Supplement to the Phase I Avian Risk Assessment and Breeding Bird Study for the Deerfield Wind Project, Bennington County, Vermont

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This document is a supplement to the Phase I Avian Risk Assessment (Kerlinger 2003, revised 2005) and the Breeding Bird Survey (Kerlinger and Dowdell 2003) reports for the Deerfield Wind Project, formerly referred to as the Searsburg/Readsboro Expansion project. The original reports were completed in 2003, and this supplement is a means of bringing those two reports up to date. For the Phase I Avian Risk Assessment, this supplement includes:

- Updates regarding empirical studies of avian-related impacts at existing wind power sites in the United States and Canada;
- Updated information about whether night migrants follow ridges in the northeastern United States;
- Information on whether FAA L-864 flashing red lights used at existing wind turbines attract or disorient night migrants, resulting in collisions; and
- Recent references regarding wind power impacts to birds.

For the Breeding Bird Survey, this supplement includes reference to a study of Bicknell's nesting at the Deerfield project site by U. S. Forest Service biologists.

I. Supplement to the Phase I Avian Risk Assessment (Kerlinger 2003)

A. Updates on recent mortality studies.

Since the original Phase I Avian Risk Assessment was conducted for the Deerfield Wind project, several studies have been completed that have reported fatality rates at wind power facilities. To provide a more complete picture of what is known regarding collision impacts to birds at wind power facilities, Appendix II from the Phase I report has been updated. Section IV of this supplement represents as complete a list as possible of empirical studies of collision impacts to birds at North American wind power facilities. Note that in the Eastern U.S. and Canada, new studies have been completed in Ontario and West Virginia, and a Tennessee study has been updated to include a longer study period. Two of the sites are ridge-top sites along major Appalachian ridges. Avian fatalities at these sites were 4 and 7 birds per turbine per year, respectively. Only a single Red-tailed Hawk was found dead at the West Virginia site, and no raptors were found dead at the multi-year study in Tennessee. The numbers of night migrating songbirds killed at these new eastern projects averaged between about 2-3 birds per turbine per year at the Ontario site, 3 per turbine/year at the West Virginia site, and 7 per turbine/year at the Tennessee site.

In the Midwestern United States, a new study was completed in Iowa that showed no fatalities of waterfowl, despite the location of turbines within about 2 km of 3 waterfowl management areas with very heavy usage by geese and ducks. A single Red-tailed Hawk was killed in each of two years of the Top of Iowa study, and night migrating songbirds averaged less than one bird per turbine per year. In the western United States, studies at the High Winds project in California, the Nine Canyon site in Oregon, and the Klondike site in Washington had

relatively few casualties with almost no waterfowl, less than one night migrant per turbine per year and a few local songbirds and other birds included in the fatality lists. Raptor fatalities, mostly American Kestrels and Red-tailed Hawks were higher at the High Winds site in California, where raptor use was greater than at most other wind power facilities. The High Winds site is less than about 40 miles from the Altamont Wind Resource Area of California, where raptor fatalities have been more numerous than at any other site in the United States.

It appears that wind turbines outside of California have not been demonstrated to impact raptors to any great extent and it is highly unlikely that there is significant risk to raptors at any of the sites studied in the west outside of California, or in the Midwestern or Eastern states. In fact, very few raptor fatalities have been reported outside of California, even after studies have been conducted on Appalachian ridges that are believed to be migration pathways for these birds. With respect to waterfowl and shorebirds, there are few fatalities in the newer studies, and night migrating songbird fatalities continue to be relatively low, although greater in the east than in the west (averaging less than or equal to about 1 per turbine vs. about 2-7 per turbine). Overall, the seven new studies summarized in Appendix I are in basic agreement with what was reported in the original Phase I Risk Assessment for the Deerfield site, and at no sites outside of California have there been biologically significant fatality rates reported.

B. Ridge following by night migrants in the eastern United States.

At the time the original Phase I Risk Assessment report for Deerfield was being written, there was a controversy regarding whether night migrating birds followed ridges or valleys at night as they migrated through the northeastern United States and Appalachian ridges. It is unclear what the source of information was to support the notion put forth by some that night migrants follow ridges or valleys. The Phase I Avian Risk Assessment (Kerlinger 2003) stated that migration at the Deerfield site was likely to be "spread across Vermont" over a broad front and were not concentrated along the mountains at Searsburg and Readsboro.

