# Black-billed Cuckoo Conservation Plan for the Bishop Hill Wind Energy Project (Phase I) Henry County, Illinois

**Prepared for:**

**Bishop Hill Energy LLC**
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## TABLE OF CONTENTS

PROJECT APPLICANT: ..... 1
1.0 AREA TO BE AFFECTED ..... 1
1.1 Project Location: ..... 1
1.2 Project Description ..... 1
2.0 BIOLOGICAL DATA OF AFFECTED SPECIES ..... 3
2.1 Black-Billed Cuckoo ..... 3
2.1.1 Migration ..... 3
2.1.2 Breeding ..... 3
2.1.3 Post-Breeding Dispersal and Lifespan ..... 4
2.1.4 Population Status ..... 4
2.1.5 Habitat Requirements ..... 8
2.1.6 Species Status in the Project Area ..... 8
3.0 DESCRIPTION OF ACTIVITIES ..... 13
3.1 Activities with Potential for Incidental Take ..... 13
3.2 Timeline ..... 13
3.3 Other Permitting Review ..... 13
4.0 EFFECTS OF THE PROPOSED ACTION ..... 13
4.1 Spatial Patterns ..... 14
4.2 Temporal Patterns ..... 14
4.3 Plans to Minimize Area Affected ..... 14
4.4 Amount of Habitat Affected ..... 15
4.5 Incidental Take of Individuals ..... 16
4.5.1 Methodology ..... 16
4.5.2 Results ..... 17
4.6 Management of the Affected Area ..... 19
4.7 Measures to Minimize and Mitigate Effects ..... 19
4.7.1 Minimization and Mitigation – Project Design and Operation ..... 19
4.7.2 Mitigation – Black-billed Cuckoo Breeding Survey Research ..... 21
4.8 Monitoring ..... 22
4.8.1 Intensive Carcass Monitoring ..... 22
4.8.2 Incidental Monitoring ..... 23

4.8.3 Reporting.....23
4.9 Adaptive Management .....23
4.9.1 Adaptive Management Goals.....23
4.9.2 Adaptive Management Plan.....23
4.10 Verification of Adequate Funding .....24
5.0 ALTERNATIVES CONSIDERED.....24
5.1 No Action Alternative.....24
5.2 Construction and Operation Alternatives .....24
6.0 EFFECTS DETERMINATION .....25
7.0 IMPLEMENTING AGREEMENT .....26
7.1 Obligations and Responsibilities.....26
7.2 Relinquishment .....26
7.3 Amendment or Modification.....26
7.4 Terms Do Not Run With the Land .....26
7.5 Compliance with Other Federal, State and Local Regulations.....26
REFERENCES .....27

## LIST OF TABLES

Table 1. Black-billed cuckoo observations by route for Illinois 1985 – 2014……..…….....6
Table 2. Post-construction monitoring surveys and black-billed cuckoo carcass at Bishop Hill Wind Energy Project……..…….....11
Table 3. Land cover types and acreages witin the Bishop Hill Wind Energy Project……..……..……..…...16
Table 4. Wind facilities with publicly available fatality estimates used in regional percent composition analysis……..……..……..…...17
Table 5. Data from California Ridge and Bishop Hill Wind Energy Projects used in regional percent composition analysis……18
Table 6. Estimated take of black-billed cuckoo at Bishop Hill Wind Energy Project…….19

## LIST OF FIGURES

Figure 1. Bishop Hill Wind Energy Project ..... 2

Figure 2. Black-billed Cuckoo Summer Distribution – Breeding Bird Survey Data ..... 5

Figure 3. BBS route locations in Illinois, designated as either available (not currently surveyed) or currently assigned for survey. ..... 7

Figure 4. Locations of potential black-billed cuckoo breeding habitat and detected carcass at Bishop Hill Wind Energy Project. Photographs included in Appendix A. .....12

## LIST OF APPENDICES

Appendix A. Project Area Photographs

Appendix B. Carcass Monitoring Plan

Appendix C. Pre-construction Survey Reports

Appendix D. Post-construction Survey Reports

Appendix E. Natural Resources Permits

Appendix F. Black-billed Cuckoo Breeding Survey and Habitat Assessment - Proposed Study Plan

## PROJECT APPLICANT:

Bishop Hill Energy LLC
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Bethesda, MD 20814
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**PROJECT NAME:** Bishop Hill Wind Energy Project

**COUNTY**: Henry County, Illinois

## 1.0 AREA TO BE AFFECTED

### 1.1 Project Location:

See Figure 1 – Project Location
Township 14N, Range 2E, Sections 23 - 26 & 36
Township 14N, Range 3E, Sections 1, 2, 10 - 36
Township 14N, Range 4E, Sections 5 - 8, 17 - 21, 28 - 33
Township 15N, Range 3E, Sections 11 - 14, 23 - 26, 35 & 36
Township 15N, Range 4E, Sections 7, 18, 19, 30 & 31

### 1.2 Project Description

Phase I of the Bishop Hill Wind Energy Project (Project), located in Henry County, Illinois (Figure 1), is owned by Bishop Hill Energy LLC (BHE), which is majority owned by TerraForm Power Inc. The Project consists of 133 wind turbines with a total nameplate capacity of 200 megawatts (MW), including 34 1.5 MW and 99 1.6 MW turbines. The Project also includes an operations and maintenance (O&M) facility, a 34.5-kilovolt (kV)/138-kV substation, access roads and underground communications and power collection systems. BHE has control of all the affected property (i.e., the facilities described above) through either ownership of the land or through lease agreements with the landowners. The Project is approximately 10.3 miles (mi) across east to west and approximately 10.6 mi north to south. The town of Bishop Hill is located in the center of the Project boundary and the town of Galva is located approximately one mi east of the Project; the northern boundary extends approximately one mi north of County Highway 81 (Figure 1). Corn and soy bean production is the dominant land use in the Project area. Trees are sparsely distributed and typically restricted to small clusters, generally associated with homes and shelterbelts, with a fewer larger woodlots within the Project boundary. The Project was granted a Special Use Permit by Henry County on May 11, 2010, and the Project has been operational since July 2012. Appendix A contains photos of the Project area.

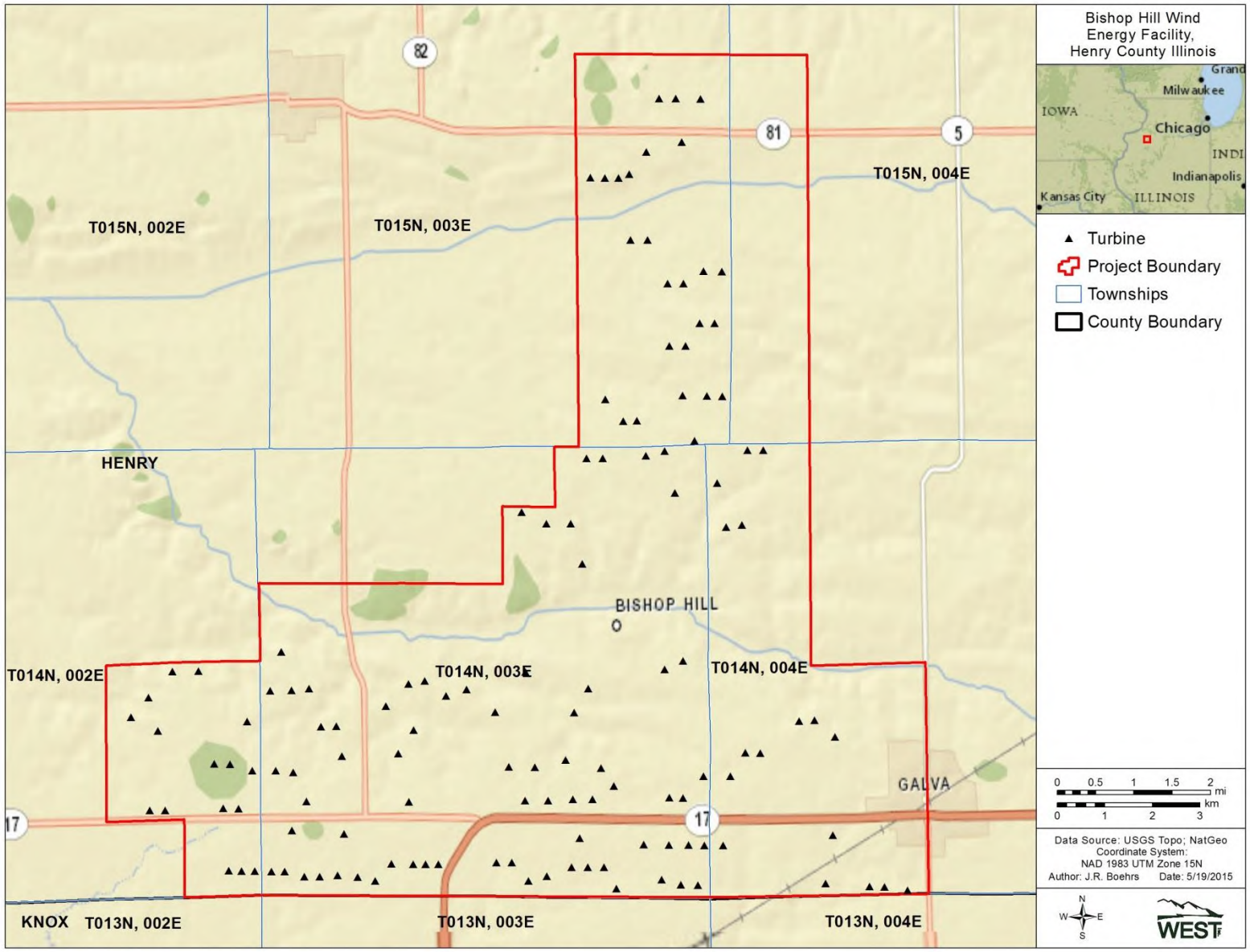



**Figure 1. Bishop Hill Wind Energy Project**

# 2.0 BIOLOGICAL DATA OF AFFECTED SPECIES

## 2.1 Black-Billed Cuckoo

### 2.1.1 Migration

The black-billed cuckoo (*Coccyzus erythropthalmus*) is a long-distance nocturnal migrant assumed to migrate over vast areas without stopping (Hughes 2001). The species engages in a short nomadic period after spring migration during which food resources are evaluated (Nolan and Thompson 1975). Individuals are commonly observed outside the breeding distribution of the species during this period (Hughes 2001). During fall migration, individuals are inconspicuous and do not typically migrate in large groups (Robbins 1991).

Generally, black-billed cuckoos begin to arrive on breeding grounds in the central United States (U.S.) from late April to early May, and the number of arrivals peaks during mid-May. Timing of migration can be highly irregular, and spring migrants can arrive as late as early June in the Midwestern U.S. (Hughes 2001) Much less is known about the timing of fall migration. Generally, migrants begin to depart breeding sites in the Midwest in late August, and peak departure occurs in late September or early October (Hughes 2001). Individuals are known to linger as late as October 31 in Illinois (Bohlen 1989) and November 13 in Ohio (Peterjohn 1989).

### 2.1.2 Breeding

Although no specific data are available for black-billed cuckoo, female yellow-billed cuckoo (*Coccyzus americanus*) appear to breed in their first year (Laymon 1998), and given that the species are closely related, it is likely that female black-billed cuckoo follow the same pattern. The onset of black-billed cuckoo nesting has been correlated with the emergence of invertebrates, and timing of first clutch is variable as it is associated with food availability. Peak breeding activity has been related to peak numbers of annual cicadas and caterpillar emergence, and the delayed onset of nesting may result from the delayed emergence of caterpillars (Hughes 2001). Generally, nesting occurs in the Midwestern U.S. from late May to late June, but active nests have been recorded as late as mid-September (Eastman 1991). Eggs have been recorded in Illinois as early as May 7 and as late as July 20 (Bent 1940). Little is known about how often cuckoos raise two broods in a year, and black-billed cuckoos are generally assumed to raise one brood per year. Records of eggs in late summer are suspected to be late first broods associated with late-season emergence of prey populations (Pistorius 1985).

Clutch size for black-billed cuckoo is most often 2 to 3 eggs, rarely 4 or 5. Eggs are usually laid every second day, but intervals of 1 to 4 days have been reported. Because incubation begins after the first egg is laid, estimates of length of incubation are variable, and range from 10 to 14 days (Hughes 2001). Incubation that begins with the first egg also results in nestlings at different phases of development within the same nest. Most young depart the nest at 6 to 7 days but are

unable to fly until approximately three weeks of age (Hughes 2001). During this stage, young climb through branches and run along the ground, and individuals have been found up to 1.3 mi away from the nest site before they were capable of flight (Sealy 1985). Because young are accompanied and fed by adults during this stage, fledging is estimated to occur at 21 to 24 days when young can fly (Sandilands 2010), although age at which juveniles are able to feed on their own is not known (Hughes 2001).

### 2.1.3 Post-Breeding Dispersal and Lifespan

After departure from the nest but before independence, parents may divide the brood to reduce competition from larger siblings (Sealy 1985), likely resulting in a relatively large area required for post-breeding dispersal of a given brood. After fledging, both adults and juveniles disperse widely in search of food (Sandilands 2010). The average lifespan of the black-billed cuckoo is not well documented; however, based on the small amount of data available from banded cuckoos, it is thought that they have relatively short lives, up to four or five years (Hughes 2010; de Magalhaes et al. 2005).

### 2.1.4 Population Status

The black-billed cuckoo experienced population declines throughout North America during the twentieth century, particularly during the 1980s and 1990s (Hughes 2001). From 1966-2012, populations in the U.S. as reported in the North American Breeding Bird Survey declined by 3.0% per year (95.0% CI = 2.2 – 10.5% per year; $n$ = 1,303 routes; Sauer et al. 2014). Trends for Illinois were similar, declining by 4.1% per year (95.0% CI = 1.3 – 6.7% per year; $n$ = 58 routes; Sauer et al. 2014).

Local abundance may be highly variable from year to year. Because cuckoo populations have been correlated with irruptions of cicadas (Nolan and Thompson 1975) and caterpillars (Jauvin and Bombardier 1996), there can be large increases in local populations from immigration during insect irruptions. Thus, black-billed cuckoo may become locally common in areas where, in most years, it is rare. The nomadic nature of the black-billed cuckoo, even during the breeding season, can result in population estimates that fluctuate annually (Sandilands 2010). Thus, long-term trends provide the best insight into population dynamics for this species.

Black-billed cuckoos were considered a common summer resident in northern Illinois in the early 1900s, but the population has declined since then due to loss of nesting habitat, such as orchards and hedgerows (Kleen et al. 2004). Breeding bird survey data indicate the species has always been more common in northern Illinois, with decreasing abundance observed in southern Illinois. The species is currently considered an uncommon migrant and summer resident in Illinois, with lower abundance occurring in southern Illinois (Kleen et al. 2004; Figure 2). As of 2013, there are estimated to be approximately 870,000 black-billed cuckoo breeding in North America, with approximately 410,000 breeding in the U.S., and approximately 5,000 breeding in Illinois (Blancher et al. 2013).

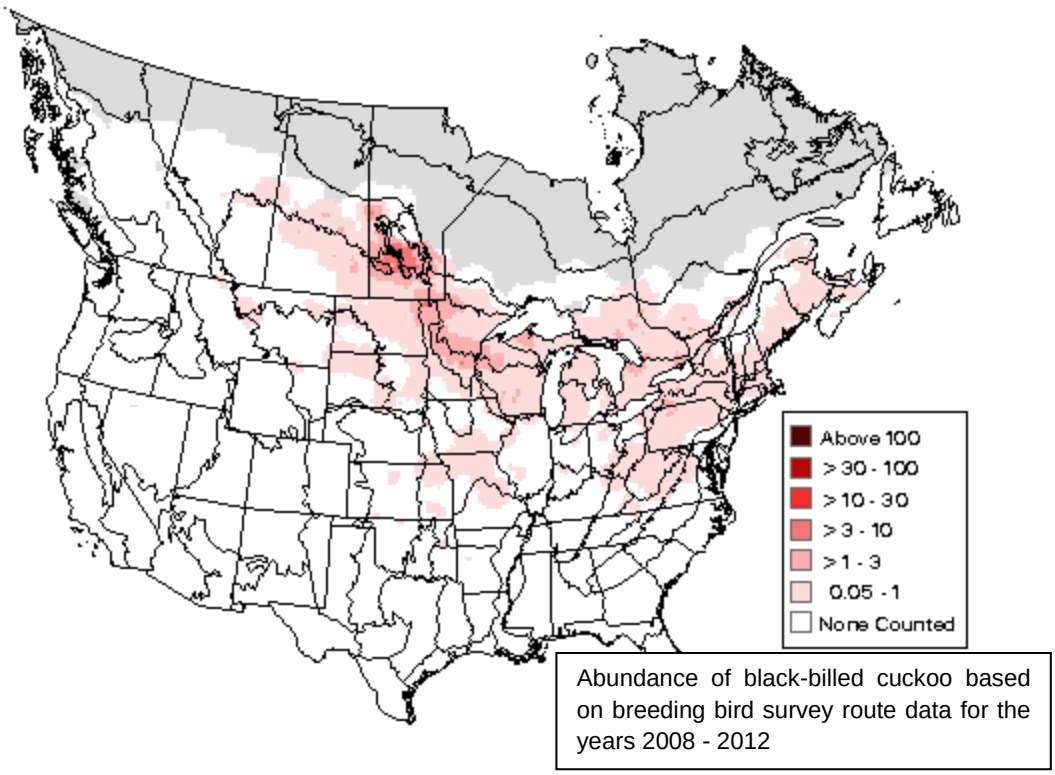



**Figure 2. Black-billed Cuckoo Summer Distribution – Breeding Bird Survey Data**

Raw breeding bird survey (BBS) data from 1985 – 2014 (Sauer et al. 2015) was reviewed to determine if areas of concentrated black-billed cuckoo records during the breeding season exist and if BBS routes near the Bishop Hill Project contain black-billed cuckoo observations. The BBS uses established routes on public roads resulting in a long-term bird survey throughout the U.S., Canada and Mexico.

