STATE OF VERMONT
PUBLIC SERVICE BOARD

Docket No. _____

Petition of UPC Vermont Wind, LLC for a Certificate of	)
Public Good pursuant to 30 V.S.A. section 248,	)
authorizing it to construct up to a 52 MW wind electric	)
generation facility, and associated transmission and	)
interconnection facilities, in Sheffield and Sutton, Vermont,	)
and operate the same.	)

PREFILED DIRECT TESTIMONY OF ROBERT D. ROY

ON BEHALF OF UPC VERMONT WIND, LLC

February 21, 2006

Summary:

Mr. Roy discusses the on-site studies and other assessments of breeding and migrating birds, bats, and other wildlife (except large mammals) that have been conducted, and he provides an opinion on the potential impact of the proposed Sheffield Wind Farm on these wildlife species. He concludes that the Project is not likely to have an undue adverse impact on wildlife species present at or near the project site.

Q. Please state your name, address and occupation.

Response. Robert D. Roy, Woodlot Alternatives, Inc., 30 Park Drive, Topsham, Maine 04086. My occupation is that of wildlife biologist.

Q. Briefly describe your background and experience.

Response. I earned my Bachelor of Science degree from the University of Maine in 1992. I am approved as a certified Wildlife Biologist by The Wildlife Society, a national organization of professional wildlife biologists. I have conducted a large number of wildlife use and impact assessment projects.

I first began conducting nighttime radar studies of bird migration in 1994, when investigating migration patterns in the vicinity of a proposed wind energy development in the Boundary Mountains of western Maine. Since then, I have conducted a large number of daytime raptor migration and nighttime radar and bat detector studies in the Northeast and central Atlantic states in a variety of landscape settings, including high linear ridgelines, individual mountain tops, the Great Lakes plain, and rolling agricultural landscapes. In total, I have conducted and overseen approximately three dozen seasonal radar migration studies from Maine to West Virginia. Some of these studies have used other methods to investigate bird and bat movements and habitat use, including acoustical recording devices, ceilometers, night-vision equipment, thermal imaging cameras, and visual observations of morning migration movements and daytime surveys of migrants foraging during stopover events.

In Vermont, I have conducted and overseen several radar and acoustic surveys of nocturnal bird and bat migration, along with several diurnal raptor migration surveys. One

of the Vermont studies occurred in northern Vermont, while the other two, including surveys at the existing wind facility at Searsburg, were in southern Vermont.

My resume is attached as ***Exhibit UPC-RR-1***.

Q. Have you previously provided testimony to the Public Service Board?

Response. Yes. In the winter of 2005, I provided testimony on behalf of EMDC, LLC regarding the East Haven Windfarm. Additionally, I provided expert testimony regarding radar and bat detector studies I conducted on behalf of a proposed project in West Virginia.

Q. What is the purpose of your testimony?

Response. The purpose of my testimony is to review the on-site studies regarding breeding and migrating birds, bats, and other wildlife (except large mammals including deer, bear and moose) that have been conducted, and to provide an opinion on the potential impact of the proposed Sheffield Wind Farm on day and night migrating birds and bats. I conclude that the project is not likely to have an undue adverse impact on wildlife species.

Woodlot's bird and bat-related field studies are provided as ***Exhibits UPC-RR-2 through -5.*** Other on-site studies are discussed in Woodlot's Sheffield Wind Farm Wildlife Habitat Summary and Assessment, ***Exhibit UPC-RR-6***, which includes the following reports as attachments:

Appendix A	Raptor Migration Survey Summary Data
Appendix B	Supplemental Report – Late Spring Bird Survey, submitted by Devine Tarbell & Associates, Inc. February 2, 2005.
Appendix C	Supplemental Report – Breeding-Bird Season Survey submitted by Normandeau Associates, Inc. June 2005.

Appendix D	Supplemental Reports – Wildlife Assessment Reports submitted by Wildworks Woodland Management. March 21, June 21, and October 18, 2004; February 7 and March 14, 2005.
Appendix E	Supplemental Report – Bat Survey Summary Report submitted by Woodlot Alternatives, Inc. January 5, 2006.
Appendix F	Site Review of Critical Habitats for White-tailed Deer, Moose and Black Bear submitted by Multiple Resource Management, Inc. February 17, 2006.

Q. Please generally describe the on-site work you or others have conducted to assess the potential impact of the Sheffield Wind Farm to migrating birds and bats.

Response. Woodlot conducted migration studies at the Sheffield Wind Farm project area during three different seasons. During the Fall of 2004, a visual survey of raptor migration, a radar survey of night-time bird and bat migration, and a detector survey for migrating bats were conducted (***Exhibit UPC-RR-2***). During the Spring of 2005, these same surveys were repeated (***Exhibit UPC-RR-3***). A third season of bat detector data was collected during the late-summer and Fall of 2005, which is summarized with the other bat data in ***Exhibit UPC-RR-4***. Finally, an assessment of potential eastern small-footed bat (*Myotis leibii*) habitat was conducted in the Fall of 2005 (***Exhibit UPC-RR-5***).

Raptor Surveys

Q. Please describe the methods used to characterize use of the Sheffield Wind Farm project area by migrating raptors.

Response. Raptor migration surveys were conducted by Woodlot in the Fall of 2004 and Spring of 2005. See ***Exhibits UPC-RR-2 and -3*** and Appendix A of ***Exhibit UPC-RR-6*** or further details. The Fall 2004 survey took place near the peak of Hardscrabble Mountain

and near the peak of Barrett Mountain (an unnamed peak just west of Norris Mountain). This mountain will heretofore be referred to as Barrett Mountain). The Spring 2005 survey took place from the survey site located near the peak of Hardscrabble Mountain.

Ten days of raptor migration surveys were conducted during the Fall of 2004 (September 11 to October 14, 2004), and ten days of surveys were conducted during the Spring of 2005 (April 5 to May 10, 2005). Surveys were generally conducted from 9 am to 3 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. Surveys were targeted for days with favorable flight conditions produced by low-pressure systems bringing southerly winds, and days following the passage of a weather front were targeted as survey days.

Surveys were based on methods used by the Hawk Migration Association of North America (HMANA). Raptor observations were recorded onto HMANA data sheets, which summarize the identification observations for each species by hour. Additional details, including location and flight path, flight height, and activity of the animal, were also recorded for each observation.

The field observations were summarized by species for each survey day and for the whole survey period. From this summary, a tally of the total number of individuals observed for each species and the observation rate (birds per hour) was prepared. The number and species composition of raptors observed flying below and above the approximate maximum height of the proposed turbines was calculated based on this information. Finally, the mapped flight paths of individual birds were reviewed to identify any overall patterns for migrating raptors.

Q. What were the results of the raptor migration surveys at the Sheffield Wind Farm project area?

Response. A total of 194 raptors, representing 10 species, were observed during the Fall 2004 survey, yielding an observation rate of 3.2 birds/hour. During the Spring 2005 survey, 98 raptors representing 10 species were observed, yielding an overall observation rate of 1.6 birds/hour.

Broad-winged hawks *(Buteo platypterus)* were the most commonly observed species. The next most common species included red-tailed hawks (*Buteo jamaicensis*), sharp-shinned hawks (*Accipiter striatus*), turkey vultures (*Cathartes aura*), and osprey (*Pandion haliaetus*).

During both seasons, flight heights were categorized as below or above 125 m (410'), which is slightly above the height of the proposed turbines. During Fall 2004, approximately 31% of the raptors observed were flying below this height while approximately 70% of raptors observed during the Spring 2005 survey were flying below it. Differences in flight altitudes between species were observed, with small species, such as the accipiters (true hawks) and falcons, typically flying lower than larger species.

Q. How do the results of raptor surveys at the Sheffield Wind Farm compare with other studies?

Response. The passage rates observed at the Sheffield Wind Farm were low compared to the results from other hawk watch sites in the region for which data was available. During Fall 2004, the other regional sites with available data had observation rates that varied from 14.6 to 70.2 birds/hour, which are 4.5 to 22 times greater than at the Sheffield Wind Farm. During Spring 2005, observation rates at the other regional sites with available data were 8.5

to 68.8 birds/hour, which are 5.2 to 43 times greater than the project area. Tables providing the results of counts at these other regional sites are provided in Appendix A of each of the two seasonal survey reports (***Exhibits UPC-RR-2 and RR-3***).

This species composition at the Sheffield Wind Farm was generally similar to other sites in the region. This is largely due to the fact that the common species observed in the project area are generally the most abundant species in the northeast.

Q. Based on the information from the project site, other wind generation projects, and the literature, do you expect the project to have an undue adverse impact to any population of raptors? Please explain.

Response. No. While the original concern about avian collisions at wind energy developments arose from observations of possibly biologically significant high mortality rates of hawks and eagles at the Altamont Pass and Solano County Wind Resource Areas in California in the 1990's (Orloff and Flannery 1992, Hunt 2002), raptor mortality at newer facilities has since proved to be very low.

The high rates of mortality that have been found in California, particularly at Altamont Pass, are attributable to at least five factors. These include: high raptor density, high prey density, high turbine density, short lattice towers, and fast spinning blades that blur at high wind speeds. The combination of these factors is unique to projects within California, although not all projects within that state include all of those factors.

Newer projects have significantly different characteristics than those found at Altamont Pass and other California developments with high raptor density. In general, newer sites have much lower raptor density and probably lower prey densities (Erickson *et al.*

2002). Additionally, newer developments have widely spaced turbines, tall tubular towers and blades that spin slow enough to be visible even at high wind speeds.

The result from these characteristics is that fewer raptors have been documented colliding with wind turbines than at the Altamont Pass facilities. In fact, hardly more than ten raptors have been found at all projects outside of California that have been used for mortality surveys. For example, Erickson *et al.* (2002) report that buteo mortality has been documented at only one facility (Buffalo Ridge, MN), as of early 2002, despite similar levels of buteo use as at Altamont Pass. Additional incidents of raptor mortality at newer wind energy facilities have since been documented. Young *et al.* (2003) report small numbers of several species killed at the Foote Creek Rim Wind Plant in Wyoming, including American kestrel (*Falco sparverius*), northern harrier (*Circus cyaneus*), and short-eared owl (*Asio flammeus*). One red-tailed hawk has been found at the Top of Iowa Wind Farm in north-central Iowa (Koford *et al.* 2005) during two years of mortality searches. One sharp-shinned hawk and one turkey vulture were found at the Mountaineer Wind Energy Center in West Virginia (Arnett 2005). All of these reported incidents of mortality compare with more than 100 raptors/year found at Altamont Pass, and estimates of thousands killed annually at that facility.

The Sheffield Wind Farm shares all of the characteristics of other modern wind energy developments outside of California. Raptor density is low, particularly during the migration period. Surveys at the site suggest no significant migration of raptors through the project area, although small numbers of raptors were observed. This is likely due to a lack of landscape features (i.e. long linear ridgelines, valleys, and coast lines) that could concentrate migration activity at the project area. Rather, the surrounding landscape consists of a series

of interrupted ridges and individual peaks that migrating raptors use as stepping stones as they pass through the area.

The anticipated mortality at the Sheffield Wind Farm facility is expected to be similar to that observed at other facilities at which mortality surveys have occurred. Specifically, raptor fatalities are expected to be uncommon. This is due to their daytime habits, which allow raptors to be aware of and avoid the turbines. Turbine density in the project area will be very low. Most importantly, wind turbines will consist of tall tubular towers and slow moving blades. Consequently, I believe that the Sheffield Wind Farm project is no different from other modern facilities that have resulted in no or little impact to raptors, and the risk of raptors colliding with the proposed turbines is very low.

Bird and Bat Radar Surveys

Q. Please briefly describe the radar surveys conducted at the Sheffield Wind Farm.

Response. Radar surveys were conducted in the Fall of 2004 and the Spring of 2005. Detailed descriptions of the methods used during the surveys are provided in the two study reports (***Exhibits UPC-RR-2 and UPC-RR-3***). The Fall survey was conducted over 18 nights from September 26 to November 3, 2004, and the Spring survey was conducted on 20 nights from April 26 to May 27, 2005. The surveys were conducted from the same site during both seasons. This site was just west of the peak of Hardscrabble Mountain. The radar used was an X-band marine surveillance radar with a peak output of 12 kilowatts (kW).

The radar was operated from sunset to sunrise during each night of operation. During each hour of the night, the radar was operated in horizontal and vertical modes. In horizontal mode, the antenna spins horizontally and the number and flight direction of

targets can be documented. In vertical mode, the antenna is rotated 90º and spins vertically, like the propeller of a plane. In this mode, the height of targets above the radar can be documented. The radar was operated at a range of 0.75 nautical miles, or 1.4 kilometers. At this range, all of Hardscrabble Mountain was included within the detection area of the radar, as was the peak of Grout Mountain, west of the radar. The limit of the radar detection range is provided in maps.

During each hour of observation, fifteen minutes of video recordings of the radar in horizontal operation were recorded and ten minutes of the radar in vertical operation were recorded. The video samples were analyzed using a digital video analysis software tool developed by Woodlot. For horizontal samples, targets were identified as birds and bats rather than insects based on their speed. The speed of targets was compared with wind speed and direction; targets traveling faster than approximately 6 m per second were identified as a bird or bat target. The software tool recorded the time, location, and flight vector for each target traveling fast enough to be a bird or bat. The results for each sample were output to a spreadsheet. For vertical samples, the software tools recorded the entry point of targets passing through the vertical radar beam, the time, and flight altitude above the radar location. The results for each sample were output to a spreadsheet. These datasets were then used to calculate passage rate (reported as the number of targets/kilometer/hour or t/km/hr), flight direction, and flight altitude of targets. These metrics were calculated hourly and summarized by night and for each season.

Q. What were the results of the radar surveys at the Sheffield Wind Farm project area?

Response. For consistency, the same radar site was used during both the Fall 2004 and Spring 2005 radar studies. The results of each night of sampling are presented in Table 1 and are summarized here. Fall passage rate was 91±18 targets/kilometer/hour. Due to topography and vegetation, it was determined during the data analysis phase of the project that a portion of the airspace around the radar was not being adequately sampled by the radar. Specifically, small stands of trees on slopes east and southeast of the radar were blocking more of the radar beam than desired. Over the course of the entire data analysis period, it was determined that these trees blocked 20-25 percent of the surrounding airspace. Consequently, the mean Fall 2004 passage rate was estimated to be approximately 20 to 25 percent higher than calculated, or approximately 109 to 114 t/km/hr.

The mean Spring passage rate was 166 ± 31 t/km/hr. Taking into account the same vegetation blocking effect identified above, the Spring results were also 'corrected' for the loss of visibility and were determined to be 20-25 percent greater than reported, or approximately 199 to 208 t/km/hr.

Table 1. Comparison of results from Sheffield Wind Farm radar surveys in fall 2004 and spring 2005

	Fall 2004	**Spring 2005**
Overall Passage Rate	114 t/km/yr	208 t/km/yr
Flight Direction	200º ± 63º	40º ± 52º
Flight Height	566 ± 31 m	522 ± 96 m
Seasonal Average flight height below 125 m	1%	6%

The mean flight height of targets above the radar locations was similar, being 566 m ± 31 m in the Fall survey and 522 m ± 96 m in the Spring survey. This resulted in 1 percent of targets observed in the Fall survey flying below the proposed turbine height of approximately 125 m. The greater variation and lower mean flight height in the Spring resulted in approximately 6 percent of the targets flying below the approximate maximum turbine height.

Flight direction during the Fall and the Spring seasons was nearly opposite. The Fall radar survey documented a mean flight direction of 200° ± 3° indicating targets were moving to the southwest while the Spring survey saw a mean flight path of 40° ± 52°, to the northeast. Flight paths from both seasons were observed to take migrants perpendicular to the ridgeline between Hardscrabble and Grout Mountains indicating there is no affect from local landscape features on bird movement through the proposed project area.

Q. How do the results of radar surveys at the Sheffield Wind Farm compare with other studies?

Response. The passage rates observed during both the Fall and the Spring migration seasons were less than, though generally similar to, passage rates observed in similar studies in the northeast. However, it should be noted that few surveys using the same methods and equipment and conducted during the same time period are available for comparison. Additionally, not all radar studies are perfectly comparable. The selection of a radar survey site is an important determinant of how effectively radars can detect birds in the surrounding airspace. The limited visibility of the radar site in the project area is a good example of this.

Due to this important, but highly variable factor, radar studies at different locations are not always equally comparable.

Differences in the overall passage rates could also be due to several factors. Surveys conducted during different years can yield different results, as the size of the continental bird population likely changes year-to-year. Weather patterns may differ from year-to-year and could affect the timing of migration. Different surveys may be timed at different points within those varying migration seasons. Available studies using similar methods are provided in Table 2. As mentioned above, not all radar studies are perfectly comparable but these data are provided because similar equipment and sampling techniques were used at all of these studies.

Table 2. Summary of passage rates from other radar studies

Fall			
Year	**Location**	**Passage Rate (t/km/hr)**	**Reference**
1994	Western Maine	551	ND&T 1995a
1994	Martinsburg, NY	225	Cooper *et al.* 1995
1998	Harrisburg, NY	122	Cooper and Mabee 1999
1998	Wethersfield, NY	168	Cooper and Mabee 1999
2003	Chautauqua, NY	238	Cooper *et al.* 2004a
2003	Mt. Storm, WV	241	Cooper *et al.* 2004b
2004	Prattsburgh, NY	200	Mabee *et al.* 2005
2004	Prattsburgh, NY	193	Woodlot 2005e
2004	Searsburg, VT	178	Woodlot 2005f
2005	Searsburg, VT	559	Woodlot 2005g
2004	Sheffield, VT	114	Woodlot 2005a
Spring			
1994	Western Maine	99	ND&T 1995b
1994	Carthage, NY	159	Cooper *et al.* 2004c
1999	Weathersfield, NY	41	Cooper *et al.* 2004c
2003	Chautauqua, NY	395	Cooper *et al.* 2004c
2005	Prattsburgh, NY	277	Woodlot 2005h
2005	Searsburg, VT	404	Woodlot 2005i
2005	Sheffield, VT	208	Woodlot 2005b

Fewer results are available for nighttime migration flight height than passage rate. Studies using similar techniques as those used at the Sheffield Wind Farm are provided in Table 3. The flight heights documented at the Sheffield Wind Farm are within the range of the heights documented at those other studies. Interestingly, it appears that flight height is generally quite high or at least consistently greater than the approximate maximum height of modern wind turbines across a fairly wide geographic area.

Table 3. Summary of flight heights from other radar studies

Year	Location	Flight Height (m)	Reference
Fall			
2003	Chautauqua, NY	532	Cooper *et al.* 2004a
2003	Mt. Storm, WV	410	Cooper *et al.* 2004b
2004	Prattsburgh, NY	365	Mabee *et al.* 2005
2004	Searsburg, VT	566	Woodlot 2005f
2005	Searsburg, VT	395	Woodlot 2005g
2004	Sheffield Wind Farm, VT	566	Woodlot 2005a
Spring			
2003	Chautauqua, NY	528	Cooper *et al.* 2004c
2005	Prattsburgh, NY	319	Mabee *et al.* 2005b
2005	Searsburg, VT	523	Woodlot 2005i
2005	Sheffield Wind Farm, VT	522	Woodlot 2005b

Q. Please generally describe the on-site work you or others have conducted to assess the potential impact of the Sheffield Wind Farm to breeding birds.

Response. Breeding bird surveys were conducted by DTA in 2004 and NAI in 2005. As part of the breeding bird survey in 2004, WWM conducted raptor nest surveys which included searches for active and inactive nests. See Appendices B and C of ***Exhibit UPC-RR-6***.

The preliminary surveys conducted in 2004 documented a variety of species common to both mature and second-growth northern hardwood forests. These included, among other species, common raven (*Corvus corax*), blue jay (*Cyanocitta cristata*), hermit thrush

(*Catharus guttatus*), veery (*C. fuscescens*), blue-headed vireo (*Vireo solitarius*), chestnut-sided warbler (*Dendroica pensylvanica*), ovenbird (*Seiurus aurocapillus*), black-throated green warbler (*D. virens*), black-throated blue warbler (*D. caerulescens*), yellow-rumped warbler (*D. coronata*), rose-breasted grosbeak (*Pheucticus ludovicianus*), dark-eyed junco (*Junco hyemalis*), and white-throated sparrow (*Zonotrichia albicollis*).

Of the 43 bird species observed during the 2005 point count surveys, the 5 most common species were black-throated blue warbler, ovenbird, black-throated green warbler, red-eyed vireo (*Vireo olivaceus*), and winter wren (*Troglodytes troglodytes*). Other frequently observed birds include the Swainson's thrush (*Catharus ustulatus*), dark-eyed junco, hermit thrush, yellow-bellied sapsucker (*Sphyrapicus varius*), American robin (*Turdus migratorius*), and magnolia warbler (*Dendroica magnolia*). Swainson's thrush occurred at higher elevations, and the peaks on which it was observed probably represent the only suitable nesting habitat in the project site for this species. Recently cut forest edge species observed included white-throated sparrows, chestnut-sided warbler, common yellowthroat (*Geothlypis trichas*), and mourning dove (*Zenaida macroura*). The forest generalists include blue jay, rose-breasted grosbeak, black-and-white warbler (*Mniotilta varia*), and black-capped chickadee (*Poecile atricapillus*) (NAI 2005).

Surveys for nesting raptors were conducted in April, May, and June 2004. These included playback surveys and searches for old nests (WWM 2005b; Appendix D). The calls produced no response and no old or existing raptor nests were observed within the project site. However, one adult northern goshawk (*Accipiter gentiles*) exhibiting territorial behavior was observed during the point counts (NAI 2005). This was observed in an area of suitable

nesting habitat located approximately 1.2 km (0.75 mi) to the west of the proposed development area on Hardscrabble Mountain.

A species that was taken into special consideration during field surveys was the Bicknell's thrush (*Catharus bicknelli*), which is rare and uncommon in Vermont. This species nests in spruce-fir forests above 1000 m (3,000'). Habitat degradation has caused the Bicknell's thrush breeding range to decrease over the past several years and birds have disappeared from various historical sites (Chipley *et al.*, 2003). The elevation of the project area at all sites is lower than 792 m (2,600'). Therefore, the Bicknell's thrush would not be expected to breed within the project area. Spring 2004 surveys examined potential nesting habitat for the Bicknell's thrush but determined that habitat was not suitable due to the project site's elevation and forest characteristics. Bicknell's thrush were not observed during any of the wildlife surveys or breeding-bird surveys conducted at the project site (NAI 2005, WWM 2005b).

Q. Based on the information from the project site, other wind generation projects, and the literature, do you expect the project to have an undue adverse impact to any population of breeding or migrating birds (including threatened or endangered species)? Please explain.

Response. No, I do not expect the project to have an undue adverse impact to populations of night migrants. Woodlot prepared an assessment of the potential risk to migrating birds of collisions with the proposed wind turbines, included in ***Exhibit UPC-RR-6*** to this testimony. That assessment provides details regarding known collision related mortality at

existing wind facilities in the United States and site-specific information that helps characterize the potential effect of the project relative to those found at other facilities.

To date, the number of passerine fatalities observed by collisions with wind turbines in the United States and Europe has been relatively small. The primary reason that migrating passerines are infrequently killed appears to be that these birds migrate at altitudes above the sweep area of wind turbines. Erickson *et al.* (2001, 2002) provided a summary of known avian collisions with wind turbines, which are often calculated as the number of fatalities/turbine/year. Those rates varied from 0 to 4.5 fatalities/turbine/year with most of the reported rates being less than 2 fatalities/turbine/year.

Subsequent work has generally provided similar results with respect to avian fatalities at existing wind farms. They estimate an average of 2.19 bird fatalities per wind turbine per year in the United States. This average rate includes the fatalities at the California wind projects, which, as described above, are greater than more modern wind projects. Recognizing that sites in California have significantly more fatalities than elsewhere, the estimated fatality rate outside of California is approximately 1.83 fatalities per turbine per year (corrected for searcher efficiency and scavenging).

Wind turbine-related fatalities are rather small compared to fatality events reported at other types of tall structures, such as tall communications towers and buildings, which have frequently included hundreds to thousands of birds (Woodlot 2003). In fact, estimates of mortality from existing wind facilities across the United States are quite small relative to other forms of collision and non-collision-related avian mortality (Table 4). As the table indicates, estimates of mortality at wind energy facilities is orders of magnitude lower than estimates of mortality from other sources.

Table 4. Summary of nation-wide bird mortality estimates		
Structure/Cause	**Total Bird Fatalities**	**Reference**
Vehicles	60 - 80 million	1
Building and Windows	98 - 980 million	2
Powerlines	10,000 - 174 million	1
Communication Towers	4 - 50 million	1
Agricultural Pesticides	67 million	3
Housecats	100 million	4
Wind Generation Facilities	10,000 - 40,000	1
1 Erickson *et al.* 2001 2 Klem 1991 3 Pimentel and Acquay 1992 4 Coleman and Temple 1993		

Further, the on-site data collected from the project area indicates that the majority of night migrants are at little risk of collision with the turbines based on flight height. The mean flight height was well above the approximate maximum height of the proposed turbines and a small percentage of targets (1 percent during the Fall 2004 survey and 6 percent during the Spring 2005 survey) were documented below turbine height. Considering that only a portion of those night migrants flying below turbine height would actually be flying near one of the proposed turbines, and that those individuals may actually see and attempt to avoid the turbines, undue adverse impacts to populations of night migrating birds are not anticipated.

Bat Surveys

Q. Please briefly describe the bat surveys conducted at the Sheffield Wind Farm.

Response. Bat detector surveys have been conducted in the project area for three migration seasons. The results of these surveys have been provided in a report, attached as ***Exhibit***

UPC-RR-4. Additionally, Woodlot conducted an assessment of potential summer maternity roost habitat for the eastern small-footed bat (Myotis leibii), attached to this testimony as ***Exhibit UPC-RR-5***.

The migration season surveys involved the deployment of one to four detectors within the guy wire array of the on-site meteorological measurement towers (met towers). During the first two migration seasons (Fall 2004 and Spring 2005), up to two Anabat II® detectors and storage ZCAIM units were deployed, depending on equipment availability.

When one detector was deployed, it was suspended at a height of approximately 20 m, and when two detectors were deployed the second was suspended at a height of approximately 10 m. During the first two seasons, the detectors were deployed in the lower met tower on Hardscrabble Mountain. During the Fall 2005 surveys, one to two detectors (again, based on equipment availability) were placed in two met towers: the upper tower on Hardscrabble Mountain and the tower on Barrett Mountain[1].

Potential call files were extracted from data files using CFCread© software. This software screens all data recorded by the bat detector and extracts call files using a filter. The filter simply removes files created by noises other than bat calls based on the characteristics of the call file and the established characteristics of northeastern bat calls. Following this initial screening, each file was visually inspected to ensure that files created by static or some other form of interference that were still within the frequency range of northeastern bats were removed from the data set. Call sequences were identified based on visual comparison of call sequences with reference libraries of known calls provided by

[1] The unnamed peak west of Norris Mountain is locally known as Barrett Mountain. While published maps do not show this, it will hereafter be referred to as Barrett Mountain in this report.

nationally-recognized bat experts, including Lynn Robbins and Chris Corben, who is also the developer of the Anabat software.

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). Using this method, many of the bat species of Vermont are identified with relative ease. Bats of the genus *Myotis* are generally difficult to distinguish from one another, so these were simply grouped into an overall *myotid* category. Additionally, calls of big brown bats (*Eptesicus fuscus*) and silver-haired bats (*Lasionycteris noctivagans*) are sometimes difficult to distinguish from one another. Consequently, care was taken when calls of these species were encountered. Finally, poor quality recordings or brief call fragments were typically labeled as "unknown".

In addition to this, an assessment of potential habitat for the eastern small-footed bat was conducted. This assessment was a desktop study of the project area and the surrounding area within three miles of the proposed turbine locations and was conducted in accordance with methods discussed with and accepted by the Vermont Fish & Wildlife Department (FWD). A digital elevation model of the project area vicinity was analyzed to identify all areas with slopes steeper than 30 degrees, as these areas could be steep enough to contain areas of open cliffs or talus slopes. Two years of aerial photography was then assessed to identify if any areas of open rock occurred within those steep areas. All areas with these criteria were mapped and provided in a summary report of that assessment.

Q. What were the results of the bat surveys at the Sheffield Wind Farm project area?

Response. Overall, a total of 357 bat calls were recorded during 322 detector-nights of sampling over the three migration seasons. This results in an overall detection rate of 1.1 calls/detector/night and Spring and Fall detection rates of 0.17 calls/detector/night and 1.2 calls/detector/night, respectively. A brief summary of the results from each of the three migration seasons and the small-footed bat habitat assessment are provided below.

Fall 2004 Bat Survey

Seventeen detector nights were recorded from September 10-15 and October 17-21, during the Fall 2004 acoustic surveys (Table 5). During this time, 30 bat call sequences were recorded. The overall detection rate during the survey was 1.76 calls/detector/night. Of the 30 sequences recorded, 28 were *myotids* and 2 were identified as big brown bat.

Spring 2005 Bat Survey

The Spring 2005 bat survey resulted in 35 detector nights from May 1 to May 31. Only six bat call sequences were recorded during that time period, four of which were *myotids* (Table 5). Of the remaining two species, one was either a big brown bat or a silver-haired bat and the other was a hoary bat (*Lasiurus cinereus*). The mean detection rate during the survey period was 0.17 calls/detector/night.

Fall 2005 Bat Survey

Two to four detectors were operated on Hardscrabble and Barret Mountains from July 15 to October 9, 2005 resulting in a total of 270 detector nights (Table 5). A total of 234 bat call sequences were recorded at Hardscrabble Mountain (mean detection rate of 1.72 calls/detector/night) and 87 were recorded at Barrett Mountain (mean detection rate of 0.65 calls/detector/night).

Sixty percent of the calls recorded at Hardscrabble Mountain were identified as silver haired bats, 13 percent were myotids, 13 percent were identified as unknown, and 10 percent were identified as big brown bats. Hoary bat calls and eastern red bat calls (*Lasiurus borealis*) were infrequent and constituted 3 percent and less than 1 percent of the recorded calls, respectively.

Unlike Hardscrabble Mountain, *myotids* were recorded most frequently (48 %) at Barrett Mountain. These were followed by big brown bat and unknown calls, each of which comprised 17 percent of all calls. Additionally, 8 percent of calls were identified as from hoary bats, 7 percent from eastern red bats, and 3 percent as from silver haired bats.

Table 5. Summary of bat detector field survey effort and results

Season/Location	Dates	# Nights	# Detector-Nights	# Recorded bat passes	Detection Rate*	Maximum passage rate recorded**
Fall 2004 Hardscrabble	Sep 10-Oct 21	11	17	30	1.76	18
Spring 2005 Hardscrabble	May 1-May 31	31	35	6	0.17	2
Fall 2005 Hardscrabble	Jul 15-Oct 9	87	136	234	1.72	101
Fall 2005 Barrett	Jul 16-Oct 9	86	134	87	0.65	16
* Number of bat passes recorded per detector-night						
** Maximum number of bat passes recorded from any single detector for a 12-hour sampling period						

Small Footed Bat Habitat Assessment

This survey suggested only one area with potentially suitable maternity roost habitat exists wholly within three miles of any of the proposed turbines. This site was a south-facing cliff approximately 1,800 feet above sea level near the summit of Simpson Hill, just southeast of Duck Pond in Sheffield, Vermont.

Five other sites located just beyond the northern periphery were identified as having potentially suitable maternity roost habitat. One of these sites extends into the northern end

of the 3 mile periphery from the project. This east facing cliff is one of the larger cliffs located on the west shore of Lake Willoughby.

Through this process, it was determined that small-footed bat habitat does occur in the vicinity of the proposed Sheffield Wind Farm. This habitat, however, is limited. The analysis indicated that much more potential habitat for maternity roosts occurs just outside of the 3-mile buffer zone around the project area that ANR recommended be used for the assessment.

Q. How do these acoustic bat survey results compare with other similar studies or what might be expected in the area?

Response. Few other studies are available with which to compare the bat detector survey results from the Sheffield Wind Farm project area. However, of those that are available, bat mortality estimates are also available. These studies are presented in Table 6. As the table shows, the bat detector survey results from the Sheffield Wind Farm (overall, 1.1 calls/detector/night) are lower than any of those available studies.

Table 6. Mortality and bat activity indices for five wind projects.

Site	Bat Mortality (#/turbine/year)	Bat activity (#/detector/night)	Source
Mountaineer, WV	38	41	1
Buffalo Mtn., TN	28	30	2, 1
Buffalo Ridge, MN	2.2	1.9	3
Foote Creek Rim, WY	+/- 2	+/- 2	4, 1
Top of Iowa, IA	1.88	N/A	5

1 – Arnett 2005
2 - Erickson et al 2002
3 - Johnson et al. 2004
4 – Young et al. 2003
5 – United States Government Accountability Office 2005

Q. Based upon all of the relevant information from the project site, other wind projects, and the literature, do you expect the Sheffield Wind Farm to have an undue adverse impact on any population of resident or migrating bats or to destroy or significantly imperil any necessary bat habitat? Please explain.

Response. Bat mortality at wind projects in the eastern United States has recently been identified as a potential risk to certain bat populations (Williams 2003). Researchers currently have limited understanding of the specific factors influencing rates of bat collision mortality, although evidence from the timing of fatalities documented at existing wind facilities and other structures suggests that migrating bats suffer the highest risk, while risk during the summer feeding and pup-rearing period is low (Johnson and Strickland 2004, Johnson *et al.* 2003, Whitaker and Hamilton 1998).

The results of the relatively few studies that have documented bat fatalities at existing wind facilities indicate that the risk of bats colliding with wind turbines can be higher than that for birds. The actual mortality rates observed range from 0.07 to 2.32 fatalities/turbine/year at facilities in open and mixed landscapes in the west and mid-west (Erickson *et al.* 2002) to 46.2 fatalities/turbine/year at facilities located on forested ridgelines in the central Appalachian states (Johnson and Strickland 2004).

The question remains as to how similar bat mortality at the Sheffield Wind Farm will be to that of other facilities that have been studied. As outlined above, bat mortality has generally been documented as low in agricultural areas and higher along forested ridges. The Sheffield Wind Farm is located in a forested landscape and is along mountaintops and ridgelines. However, it is located at the northern extent of the Appalachian Mountains, not

in the central Appalachians, and it is anticipated that impacts to bats will be lower than in those more southern areas.

Perhaps the most applicable method of assessing the risk of the project to bats is to compare detection rates from the Sheffield Wind Project to detection rates at facilities at which bat mortality has also been documented. Those detection and mortality rates are provided in Table 6, above. As the table shows, facilities at which relatively high mortality has been documented have also produced relatively high detection rates. At facilities with low detection rates, relatively few bat fatalities have been documented.

The detection rates at the Sheffield Wind Farm are less than any of those documented at the facilities listed in Table 6. If the relationship between detection rate and fatality apparent in Table 6 holds true for all wind facilities in general, fatality at the Sheffield Wind Farm could be expected to be lower than at all of those facilities. If this is the case, then it is anticipated that fatalities that occur at the Sheffield Wind Farm will not represent an undue adverse affect on bat populations in the vicinity of the project.

Q. Please generally describe the on-site work you or others have conducted to assess the potential impact of the Sheffield Wind Farm to other wildlife species.

Response. A number of natural resource field surveys were conducted in the project area from 2003 to 2005, summarized by Woodlot in a wildlife resources information summary and impact assessment report, ***Exhibit UPC-RR-6***. The surveys that have been conducted include general reconnaissance-level wildlife observation studies during all seasons of the year, surveys in winter to identify tracks of animals using the project area in winter, habitat-specific investigations of large-mammal use of the project area, wetlands mapping, rare plant

and animal surveys, breeding bird point count surveys, bat detector surveys, raptor migration surveys, and nighttime migration surveys using radar.

The surveys listed above provide an abundance of information on the dominant plant and animal communities that occur within the Sheffield Wind Farm Project area. No obvious concentrations of wildlife, rare species, or critical wildlife habitat were observed over the three years when surveys were conducted. In general, the wildlife community present is indicative of the available habitats and includes species common to northern New England. These species are generally common and many are tolerant of the land use practices (i.e. timbering activity) that are common to the area.

Q. Based upon your review, do you expect the Sheffield Wind Farm to have an undue adverse impact to any wildlife population? Please explain.

Response. No, I do not expect that the project will create undue adverse impacts to the wildlife communities in the project area. Many of the common species observed in the project area have rather general habitat requirements or are tolerant to habitat variation within their normal home range. Recent forest harvesting across most of the study area has resulted in a wildlife community adaptable to variable habitat conditions across the landscape and over time. Consequently, the wildlife community present in the project area has generally already responded to changes in habitat (dissection of forested habitats, introduction of young forest stands, increased edge habitat, etc.) that the project would otherwise have created in an uncut forest.

The actual footprint of the project is small, relative to the overall extent of the undeveloped ridges and peaks of Hardscrabble, Barrett, and Norris Mountains. Individual

turbine locations are generally about one acre in size and many of these occur in heavily harvested areas. Additionally, the design of the roads needed for construction and operation of the project have, to the extent possible, used existing roadways that have been constructed for forest harvesting. The overall result of the construction of the project will be relatively little direct habitat loss, and that small loss will be dispersed across a broad area in the landscape.

It is anticipated that disturbance from the project on some local wildlife will occur. In general, this indirect effect (which could include disruption of nesting or decreased use of the habitat immediately adjacent to the turbines) is expected to be greatest during construction. Following construction, these types of effects are expected to become less common and, over time, may disappear altogether. This has been observed for breeding birds at the Searsburg facility, which is the only operating facility in the region with generally similar landscape characteristics. Breeding bird surveys before, during, immediately after, and seven years after construction of that project showed decreased use of the area the year of and the year after construction. Seven years after construction, more species were documented using the area than before construction. While the species documented were generally the same, the abundance of some forest species (the site was entirely forested with mature forest) did decline, and it was determined that the loss in the forested habitat created that effect (Kerlinger 2002, 2003).

It is anticipated that effects of the Sheffield Wind Farm will be similar in that, over time, much of the local wildlife community is expected to utilize habitats immediately adjacent to the project.

Q. Does this conclude your testimony at this time?

Response. Yes.