Since the original risk report was written, new radar studies have been conducted at a large number of ridge and mountaintop sites throughout the northeastern United States, including Appalachian mountains and ridges between Vermont and West Virginia. Kerlinger (2005) analyzed 5 radar studies conducted at 4 Appalachian ridgetop sites in Pennsylvania, Maryland, and West Virginia. The results of the 5 studies cited by Kerlinger revealed no evidence for ridge following. The radar results revealed that migrants crossed the ridges at an oblique angle to them, in contrast to what would be predicted if birds were following ridges. There was also a large amount of variation in flight direction from night to night, which would not be expected if birds were following the ridges. In addition, the numbers of birds aloft over the ridges were not extraordinary. Finally, the mean height of migration along Appalachian ridges was between 410 and 580 m, with less than about 14% of birds flying below about 122 m (~400 feet – the approximate height of many modern turbines). If birds were following the ridge, they would be predicted to fly at much lower altitudes, i.e, less than about 150-200 m.

It is interesting that the results of radar studies conducted for the Deerfield Project (and other projects in the northeast) are not that dissimilar from the results from Appalachian ridges (Kerlinger 2005, Erickson 2005). The height of migration and the flight direction at the

Deerfield site are almost identical to the direction of migrants crossing Appalachian ridges. Moreover, the direction of the birds at Deerfield showed that they were not following ridges.

The new radar studies do not provide support for the hypothesis that night migrating birds follow topographic leading lines like the ridges of Vermont. This is in agreement with other radar studies that show that these birds do not follow lakefronts such as those along the Great Lakes (Diehl et al. 2003). Overall, there is increasing evidence to support the view among avian biologists that migration of night migrating birds is generally broad front and proceeds at relatively high altitudes during most of the night.

C. Collisions of night migrating birds and FAA flashing red strobe lights.

It has long been believed that lights attract or disorient night migrating birds to man-made structures, leading to collisions with those structures. The Phase I Avian Risk Assessment (Kerlinger 2003) discusses the issue particularly with regard to the experience at communication towers, and notes that communication towers have different lighting than wind turbines. Wind turbines have one or two (side by side) flashing red Federal Aviation Administration (FAA) lights (L-864), whereas communication towers have multiple sets of lights at different heights, including both steady burning red (L-810) lights and flashing red lights (L-864). Reviews by Kerlinger and Kerns (2003) and Kerlinger (2004, 2005) have shown that the red flashing lights on wind turbines do not attract or disorient birds. The evidence for this has recently been analyzed and shows that there has not been a large-scale fatality event at a wind turbine lit only with L-864 lights. The mortality studies analyzed include those in Appendix I of this document. Not only were there no large scale fatality events that would suggest attraction or disorientation of night migrants, but there was no difference in the rate of fatalities of night migrants at turbines with L-864 red flashing lights and turbines not equipped with FAA obstruction lighting.

This finding is important because the U. S. Fish and Wildlife Service (USFWS) voluntary and interim guidance document for siting and developing wind power facilities (2003) specifically recommended that "solid red or pulsating red incandescent lights should not be used, as they appear to attract night-migrating birds at a much higher rate than white strobes." The USFWS recommendations for communication towers (2000) are almost identical. However, there has not been a published report that has addressed whether flashing or pulsating red lights, incandescent or otherwise, attract or disorient birds causing collisions with structures.

The results of the fatality studies at wind plants from across the United States (and Canada) do not support the contention that FAA L-864 red flashing lights attract or disorient birds leading to collisions with turbines (see the attached Table 1). Without the attraction of steady burning red (or other color) lights, the likelihood of large-scale fatality events or large numbers of fatalities is very low. These findings support the original Phase I Risk Assessment that risk to night migrating birds is likely to be similar to that demonstrated at other eastern and Midwestern wind power facilities and that fatality numbers will not be biologically significant.

D. Recent references.

A list of recent references used for this supplement are provided in Section III. Most of these have appeared since the original Phase I was written in 2003.