Statewide, a total of 204 black-billed cuckoo detections were recorded on 2,295 survey routes during the analysis period and consistent with the known episodic population cycle of black-billed cuckoo for an average of 0.09 black-billed cuckoo/route (Table 1). Over the most recent five years of data (2009 – 2014), 12 black-billed cuckoo were recorded over 503 survey routes for an average of 0.02 black-billed cuckoo/route. During the most recent five years, black-billed cuckoo were detected on a total of eight unique survey routes, and black-billed cuckoo were not detected on the same survey route more than once in the five-year period (Figure 3). All routes with black-billed cuckoo detections over the most recent five years were located towards the western boundary of the state near the Mississippi and Illinois Rivers.

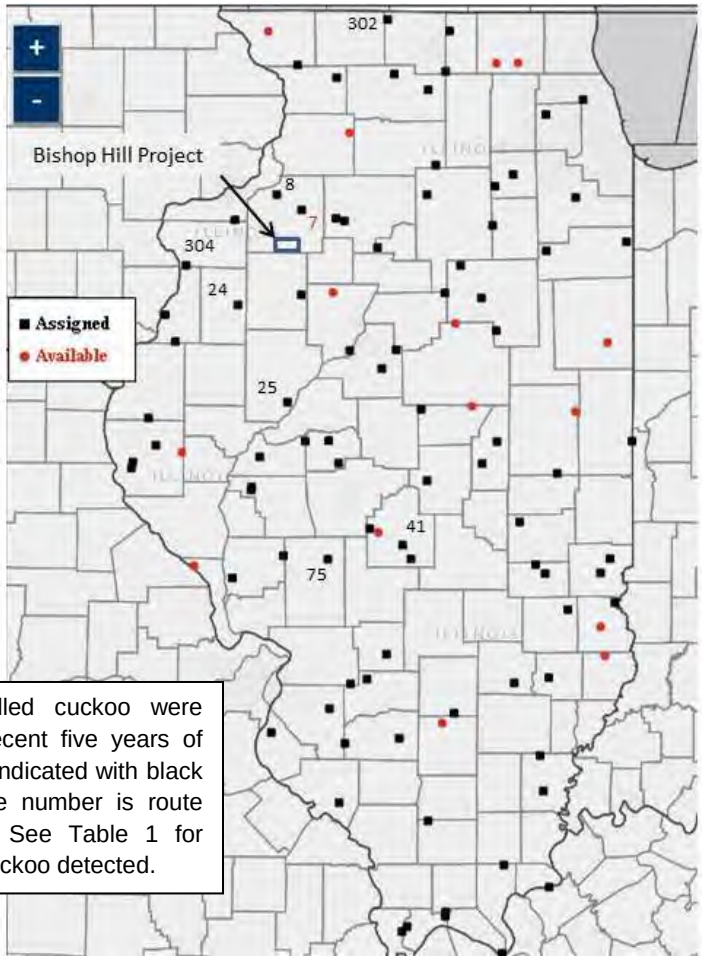
**Table 1. Black-billed cuckoo observations by route for Illinois 1985 – 2014.**

| Route number | Year | Count |
|---|---|---|
| 1 | 1985 | 2 |
| | 1986 | 1 |
| | 1989 | 3 |
| | 1990 | 2 |
| | 1991 | 1 |
| | 1992 | 1 |
| 2 | 1987 | 2 |
| | 1989 | 1 |
| | 1990 | 3 |
| | 1993 | 1 |
| | 2002 | 2 |
| | 2006 | 1 |
| | 2007 | 2 |
| 3 | 1991 | 1 |
| | 1998 | 1 |
| | 2008 | 3 |
| 4 | 1993 | 1 |
| 5 | 1991 | 1 |
| 7 | 1986 | 2 |
| | 1989 | 1 |
| 8 | 1985 | 2 |
| | 1986 | 1 |
| | 1988 | 2 |
| | 1989 | 2 |
| | 1990 | 2 |
| | 1992 | 1 |
| | 1993 | 1 |
| | 1994 | 1 |
| | 2013 | 3 |
| 9 | 1990 | 2 |
| 10 | 1986 | 1 |
| | 1988 | 6 |
| | 1989 | 1 |
| | 1990 | 1 |
| | 1994 | 1 |
| | 1995 | 4 |
| | 1997 | 1 |
| | 2004 | 1 |

| Route number | Year | Count |
|---|---|---|
| 11 | 1990 | 1 |
| | 1991 | 1 |
| 13 | 1992 | 1 |
| 14 | 1990 | 1 |
| | 1997 | 1 |
| 16 | 1990 | 1 |
| 17 | 1990 | 1 |
| 18 | 1988 | 1 |
| | 1989 | 1 |
| | 1991 | 1 |
| 19 | 1986 | 1 |
| | 1991 | 1 |
| 22 | 1997 | 1 |
| | 2003 | 1 |
| 23 | 1985 | 1 |
| 24 | 1989 | 1 |
| | 1991 | 1 |
| | 1992 | 1 |
| | 2010 | 1 |
| 25 | 1987 | 1 |
| | 1989 | 3 |
| | 1993 | 2 |
| | 1994 | 1 |
| | 1995 | 1 |
| | 1999 | 1 |
| | 2003 | 2 |
| | 2004 | 1 |
| | 2005 | 1 |
| | 2007 | 1 |
| | 2014 | 2 |
| 27 | 1994 | 2 |
| | 1997 | 2 |
| 33 | 1986 | 1 |
| 34 | 2007 | 2 |
| 35 | 1985 | 1 |
| | 1992 | 2 |
| | 1994 | 5 |
| | 1998 | 1 |

| Route number | Year | Count |
|---|---|---|
| 37 | 1992 | 1 |
| | 1994 | 1 |
| | 1996 | 1 |
| 38 | 1986 | 1 |
| | 1988 | 2 |
| | 1991 | 3 |
| | 1992 | 3 |
| | 1995 | 1 |
| | 1996 | 2 |
| | 1997 | 1 |
| | 1998 | 3 |
| | 1999 | 1 |
| | 2001 | 3 |
| | 2002 | 1 |
| | 2003 | 5 |
| | 2004 | 1 |
| | 2008 | 1 |
| | 2011 | 2 |
| 40 | 1993 | 1 |
| 41 | 2003 | 3 |
| | 2004 | 2 |
| | 2011 | 1 |
| 44 | 1999 | 1 |
| 45 | 2001 | 1 |
| 46 | 1991 | 1 |
| | 2004 | 1 |
| | 2006 | 1 |
| | 2007 | 1 |
| 48 | 1988 | 2 |
| 51 | 2003 | 1 |
| | 2007 | 1 |
| 52 | 1993 | 1 |
| 58 | 1985 | 1 |
| | 1992 | 1 |
| 60 | 1986 | 1 |
| | 1989 | 1 |
| | 1996 | 1 |

| Route number | Year | Count |
|---|---|---|
| 62 | 1985 | 1 |
| | 1986 | 1 |
| 66 | 1993 | 2 |
| | 2005 | 2 |
| | 2008 | 2 |
| 74 | 2007 | 1 |
| 75 | 1998 | 1 |
| | 2002 | 2 |
| | 2004 | 2 |
| | 2007 | 1 |
| | 2011 | 1 |
| 77 | 2000 | 1 |
| | 2001 | 1 |
| | 2003 | 1 |
| 301 | 2004 | 1 |
| | 2008 | 1 |
| 302 | 2002 | 1 |
| | 2003 | 2 |
| | 2006 | 2 |
| | 2007 | 3 |
| | 2008 | 1 |
| | 2009 | 1 |
| 304 | 2010 | 1 |




Routes where black-billed cuckoo were detected in the most recent five years of survey 2009 - 2014 are indicated with black route number; red route number is route closest to the Project. See Table 1 for number of black-billed cuckoo detected.

**Figure 3. BBS route locations in Illinois, designated as either available (not currently surveyed) or currently assigned for survey.**

The closest route to the Project is the Atkinson route (number 07) and is located approximately 11 mi to the north. Two black-billed cuckoo were recorded in 1986 and the most recent observation was recorded in 1989. The route has been surveyed sporadically with no surveys conducted in 2013 or 2014.

In summary, breeding black-billed cuckoos are uncommon in Illinois evidenced by a state-wide rate of 0.09 black-billed cuckoo/route from 1985 - 2014. More recent data from 2009 - 2014 shows a lower rate of 0.02 black-billed cuckoo/route. Based on the route-level analysis for the Project, black-billed cuckoo should be considered unlikely to occur as breeders on the BBS routes associated with the Project. The BBS is limited to roadside surveys on public roads, so uncommon species with specific habitat requirements may not be appropriately represented by the BBS.

### 2.1.5 Habitat Requirements

Spencer (1943) studied six black-billed cuckoo nests and found nesting habitat ranged from an 'open wooded area' (two nests) to second growth forest and thickets (four nests). Additional information on breeding habitat preferences is provided in breeding bird atlases, which provide important information on bird distributions but typically contain incidental information rather than study results (Hughes 2001). During the breeding season, black-billed cuckoos use a wide range of habitats but are most commonly associated with forest edges, fencerows, riparian areas and shrublands (Spencer 1943, Hughes 2001). Kleen et al. (2004) describes the species as more likely to utilize the "older, more wooded side of woodland edges" and is "less likely to be found near suburbia than the yellow-billed cuckoo." Trends in habitat use across breeding bird atlas records suggest that black-billed cuckoos will nest in habitat associated with water or marshy areas and use trees that typically form thickets such as willow, alder, birch and beech (Hughes 2001). Black-billed cuckoos will also nest in open woodlands that have branches to support nests as low as 2 to 3 feet (ft) above ground (Hughes 2001). Little is known about the territorial behavior of the black-billed cuckoo (Hughes 2001), but Freeman and Merriam (1986) hypothesized that home range size is 5 to 12 acres. Little is known about habitat use during migration, it is assumed to be similar to breeding habitat (Hughes 2001).

### 2.1.6 Species Status in the Project Area

*2.1.6.1 Pre-construction Surveys*

Black-billed cuckoo were not detected at the Project area during pre-construction avian surveys conducted between August 2009 and June 2010 (see Appendix C for pre-construction survey reports).

<u>Fixed-point bird use surveys</u>

Fixed-point bird use surveys were conducted within the Bishop Hill Project area by Western EcoSystems Technology, Inc. from August 18, 2009 through May 25, 2010 (Good et al. 2010a); the approximately 115,000 acre area surveyed was larger than the Phase I Bishop Hill Project, but encompassed all of the current Project area covered in this Conservation Plan. Point count stations were sampled for a period of 20 minutes during each survey event. Surveys of half of the point-count stations were conducted once per week during the fall and spring migration periods (August 18 - November 15 and March 1 - May 31), with each station being surveyed every other week. Half of the point-count stations were surveyed every other week during the winter (November 15 - February 28), with each station being surveyed on a monthly basis. No fixed point-count surveys were conducted during the summer (June 1 - August 17). Refer to the breeding songbird surveys conducted during this period. A total of 544 20-minute fixed-point surveys was conducted: 238 in fall, 85 in winter and 221 in spring. Surveys were carried out during daylight hours, and survey periods varied to approximately cover all daylight hours during a season. Results of these surveys are summarized below.

A total of 5,651 birds within 1,876 groups was observed during the fixed-point surveys, 86 of which were raptors. Sixty-five species were recorded, with an average species richness of 0.55

large bird species/800-m plot/20-minute survey and 1.77 small bird species/100-m plot/20-minute survey. The total number of species observed was greater in spring (55) and fall (45) than in winter (15). Five species (7.7% of all species) composed 53.7 percent of the observations: European starling (*Sturnus vulagris*), red-winged blackbird (*Agelaius phoeniceus*), common grackle (*Quiscalus quiscula*), snow goose (*Chen caerulescens*) and brown-headed cowbird (*Molothrus ater*). All other species each comprised less than five percent of the observations.

Overall, large bird use was highest in spring (3.74 birds/800-m plot/20-minute survey), followed by fall (1.35 birds/800-m plot/20-minute survey) and winter (0.29 birds/800-m plot/20-minute survey). Small bird use followed a similar pattern, with higher use in the spring and fall (9.36 and 8.27 birds/100-m plot/20-minute survey, respectively) than in winter (1.79 birds/100-m plot/20-minute survey). Use by birds in the Project area was not strongly related to topographic features within the Project area. Raptor use within 1.0 mi of the South Edward River was only slightly higher than in the rest of the Project area. Use by small birds and waterfowl was lower within 1.0 mi of the South Edward River compared to the remainder of the Project area.

Four sensitive species were recorded during fixed-point bird use surveys. Three Illinois state-listed endangered species were observed: two loggerhead shrikes were observed (both in the spring), seven northern harriers (four in the fall and three in the spring) and two upland sandpipers (both in the spring). A single bald eagle was recorded during fixed-point surveys in the spring. The number of state-listed endangered species observations may represent repeated observations of the same individual. No black-billed cuckoo were observed.

<u>Breeding Songbird Surveys</u>

Breeding songbird surveys were conducted within the larger overall 115,000-acre Bishop Hill Project area by Western EcoSystems Technology Inc. from May 26 through June 15, 2010 (Good et al. 2010a). A total of 155 points was established within the 555 acres of suitable grassland habitat within 0.25 mi of potential turbine locations. A minimum of one point count was placed within each parcel of suitable grassland, with additional points placed within larger grasslands. Five-minute surveys were conducted in the hours between dawn and noon at each of the 155 points by a qualified biologist. A total of 460 five-minute surveys was conducted.

A total of 5,402 individual birds in 3,609 groups was recorded during the breeding songbird surveys. Overall, 73 species were observed; a mean of 5.79 species was observed per survey. Red-winged blackbird (1.4% of all species observed) composed more than 34.9 percent of all observations during the breeding songbird surveys. All other species each composed less than 7 percent of the observations.

Two sensitive species were recorded during breeding songbird surveys. Nineteen upland sandpipers and a single common moorhen (both state-endangered) were observed within the Project area. The number of birds observed may represent repeat observations of the same individual, since the same point count locations were surveyed three times during the breeding

season. No black-billed cuckoo were observed, although the surveys were focused in grassland habitat.

Pre-construction Nest Surveys

All native habitats, including wooded habitat, directly impacted by construction activities during the breeding season were surveyed for nests by a trained biologist prior to construction. No black-billed cuckoo nests were detected in these surveys.

*2.1.6.2 Black-billed Cuckoo Habitat Evaluation*

Aerial imagery was examined and areas of woody vegetation were placed into three categories: woodlot, shelterbelt (shrubs) and shelterbelt (trees) based on the size of the patch, the configuration of the patch (linear versus non-linear) and color of the vegetation. The habitat map was used to guide a site visit in December 2014 to evaluate the Project for potential black-billed cuckoo breeding habitat. Patches of woody vegetation with a dense understory of branches at the patch edge as low as 2 to 3 ft above the ground were considered potential black-billed cuckoo breeding habitat. Per Hughes (2001) and Kleen et al. (2004), any habitat that would be difficult to walk through was considered potential black-billed cuckoo breeding habitat.

The Project occurs in the Central Corn Belt Plains Level III Ecoregion, which consists of flat to rolling plains that have largely been converted to agriculture (94.0% of the habitat at Bishop Hill). The Project contains a few shelterbelts (1.2% of habitat) and large woodlots (4.8% of habitat; Figure 4). There are approximately 2,103 acres of potential black-billed cuckoo habitat (5.4%) within the approximately 39,053 acre Project boundary, consisting of approximately 134 acres of shrubland (mostly shelterbelts), approximately 300 acres of shelterbelt trees and approximately 1,669 acres of woodlots (see Table 3 in Section 4.4). Based on the desktop and field examination of habitat conditions, most of the woodlots have potential to support breeding black-billed cuckoos because these areas have a dense complex understory. Twenty-four patches of habitat in the Project area are greater than 12.4 acres in size (the upper estimate of black-billed cuckoo home range size [see Section 2.1.5 above]); the three largest are 138, 253 and 688 acres of the approximately 39,053 acre Project area.

*2.1.6.3 Black-billed Cuckoo Carcass Detections and Correlates of Risk*

During multiple years of post-construction monitoring, two black-billed cuckoo carcasses were detected at the Project (Table 2; Figure 4; Appendix D).

To understand if risk could be identified for black-billed cuckoos based on information from carcass detections, the spatial (i.e., location) and temporal (i.e., timing) information associated with carcasses in the context of life history and habitat preferences of black-billed cuckoo was examined. As only two carcasses were detected, limited inference can be drawn regarding spatial and temporal correlates of risk. The carcasses detected were not at turbines near a woodlot (Table 2), and there were turbines near woodlots that were monitored where carcasses were not detected. Collisions of nocturnal migrants with towers are hypothesized to be influenced by the type of lighting on the structure and weather conditions, specifically the presence of fog or low clouds (Bevanger 1994, Shire et al. 2000, Gehring et al. 2009).

Comparing the fatality rate of birds near lighted and non-lighted turbines indicates that the red blinking lights on lighted wind turbines do not create a strong attractant (Kerlinger et al. 2010). Rain, thunderstorms or fog did not occur overnight during the estimated dates when the carcasses occurred (Table 2). Thus, the carcass discoveries were not likely related to an inclement weather event typically associated with bird collision risk at structures.

**Table 2. Post-construction monitoring surveys and black-billed cuckoo carcass at Bishop Hill Wind Energy Project**

| Survey time period | Number and Date of Black-billed Cuckoo Found | Turbine Number | Age | Habitat at Turbine (≤328 ft) | Weather During Night of Estimated Occurrence |
|---|---|---|---|---|---|
| Fall 2012 | July 26, 2012 - incidental find | 119 | Juvenile | Agriculture | Clear, July 23 - 24 |
| Spring 2013 | None | NA | NA | NA | NA |
| Fall 2013 | None | NA | NA | NA | NA |
| Spring 2014 | None | NA | NA | NA | NA |
| Fall 2014 | None | NA | NA | NA | NA |
| Fall 2015 | September 18, 2015 | 36 | Juvenile | Agriculture | Clear, Sept 15 - 16 |

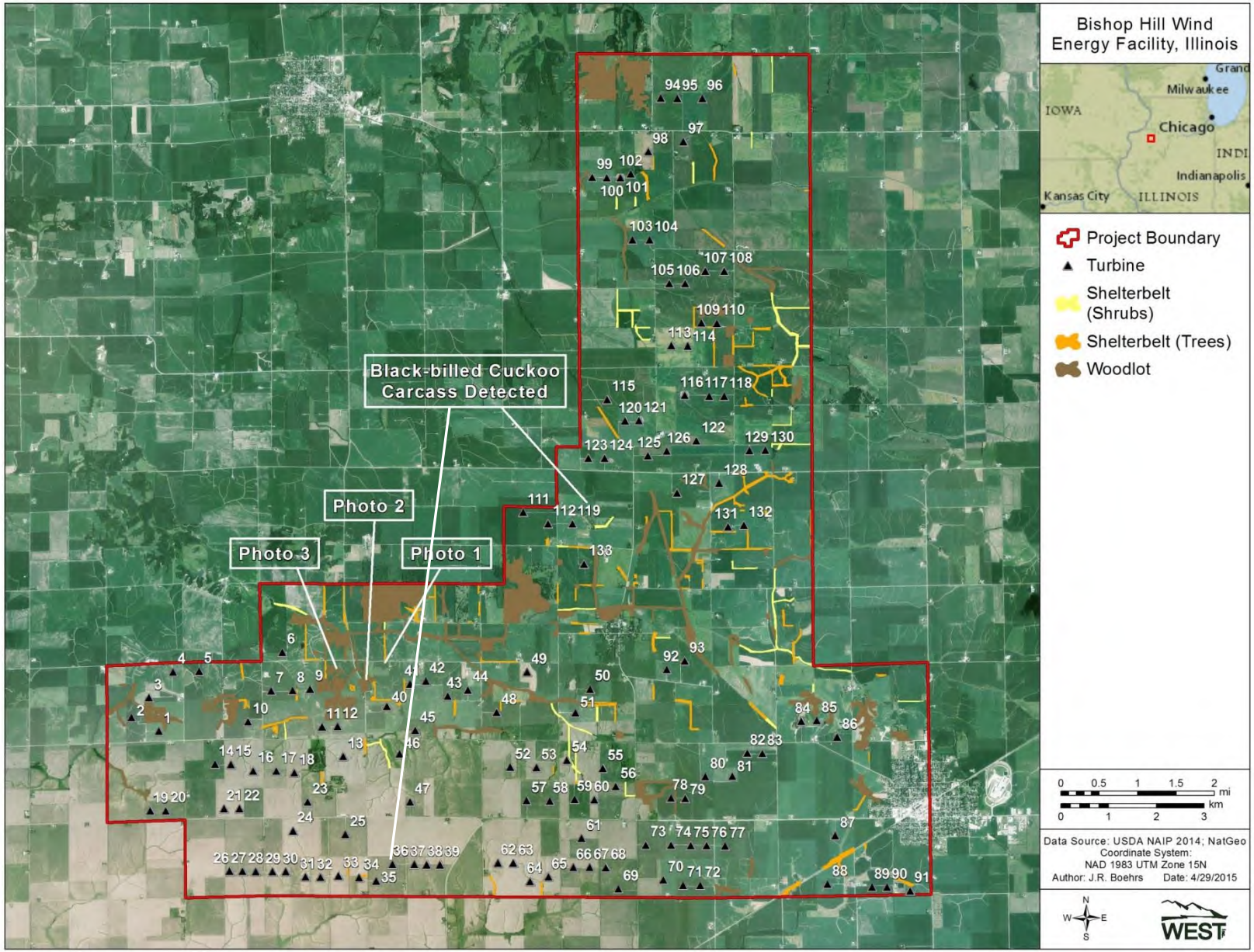



**Figure 4. Locations of potential black-billed cuckoo breeding habitat and detected carcasses at Bishop Hill Wind Energy Project. Photographs included in Appendix A.**

# 3.0 DESCRIPTION OF ACTIVITIES

## 3.1 Activities with Potential for Incidental Take

The activity that may result in the take of a black-billed cuckoo is the continued operation of the Project.

## 3.2 Timeline

BHE proposes to continue to operate the Project for up to 25 years, through 2040.

## 3.3 Other Permitting Review

The Project received all necessary permits to construct and operate prior to construction in 2011. As attached in Appendix E, the wildlife permits received for the Project include:

- USFWS Migratory Bird Permit - 5/14/12 through 3/31/15
- USFWS Migratory Bird Permit - 5/13/14 through 3/31/15
- IDNR T/E Permit – 5/18/15 through 12/31/15
- IDNR Scientific Collection Permit - 5/7/15 through 12/31/15 (carcass monitoring)
- IDNR Scientific Collection Permit - 4/27/15 through 12/31/15 (trial carcasses)
- IDNR Scientific Collection Permit - 10/16/14 through 12/31/15

No other permit reviews are currently ongoing.

BHE has been coordinating with the DNR throughout the siting, permitting and operation phases of the Project. Coordination started in 2006 as part of the initial siting and permitting process, and continued through 2011, including meetings in July 2009 and April 2010 to discuss proposed surveys and survey results.

# 4.0 EFFECTS OF THE PROPOSED ACTION

As stated above, continued operation of the Project may result in the incidental take of black-billed cuckoo through collision with wind turbines. As described in Section 2.1.6.1, no black-billed cuckoos were identified during pre-construction avian use surveys and no black-billed cuckoo nests were identified in the pre-construction nest surveys that were conducted. Although there is some potential breeding habitat in the Project area (Figure 4), it is relatively uncommon, and the Project is located in a portion of the overall black-billed cuckoo range with relatively low abundance during the breeding season (Figure 2). Therefore, migrating individuals are expected to be primarily affected, with effects to breeding individuals anticipated to be unlikely. No effects to breeding habitat would occur due to operation of the Project because no wooded habitat will be cleared or modified.

## 4.1 Spatial Patterns

As noted in Section 2.1.6.2, one black-billed cuckoo carcass was detected in July 2012 and one carcass was detected in September 2015 during post-construction monitoring. The 2012 carcass was a juvenile bird and the carcass was estimated to have been on the ground for 2 to 3 days before it was discovered, according to the qualified biologists conducting the post-construction monitoring. The carcass was discovered approximately 180 ft from turbine 119 and had been scavenged by the time of discovery. The 2015 carcass was a juvenile bird and the carcass was estimated to have occurred 2 to 3 days before it was discovered. The carcass was found approximately 177 feet from turbine 36. Turbines 36 and 119 are located in agricultural habitat and are both within approximately 0.3 mi of two shelterbelts turbine 119 is within 0.80 miles of a woodlot and turbine 36 is approximately 2 miles from a woodlot. Carcasses were not encountered at searched turbines in closer proximity to shelterbelts or woodlots during multiple seasons of spring and fall monitoring. Inference regarding spatial patterns of collision risk are limited by the small sample of carcasses (n = 2). However, based on the current sample, there is no apparent association of carcass locations to black-billed cuckoo habitat (shelterbelts or woodlots).

## 4.2 Temporal Patterns

The 2012 carcass found at the Project was detected in the latter half of July, which coincides with the latter part of the breeding season. However, given the timing of this carcass (late in the breeding season but early for fall migration) and the nomadic behavior of black-billed cuckoos associated with caterpillar irruptions, the available data do not allow a conclusion on whether the individual had been breeding in the Project area or was arriving from a different area. The 2015 carcass was detected in mid-September, coinciding with the fall migration period. Rain, thunderstorms, or fog did not occur overnight during the estimated dates when the carcasses occurred, and there were rain and thunderstorm events without associated discovery of carcasses. Thus, carcass discovery did not occur with inclement weather events typically associated with bird collision risk at structures (Bevanger 1994; Shire et al. 2000; Gehring et al. 2009).

In conclusion, it is not possible to identify specific locations or time periods of risk to black-billed cuckoo from the Project, but the small sample of data indicates that risk may occur in late July and fall migration.

## 4.3 Plans to Minimize Area Affected

During siting of the Project, all of the turbines were placed in cultivated areas (versus several in non-agricultural land in the original layout), avoiding black-billed cuckoo habitat. Additional siting measures were followed to avoid and minimize impacts to wildlife, including the black-billed cuckoo:

- Siting all turbines more than 0.5 mi from the South Edward River (versus several located within 0.5 mi of river in the original layout), and the majority more than 1.0 mi from the river. All turbines were additionally located more than 328 ft from woodlots located along the river. This measure provided setbacks from potential black-billed cuckoo riparian habitat along the river.

- Project facilities were located to avoid: (1) documented locations of any species of wildlife, fish or plants protected under the federal ESA or the state Endangered Species Protection Act such as the black-billed cuckoo, (2) known local bird migration pathways and daily movement flyways, (3) areas where birds are highly concentrated. The Project area is not known for having a high incidence of fog, mist, low cloud ceilings and low visibility.

- Fragmentation of wildlife habitat (including fragmentation of tracts of wooded potential black-billed cuckoo habitat) was avoided through the use, where practical, of lands already disturbed, including using existing roadways.

During construction, further measures were taken to avoid and minimize impacts to wildlife, including the black-billed cuckoo:

- All native habitats (including potential black-billed cuckoo habitat) directly impacted by construction activities during the breeding season were surveyed for nests by a trained biologist prior to construction.

- During Project construction, riparian areas (including wooded riparian areas that could be potential black-billed cuckoo habitat) were avoided, where feasible. If avoidance was not feasible, activities within riparian areas were conducted in conformance with storm water pollution protection plan requirements.

- Removal or disturbance of vegetation (including woody vegetation that could provide black-billed cuckoo habitat) was minimized through site management (e.g., by utilizing previously disturbed areas, designating limited equipment/materials storage yards and staging areas, scalping) and reclaiming all disturbed areas not required for operations.

- Project personnel were advised regarding speed limits on roads (25 mph) and travel was restricted to designated roads to minimize wildlife mortality due to vehicle collisions, including minimizing the potential for collision with black-billed cuckoos.

No additional avoidance or minimization measures are proposed at this time because (1) the siting and construction measures already committed to by BHE have and will continue to minimize impacts to the black-billed cuckoo; (2) no specific collision risk patterns have been detected and therefore there is no basis for effective design of potential minimization measures such as curtailment; and (3) impacts to the species have been low and are predicted to remain low during the term of the permit.

## 4.4 Amount of Habitat Affected

As described in Section 2.1.6.2, there are approximately 2,103 acres of potential black-billed cuckoo habitat (5.4%) within the approximately 39,053 acre Project boundary, consisting of

approximately 134 acres of shrubland (mostly shelterbelts), approximately 300 acres of shelterbelt trees and approximately 1,669 acres of woodlots (Table 3). The Project is already built and operational, and as stated above, impacts to black-billed cuckoo habitat were avoided and minimized during siting and construction. No impacts to black-billed cuckoo habitat will occur during operation of the Project.

**Table 3. Land cover types and acreages within the Bishop Hill Wind Energy Project**

| Land Cover | Acres | Percent |
|---|---|---|
| Agriculture | 32,855.45 | 84.13% |
| Developed | 1701.78 | 4.36% |
| IL SAFE Area | 42.50 | 0.11% |
| Mowed Grassland | 219.03 | 0.56% |
| Native Grassland | 198.27 | 0.51% |
| Open Water | 18.017 | 0.05% |
| Pasture | 861.16 | 2.21% |
| Savannah | 315.75 | 0.81% |
| Shelterbelt with Shrubs | 134.40 | 0.34% |
| Shelterbelt with Trees | 299.55 | 0.77% |
| Unmowed Grassland/CRP | 738.17 | 1.89% |
| Woodlot | 1,669.15 | 4.27% |
| **Total** | **39,053.23** | |

## 4.5 Incidental Take of Individuals

A regional percent composition approach was used to estimate the incidental take of black-billed cuckoos at the Project. The regional percent composition approach pools carcass data from other wind energy projects over time and from various locations within a given region to calculate a take estimate for black-billed cuckoo by determining the anticipated percent of all bird carcasses that will be black-billed cuckoos over the 25 year operational period.

### 4.5.1 Methodology

Wind energy facilities with publicly available carcass data were used to determine the percentage of all bird carcasses that were black-billed cuckoos. Based on proximity to the Project and black-billed cuckoo distribution, data from wind energy facilities in Illinois, Indiana, Ohio, Wisconsin and Michigan were included in the analysis (see Figure 2). Thus, data from wind energy facilities in these states produce a representative range of estimated fatality rates for black-billed cuckoos at the Bishop Hill Wind Energy Project.

Estimated fatality rates (fatalities/turbine/study period) were obtained for all birds and black-billed cuckoos for all publicly available projects within the specified region. The estimated fatality rates were multiplied by the number of turbines surveyed during monitoring to estimate the rate

of fatalities per turbine during defined study periods and adjusted for plot size. The adjusted fatality rates were averaged for facilities with multiple years of monitoring. Study period was defined as the period of time the facility was monitored within a year.

Percent composition of black-billed cuckoo fatalities to all bird fatalities is calculated as follows:

$$\%\ \text{composition} = \frac{\sum_{i=1}^{n} \textit{a}\text{djusted black billed cuckoo fatalities/turbines searched/study period at facility i}}{\sum_{i=1}^{n} \textit{a}\text{djusted all bird fatalities/turbines searched/study period at facility i}}$$

where n is the number of facilities.

The estimated total bird fatalities at the Project based on four years of post-construction monitoring data were multiplied by the regional percent composition of black-billed cuckoo fatalities to estimate the black-billed cuckoo take at the Project.

### 4.5.2 Results

There are seven wind energy facilities with publicly available data in Illinois, Indiana, Wisconsin and Michigan; there are no wind projects in Ohio with publicly available fatality data (Table 4). In addition, data from two wind facilities in Illinois - the California Ridge Wind Energy Project and the Bishop Hill Wind Energy Project - were included in the dataset for the regional percent composition analysis (Table 4).

**Table 4. Wind facilities with publicly available fatality estimates used in regional percent composition analysis**

| Project Name[1] | State | Year of Study | Black-billed cuckoo detected |
|---|---|---|---|
| Blue Sky Green Field | WI | 2008 | No |
| Cedar Ridge | WI | 2009 - 2010 | Yes |
| Crescent Ridge | IL | 2005 | No |
| Forward | WI | 2008 | Yes |
| Fowler I | IN | 2009 | No |
| Grand Ridge I | IL | 2009 | No |
| Kewaunee County | WI | 1999 - 2001 | No |
| Bishop Hill | IL | 2012 - 2015 | Yes |
| California Ridge | IL | 2013 - 2015 | Yes |

[1] References

| Project Name | Citation |
|---|---|
| Blue Sky Green Field | Gruver et al. 2009 |
| Cedar Ridge | BHE Environmental 2010 |
| Crescent Ridge | Kerlinger et a. 2007 |
| Forward | Gradsky and Drake 2011 |
| Fowler I | Johnson et al. 2010 |
| Grand Ridge I | Derby et al. 2010 |
| Kewaunee County | Howe et al. 2002 |
| Bishop Hill | Table 5 |
| California Ridge | Table 5 |

**Table 5. Data from California Ridge and Bishop Hill Wind Energy Projects used in regional percent composition analysis**

| Project Name | Study Period | Estimated bird fatality/ turbine/year | Black-billed cuckoo carcass/study period | No. turbines searched | Estimated Birds /turbine /study period | Estimated Birds/ turbines searched/ study period | Estimated Black-billed cuckoo/ turbines searched/ study period |
|---|---|---|---|---|---|---|---|
| Bishop Hill | Fall 2012 | 0.84 | 1 | 12 | 1.48 | 29.41 | 0.90 |
| | Fall 2013 | 1.65 | 0 | 12 | | | |
| | Fall 2014 | 1.30 | 0 | 12 | | | |
| | Fall 2015 | 2.05 | 1 | 20 | | | |
| | Spring 2013 | 0.05 | 0 | 30 | | | |
| | Spring 2014 | 0 | 0 | 30 | | | |
| California Ridge | Fall 2013 | 2.64 | 1 | 20 | 2.64 | 68.84 | 1.52 |
| | Fall 2014 | 2.47 | 1 | 27 | | | |
| | Fall 2015 | 2.61 | 1 | 16 | | | |
| | Spring 2013 | 0.08 | 0 | 30 | | | |
| | Spring 2014 | 0.05 | 0 | 30 | | | |

Analysis of the data at the nine facilities resulted in an estimated 997.43 bird fatalities/turbines searched/study period and an estimated 4.32 black-billed cuckoo fatalities/turbines searched/study period. The regional percent composition of estimated black-billed cuckoo fatalities to estimated bird fatalities is approximately 0.4 percent (4.32 black-billed cuckoo/997.43 all birds = 0.0043).

Applying the regional percent composition of black-billed cuckoo estimated fatalities to the Project-specific estimated bird fatalities results in an estimated average of 0.86 black-billed cuckoo fatalities/study period at Bishop Hill Wind Energy Project (Table 6). Study period in this case represents spring and fall migration, when the Project-specific carcass studies have occurred. To account for variability, a range of 0 to 1 black-billed cuckoo take per year is estimated for the Project. Over the 25 year operation of the Project, estimated take would be up to 25 black-billed cuckoos (Table 6) after implementation of avoidance and minimization measures described above. The applicant is therefore applying for an ITA to take up to 25 black-billed cuckoos over the 25-year permit term.

**Table 6. Estimated take of black-billed cuckoo at Bishop Hill Wind Energy Project**

| Estimated bird fatalities per turbine per year (Project)[1] | Estimated relative abundance of black-billed cuckoo carcasses as % of all birds (regional ) | Estimated black-billed cuckoo fatalities/ turbine /year | Estimated black-billed cuckoo fatalities /Project (133 turbines)/year | Range of take for 25 years operation |
|---|---|---|---|---|
| 1.48 | 0.4% | 0.006 | Average = 0.86<br>Range of 0 to 1 | 0-25 |

[1] Based on four years of post-construction data

## 4.6 Management of the Affected Area

The Project is already built and operational, and as stated above, impacts to black-billed cuckoo habitat were avoided and minimized during siting and construction. As described in Section 4.3, the majority of impacts occurred within tilled fields, and any impacts to non-tilled fields were minimized during construction and restored after construction. No impacts to wooded habitat will occur during operation of the Project, and continued operation of the Project will not affect the ability of the black-billed cuckoo to use wooded habitat adjacent to the turbines and other components of the Project.

## 4.7 Measures to Minimize and Mitigate Effects

### 4.7.1 Minimization and Mitigation – Project Design and Operation

Design and operation of the Project incorporates the following measures to minimize and mitigate impacts to wildlife, including the black-billed cuckoo:

- Hunting, fishing, dogs, or possession of firearms by BHE employees and designated contractor(s) in the Project area is prohibited during operation and maintenance, to minimize the potential for injury to wildlife including the black-billed cuckoo.

- Turbines employ unguyed, tubular towers and slow-rotating, upwind rotors; this design minimizes risk of bird collision.

- Avian Power Line Interaction Committee (2006) suggested practices were used to ensure that the transmission line was designed and constructed in a manner to minimize bird collision and electrocution risk.

- Collection and communication lines are buried, avoiding the potential for bird collision.

- Lighting is minimized to that which is required by the Federal Aviation Administration. The Federal Aviation Administration typically requires every structure taller than 200 ft above ground level to be lighted, but in the case of wind power developments, it allows a strategic lighting plan that provides complete conspicuity to aviators but does not require lighting every turbine. BHE developed a lighting plan for the Project that includes the lighting of 82 Project turbines and one met tower with medium intensity dual red synchronously flashing lights for night-time use and daytime use, if needed. The turbines are lighted only as required by Federal Aviation Administration regulations, plus a low voltage, shielded light on a motion sensor at the entrance door to each turbine. To avoid disorienting or attracting birds such as the black-billed cuckoo, lighting on turbines employs strobed, minimum-intensity lights as recommended by the USFWS.

- All applicable hazardous material laws and regulations existing or hereafter enacted or promulgated regarding these chemicals are complied with and a Spill Prevention, Control and Countermeasure Plan is implemented. The only hazardous chemicals anticipated to be on-site are the chemicals contained in diesel fuel, gasoline, coolant (ethylene glycol) and lubricants in machinery. Hazardous chemicals contained in diesel fuel, gasoline, coolant (ethylene glycol) and lubricants are not stored in or near any stream, nor does any vehicle refueling or routine maintenance occur in or near streams. When work is conducted in and adjacent to streams, fuels and coolants are contained in the fuel tanks and radiators of vehicles or other equipment. Minimizing the potential for contamination minimizes the potential for adverse effects to black-billed cuckoo habitat in the Project.

- Fires will be handled in accordance with the Fire Protection and Prevention Plan (Invenergy Services 2013). The plan includes pre-fire planning with the local fire department, fire prevention through good housekeeping and equipment maintenance, reporting fires to the local fire authorities and BHE management and limited fire suppression using fire extinguishers by trained BHE personnel. At all times during operation, satisfactory spark arresters will be maintained on internal combustion engines. Preventing fires minimizes the potential for adverse effects to black-billed cuckoo habitat in the Project.

- Turbine blades remain fully feathered (i.e., blades are oriented parallel to the wind) so rotors move very slowly prior to reaching the turbine cut-in speed. At cut-in wind speeds, the blades pitch into the wind, rotor speeds increase and the generators eventually close their electrical breaker and begin generating electricity at some slightly higher wind speed, when steady wind power is provided by the rotor to the generator. Although this measure is generally employed to minimize collision risk for bats, reducing the amount of time when blades are actively spinning may also reduce the risk of bird collision.

Given the low levels and unpredictable pattern of black-billed cuckoo take for the Project, no additional minimization or operational mitigation measures are proposed.

### 4.7.2 Mitigation – Black-billed Cuckoo Breeding Survey Research

In order to mitigate for the anticipated low level of take, BHE proposes to conduct breeding surveys for the black-billed cuckoo, in order to gather useful information that will inform DNR management decisions to help conserve, protect and enhance black-billed cuckoo habitat and populations in the state. Appendix F contains further details on the proposed approach to the black-billed cuckoo breeding survey; the study plan is based on *A natural history summary and survey protocol for the western distinct population segment of the yellow-billed cuckoo* (Halterman et al. 2015).

The objectives of the research are to document the presence or absence of breeding black-billed cuckoos and assess black-billed cuckoo habitat conditions in the Middle Fork State Fish and Wildlife Management Area located within the Vermilion River and Little Vermilion River Conservation Opportunity Area (COA) located in Champaign and Vermilion Counties.

The Vermilion River and Little Vermilion River COA is located in a part of the state with relatively few black-billed cuckoo BBS records, none of which have been recorded in the last five years. However, the BBS route closest to this COA is not located in prime cuckoo breeding habitat, and therefore a survey in suitable habitat within the COA would provide valuable information on whether the cuckoos are breeding in this part of the state. The Middle Fork State Fish and Wildlife Area was selected for black-billed cuckoo surveys and habitat assessment based on the presence of deciduous forest habitat which is located in patch sizes that are sufficient to provide suitable black-billed cuckoo breeding habitat (Appendix F).

It is anticipated that BHE will fund two years of surveys along approximately 2,200 meters in the Middle Fork State Fish and Wildlife Area; as Appendix F details, each transect will be surveyed four times during the breeding season. Additionally, information on habitat with regards to three prime criteria related to black-billed cuckoo habitat suitability (general forest structure, understory canopy height and understory density) will be recorded for all the transects.

The results of the surveys will be provided to the DNR for use in conservation decisions, such as habitat management approaches. The surveys have value even if black-billed cuckoo are not

detected for several reasons. First, the survey is designed specifically to determine presence/absence of black-billed cuckoo, and negative results still provide important information regarding the species' distribution in the eastern part of the state compared other types of broad-scale data (e.g., BBS). Second, the habitat data will help evaluate suitable black-billed cuckoo habitat in the Middle Fork State Fish and Wildlife Area, which can be used to inform habitat management decisions.

## 4.8 Monitoring

### 4.8.1 Intensive Carcass Monitoring

Post-construction avian and bat carcass monitoring has been and will continue to be conducted in accordance with the monitoring plan in Appendix B; Appendix D contains the reports documenting the results of the carcass monitoring that has been done to date. Monitoring will also help determine the effectiveness of avoidance, minimization and mitigation measures in reducing impacts at the facility. The results of post-construction monitoring intended to provide an estimate of overall fatality at a facility can be influenced by several sources of bias during field-sampling. To provide corrected estimates of fatality rates, monitoring methods account for important sources of field-sampling bias including 1) carcasses that occur on a highly periodic basis, 2) carcass removal by scavengers, 3) searcher efficiency, 4) failure to account for the influence of site conditions (e.g., vegetation) in relation to carcass removal and searcher efficiency rates and 5) carcasses or injured birds or bats that may land or move to areas not included in the search plots (Kunz et al. 2007). BHE's post-construction mortality monitoring methods were designed to account for these sources of bias and adapt to preliminary results such that effectiveness, efficiency and accuracy of the study is maximized.

Post-construction mortality monitoring at the Project will[1] involve standardized carcass searches (first three years of operations; concluded in fall 2015), follow-up standardized carcass searches (once every three years thereafter), searcher efficiency trials and carcass removal trials. Standardized carcass searches will allow statistical analysis of the search results and calculation of fatality estimates. Carcass searches were conducted during spring (April 15 through May 15) and fall (August 1 through September 30) during the first three years of Project operation by a consultant to establish baseline estimates of bird and bat fatality rates. Follow-up carcass searches will be conducted during the late summer and fall season (July 15 September 30, encompassing the time period when the black-billed cuckoo carcass was detected at the Project, on July 26 and September 18) once every three years to confirm that no significant increase in estimated bird or bat fatality rates has occurred relative to the baseline estimates.

Fatality estimates will be determined using a fatality estimator that corrects for searcher efficiency and carcass removal biases. Fatality estimates will be expressed both in terms of fatalities/turbine/season and fatalities/turbine/year and in terms of fatalities/MW/season and

[1] Some of this work has already occurred (see Table 2); however "will" is used for clarity and to reflect that monitoring will continue in the future.

fatalities/MW/year and accompanied by precision and variance estimates to facilitate comparison with other studies.

### 4.8.2 Incidental Monitoring

BHE personnel are trained on wildlife and how to respond to the discovery of a carcass or injured animal. An incidental reporting process was developed for operations personnel that requires the documentation and reporting of animal carcasses detected within the Project area. Operations personnel are prohibited from touching the carcass, and are required to immediately photograph and report it within two hours of discovery to the BHE environmental staff. Once the field report is submitted, the environmental staff are required to assess each carcass report, deferring to a biologist when necessary and report all state-listed endangered or threatened species to the DNR within 24 hours of identification.

### 4.8.3 Reporting

Reports will be provided to the DNR to summarize the results of the follow-up intensive carcass surveys that will occur every three years. All post-construction monitoring results and indicators of the effectiveness of the minimization and mitigation measures outlined in this plan will be summarized in reports. These reports will include fatality estimates and data summaries. Any black-billed cuckoo carcasses that are detected will be promptly reported to the DNR.

## 4.9 Adaptive Management

### 4.9.1 Adaptive Management Goals

The goals of the adaptive management plan are to enable the Project to respond to monitoring data collected over the term of the permit. Certain trigger events and subsequent changes to the avoidance, minimization and mitigation plan have been defined as a part of the adaptive management plan, to guide the adaptive process.

### 4.9.2 Adaptive Management Plan

The events that would trigger changes to the avoidance, minimization and mitigation plan presented herein would be documented take of black-billed cuckoo above the anticipated level, which is expected to average up to 1 per year over the 25 year term of the permit.

If any black-billed cuckoo carcasses are detected at the Project during one year, the following actions will be taken.

1) DNR will be notified within one business day of positive identification of the discovery.
2) Carcass information will be examined and included in Project's database

A rolling average will be kept of detected black-billed cuckoo carcasses. If, over a three year period, three or more black-billed cuckoo carcasses are detected (an average of 1 detected per year), the following actions will be taken:

1) DNR will be notified within one business day of positive identification of the discovery.

2) Carcass information will be examined and included in Project's database BHE and the DNR will meet and confer to determine, based on the available data, the circumstances under which the carcasses occurred.
3) If a particular cause for the carcasses can be identified, BHE will develop specific additional on-site and/or operational mitigation measures in consultation with DNR to address the those causes
    - BHE will conduct follow-up post-construction monitoring during the subsequent year in the season(s) in which the carcasses were discovered to assess whether on-site mitigation measures were successful at reducing mortality.
4) If there continues to be no spatial, weather or temporal pattern to when and where black-billed cuckoo carcasses are found, no mitigation measures will be taken based on one three-year period of exceeding the anticipated take levels. However, if two consecutive three year periods occur where three or more black-billed cuckoo carcasses are detected and no spatial or temporal pattern is detected BHE and DNR will determine the need to pursue an amendment to the Incidental Take Authorization and the potential for adding offsite mitigation (i.e., additional research and/or other support of offsite conservation efforts).

This adaptive management plan will apply throughout the life of the Project to provide effective avoidance, minimization and mitigation measures for avoiding and reducing impacts to black-billed cuckoo.

## 4.10 Verification of Adequate Funding

BHE has already funded and completed three years of intensive monitoring at the Project and will continue to fund fall monitoring at three-year intervals for the life of the Project. Prior to each year of follow-up monitoring, BHE will provide the DNR with a letter certifying that a monitoring contract has been executed with a firm qualified to conduct monitoring in accordance with the approved monitoring plan. Funding may be in the form of bonds, certificates of insurance, escrow accounts or other financial instruments adequate to carry out all aspects of the conservation plan.

# 5.0 ALTERNATIVES CONSIDERED

## 5.1 No Action Alternative

The No Action alternative in this case would consist of the Project not being developed, constructed or operated. The Bishop Hill Wind Energy Project has been built and operational since July 2012. This option is considered to be a non-viable alternative.

## 5.2 Construction and Operation Alternatives

Since the project is already constructed and operational, no construction alternatives were considered. The Project was sited to avoid and minimize impacts to the black-billed cuckoo by

placing all turbines in cultivated fields and avoiding and minimizing impacts to wooded habitat. Placing turbines elsewhere in the county would not be expected to reduce the risk to the black-billed cuckoo.

Two black-billed cuckoo carcasses were discovered in four years of post-construction monitoring in agricultural fields during periods of clear weather. As described in Sections 4.1 and 4.2, it is not possible to identify specific location or time periods of risk to the black-billed cuckoo, and therefore BHE concluded that operational modifications are not an appropriate alternative.

## 6.0 EFFECTS DETERMINATION

The continued operation of the Bishop Hill Wind Energy Project will not impact the likelihood of the survival of the black-billed cuckoo in Illinois for the following reasons:

- Operation of the Project is expected to result in 0 to 1 black-billed cuckoo carcasses per year (compared to estimated breeding population of 410,000 in the U.S. and breeding population of 5,000 in Illinois).
- Operation of the Project will not impact black-billed cuckoo habitat and will not affect the black-billed cuckoo's ability to use adjacent wooded habitat during breeding or migration.
- As stated in Section 2.1, the black-billed cuckoo life history is characterized by a short life span and relatively high reproductive output, with breeding occurring every year of a female's life. In species with this type of life history, survival of individuals is not the driver of population trends. Instead, impacts to fecundity, such as direct impacts to nests and nest success have more influence on population dynamics (Stahl and Oli 2006). Furthermore, population trends of North American birds with similar life history strategies are not discernibly affected by collision mortality such as that anticipated at the Project (Arnold and Zink 2011).

In conclusion, the low level of anticipated annual take of primarily migrating individuals is not anticipated to affect the black-billed cuckoo population that migrates through or breeds in Illinois.

# 7.0 IMPLEMENTING AGREEMENT

## 7.1 Obligations and Responsibilities

BHE will be responsible for implementing the Conservation Plan. BHE will promptly report any black-billed cuckoo carcasses to the DNR, including any documented during the scheduled 2016 carcass survey. Summary reports of the follow-up carcass surveys that will be conducted every three years after the 2016 carcass survey will be submitted to the DNR, starting with the fall 2019 report.

## 7.2 Relinquishment

BHE reserves the right to relinquish the ITA prior to expiration by providing thirty (30) days advance written notice to the IDNR. BHE may surrender the ITA by returning it to the IDNR along with a written statement of its intent to surrender and cancel the ITA. The ITA shall be deemed void and canceled upon receipt of the permit by the IDNR.

## 7.3 Amendment or Modification

The Conservation Plan may be amended or modified with the written consent of both BHE and IDNR.

## 7.4 Terms Do Not Run With the Land

The terms the Conservation Plan and ITA are not intended to run with the land, and will not bind the existing owners of covered lands or subsequent purchasers of the project or covered lands unless such parties agree in writing to become bound by the Conservation Plan and ITA.

## 7.5 Compliance with Other Federal, State and Local Regulations

BHE certifies that all activities undertaken at the Bishop Hill Wind Energy Project are in compliance with applicable federal, state and local regulations. No federal take authorization for the black-billed cuckoo is required.

The undersigned certify that they have the legal authority to carry out the obligations and responsibilities set forth in this agreement and Conservation Plan.

Rebecca Cranna
Bishop Hill Energy LLC

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# Appendix A. Project Area Photographs

**Photo 1. Looking north; shelterbelt in middle ground is not likely black-billed cuckoo breeding habitat.**

**Photo 2. Looking east; woodlot is potential black-billed cuckoo breeding habitat.**

**Photo 3. Looking north; woodlot is potential black-billed cuckoo breeding habitat.**

# Appendix B. Carcass Monitoring Plan

# 1.0 CARCASS MONITORING PLAN

## 1.1 Monitoring Goals

The goals of post-construction monitoring are to determine overall bird and bat fatality rates at the Project and evaluate the circumstances under which fatalities occur. Post-construction monitoring results also provide triggers for adaptive management.

## 1.2 Species to be Monitored

The post-construction monitoring plan will address all bird and bat fatalities observed within the Project area. The monitoring plan is designed to detect carcasses and calculate all bat (and bird) fatality estimates with enough precision to determine if the operational protocols are effective in reducing all bat fatalities at the Project and with other operating projects. Within the overall bat and bird fatality estimates, estimates by species will be made, if possible, based on the number of carcasses detected.

## 1.3 Permits and Wildlife Handling Procedures

### 1.3.1 Permits

State and federal collecting/salvaging permits will be acquired from the Illinois Department of Natural Resources and the USFWS by BHE's consultants and BHE prior to commencement of the study to enable searchers to collect and handle carcasses in compliance with laws pertaining to the collection and possession of wildlife and migratory birds.

### 1.3.2 Wildlife Handling Procedures

All carcasses found will be labeled with a unique number, individually bagged and retained in a freezer at the Project Operations and Maintenance building. A copy of the original data sheet for each carcass will be placed in the bag with each frozen carcass. The carcasses may be used in searcher efficiency and carcass removal trials. In the event that a carcass of an ESA- or state-listed species is found, BHE will arrange to submit the carcass to the appropriate authorities. If an injured bird or bat is found, the animal will be sent to a local wildlife rehabilitator, when possible.

## 1.4 Monitoring

### 1.4.1 Study Design

The results of post-construction monitoring efforts intended to provide an estimate of overall fatality at a facility can be influenced by several sources of bias during field-sampling. To provide corrected estimates of overall fatality rates, the methodology of carcass monitoring efforts must account for important sources of field-sampling bias including 1) fatalities that occur on a highly periodic basis, 2) carcass removal by scavengers, 3) searcher efficiency, 4) failure to account for the influence of site conditions (e.g., vegetation) in relation to carcass removal and searcher efficiency rates and 5) fatalities or injured birds or bats that may land or move to

areas not included in the search plots (Kunz et al. 2007). BHE's proposed post-construction carcass monitoring plan methodology is designed to account for these sources of bias and adapt to preliminary results such that effectiveness, efficiency and accuracy of the study is maximized.

Post-construction carcass monitoring at the Project will involve standardized carcass searches (during spring and fall in the first three years of operations), follow-up standardized carcass searches (during fall every three years thereafter), searcher efficiency trials and carcass removal trials. Standardized carcass searches will allow statistical analysis of the search results, calculation of overall fatality estimates and assessment of correlations between fatality rates and potentially-influential variables (e.g., weather, location). Carcass searches will be conducted during the first three years of Project operation during spring (April 15 through May 15) and fall (August 1 through September 30) by a consultant and by specifically-trained BHE personnel to establish baseline fatality estimates of bird and bat fatality. Follow-up carcass searches will be conducted by trained BHE personnel or contractors during the late summer and fall season (July 15 - September 30, encompassing the time period where black-billed cuckoo carcasses have been detected at the Project) once every three years to confirm that no significant increase in overall bird or bat mortality has occurred relative to the baseline mortality estimates. If after the first two follow up surveys no black-billed cuckoo carcasses are documented in July, CRWE may adjust the survey window accordingly, to August 1 – September 30. Searcher efficiency and carcass removal rates are two sources of field bias in mortality studies that have been proven to be highly variable and site- and researcher-specific; mortality estimators are highly sensitive to these parameters (Huso 2010). Kunz et al. (2007) and the USFWS (2010) Wind Turbine Guidelines Advisory Committee both strongly recommend that all mortality studies should conduct searcher efficiency and carcass removal trials that follow accepted methods and address the effects of differing vegetation types.

#### *1.4.1.1 Focus Species*

The post-construction monitoring study design is intended to enable detection of all bird and bat carcasses that may occur within searched areas of the Project area, as well as support the development of fatality estimates for all bird and bat species found during the mortality searches.

#### *1.4.1.2 Sample Size*

During the first three years of monitoring, standardized carcass searches were conducted at 30 turbines. This sample size optimizes field survey effort while maximizing expected confidence in the data and associated results. Table A.1 was developed using a mean bat fatality rate and mean standard deviation calculated from results of studies at other wind energy facilities in the region. Bat fatality rates were used because they have been much more variable than bird fatality rates at wind facilities (Poulton 2010); a sample size adequate for confidence in bat data will therefore also be adequate for confidence in bird data. This table presents the 95 percent confidence intervals associated with a variety of sample sizes and demonstrates the diminishing returns in confidence as sample size is increased. A sample size of 60 turbines would require twice the survey effort but would not confer twice as much confidence in results as sampling of

the 30 turbines would. When extrapolated over the entire facility (133 turbines), the upper confidence limit fatality estimate for a sample size of 30 turbines is not appreciably different than those for larger sample sizes. Sample sizes smaller than 30 turbines have increasingly larger confidence intervals and may also result in datasets which have higher standard deviations (further decreasing confidence).

During follow-up studies (discussed below under timing and duration) conducted every three years by trained BHE personnel or contractors, a sample size of 15 turbines will be studied. This sample size is adequate for follow-up studies, as the purpose of these studies is to provide fatality estimates that can be compared against the baseline estimate established during the first three years of monitoring to confirm that no significant increase in overall bird or bat mortality has occurred.

Table A.1 Confidence Intervals of Turbine Sample Sizes for Post-Construction Monitoring.[1]

| **No. of Turbines Searched** | **Mean Fatality (bats/turbine/year)** | **95.0% Confidence Limits** | | **95.0% Confidence Interval** |
|---|---|---|---|---|
| | | **Low** | **High** | |
| 10 | 27.9 | 20.0 | 35.8 | 7.9 |
| 20 | 27.9 | 22.8 | 33.0 | 5.1 |
| 30 | 27.9 | 23.8 | 32.0 | 4.1 |
| 40 | 27.9 | 24.4 | 31.4 | 3.5 |
| 50 | 27.9 | 24.8 | 31.0 | 3.1 |
| 60 | 27.9 | 25.1 | 30.7 | 2.8 |
| 80 | 27.9 | 25.4 | 30.4 | 2.5 |
| 100 | 27.9 | 25.7 | 30.1 | 2.2 |

[1] For this analysis, mean fatality estimate and mean standard deviation of datasets were obtained from a subset of the post-construction monitoring studies presented in Table 4.2 of the ABPP that reported the necessary data.

A significant increase is defined as a measurable, statistically significant ($p \leq 0.10$) increase in estimated fatality relative to the baseline fatality estimate. A sample size of 15 turbines will meet the goal of detecting significant increases, as differences small enough that their detection requires a sample size of 30 turbines instead of 15 are unlikely to be biologically-justifiable as significant.

The 30 turbines sampled for the first three years of monitoring were determined using a stratified random sampling approach. The 15 turbines to be sampled for follow-up studies will be selected from the initial 30 sample turbines using a stratified random sampling approach. Selecting the follow-up sample turbines from the intensive sample turbines will reduce the introduced variables (i.e., location) and provide a more accurate comparison of fatality rates between study years.

*1.4.1.3 Search Intervals*

Search intervals were once weekly for each of the 30 sample turbines during the spring and fall periods during the first three years of monitoring and will be once weekly for each of the 15 sample turbines during the follow-up studies. The turbine search schedule and order will be randomized so that each turbine's search plot will be sampled at differing periods during the day. If more or less intensive monitoring is deemed necessary following initial data collection (carcass searches and carcass removal trials) at the site, the search intervals will be modified accordingly. The Wind Turbine Guidelines Advisory Committee guidelines recommend that "carcass search intervals should be adequate to answer applicable questions at an appropriate level of precision to make general conclusions about the project" (USFWS 2010). A weekly search interval for fatality monitoring was deemed adequate by Kunz et al. (2007) and studies have demonstrated that a weekly search interval provides effective carcass monitoring and adequately estimates impacts from wind energy facilities (Gruver et al. 2009; Young et al. 2009), such that the added effort associated with more frequent intervals is not warranted.

### 1.4.2 Field Methods

*1.4.2.1 Plot Size, Vegetation Mowing, Visibility Classes*

Search plots measuring 256 x 256 ft will be established at the base of each sampled turbine. The methods used to establish this search plot size are recommended for detecting carcasses of both birds and bats by the Wind Turbine Guidelines Advisory Committee (USFWS 2010) and are supported by several other studies that have indicated that the majority of bird and bat carcasses typically fall within 100 ft of the turbine or within 50 percent of the maximum height of the turbine (Kerns and Kerlinger 2004; Arnett et al. 2005; Young et al. 2009; Jain et al. 2007, 2008, 2009; Piorkowski and O'Connell 2010; USFWS 2010). This plot size will exceed one-half the maximum turbine rotor height of the Project turbines (246 ft [75 m]). This should minimize the number of fatalities or injured birds or bats that land or move outside of the search plots and thereby reduce the number of bird or bat carcasses that would be undetected, causing underestimation of overall fatality.

Each search plot will be centered on a turbine location. Thirteen transects will be established in each plot for complete survey coverage. Vegetation will be mowed in each plot prior to the beginning of each study period to improve searcher efficiency. Although the majority of vegetation within each search plot is expected to consist of row crops or fallow fields, visibility classes will be established if vegetation type and density vary sufficiently. If necessary, visibility classes will be mapped within each plot, and searches will be designed to preferentially include areas of higher visibility to maximize searcher efficiency. Searcher efficiency and carcass removal rates will be determined for each visibility class.

*1.4.2.2 Timing and Duration*

Standardized carcass searches will be conducted at the Project site for a total of four weeks in the spring (April 15 through May 15) and eight weeks during fall (August 1 through September 30). Carcass searches will be conducted by both a consultant and specifically trained BHE personnel during the first three years of Project operation. Trained BHE personnel or

contractors will conduct follow-up carcass searches for ten weeks during late summer and fall (July 15 through September 30, encompassing the time period when the black-billed cuckoo carcass was detected at the Project, July 26) every three years to determine bird and bat fatality rates.

*1.4.2.3 Standardized Carcass Searches*

All carcass searches will be conducted by a consulting biologist or appropriately-trained BHE personnel experienced in conducting fatality search methods, including proper handling and reporting of carcasses. Searchers will be familiar with and able to accurately identify bird and bat species likely to be found at the Project area. Any unknown birds and bats discovered during fatality searches will be sent to a qualified USFWS-approved bird or bat expert for positive identification. During searches, searchers will walk at a rate of approximately 2 mph while searching 10 ft on either side of each transect.

For all carcasses found, data recorded will include:

- Date and time,
- Initial species identification,
- Sex, age and reproductive condition (when possible),
- GPS location,
- Distance and bearing to turbine,
- Substrate/ground cover conditions,
- Condition (intact, scavenged),
- Any notes on presumed cause of death, and
- Wind speeds and direction and general weather conditions for nights preceding search.

A digital picture of each detected carcass will be taken before the carcass is handled and removed. As previously mentioned, all carcasses will be labeled with a unique number, bagged and stored frozen (with a copy of the original data sheet) at the Project Operations and Maintenance building.

Bird and bat carcasses found in non-search areas (e.g., near a Project turbine not included in the study) will be coded as “incidental finds” and documented as much as possible in a similar fashion to those found during standard searches. Maintenance personnel will be informed of the timing of standardized searches and, in the event that maintenance personnel find a carcass or injured animal, these personnel will be trained on the collision event reporting protocol. Any carcasses found by maintenance personnel will also be considered incidental finds. Incidental finds will be included in survey summary totals but will not be included in the mortality estimates.

*1.4.2.4 Searcher Efficiency and Carcass Removal Trials*

Searcher efficiency trials will be used to estimate the percentage of all bird and bat fatalities that are detected during the carcass searches. Similarly, carcass removal trials will be used to estimate the percentage of bird and bat fatalities that are removed by scavengers prior to being located by searchers. When considered together, the results of these trials will represent the

likelihood that a bird or bat fatality that falls within the searched area will be recorded and considered in the final fatality estimates.

Trials will be conducted during each study period by placing “trial” carcasses in the search subplots (one trial during the spring monitoring season and two trials during the fall monitoring season) to account for changes in personnel, searcher experience, weather and scavenger densities. A total of 50 searcher efficiency trial carcasses, 25 birds of variable sizes and 25 bats, will be placed in subplots according to randomly selected distances and azimuths from each turbine prior to the carcass search on the same day. Per Wind Turbine Guidelines Advisory Committee (2010) guidelines, this is the maximum number of carcasses that can be distributed across a sample size of 30 turbines without exceeding the limit of two trial carcasses per turbine and with some allowance for variation in number of trial carcasses placed at each turbine. Searcher efficiency and carcass removal trials will be limited to one spring and two fall trials to avoid attracting scavengers to the site with carcasses and potentially artificially inflating the carcass removal rate.

Each trial carcass will be discretely marked and labeled with a unique number so that it can be identified as a trial carcass. Prior to placement, the date of placement, species, turbine number, distance and direction from turbine and visibility class (if applicable) will be recorded. Species such as house sparrows (*Passer domesticus*) and European starlings (*Sturnus vulgaris*) may be used to represent small-sized birds; rock doves (*Columba livia*) and commercially raised hen mallards (*Anas platyrhynchos*) or hen pheasants (*Phasianus colchicus*) may be used to represent medium-sized to large birds. Non-listed bat species carcasses recovered during the study will be re-used in the searcher efficiency trials, if allowed by permit. Brown mice (*Mus* or *Peromyscus* spp.) may be used to represent bats if bat carcasses are not available. If vegetation classes are established, trial carcasses will be placed in a variety of vegetation classes so that searcher efficiency rates can be determined for each class. No more than two trial carcasses will be placed simultaneously at a single turbine.

Searcher efficiency trials will be conducted blindly; the searchers will not know when trials are occurring, at which search turbines trial carcasses are placed, or where trial carcasses are location within the subplots. The number and location of trial carcasses found by searchers will be recorded and compared to the total number placed in the subplots. Searchers will be instructed prior to the initial search effort to leave carcasses, once discovered to be trial carcasses, in place. The number of trial carcasses available for detection (non-scavenged) will be determined immediately after the conclusion of the trial.

Searcher efficiency of the consultant searchers and BHE searchers will be combined to generate the estimate of searcher bias for calculation of baseline fatality estimates. Searcher efficiency rates will be spot-checked each year of follow-up monitoring to ensure that initial estimates continue to be valid. Spot-check trials will use 20 carcasses (10 bird and 10 bat) as there will be fewer (15) sample turbines at which to place the carcasses. All other methods will remain the same. The follow-up searcher efficiency rates will be compared to the baseline searcher efficiency rates using a t-test (significant $p \leq 0.10$) to determine if searcher efficiency

has changed appreciably such that adjustments to the follow-up monitoring studies should be made.

Carcass removal trials will be conducted immediately following the baseline searcher efficiency trials using the same trial carcasses. Trial carcasses will be left in place by searchers and monitored for a period of up to 30 days. Carcasses will be checked on days 1, 2, 3, 4, 5, 6, 7, 10, 14, 20 and 30. The status of each trial carcass will be recorded throughout the trial. Carcass removal rates will also be spot-checked each year of follow-up monitoring to ensure that initial estimates continue to be valid. The follow-up carcass removal rates will be compared to the baseline carcass removal rates using a t-test (significant $p \leq 0.10$) to determine if carcass removal has changed appreciably such that adjustments to the follow-up monitoring studies should be made.

*1.4.2.5 BHE Personnel Training*

BHE searchers will be full-time BHE employees who will be trained by qualified biologists in conducting: (1) standardized carcass searches and search protocols; (2) bird and bat identification and procedures to confirm identifications of rare species; and (3) wildlife handling procedures for all dead or injured wildlife discovered at the Project.

Standardized Carcass Searches. BHE searchers will be trained by a qualified biologist of BHE's choice, most likely the consulting biologist conducting the baseline carcass monitoring. Training will include:

- Location, size and configuration of each search plot and how to record carcass location;
- Knowledge of the visibility classes within each plot;
- Start and stop points and width of search transects;
- Search/walking speed;
- Practice searches with planted carcasses;
- Familiarity with data sheets;
- Recording data and observations that assist with data interpretation;
- Photographing carcasses; and
- Procedures for handling, storing and transmitting bat carcasses for positive identification.

Statistical tests (t-test, significant $p \leq 0.10$) will be conducted (1) to compare baseline fatality estimates determined using data collected by trained BHE personnel to estimates determined using data collected by the consultant and (2) to compare searcher efficiency rates of the trained BHE personnel to searcher efficiency rates of the consultant. These tests will confirm that BHE personnel are adequately trained and qualified to accurately conduct follow-up carcass searches.

Bird and Bat Identification. BHE personnel will be permitted to handle bird and bat carcasses as described in Section 1.3.1 in this monitoring plan. Any unknown carcass or those requiring additional study for identification (e.g., feather spot, bat wing, *Myotis* bats) will be labeled with a unique identification number, bagged and retained for future reference. All unknown birds and

bats will be collected and provided to a qualified, USFWS-approved bird or bat expert for inspection and identification verification.

Wildlife Handling Procedures. Prior to April 15 of each year, BHE will conduct training sessions for Project personnel to ensure that wildlife handling procedures described in Section 1.3.2 in this monitoring plan are properly implemented.

### 1.4.3 Statistical Methods for Estimating Fatality Rates

The methodology estimating overall bird and bat fatality rates will largely follow the estimator proposed by Erickson et al. (2003), as modified by Young et al. (2009). Huso (2010) has recently proposed an estimator that may offer less bias than the Erickson estimator. The positive bias and different sensitivity to searcher efficiency and carcass removal rates associated with the Huso estimator may make comparisons to estimates derived using the Erickson (2003) or Shoenfeld (2004) estimators, which tend towards negative biases, problematic. The bird and bat fatality rates presented in the ABPP were mostly calculated from studies that used either the Erickson or Shoenfeld estimators or modifications thereof (the calculations and assumptions of these estimators are very similar). Therefore, maintaining the same biases and assumptions in estimating overall bird and bat fatality at the Project site will be useful for developing fatality estimates that can be compared to other sites and used to determine if any of the adaptive management triggers have been met.

Following Erickson et al. (2003), the estimate of the total number of wind turbine-related casualties will be based on four components: (1) observed number of casualties, (2) searcher efficiency, (3) scavenger removal rates and (4) estimated percent of casualties that likely fall in non-searched areas, based on percent of area searched around each turbine. Variance and 90.0% confidence intervals will be calculated using bootstrapping methods (Erickson et al. 2003 and Manly 1997 as presented in Young et al. 2009). Calculations and analyses will be conducted separately for medium/large birds, small birds and bats to provide results specific to each group.

#### *1.4.3.1 Mean Observed Number of Casualties (c)*

The estimated mean observed number of casualties (c) per turbine per study period will be calculated as:

$$c = \frac{\sum_{j=1}^{n} c_j}{n}$$

where n is the number of turbines searched and $c_j$ is the number of casualties found at a turbine. Incidental mortalities (those found outside of the search plots or by maintenance personnel) will not be included in this calculation, nor in the estimated fatality rate.

#### *1.4.3.2 Estimation of Searcher Efficiency Rate (p)*

Searcher efficiency (p) will represent the average probability that a carcass was detected by searchers. The searcher efficiency rates will be calculated by dividing the number of trial carcasses observers found by the total number that remained available during the trial (non-

scavenged). Searcher efficiency will be calculated for each season, for varying distances from the turbine and for each vegetation class, if applicable.

*1.4.3.3 Estimation of Carcass Removal Rate (t)*

Carcass removal rates will be estimated to adjust the observed number of casualties to account for scavenger activity at a site. Mean carcass removal time (t) will represent the average length of time a planted carcass remained at the site before it was removed by scavengers. Mean carcass removal time will be calculated as:

$$t = \frac{\sum_{i=1}^{s} t_i}{s - s_c}$$

where *s* is the number of carcasses placed in the carcass removal trials and $s_c$ is the number of carcasses censored. This estimator is the maximum likelihood (conservative) estimator assuming the removal times follow an exponential distribution, and there is right-censoring of the data. For the Project study, any trial carcasses still remaining at 30 days will be collected, yielding censored observations at 30 days. If all trial carcasses are removed before the end of the search period, then $s_c$ will be zero and the carcass removal rate will be calculated as the arithmetic average of the removal times. Carcass removal rate will be calculated for each season.

*1.4.3.4 Search Area Adjustment (A)*

Although a complete-coverage methodology will be used, certain areas may be excluded from searching due to safety or access limitations. The adjustment for any areas that were not searched (A) will be approximated as:

$$A = \frac{\sum_{k=1}^{12} \frac{c_k}{p_k\, s_k}}{\sum_{k=1}^{12} \frac{c_k}{p_k}}$$

where $c_k$ is the observed number of casualties found in the $k^{th}$ 10-m distance band from the turbine, $p_k$ is the estimated searcher efficiency rate in the $k^{th}$ 10-m distance band from the turbine, and $s_k$ is the proportion of the $k^{th}$ 10-m distance bands that were sampled across all turbines.

*1.4.3.5 Estimation of the Probability of Carcass Availability and Detection (π)*

Searcher efficiency and carcass removal rates will be combined to represent the overall probability (π) that a casualty incurred at a turbine would be reflected in the post-construction mortality study results. This probability will be calculated as:

$$\pi = \frac{t \cdot p}{I} \cdot \left[ \frac{\exp\left(1/t\right) - 1}{exp\left(1/t\right) - 1 + p} \right]$$

where *I* is the interval between searches. For this study, I=7 for baseline carcass searches during the spring and fall periods and for the fall period during follow-up carcass searches.

*1.4.3.6 Estimation of Facility-Related Mortality (m)*

Mortality estimates will be calculated using the estimator proposed by Erickson et al. (2003), as modified by Young et al. (2009). The estimated mean number of casualties/turbine/study period

(m) will be calculated by dividing the estimated mean observed number of casualties/turbine/study period (c) by π, an estimate of the probability a carcass was not removed and was detected and then multiplying by *A*, the adjustment for the area within the search plots which was not searched:

$$m = A \cdot \frac{c}{\pi}$$

## 1.5 Data Analysis

Analysis of data collected during the post-construction mortality study will include fatality estimates for all birds and bats to the taxonomic level where fatality estimates can be calculated (i.e., it is difficult to calculate representative fatality rates from small numbers of carcasses, so species- and genus-level fatality calculations may not be possible for some species/genera). Data analysis will be performed to assess fatality estimates by turbine location. Data will also be analyzed to determine the influence of factors such as date and location on bird and bat fatality rates.

A variety of statistical tests may be applied to the data to analyze the patterns of fatality rates in relationship to species/genera/taxa, season and location. Statistical tests applied to the data may include: ANOVA, tabular summary, graphical representation (least squares, regression, interaction plot, etc), t-test, univariate association analyses (Pearson's and Spearman's rank correlations, linear regression), multivariate regression, chi-square goodness-of-fit and test of independence and F test. Tests will be selected based on the parameter(s) under analysis, the ability of the data to meet test assumptions and the suitability of tests for different forms of data. Comparisons between baseline overall bird and bat fatality estimates and those of follow-up studies will be evaluated using t-tests. In general, p values equal to or less than 0.10 will be considered significant.

While statistical tests will not be used to correlate fatalities with weather variables, BHE will qualitatively evaluate fatality events with regards to notable weather events.

# Appendix C. Pre-Construction Survey Reports

# Wildlife Baseline Studies for the Bishop Hill Wind Project Henry County, Illinois

## Final Report
## August 2009 – June 2010

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# EXECUTIVE SUMMARY

Invenergy has proposed a wind-energy facility in Henry County, Illinois, known as the Bishop Hill Wind Project. Invenergy contracted Western EcoSystems Technology, Inc. to conduct wildlife and landcover surveys in the Bishop Hill Wind Project to estimate the potential impacts of facility construction and operations on wildlife. Baseline studies at the Bishop Hill Wind Project consisted of fixed-point bird use surveys, breeding songbird surveys, ground-based raptor nest surveys, acoustic bat surveys, bat mist-net surveys, landcover mapping, and incidental wildlife observations. The results of acoustic bat surveys and bat mist-net surveys are presented in a separate report.

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

The objective of the fixed-point bird use surveys was to estimate the seasonal, spatial, and temporal use of the study area by birds, particularly raptors. Fixed-point bird surveys were conducted at 34 points established throughout the Bishop Hill Wind Project from August 18, 2009, through May 25, 2010, a period corresponding to the spring and fall migration seasons and the winter season. A total of 544 20-minute fixed-point bird surveys were completed and 65 unique bird species were identified. A total of 5,651 individual birds were observed, 86 of which were raptors. Within the plots (2,625 feet [800 meters] for large birds and 328 feet [100 meters] for small birds), a total of 5,353 individual birds were observed, 85 of which were raptors, and 62 species were identified. The most common raptor species observed in the study area were red-tailed hawk and American kestrel.

Waterfowl use was higher during the spring (2.58 birds/plot/20-minute survey), primarily due to one large group of snow goose. Moderate levels of shorebird use were observed in the fall and spring (0.45 and 0.42 birds/plot/20-minute survey, respectively), while waterbird use was low throughout the study (0.02 or less during all seasons). Raptor use was low overall, but higher during the fall (0.20 birds/plot/20-minute survey) and lowest during the winter (0.08). Passerine use was higher in the spring and fall (9.28 and 8.26 birds/plot/20-minute survey), compared to the winter (1.79). However, as the focus for small birds was within a 100-meter viewshed, the use by small bird types was not directly comparable to the use by large bird types.

During the fixed-point bird use surveys, 267 groups (defined as one or more individuals) of large birds totaling 1,078 individuals were observed flying. For all large bird species combined, 35.3% of birds were observed flying below the likely rotor-swept height, 12.0% were within, and 52.7% were observed flying above the rotor-swept height for typical turbines that could be constructed in the Bishop Hill Wind Project. Bird types most often observed flying within the rotor-swept height were turkey vultures (58.9%), large corvids (27.7%), and raptors (15.8%). A total of 3,559 passerines and other small birds in 969 groups were recorded flying within 100-meters of the

survey points in the Bishop Hill Wind Project, with 91.9% below the rotor-swept height, 8.1% within, and none were observed flying above the rotor-swept height.

Based on the use (measure of abundance) of the study area by each species and the flight characteristics observed for that species, Canada goose had the highest relative probability of turbine exposure. The raptor species with the highest relative exposure index was red-tailed hawk, which was ranked fourth of all species. For passerines and other small birds within 100-meters of the point, red-winged blackbird had the highest exposure index.

Use by birds varied between bird point count locations. Bird use was examined to determine if use was affected by distance to the South Edwards River. Use by birds and bird sub-types was not significantly different within one-mile of the South Edwards River versus the rest of the Bishop Hill Wind Project.

The primary objective of the breeding songbird survey was to to identify any federal- or state-listed songbirds breeding within the Bishop Hill Wind Project. Breeding songbird surveys were conducted three times between May 26 and June 15, 2010, for a total of 460 5-minute surveys. A total of 5,402 individual bird observations within 3,609 separate groups were recorded, and 73 unique bird species were identified. Red-winged blackbirds (1.4% of all species) composed 34.9% of all observations. No other species made up more than 7% of the observations individually. No species listed as threatened or endangered under the federal endangered species act were observed. Nineteen upland sandpipers and a single common moorhen (both state endangered species), were observed during breeding songbird surveys.

The objective of the ground-based raptor nest surveys was to record raptor nests that may be subject to disturbance and/or displacement by wind-energy facility construction and/or operation. Ground-based surveys were conducted in March 2010. The surveys were conducted prior to leaf-out to improve the chances of finding nests. Eight active red-tailed hawk nests, three active great horned owl nests, and 43 inactive unknown raptor or great-horned owl nests were located in or within one mile (1.6 km) of the Bishop Hill Wind Project, resulting in an active nest density of 0.06 nests/square mile.

The objective of incidental wildlife observations was to record wildlife seen outside of the standardized surveys. The most abundant bird species recorded incidentally were Canada goose (56 individuals), red-tailed hawk (40), and American kestrel (39). Eight mammal species were also recorded incidentally, with white-tailed deer being the most commonly observed species (nine observations). One reptile, eastern garter snake, was also recorded as an incidental observation at the Bishop Hill Wind Project.

The dominant land cover type within the Bishop Hill Wind Project was tilled agriculture (85%), and corn and soybean were the dominant crops. Woodlots, the second most common land cover type, comprised less than 4% of land cover. Each remaining land cover type comprised less than 3% of the overall land use. The majority of potential wildlife habitat was located along the South Edwards River.

Based on fixed-point bird use data collected for the Bishop Hill Wind Project, mean annual raptor use was 0.13 raptors/plot/20-minute survey. The annual rate was low relative to raptor use at other wind-energy facilities in the west where raptor fatality rates have been highest.

The data collected at the Bishop Hill Wind Project indicate that a low number of raptors utilized the study area during the study period compared with other sites. While use by birds varied throughout the study area, use was not significantly higher within one mile (1.6 km) of the South Edwards River. The proposed facility is located within an area that is dominated by tilled agriculture. The U.S. Fish and Wildlife Service interim guidelines for wind-energy development and the Wind Turbine Guidelines Advisory Committee suggest that tilled agriculture is the preferred land use type for siting turbines versus native habitats. To date, the range of overall bird fatality estimates at six Midwest wind-energy facilities that were studied using comparable methods as those used at the Bishop Hill Wind Project have ranged from 0.6 to 7.17 bird fatalities per megawatt per year, with most of the fatalities (about 84%) being songbirds, and only eight raptor fatalities recorded (including three incidental finds). The results of the bird studies conducted at the Bishop Hill Wind Project indicate that fatality rates for raptors may be similar to fatality rates documented at other wind-energy facilities in areas of the Midwest dominated by tilled agriculture. Few post-construction studies of wind-energy facilities in the Midwest are available for comparison, and only one post-construction study of bird fatality rates at wind-energy facilities in Illinois has been made public. The impacts of wind-energy facilities on wildlife in Illinois and the Midwest will become more defined as the results of ongoing research become available.

Invenergy has committed to placing turbines within tilled and un-tilled agricultural areas, and avoiding placing turbines within pasture and grassland habitats. The area with the highest diversity of landcover is located along the South Edwards River. Invenergy has proposed placing turbines a minimum of ½ mile from the South Edwards River, with turbines placed at greater distances where potential wildlife habitat extends beyond ½ mile from the South Edwards River. The results of bird studies within the project area show that raptor use rates are lower than observed at other wind-energy facilities. Fatality rates of birds are expected to be similar to those observed at other wind-energy facilities in the Midwest, based on data collected during this study, placement of wind turbines within agricultural areas, and placement of turbines away from the South Edwards River.

Some species listed as threatened or endangered under the Illinois endangered species act, or the bald and golden eagle protection act were observed within the project area. Two species (bald eagle and common moorhen), were recorded only once during the study. One species (loggerhead shrike) was recorded on three occasions. These species occurred at relatively low densities, and risks of collisions are considered low based on their low abundance. Northern harrier and upland sandpiper were more commonly observed during the study. These species may have a higher potential to be affected by the proposed project; however, the overall potential for collision or displacement impacts to occur during operation are still considered low based on each species biology, studies of impacts at other wind-energy facilities, and the placement of turbines within tilled agriculture areas. Some potential exists for construction activities associated with project infrastructure to affect individual state-listed bird species if construction occurs within occupied habitats. This potential can be reduced or eliminated by monitoring for

state-listed bird species nests during construction, and avoiding construction activities within occupied habitats while state-listed bird species are incubating eggs or brooding young.

## STUDY PARTICIPANTS

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# TABLE OF CONTENTS

EXECUTIVE SUMMARY ..... i
INTRODUCTION ..... 1
STUDY AREA ..... 1
METHODS ..... 2
Fixed-Point Bird Use Surveys ..... 2
Survey Plots ..... 2
Survey Methods ..... 2
Observation Schedule ..... 3
Use Comparison ..... 3
Breeding Songbird Surveys ..... 3
Study Design ..... 3
Observation Schedule ..... 4
Raptor Nest Surveys ..... 4
Landcover Mapping ..... 5
Incidental Wildlife Observations ..... 5
Statistical Analysis ..... 5
Quality Assurance and Quality Control ..... 5
Data Compilation and Storage ..... 5
Fixed-Point Bird Use Surveys ..... 5
Species Richness ..... 5
Bird Use, Composition, and Frequency of Occurrence ..... 5
Bird Flight Height and Behavior ..... 6
Bird Exposure Index ..... 6
Spatial Use ..... 6
Use Comparison ..... 6
Breeding Songbird Surveys ..... 7
Species Richness ..... 7
RESULTS ..... 7
Fixed-Point Bird Use Surveys ..... 7
Species Richness ..... 7
Bird Use, Composition, and Frequency of Occurrence by Season ..... 8
Waterbirds ..... 8
Waterfowl ..... 8
Shorebirds ..... 8
Diurnal Raptors ..... 8
Nocturnal Raptors ..... 9
Vultures ..... 9
Upland Game Birds ..... 9
Large Corvids ..... 9
Passerines ..... 9
Swifts/Hummingbirds ..... 10

Woodpeckers ... 10
Bird Flight Height and Behavior ... 10
Bird Exposure Index ... 10
Spatial Use ... 11
Sensitive Species Observations ... 11
Breeding Songbird Surveys ... 11
Sensitive Species ... 12
Raptor Nest Surveys ... 12
Landcover Mapping ... 12
Incidental Wildlife Observations ... 12
Bird Observations ... 13
Mammal Observations ... 13
Reptile Observations ... 13
Sensitive Species Observations ... 13
DISCUSSION AND IMPACT ASSESSMENT ... 13
Potential Impacts ... 13
Direct Impacts ... 14
Raptors ... 14
Waterfowl ... 15
Turkey Vultures ... 15
Passerines ... 15
Indirect Impacts ... 16
Displacement Impacts ... 16
Threatened, Endangered, and Sensitive Species ... 18
Upland Sandpiper ... 18
Northern Harrier ... 19
Loggerhead Shrike ... 19
Bald Eagle ... 20
Common Moorhen ... 20
CONCLUSION ... 20
REFERENCES ... 21

## LIST OF TABLES

Table 1. Results of land cover mapping within the Bishop Hill Wind Project ... 29

Table 2 Descriptions of habitats mapped at the Bishop Hill Wind Project by Western EcoSystems Technology, Inc. ... 30

Table 3. Summary of species richness (species/plot[a]/20-minute survey) and sample size, by season and overall, during the fixed-point bird use surveys at the Bishop Hill Wind Project, August 18, 2009 – May 25, 2010. ... 31

Table 4a. Total number of individuals and groups observed, regardless of distance from the observer, for each bird type and species, by season and overall, during the fixed-point bird use surveys at the Bishop Hill Wind Project, August 18, 2009 – May 25, 2010..... 32

Table 4b. Total number of individuals and groups observed with the plots (2,654 ft [800 m] from the point for large birds and 328 ft [100 m] for small birds) for each bird type and species, by season and overall, during the fixed-point bird use surveys at the Bishop Hill Wind Project, August 18, 2009 – May 25, 2010..... 36

Table 5a. Mean bird use (number of birds/800-meter plot/20-minute survey), percent of total composition (%), and frequency of occurrence (%) for each large bird type and species by season during the fixed-point bird use surveys at the Bishop Hill Wind Project, August 18, 2009 – May 25, 2010. ..... 39

Table 5b. Mean bird use (number of birds/100-m plot/20-minute survey), percent of total composition (%), and frequency of occurrence (%) for each small bird type and species by season during the fixed-point bird use surveys at the Bishop Hill Wind Project, August 18, 2009 – May 25, 2010. ..... 41

Table 6. Flight height characteristics by bird type during fixed-point bird use surveys at the Bishop Hill Wind Project, August 18, 2009 – May 25, 2010. Large bird observations were limited to within 800 meters (m) and small birds were limited to within 100 m..... 43

Table 7a. Relative exposure index and flight characteristics for large bird species during the fixed-point bird use surveys at the Bishop Hill Wind Project, August 18, 2009 – May 25, 2010..... 44

Table 7b. Relative exposure index and flight characteristics for small bird species during the fixed-point bird use surveys at the Bishop Hill Wind Project, August 18, 2009 – May 25, 2010..... 45

Table 8. Paired t-test results comparing bird use by visit for stations outside of the 1-mile buffer versus areas within the 1-mile buffer of the South Edwards River. Negative differences in means represent higher use rates within the 1-mile buffer of the South Edwards River. A p-value of more than 0.10 was not considered significant..... 47

Table 9. Summary of sensitive species observed at the Bishop Hill Wind Project during fixed-point bird use surveys (FP), breeding songbird survey (BSS), and as incidental wildlife observations (Inc.), August 18, 2009 – June 15, 2010. ..... 48

Table 10. Summary of overall bird use (number of birds/plot/five-minute survey), species richness (species/five-minute survey), and sample size during the breeding songbird surveys in the Bishop Hill Wind Project, May 26 – June 15, 2010..... 49

Table 11. Total number of groups (# grps) and individuals (# obs) for each bird type and species during summer breeding songbird surveys in the Bishop Hill Wind Project, May 26 – June 15, 2010..... 50

Table 12. Nesting raptor and owl species and nest density for the Bishop Hill Wind Project and within a one-mile buffer..... 53

Table 13. Incidental wildlife observed while conducting all surveys at the Bishop Hill Wind Project; August 18, 2009 – June 15, 2010. ..... 54

Table 14. Comparison of seasonal raptor use at other wind-energy facilities in the Midwestern region to the Bishop Hill Wind Project. ..... 55

Table 15. Avian mortality associated with other wind-energy facilities in the Midwestern region. ..... 56

## LIST OF FIGURES

Figure 1. Location of the Bishop Hill Wind Project. ..... 57

Figure 2. Overview of the Bishop Hill Wind Project. ..... 58

Figure 3. The land cover types and coverage within the Bishop Hill Wind Project. ..... 59

Figure 4. Fixed-point bird use points at the Bishop Hill Wind Project. ..... 60

Figure 5. Breeding songbird points at the Bishop Hill Wind Project. ..... 61

Figure 6a. Waterfowl use during the fixed-point bird use surveys at the Bishop Hill Wind Project. ..... 62

Figure 6b. Shorebird use during the fixed-point bird use surveys at the Bishop Hill Wind Project. ..... 63

Figure 6c. Raptor use during the fixed-point bird use surveys at the Bishop Hill Wind Project. ..... 64

Figure 6d. Buteo use during the fixed-point bird use surveys at the Bishop Hill Wind Project. ..... 65

Figure 6e. Falcon use during the fixed-point bird use surveys at the Bishop Hill Wind Project. ..... 66

Figure 6f. Passerine use during the fixed-point bird use surveys at the Bishop Hill Wind Project. ..... 67

Figure 7a. Flight paths of waterbirds and shorebirds at the Bishop Hill Wind Project. ..... 68

Figure 7b. Flight paths of waterfowl at the Bishop Hill Wind Project. ..... 69

Figure 7c. Flight paths of accipiters at the Bishop Hill Wind Project. ..... 70

Figure 7d. Flight paths of buteos at the Bishop Hill Wind Project. ..... 71

Figure 7e. Flight paths of falcons at the Bishop Hill Wind Project. ..... 72

Figure 7f. Flight paths of northern harriers and eagles at the Bishop Hill Wind Project. ..... 73

Figure 7g. Flight paths of vultures at the Bishop Hill Wind Project. ..... 74

Figure 8. Upland sandpipers observed during the breeding songbird surveys at the Bishop Hill Wind Project. ..... 75

Figure 9. Location of raptor and owl nests at the Bishop Hill Wind Project. ..... 76

Figure 10. Comparison of annual raptor use between the Bishop Hill Wind Project and other United States wind-energy facilities. ..... 77

# INTRODUCTION

Invenergy has proposed a wind-energy facility, known as the Bishop Hill Wind Project (BHWP), in Henry County, Illinois (Figures 1 and 2). Invenergy contracted Western EcoSystems Technology, Inc. (WEST) to conduct wildlife and landcover surveys in the BHWP to estimate the potential impacts of wind-energy facility construction and operations on wildlife.

The principal objectives of the study were to: 1) provide site-specific bird and bat resource and use data that would be useful in evaluating potential impacts from the proposed BHWP; 2) provide information to be used in project planning and design of the facility to minimize impacts to birds and bats; and 3) recommend further studies or potential mitigation measures, if warranted. The protocols for the baseline studies were similar to those used at other wind-energy facilities across the nation, and follow the guidance of the National Wind Coordinating Collaborative (Anderson et al. 1999) and the Wind Turbines Guidelines Advisory Committee (WTGAC 2010). The protocols were developed based on WEST's experience studying wildlife at proposed wind-energy facilities throughout the United States, and were designed to help predict potential impacts to bird (particularly raptors) and bat species.

Baseline surveys, conducted from August 18, 2009, through June 15, 2010, at the BHWP consisted of fixed-point bird use surveys, breeding songbird surveys, ground-based raptor nest surveys, acoustic bat surveys, bat mist-net surveys, land cover surveys, and incidental wildlife observations. Results of the acoustic bat and bat mist-net surveys were presented in separate final reports.

In addition to site-specific data, this report presents existing information and results of studies conducted at other wind-energy facilities. The ability to estimate potential bird mortality at the proposed BHWP is greatly enhanced by operational monitoring data collected at other existing wind-energy facilities. For several wind-energy facilities, standardized data on fixed-point bird use surveys were collected in association with standardized post-construction (operational) monitoring, allowing comparisons of bird use with bird mortality. Where possible, comparisons with regional and local studies were made.

# STUDY AREA

The proposed BHWP is located in Henry County, Illinois (Figure 1), and falls within the Interior River Valleys and Hills Ecoregion, which encompasses a large portion of western and southern Illinois (Woods et al. 2007). The proposed BHWP is located on a landscape of gently rolling hills and elevations within the study area range from approximately 780 to 950 feet (ft; 237 to 290 meters [m]) above mean sea level (Figure 2). Portions of the Edwards River and South Edwards River (SER), Indian Creek, and West Fork Spoon River occur within the BHWP.

The proposed project is located within a landscape dominated by tilled agriculture, with smaller areas of deciduous forest, developed areas, and grasslands (Tables 1 and 2). Most of the BHWP is private land and is lightly populated with scattered farms and houses. The towns of Bishop Hill, Galva, and Woodhull are located within the proposed BHWP.

The total project size will be 400 MW. The first phase will likely be comprised of 133 1.5-MW GE Turbines. The tower height and blade length have not been determined. A rotor-swept height (RSH) for potential collision with a turbine blade of 115- to 427-ft (35- to 130-m) above ground level (AGL) was used for the purposes of the analysis.

# METHODS

For the purposes of this report, studies at the BHWP consisted of the following: 1) fixed-point bird use surveys, 2) breeding songbird surveys, 3) ground-based raptor nest surveys, 4) landcover mapping, and 5) incidental wildlife observations.

## Fixed-Point Bird Use Surveys

The objective of the fixed-point bird use surveys was to estimate the seasonal and spatial use of the BHWP by birds, particularly raptors (defined here as kites, accipiters, buteos, harriers, eagles, falcons, and ospreys). Fixed-point surveys (variable circular plots) were conducted using methods described by Reynolds et al. (1980).

### *Survey Plots*

Thirty-four points were selected to achieve relatively even coverage of the study area (Figure 4). Point count locations were established within portions of the BHWP where turbines could potentially be located and no points were placed within the potential transmission line development area. Points were established using a systematic sample with a random start along public roads, and were adjusted up to 0.25 mile (400-m) upon initial field visits to maximize the viewshed surrounding each point. All birds seen during each 20-minute (min) fixed-point bird use survey were recorded. Point counts were surveyed for 20-min to be consistent with methodologies employed at other wind-energy facilities. Each survey plot was a 2,625-ft (800-m) radius circle centered on the point.

### *Survey Methods*

All species of birds observed during fixed-point bird use surveys were recorded. Observations of large birds beyond the 2,625-ft (800-m) radius were recorded, but were not included in the statistical analyses; for small birds, observations beyond the 328-ft (100-m) radius were recorded but were not included in calculations of use estimates. A unique observation number was assigned to each observation.

The date, start, and end time of the survey period, and weather information (e.g., temperature, wind speed, wind direction, and cloud cover) were recorded for each survey. Species or best possible identification, number of individuals, sex and age class (if possible), distance from plot center when first observed, closest distance, altitude above ground, activity (behavior), and habitat(s) were recorded for each observation. The behavior of each bird observed and the vegetation type in which (or over which) the bird occurred were recorded based on the point of first observation. Approximate flight height and distance from point at first observation were recorded to the nearest meter (3.3-ft) interval. Other information recorded about the observation

included whether or not the observation was auditory only and the 10-min interval of the 20-min survey in which it was first observed.

Locations of raptors, other large birds, and species of concern seen during fixed-point bird use surveys were recorded on field maps by unique observation number. Flight paths and perched locations were digitized using ArcGIS 9.3. Any comments were recorded in the comments section of the data sheet. Unusual and unique animal observations were recorded on the incidental datasheets.

*Observation Schedule*

Sampling intensity was designed to document bird use and behavior by habitat and season within the study area. Fixed-point bird use surveys were conducted from August 18, 2009, through May 25, 2010. Surveys of half of the point-count stations (17) were conducted once per week during the fall and spring (August 18 to November 15 and March 1 to May 31), with each station being surveyed every other week. Half of the point-count stations were surveyed every other week during the winter (November 15 to February 28), with each station being surveyed on a monthly basis. No fixed-point surveys were conducted during the summer (June 1 to August 17). Surveys were carried out during daylight hours and survey periods varied to approximately cover all daylight hours during a season.

*Use Comparison*

The objective of the use comparison was to evaluate bird use near the SER to bird use in the rest of the BHWP to attempt to determine if bird use is higher along the SER. A 1-mile (1.6-kilometer [km]) buffer was established around the SER and encompassed nine point count locations. Overall use of the BHWP by avian subtypes was evaluated for each study season both inside and outside the 1-mile buffer surrounding the SER.

**Breeding Songbird Surveys**

The objective of the breeding songbird survey was to identify any federal- or state-listed songbirds breeding within the BHWP.

*Study Design*

One-hundred-fifty-five points were established within the 555 acres of suitable grassland habitats within 0.25 mile (400-m) of potential turbine locations (Figure 5). A minimum of one point count was placed within each parcel of suitable grassland, with additional points placed within larger grasslands. Grasslands as small as grass buffer strips within crop fields were surveyed. Point locations were systematically located within appropriate grassland habitat using a random start on leased land. Point counts were placed adjacent to suitable grassland on unleased land if it was located adjacent to a public road. Points were established a minimum of 328-ft (100-m) apart and had a 328-ft (100-m) viewshed and were surveyed using methods similar to Reynolds et al. (1980). The location of each point was recorded with a global positioning system (GPS) unit. Five-minute surveys were conducted at each of the 155 points by a qualified biologist. Point count duration was similar to durations used by during the US Geological Survey (USGS) breeding bird surveys (BBS; USGS 2001).

All birds seen during each survey were identified to species level, or best possible identification and the estimated distance to each bird observed was recorded to the nearest three feet (one meter). The flight direction (bearing) of observed birds was recorded and flight characteristics (e.g., height above ground [AGL] at first observation, lowest and highest observations) were recorded to the nearest meter. Using the breeding bird atlas codes, indications of breeding activity was recorded in addition to each bird's behavior. Behavior categories recognized were perched (PE), soaring (SO), flapping (FL), flushed (FH), circle soaring (CS), hunting (HU), gliding (GL), and other (OT, noted in comments). Weather information (e.g., temperature, wind speed, wind direction and cloud cover) was recorded for each survey. Any comments or unusual observations were noted in the comments section and incidental observations of state and federal threatened or endangered species were recorded, regardless of whether they were detected within the survey time or while at a point-count location.

*Observation Schedule*

Surveys began at approximately dawn and did not extend past 1200. To the greatest extent possible, surveys were not conducted on mornings with winds exceeding 12 miles per hour (mph; 19 km per hour [kph]; Beaufort Scale of 3[1]), periods of rain lasting more than 20-min, or heavy fog due to reduced detectability of birds. Surveys were conducted three times at each of the 155 points from May 26 to June 15, 2010.

## Raptor Nest Surveys

The objective of the ground-based raptor nest surveys was to locate raptor nests in and within one mile of the BHWP. A ground-based search for nesting raptors was conducted in March 2010 that included the entire boundary of the BHWP and a 1-mile (1.6-km) buffer. Ground-based surveys were completed by driving along public roads and accessible private roads and looking for raptor nest structures within areas of suitable habitat (trees, power poles, etc). Areas with potentially suitable habitat were viewed with binoculars and spotting scopes, and searched for potential raptor or owl nest structures. Private, leased lands were accessed on foot when closer views of potential nesting habitat were needed. Potential nest locations were recorded on recent aerial photographs, and digitized in ArcGIS 9.3. Current status (inactive [no raptor on or near nest], active [raptor present on nest or nearby exhibiting nesting behavior such as carrying nest

[1] The Beaufort Wind Force Scale is an empirical measure of wind speed based on observed conditions. Originally developed for establishing conditions on the sea based on observed condition of the waves, it offers an estimated wind speed in knots. On land, the Beaufort Scale wind speed in mph or kph is approximated by comparing the observed conditions based on the movement of smoke, vegetation, and structures.

Based on NOAA (2007):

Beaufort Scale 0 – "calm" – smoke rises vertically: approximate wind speed of zero to less than one mph (less than 1.6 kph).
Beaufort Scale 1 – "light air" – smoke drifts with air: approximate wind speed one to three mph (1.6 to 4.8 kph).
Beaufort Scale 2 – "light breeze" – weather vanes move: approximate wind speed four to seven mph (6.4 to 11.3 kph).
Beaufort Scale 3 – "gentle breeze" – leaves move: approximate wind speed eight to 12 mph (12.9 to 19.3 kph).
Beaufort Scale 4 – "moderate breeze" – small branches move: approximate wind speed 13 to 18 mph (20.9 to 29.0).
Beaufort Scale 5 – "fresh breeze" – small trees move: approximate wind speed 19 to 24 mph (30.6 to 38.6 mph).
Beaufort Scale 6 – "strong breeze" – large branches move: approximate wind speed 25 to 31 mph (40.2 to 50.0 kph).
Beaufort Scale 7 – "near gale" – entire trees move: 32 to 38 mph (51.5 to 61.2 kph).
Beaufort Scale 8 – "gale" – twigs break off of trees: approximate wind speed 39 to 46 mph (62.8 to 74.0 kph).
Beaufort Scale 9 – "strong gale" – shingles are blown off of roofs: approximate wind speed 47 to 54 mph (75.6 to 88.5 kph).
Beaufort Scale 10 – "storm" – trees are uprooted and buildings are damaged: approximate wind speed 55 to 63 mph (88.5 to 103 kph).
Beaufort Scale 11 – "violent storm" – widespread damage: approximate wind speed 64 to 73 mph (103 to 117 kph).
Beaufort Scale 12 – "hurricane" – violent destruction: approximate wind speed of more than 73 mph (117 kph).

material, defending nest, etc.], incubating, young in nest), and species present were recorded for each nest.

### Landcover Mapping

Landcover types within the BHWP were mapped on recent aerial photographs, and verified in the field during August 2009. The purpose of the landcover mapping was to identify potential habitat for federally- or state-listed species to guide breeding bird surveys, and to provide Invenergy with landcover location information that could be used when planning turbine locations.

### Incidental Wildlife Observations

The objective of incidental wildlife observations was to document presence of wildlife seen outside of the standardized surveys. All raptors, unusual or unique birds, sensitive species, mammals, reptiles, and amphibians were recorded in a similar fashion to standardized surveys. The observation number, date, time, species, number of individuals, sex/age class, distance from observer, activity, height above ground (for bird species), habitat, and, in the case of sensitive species, the location was recorded using a GPS unit.

### Statistical Analysis

*Quality Assurance and Quality Control*

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

*Data Compilation and Storage*

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

*Fixed-Point Bird Use Surveys*

<u>Species Richness</u>
Species lists (with the number of observations and the number of groups) were generated by season, and included all observations of birds detected regardless of their distance from the observer. Species richness was (i.e., number of species/plot/20-min survey) compared among seasons for fixed-point bird use surveys.

<u>Bird Use, Composition, and Frequency of Occurrence</u>
For the standardized fixed-point bird use estimates, only observations of large birds detected within the 2,625 ft (800 m) radius plot were used in the analysis. For small birds only

observations within a 328 ft (100 m) radius were used. Estimates of mean bird use (i.e., number of birds/plot/20-min survey) were used to compare differences between bird types, seasons, survey points, and other wind-energy facilities. Mean use was calculated by determining the number of birds seen within each 800-m plot (or 100-m plot for small birds) for each given visit and then averaged by the number of plots surveyed during that visit. A second averaging occurred across the number of visits during the season and/or entire study period. A visit was defined as the required length of time to survey all of the plots once within the study area.

Percent composition was calculated as the proportion of the overall mean use for a particular bird type or species, and the frequency of occurrence was calculated as the percent of surveys in which a particular bird type or species was observed. Frequency of occurrence and percent composition provide relative measures of species use of the proposed BHWP. For example, a particular species might have relatively high use estimates for the study area based on just a few observations of large groups. However, the frequency of occurrence would indicate that the species only occurred during a few of the surveys and therefore may be less likely to be affected by the wind-energy facility or the transmission corridor.

Bird Flight Height and Behavior

To calculate potential risk to bird species, the first flight height recorded was used to estimate the percentages of birds flying within the likely rotor-swept height (RSH) for collision with turbine blades of 35 to 130 m AGL, which is the blade height of turbines likely to be used at the BHWP.

Bird Exposure Index

The bird exposure index is used as a relative measure of how often birds fly at heights similar to blades of modern wind turbines. A relative index of bird exposure (R) was calculated for bird species observed during the fixed-point bird use surveys using the following formula:

$$R = A*P_f*P_t$$

Where A equals mean use for species *i* (large bird observations within 2,625-ft [800 m] of the observer or 328 ft [100 m] for small birds), $P_f$ equals the proportion of all observations of species *i* where activity was recorded as flying (an index to the approximate percentage of time species *i* spends flying during the daylight period), and $P_t$ equals the proportion of all initial flight height observations of species *i* within the likely RSH.

Spatial Use

Large bird flight paths were qualitatively compared to study area features (e.g., topographic features). The objective of mapping observed large bird locations and flight paths was to look for areas of concentrated use by raptors and other large birds and/or consistent flight patterns within the study area.

Use Comparison

Avian use at stations within one mile of the SER (nine points) was compared to use at stations in the remainder of the BHWP (25 points). Paired t-tests were calculated to compare the mean use values for each major bird type. The following one-sample t-test statistic was used:

$$t = \frac{\bar{x}_d - 0}{s_d / \sqrt{n}}$$

where n is the number of visits and $\bar{x}_d$ and $s_d$ are the sample mean and standard deviation of the differences, respectively (Devore and Peck 2007). The degrees of freedom were n-1. These results were conservative and no statistical adjustment (Tukey or Bonferroni) was applied.

*Breeding Songbird Surveys*

Species Richness

Species lists (with the number of observations and the number of groups) were generated by season, and included all observations of birds detected regardless of their distance from the observer. Species richness was calculated as the mean number of species observed per survey (i.e., number of species/100- m plot/five-min survey).

# RESULTS

Surveys were completed at the BHWP from August 18, 2009, through June 15, 2010. Ninety-one bird species, eight mammal species, and one reptile species were identified during all surveys completed at the BHWP. Results of the fixed-point bird use surveys, breeding songbird surveys, raptor nest surveys, landcover mapping surveys, and incidental wildlife observations, as well as the specific numbers of unique species for each wildlife survey type, are discussed in the sections below.

## Fixed-Point Bird Use Surveys

A total of 544 20-min fixed-point bird use surveys were conducted at the BHWP (Table 3). For all birds observed, regardless of distance from the observer, a total of 5,651 individual birds were observed, 86 of which were raptors, and 65 bird species were identified (Table 4a). Within the plots (2,625 ft [800 m] for large birds and 328 ft [100 m] for small birds), a total of 5,353 individual birds were observed, 85 of which were raptors, and 62 species were identified (Table 4b).

*Species Richness*

Sixty-five species were observed over the course of all fixed-point bird use surveys, but only 62 species were observed within the plots, resulting in a mean number of 0.55 large bird species/2,625-ft (800 m) plot/20-min survey and 1.77 small bird species/328 ft (100-m) plot/20-min survey (Table 3). More species were observed during the spring (55 species), followed by the fall (45) and the winter (15; Table 3). The mean number of species per plot per survey (species richness) for large birds was higher in the spring (0.92 species/plot/survey), followed by the fall (0.55) and the winter (0.22; Table 3). For small birds, species richness was also highest in the spring (3.61 birds/plot/survey), followed by the fall (1.45) and the winter (0.45; Table 3).

For all birds observed, a total of 5,651 individual bird observations within 1,876 separate groups (i.e. flocks) were recorded during the fixed-point bird surveys (Table 4a). Five species (7.7% of all species) composed 53.7% of the observations: European starling (*Sturnus vulgaris*), red-

winged blackbird (*Agelaius phoeniceus*), common grackle (*Quiscalus quiscula*), snow goose (*Chen caerulescens*), and brown-headed cowbird (*Molothrus ater*). All other species comprised less than 5% of the observations. The most abundant large bird species observed were snow goose (500 individuals in one group) and killdeer (*Charadrius vociferus*; 193 individuals in 95 groups). Eighty-six individual diurnal raptors were recorded within the BHWP, representing five species (Table 4a). Red-tailed hawk (*Buteo jamaicensis*) and American kestrel (*Falco sparverius*) were the most abundant diurnal raptor species observed. One nocturnal raptor species, barred owl (*Strix varia*; two individuals), was also recorded (Table 4a).

*Bird Use, Composition, and Frequency of Occurrence by Season*

Mean bird use, percent composition, and frequency of occurrence were calculated by season for large birds (Table 5a) and small birds (Table 5b). The highest overall large bird use occurred in the spring (3.74 birds/2,625-ft (800-m) plot/20-min survey), followed by the fall (1.35) and the winter (0.29; Table 5a). For small birds, use was higher in the spring and fall (9.36 and 8.27 birds/328 ft (100-m) plot/20-min survey, respectively) compared to in the winter (1.79; Table 5b).

Waterbirds

Waterbirds had the higher use in the spring (0.02 birds/2,625-ft (800-m) plot/20-min survey) than in the fall (less than 0.01) and waterbirds were not observed in the winter (Table 5a). Great blue heron (*Ardea herodias*) was the only waterbird species observed in the spring, and great egret (*A. alba*) was the only waterbird species observed in the fall. Waterbirds comprised less than 0.5% of the overall bird use and were observed during fewer than 2% of the fixed-point bird use surveys in either season (Table 5a).

Waterfowl

Waterfowl had substantially higher use in the spring (2.58 birds/2,625-ft (800-m) plot/20-min survey) compared to the fall (0.29) and were not observed in the winter (Table 5a). The higher waterfowl use in the spring was due to one group of 500 snow geese that made up 56.1% of the overall spring large bird use. Waterfowl comprised the majority (68.8%) of large bird use in the spring and 21.2% of use in the fall. Although some relatively large groups of waterfowl were observed, waterfowl were not frequently observed. Waterfowl were observed during 7.6% of the spring fixed-point bird use surveys and 1.7% of surveys in the fall (Table 5a).

Shorebirds

Shorebirds were only observed in the fall and spring, and use was similar between these seasons (0.45 and 0.42 birds/2,625-ft (800-m) plot/20-min survey, respectively; Table 5a). Shorebirds comprised 33.6% of the overall large bird use in the fall and 11.1% of use in the spring. Shorebirds were observed more frequently in the spring (30.3% of surveys) than in the fall (11.3%; Table 5a). Killdeer comprised the majority of shorebird use during the fixed-point bird use surveys.

Diurnal Raptors

Raptor use was highest in the fall (0.20 bird/2,625-ft (800-m) plot/20-min survey), followed by spring (0.13) and winter (0.08; Table 5a). Red-tailed hawk had the highest use by any raptor species during all three seasons (fall: 0.09 bird/2,625-ft (800) plot/20-min survey; winter: 0.06;

and spring: 0.08) and American kestrel had the second highest use in all three seasons (fall: 0.08; winter: 0.02; and spring: 0.04). These two species were the only raptor species observed in all seasons surveyed. Raptors comprised 26.7% of the overall large bird use in the winter, 15.0% in the fall, and only 3.5% in the spring. Raptors were observed during 17.2% of fixed-point bird use surveys in the fall, 11.8% of the spring surveys, and 5.9% of surveys in the winter (Table 5a).

Nocturnal Raptors

Barred owl (*Strix varia*), the only nocturnal raptor species observed, was observed in the winter (0.02 bird/2,625-ft (800-m) plot/20-min survey; Table 5a). The barred owl comprised 6.7% of large bird use in the winter and was observed during about 1% of the winter fixed-point bird use surveys (Table 5a).

Vultures

Vultures were represented solely by turkey vulture (*Cathartes aura*), and this species was only observed in the spring and fall (0.15 and 0.10 birds/2,625-ft (800-m) plot/20-min survey, respectively; Table 5a). Turkey vulture comprised 7.2% of the large bird use in the spring and 3.9% in the fall. However, vultures were more frequently observed in the spring (9.7% of fixed-point bird use surveys) than in the fall (5.5%; Table 5a).

Upland Game Birds

Upland game birds had higher use in the spring (0.14 birds/2,625-ft (800-m) plot/20-min survey) than in the fall (0.02; Table 5a). Upland game birds were not observed during the winter surveys. Upland game birds comprised less than 4% of the overall large bird use during any season. Upland game birds were observed during 9.7% of surveys in the spring, compared to 1.7% of the fall surveys (Table 5a). Ring-necked pheasant (*Phasianus colchicus*) and northern bobwhite (*Colinus virginianus*) comprised the majority of upland game bird use.

Large Corvids

American crow (*Corvus brachyrhynchos*) was the only large corvid observed at the BHWP and use by this species was relatively even through all three seasons (fall: 0.12 bird/2,625-ft (800-m) plot/20-min survey; winter: 0.13; and spring: 0.10; Table 5a). American crow comprised 43.3% of overall large bird use in the winter, compared to 9.0% in the fall and 2.7% in the spring. American crows were observed during 8.8% of fixed-point bird use surveys in the winter, 7.1% of surveys in the spring, and 6.3% of the fall surveys (Table 5a).

Passerines

A 100-m viewshed was used during fixed-point bird use surveys for passerines, and therefore, descriptive statistics were not directly comparable between use by small bird and large bird types. Passerine use was higher in the spring and fall (9.28 and 8.26 birds/328 ft (100-m) plot/20-min survey, respectively), compared to in winter (1.79; Table 5b). Red-winged blackbird had the highest use by any one small bird species in the spring (2.79 birds/328 ft (100-m) plot/20-min survey), while European starling had the highest use in the fall (2.13), and horned lark (*Eremophila alpestris*) had the highest use in winter (0.44). Passerines were observed during 93.3% of surveys in the spring, 69.3% of the fall surveys, and during only 37.3% of the winter surveys (Table 5b).

Swifts/Hummingbirds

Chimney swift (*Chaetura pelagica*), a small bird type, was the only swift/hummingbird species observed, and use by chimney swift was higher in the spring (0.06 bird/328 ft (100-m) plot/20-min survey) than in the fall (less than 0.01; Table 5b). Chimney swifts were not observed in the winter. Chimney swifts were observed during 4.2% of fixed-point bird use surveys in the spring and in less than 1% of fall surveys (Table 5b).

Woodpeckers

Use by woodpeckers, another small bird type, was higher in the spring (0.02 birds/328 ft (100-m) plot/20-min survey) than during the other seasons (fall: less than 0.01; and woodpeckers were not observed in the winter). Woodpeckers were observed during less than 3% of the fixed-point bird use surveys in either the spring or fall (Table 5b).

*Bird Flight Height and Behavior*

Flight height characteristics were estimated for both bird types and bird species (Tables 6, 7a and 7b), but only for birds observed within the plots. During the fixed-point bird use surveys, 267 large bird groups totaling 1,078 individuals were observed flying within the 2,625-ft (800-m) plot (Table 6). Overall, 12.0% of flying large birds were recorded within the RSH, 35.3% were below, and 52.7% were recorded above the RSH (Table 6). Most (72.4%) flying raptors were observed below the RSH, 15.8% were within the RSH, and 11.8% were above the RSH. Turkey vultures had the highest percentage of flying birds within the RSH (58.9%), followed by large corvids (27.7%). Raptors had the third highest percentage (15.8%) of flying large birds within the RSH, primarily due to 21.4% of buteo observations recorded at this height. All flying waterbirds (100%) and most shorebirds (96.6%) were observed below the RSH, while the majority of flying waterfowl (81.0%) were observed above the RSH. Doves/pigeons and upland game birds were typically observed flying below the RSH, and owls were not observed in flight (Table 6). A total of 3,559 small birds were observed flying within 328 ft (100 m) of the point in 969 groups, with 91.9% recorded flying below and 8.1% within the RSH, and passerines had the same flight height distribution (91.9% below and 8.1% within the RSH; Table 6). All woodpeckers were observed flying below the RSH, while 18.2% of swifts/hummingbirds observations were within the RSH and the remaining 81.8% of swifts/hummingbirds were observed below the RSH.

Turkey vulture was the only species flying within the RSH during the majority of the initial observations (58.9%; Table 7a). One bald eagle (*Haliaeetus leucocephalus*) was observed flying within the RSH, but this was based on only one observation. