned hawk | | 1 | 1 |
| turkey vulture | 11 | 57 | 68 |
| unidentified buteo | | 1 | 1 |
| **TOTAL** | **13** | **78** | **91** |

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**Appendix D Table 4**. Summary of Regional Spring 2009 (February to May) Migration Surveys*

| Site Number** | Location | Observation Hours | BV | TV | OS | BE | NH | SS | CH | NG | RS | BW | RT | RL | GE | AK | ML | PG | SW | MK | EK | SK | UR | UB | UA | UF | UE | TOTAL | BIRDS/ HOUR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | **Highland Wind Farm; Highland, ME** | 139 | 0 | 132 | 5 | 9 | 1 | 16 | 2 | 3 | 0 | 15 | 60 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 12 | 4 | 0 | 0 | 0 | 260 | 1.87 |
| **2** | **Barre Falls; Barre, MA** | 118.25 | 0 | 64 | 66 | 19 | 14 | 100 | 10 | 1 | 11 | 593 | 78 | 0 | 0 | 67 | 2 | 1 | 0 | 0 | 0 | 0 | 8 | 0 | 0 | 0 | 0 | 1034 | 8.74 |
| **3** | **Poquonock; Poquonock, CT** | 378 | 15 | 242 | 75 | 22 | 15 | 111 | 35 | 2 | 36 | 634 | 172 | 1 | 2 | 30 | 6 | 3 | 0 | 1 | 0 | 0 | 23 | 2 | 1 | 1 | 0 | 1429 | 3.78 |
| **4** | **Plum Island; Newburyport, MA** | 136.25 | 0 | 44 | 35 | 5 | 121 | 141 | 18 | 0 | 0 | 1 | 5 | 4 | 0 | 672 | 79 | 21 | 0 | 0 | 1 | 0 | 3 | 0 | 2 | 2 | 0 | 1154 | 8.47 |
| **5** | **Pilgrim Heights, North Truro, MA** | 304 | 1 | 703 | 94 | 13 | 20 | 353 | 63 | 2 | 22 | 137 | 81 | 2 | 0 | 404 | 42 | 10 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 3 | 0 | 1954 | 6.43 |
| **6** | **Bradbury Mt. State Park, Pownal, ME** | 442.75 | 1 | 280 | 321 | 46 | 114 | 747 | 56 | 6 | 92 | ### | 273 | 0 | 1 | 394 | 68 | 6 | 1 | 0 | 0 | 1 | 21 | 22 | 12 | 0 | 2 | 4116 | 9.30 |

*** Data obtained from HMANA 2009.**

**** See map to right for site location.**

**Appendix D Table 5**. Summary of available spring raptor data at proposed wind sites in the East 1999-2008

| Project Site | Landscape | Survey Period | # of Survey Days | # of Survey Hours | Total # Observed | # of Species Observed | Seasonal Passage Rate (raptors/hr) | (Turbine Ht) and % Raptors Below Turbine Height | Full citation |
|---|---|---|---|---|---|---|---|---|---|
| **Spring 1999** | | | | | | | | | |
| Wethersfield, Wyoming Cty, NY | Agricultural plateau | April 20 - May 24 | 24 | 97 | 348 | 12 | 3.6 | n/a (23 m mean flight height) | Cooper, B.A., and T.J. Mabee. 1999. Bird migration near proposed wind turbine sites at Wethersfield and Harrisburg, New York. Unpublished report prepared for Niagara–Mohawk Power Corporation, Syracuse, NY, by ABR, Inc., Forest Grove, OR. 46 pp. |
| **Spring 2003** | | | | | | | | | |
| Westfield Chautauqua Cty, NY | Great Lakes Shore | April 16 - May 15 | 50 | 100.7 | 2,578 | 17 | 25.6 | n/a (278 m mean flight height) | Cooper, B.A., A.A. Stickney, J.J. Mabee. 2004. A visual and radar study of 2003 spring bird migration at the proposed Chautauqua wind energy facility, New York. 2004. Final Report prepared by ABR Inc. Chautauqua Windpower LLC. |
| **Spring 2005** | | | | | | | | | |
| Churubusco, Clinton Cty, NY | Great Lakes plain/ADK foothills | Spring 2005 | 10 | 60 | 170 | 11 | 2.83 | (120 m) 69% | Woodlot Alternatives, Inc. 2005b. A Spring Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Marble River Wind Project in Clinton and Ellenburg, New York. Prepared for AES Corporation. |
| Clinton/Ellenburg, Clinton Cty, NY | Great Lakes plain/ADK foothills | April 18 to April 20 | 3 | 21 | (2 non-migrant BWHA) | 1 | 0.1*** | n/a | New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008. |
| Dairy Hills, Clinton Cty, NY | Great Lakes Shore | April 15 to April 26 | 5 | 20 | 50 | 6 | 2.5 | 125 m (94.7%)* | New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008. |
| Altona, Clinton Cty, NY | Great Lakes plain/ADK foothills | May 5 to May 6 | 3 | 21 | (4 non-migrant TUVU) | 1 | 0.19*** | n/a | New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008. |