II. Supplement to the Breeding Bird Survey Report (Kerlinger and Dowdell 2003)

With respect to the Breeding Bird Survey report (Kerlinger 2003), only one additional piece of information has emerged since the original report was completed. In June 2005, a Bicknell's Thrush survey was conducted by U.S. Forest Service (USFS) biologists at the Deerfield site. The survey was conducted only on the eastern mountaintop site (elevation of 2,890-3,109 feet [881-948 m] ASL) because the habitat on the western site was lacking in suitable habitat. Bicknell's Thrush is a rare, high elevation, spruce-fir forest species that is deemed a species of concern by the state and federal wildlife agencies. On June 8 and 23, 2005, a study was conducted by Jenna Casey, a Wildlife Biologist Student Trainee with the Green Mountain National Forest (2005). She conducted playback surveys in which she listened for Bicknell's Thrush songs and used tape recordings of the songs of Bicknell's Thrush in an attempt to elicit responses from those birds. The methods used were those recommended by the Vermont Institute of Natural Science for surveying of this species. No responses or sightings were reported by Casey (2005), whose findings were also reported by Joe Torres of the USFS (2005). Casey reported that species such as Swainson's Thrush, Blackpoll Warbler, White-throated Sparrow, and Winter Wren were detected during the surveys for Bicknell's Thrush. No quantitative information was available on the nesting species at the Deerfield site.

The lack of responses and negative findings reported by Casey (2005) and Torres (2005), along with their statements to the effect that the physical habitat was not suitable for Bicknell's Thrush, are consistent with findings reported by Kerlinger (2002, 2003), and Kerlinger and Dowdell (2003). Breeding bird studies by Kerlinger (2002) and Kerlinger and Dowdell (2003) failed to find suitable habitat for the species and did not find the species nesting on site. The latter study also used tape-recorded playbacks. Taken together, these studies strongly suggesting that Bicknell's Thrush is not nesting on the Deerfield site.

III. Literature Cited

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IV. Review of Recent Avian Mortality Studies

The following list updates the list presented in Appendix II of the Phase I Avian Risk Assessment for the Deerfield Wind Project (Kerlinger 2003). The bulleted list that follows includes seven additional studies and more detailed information on studies that was available for many of the reports that existed in 2003 when the Phase I assessment was originally conducted.

An asterisk following a project site indicates that the mortality study was performed (or reported) after the Deerfield Phase I Avian Risk Assessment (2003).

- **West Virginia*** – Mountaineer Wind Energy Center, 44 modern turbines on forested ridge, one-year study (22 searches of all turbines), 69 fatalities found, ~200-plus total fatalities when corrected for searcher efficiency and scavenging (4+ fatalities per turbine per year; ~3 night-migrating songbirds, one Red-tailed Hawk); Kerns and Kerlinger 2004.

- **Pennsylvania** – Garrett (Somerset County), eight modern turbines in farm fields, twelve months, zero fatalities; Kerlinger 2001.

- **New York** – Madison, seven modern turbines on farmland, one year, four fatalities (two migrant songbirds, one owl, and one woodpecker); Kerlinger 2002.

- **New York** - Tug Hill Plateau, two older turbines in farmland, two migration seasons, zero fatalities; Cooper et al. 1995.

- **Tennessee** – Buffalo Mountain, three turbines on forested/strip-mined mountain, three years, approximately seven fatalities per turbine per year (night migrating song and other birds); Nicholson 2001, 2002, and personal communication.

- **Vermont** – Searsburg near Green Mountain National Forest, eleven modern turbines on forested mountain top studied during nesting and fall migration season, zero fatalities; Kerlinger 2002.

- **Massachusetts** - Hull, one modern turbine, open grassy fields adjacent to school and ferry terminal on island in Boston Harbor, informal searches for at least one year on dozens of occasions have revealed no fatalities; Malcolm Brown, personal communication, 2002.

- **Minnesota** – Buffalo Ridge near Lake Benton, 200+ modern turbines in farm and grassland, four years (1996-1999), 53 fatalities found, 2-4 fatalities per turbine per year (mostly songbirds and one hawk); displacement found among grassland nesting songbirds; Johnson et al. 2002.

- **Kansas** – St. Mary's, two modern turbines in grassland prairie, two migration seasons; 33 surveys, zero fatalities; Young 1999.

- **Wisconsin** – Kewaunee County Peninsula, 31 modern turbines in farmland, two years (four migration seasons), 25 fatalities, approx. 1.3 fatalities per turbine per year, (three waterfowl, 14 songbirds, some night migrants); Howe et al. 2002.

- **Wisconsin** – Shirley, two modern turbines in farmland, 54 surveys, one fatality (night migrating songbird); report to Wisconsin Department of Natural Resources Bureau of Integrated Science Services, Richter Museum of Natural History Special Report, and Howe and Atwater 1999.

- **Iowa** – Algona, three modern turbines in farmland, three seasons, zero fatalities; Demastes and Trainer 2000.

- **Iowa*** – Top of Iowa, 89 modern turbines (26 studied) in tilled farmland, two years, seven carcasses found, approx. one fatality per turbine per year (songbirds, two Red-tailed Hawks, no shorebirds or waterfowl); Koford et al. 2005, Iowa DNR and Iowa State University.

- **Colorado** – Ponnequin, 29 (44 in 2001) modern turbines in rangeland, five years - 1999-2003, approx. two dozen birds per year, one duck, one American Kestrel fatality; Curry & Kerlinger unpublished data.

- **Wyoming** – Foote Creek Rim, 69 modern turbines in rangeland, two years, 75 turbine fatalities (songbirds, including 48% night migrants, plus four raptors), 1.8 fatalities per

turbine per year (15 additional fatalities were found at guyed meteorology towers); Young et al. 2003.

- **Oregon*** – Klondike, 16 modern turbines in rangeland and shrub-steppe, one year, eight fatalities found (songbirds, including 50% night migrants, plus two Canada Geese), 1.3 fatalities per turbine per year; Johnson et al. 2003.

- **Oregon** – Vansycle, 38 modern turbines in farm and rangeland, one year, 11 birds (seven songbirds, including about four night migrants, and four gamebirds); Erickson et al. 2000.

- **Oregon-Washington** – Stateline Project, 1.5 years, 106 fatalities including seven raptors (28+ bird species total) at 124 of 399 modern turbines in farmland, 1.7 fatalities per turbine per year, 1.0 night migrant fatalities per turbine per year; Erickson et al. 2003.

- **Washington*** – Nine Canyons, 37 modern turbines, prairie and farmland, one year, 36 bird fatalities found (mostly songbirds, one kestrel, one Short-eared Owl), 3.6 fatalities per turbine per year; Erickson 2003.

- **California** - Altamont Pass Wind Resource Area (APWRA), 5,400 older turbines mostly on lattice towers in grazing and tilled land, many years, large numbers of raptor fatalities (>400 reported) and some other birds; Howell and DiDonato,1991, Howell 1997, Orloff and Flannery 1992, 1996, Kerlinger and Curry 1997, Thelander and Rugge 2000.

- **California** – Montezuma Hills, 237 older turbines, 11 modern turbines in tilled farmland, two-plus years, 30-plus fatalities found (including 10 raptors, two songbirds, one duck); Howell 1997.

- **California*** - High Winds, 90 modern turbines in tilled farmland, one year (of three-year study), 103 carcasses found (raptors, few songbirds, few waterbirds); Report to High Winds Technical Advisory Committee.

- **California** - San Gorgonio Pass Wind Resource Area, thousands of older turbines, 120 studied in desert, two years, 30 fatalities (nine waterfowl, two raptors, four songbirds, etc.); Anderson et al. 2000.

- **California** - Tehachapi Pass Wind Resource Area, thousands of turbines, 100's of mostly older turbines studied, in Mojave Desert mountains (grazing grassland and scrub), two-plus years, 84 fatalities (raptors, songbirds); Orloff 1992, Anderson et al. 2000.

<u>Canada</u>

- **Ontario*** – Pickering Wind Turbine, one modern turbine near a marsh, two migration seasons, two nocturnal migrant fatalities; James, unpublished report.

- **Ontario*** – Exhibition Place, one modern turbine in Toronto on the lakefront, two migration seasons, one Starling and one American Robin fatality; mortality projected at three birds per year; James and Coady 2003.

Table 1. Summary of Wind Power Projects and Associated Avian Data

Project Site	# Turbines/ Windfarm studied	Height of Turbines	Lighting/Beacons	Study Duration/ Search Interval	# Dead Night Migrant Carcasses*, **	Estimated Fatalities per Turbine per Year***
High Winds, Solano County, CA[i]	93/ 93	100 m (328 feet)	12 – L-864 flashing red, strobelike 15 – L-810 flashing red incandescent	1 year	~19	<1 per turbine per year
Klondike, OR[ii]	16/16	100 m (328 feet)	9 – L-864 flashing red strobelike	1 year	~4	<1 per turbine per year
Vancycle, OR[iii]	38/38	74 m (243 feet)	11 – L-864 flashing red strobelike	1 year	~5	<1 per turbine per year
Nine Canyons, WA[iv]	37/37	91 m (298 feet)	15 – L-864 flashing red strobelike	1 year	~8	<1 per turbine per year
Stateline, OR/WA[v]	394/	74 m (243 feet)	111 - L-864 flashing red strobelike	1.5 years	19 per year	<1 per turbine per year
Ponnequin, CO[vi]	29; increase to 44/29-44	79 m (259 feet)	44 – L-864 flashing red incandescent	5 years	~5 per year	<1 per turbine per year
Foote Creek Rim, WY[vii]	69	61 m (201 feet)	None	3.5 years	12 per year	<1 per turbine per year
Buffalo Ridge, MN[viii]	353	76 m (249 feet; maximum)*	Some steady burning red, others flashing red	4 years	7 per year	~3 per turbine per year
Top of Iowa, IA[ix]	89/26	98 m (321 feet)	52 – L-810? steady burning red, 37 – L-864 flashing red strobelike	2 years	3.5 per year	<1 per turbine per year

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Northeast Wisconsin, WI[x]	31/31	89 m (292 feet)	~ 22 - L-864 flashing red ?	2 years	~5 per year	<1 per turbine per year
Searsburg, VT[xi]	11/11	58.5 m (192 feet)	None	5 months	0	<1 per turbine per year
Madison, NY[xii]	7/7	100 m (328 feet)	7 – L-864 flashing red strobelike	1 year, monthly searches – every 10 days during migration	3 per year	~1-2 per turbine per year
Green Mountain, PA[xiii]	8/8	90 m (295 feet)	8 – L-864 flashing red incandescent	1 year, monthly searches – every 10 days during migration	0	<1 per turbine per year
Mountaineer, WV[xiv]	44/43	105 m (344 feet)	12 – L-864 flashing red strobelike	8 months, weekly during migration	~30* per year	~3* per turbine per year
Buffalo Mountain, TN[xv]	3/3	88 m (289 feet)	3 - L-865 flashing white strobe	3 years (only 2 years of data available	11.5 per year	~7 per turbine per year
Exhibition Place and Pickering, ON[xvi]	2/2	94 m (308 feet) & 117 m (384 ft)	2 – L-864 flashing red strobelike	Spring and Fall Migration seasons	3 per year	~3-4 per turbine per year

* A large-scale fatality event involving slightly more than 30 birds was excluded from the analysis. This event was caused determined to be caused by sodium vapor lamps at a substation (see text above for details).

** Numbers of carcasses are given as approximations because it is not always possible to determine if birds were killed during migration or during daytime flight not associated with migration.

*** Estimated fatalities per turbine/year is for migrants only, corrected for likely scavenging and searcher efficiency as reported in study or at similar sites. Fatalities at guyed meteorology towers were not included in numbers of fatalities. Per year indicates 2 migration season (spring and fall)

[i] Curry & Kerlinger, LLC, Report to TAC, 2004.
[ii] Johnson et al. 2003.
[iii] Erickson et al. 2000.
[iv] Erickson et al. 2003.
[v] Erickson et al. 2003.
[vi] Unpublished Data, Curry & Kerlinger, LLC.
[vii] Young et al. 2003.
[viii] Johnson et al. 2003.
[ix] Koford et al. 2005.
[x] Howe et al. 2002.
[xi] Kerlinger 2002a.
[xii] Kerlinger 2002b.
[xiii] Kerlinger 2001.
[xiv] Kernsand Nicholson 2001, 2002.
[xv] Nicholson 2001, 2001.
[xvi] James no date, James and Coady 2003.