**Appendix D Table 5**. Summary of available spring raptor data at proposed wind sites in the East 1999-2008

| Project Site | Landscape | Survey Period | # of Survey Days | # of Survey Hours | Total # Observed | # of Species Observed | Seasonal Passage Rate (raptors/hr) | (Turbine Ht) and % Raptors Below Turbine Height | Full citation |
|---|---|---|---|---|---|---|---|---|---|
| Bliss Wind Park, Eagle, Wyoming Cty, NY | Agricultural and wooded plateau | April 21, 26, 28 | 3 | 21 | 19 | 3 | 0.9 | n/a | New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008. |
| Alabama, Genesee Cty, NY | Great Lakes plain/ADK foothills | April 16-April 29 | 5 | 20 | 177 | 8 | 9 | (125 m) 84.5%* | New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008. |
| High Sheldon, Wyoming Cty, NY | Agricultural and wooded plateau | April 2 to May 14 | 7 | 37 | 119 | 7 | 3.2 | n/a | New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008. |
| Wethersfield, Wyoming Cty, NY | Agricultural and wooded plateau | April 22 to April 29 | 3 | 21 | 5 | 3 | 0.1 | n/a | New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008. |
| New Grange, Chautauqua Cty, NY | Great Lakes plain/ADK foothills | April 16 to May | 5 | 20 | 55 | 8 | 4.37 | n/a | New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008. |
| Stockton, Chautauqua Cty, NY | Great Lakes plain/ADK foothills | April 16 to May 15 | 5 | 20 | 122 | 8 | 4.65 | n/a | New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008. |
| Clayton, Jefferson Cty, NY | Agricultural plateau | March 30 - May 7 | 10 | 58 | 700 | 14 | 12.1 | (150 m) 61% | Woodlot Alternatives, Inc. 2005a. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Clayton Wind Project in Clayton, New York. Prepared for PPM Atlantic |

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**Appendix D Table 5**. Summary of available spring raptor data at proposed wind sites in the East 1999-2008

| Project Site | Landscape | Survey Period | # of Survey Days | # of Survey Hours | Total # Observed | # of Species Observed | Seasonal Passage Rate (raptors/hr) | (Turbine Ht) and % Raptors Below Turbine Height | Full citation |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Renewable. |
| Prattsburgh, Steuben Cty, NY | Agricultural plateau | Spring 2005 | 10 | 60 | 314 | 15 | 5.23 | (125 m) 83% | Woodlot Alternatives, Inc. 2005c. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windfarm Prattsburgh Project in Prattsburgh, New York. Prepared for UPC Wind Management, LLC. |
| Cohocton, Steuben Cty, NY | Agricultural plateau | Spring 2005 | 10 | 60 | 164 | 11 | 2.73 | (125 m) 77% | Woodlot Alternatives, Inc. 2005. Avian and Bat Information Summary and Risk Assessment for the Proposed Cohocton Wind Power Project in Cohocton, New York. Prepared for UPC Wind Management, LLC. |
| Munnsville, Madison Cty, NY | Agricultural plateau | April 5 to May 16 | 10 | 60 | 375 | 12 | 6.25 | (118 m) 78% | Woodlot Alternatives, Inc. 2005d. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Munnsville Wind Project in Munnsville, New York. Prepared for AES-EHN NY Wind, LLC. |
| Moresville, Delaware County, NY | Forested ridge | March 28 to May 10 | 8 | 45 | 170 | 6 | 3.8 | n/a | New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008. |
| Sheffield, Caledonia Cty, VT | Forested ridge | April to May | 10 | 60 | 98 | 10 | 1.63 | (125 m) 69% | Woodlot Alternatives, Inc. 2006b. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC. |
| Deerfield, Bennington Cty, VT (Existing facility) | Forested ridge | April 9 to April 29 | 7 | 42 | 44 | 11 (for both sites combined) | 1.05 | (125 m) 83% (at both sites combined) | Woodlot Alternatives, Inc. 2005e. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy/Deerfield Wind, LLC. |
| Deerfield, Bennington Cty, VT (Western expansion) | Forested ridge | April 9 to April 29 | 7 | 42 | 38 | 11 (for both sites combined) | 0.9 | (125 m) 83% (at both sites combined) | Woodlot Alternatives, Inc. 2005e. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy/Deerfield Wind, LLC. |

**Appendix D Table 5**. Summary of available spring raptor data at proposed wind sites in the East 1999-2008

| Project Site | Landscape | Survey Period | # of Survey Days | # of Survey Hours | Total # Observed | # of Species Observed | Seasonal Passage Rate (raptors/hr) | (Turbine Ht) and % Raptors Below Turbine Height | Full citation |
|---|---|---|---|---|---|---|---|---|---|
| **Spring 2006** | | | | | | | | | |
| Mars Hill, Aroostook Cty, ME | Forested ridge | April 12 to May 18 | 10 | 60.25 | 64 | 9 | 1.06 | (120 m) 48% | Woodlot Alternatives, Inc. 2006c. A Spring 2006 Radar, Visual, and Acoustic Survey of Bird Migration at the Mars Hill Wind Farm in Mars Hill, Maine. Prepared for Evergreen Windpower, LLC. |
| Lempster, Sullivan County, NH | Forested ridge | Spring 2006 | 10 | 78 | 102 | n/a | 1.3 | 125 m (18%) | Woodlot Alternatives, Inc. 2007a. A Spring 2007 Survey of Nocturnal Bird Migration,Breeding Birds, and Bicknell's Thrush at the Proposed Lempster Mountain Wind Power Project Lempster, New Hampshire. Prepared for Lempster Wind, LLC. |
| Howard, Steuben Cty, NY | Agricultural plateau | April 3 to May 19 | 9 | 52.5 | 260 | 11 | 4.95 | (125 m) 64% | Woodlot Alternatives, Inc. 2006d. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Howard Wind Power Project in Howard, New York. Prepared for Everpower Global. |
| Chateaugay, Franklin Cty, NY | Great Lakes plain/ADK foothills | April 19 to April 28 | 3 | 21 | 47 | 12 | 1.9 | (121 m) 3% | New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008. |
| St. Lawrence, Jefferson Cty, NY | Great Lakes Shore | April 14 to May 12 | 4 | 12 | 91 | 8 | 7.5 | (125 m) 81%** | New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008. |
| Cape Vincent, Jefferson Cty, NY | Great Lakes Shore | April 14 to May 12 | 4 | 12 | 79 | 10 | 6.5 | (125 m) 72% | New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008. |
| Stockton, Chautauqua Cty, NY | Great Lakes plain/ADK foothills | n/a | n/a | n/a | n/a | n/a | 4.65 | n/a | New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008. |
| **Spring 2007** | | | | | | | | | |

**Appendix D Table 5**. Summary of available spring raptor data at proposed wind sites in the East 1999-2008

| Project Site | Landscape | Survey Period | # of Survey Days | # of Survey Hours | Total # Observed | # of Species Observed | Seasonal Passage Rate (raptors/hr) | (Turbine Ht) and % Raptors Below Turbine Height | Full citation |
|---|---|---|---|---|---|---|---|---|---|
| St Lawrence, Jefferson Cty, NY | Great Lakes Shore | March 21 to May 1 | 7 | 21 | 232 | 8 | 15.4 | (125 m) 81%** | New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008. |
| Cape Vincent, Jefferson Cty, NY | Great Lakes Shore | March 21 to May 1 | 7 | 21 | 205 | 9 | 9.8 | (125 m) 72% | New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008. |
| New Grange, Chautauqua Cty, NY | Great Lakes plain/ADK foothills | April 26 to May 22 | 5 | n/a | n/a | n/a | 4.37 | n/a | New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008. |
| Jericho Rise, Franklin Cty, NY | Great Lakes plain/ADK foothills | April 4 to May 28 | 8 | 32 | 112 | 10 | 3 | (125 m) 74.6% | New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008. |
| Stetson, Penobscot Cty, ME | Forested ridge | April 26 to May 4 | 9 | 59 | 34 | 10 | 0.6 | (125 m) 65% | Woodlot Alternatives, Inc. 2007b. A Spring 2007 Survey of Bird and Bat Migration at the Stetson Wind Project, Washington County, Maine. Prepared for Evergreen Wind V, LLC. |
| Laurel Mountain, Preston Cty, WV | Forested ridge | March 30 to May 17 | 10 | 63.75 | 266 | 12 | 4.17 | (125 m) 55% | Stantec Consulting. 2008b. A Spring 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Laurel Mountain Wind Energy Project near Elkins, West Virginia – November 2007. Prepared for AES Laurel Mountain, LLC. |
| **Spring 2008** | | | | | | | | | |
| Oakfield, Aroostock Cty, ME | Agricultural plateau | April 25-May 30 | 12 | 79 | 58 | 9 | 0.7 | (120 m) 80% | Stantec Consulting. 2008c. Spring and Summer 2008 Bird and Bat Migration Survey Report Visual, Radar, and Acoustic Bat Surveys for the Oakfield Wind Project in Oakfield, Maine. Prepared for First Wind Management, LLC. |

**Appendix D Table 5**. Summary of available spring raptor data at proposed wind sites in the East 1999-2008

| Project Site | Landscape | Survey Period | # of Survey Days | # of Survey Hours | Total # Observed | # of Species Observed | Seasonal Passage Rate (raptors/hr) | (Turbine Ht) and % Raptors Below Turbine Height | Full citation |
|---|---|---|---|---|---|---|---|---|---|
| Roxbury, Oxford Cty, ME | Forested ridge | March 11 to May 27 | 15 | 97 | 118 | 12 | 1.2 | n/a | Stantec Consulting. 2008d. Spring 2008 Bird and Bat Migration Survey Report Breeding Bird, Raptor, and Acoustic Bat Surveys for the Record Hill Wind Project Roxbury, Maine. Prepared for Record Hill Wind, LLC. |
| Lincoln, Penobscot Cty, ME | Forested ridge | April 3 to June 3 | 15 | 108 | 122 | 12 | 1.1 | (125 m) 76% | Stantec Consulting. 2008e. Spring 2008 Bird and Bat Migration Survey Report Visual, Radar, and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for First Wind Management, LLC. |
| Greenland, Grant Cty, WV | Forested ridge | March 21 to May 14 | 10 | 68 | 212 | 9 | 3.12 | (125 m) 68% | Stantec Consulting. 2008f. Spring, Summer, and Fall 2008 Bird and Bat Migration Survey Report Visual, Radar, and Acoustic Bat Surveys for the New Creek Mountain Project West Virginia. Prepared for AES New Creek, LLC. |
| Highland, Maine | Forested ridge | March 25 to May 19 | 12 days Witham, 8 days Briggs | 139 | 260 | 12 | 1.87 | (130.5 m) Whitham 80 %, Briggs 86% | *this report* |
| *Calculated for spring and fall combined. | | | | | | | | | |
| **Calculated for spring and fall 2006 and 2007 combined. | | | | | | | | | |
| ***Non-migrants were not included in seasonal passage rates in NYSDEC 2008 table but were included in passage rates here. | | | | | | | | | |

# Appendix 12-2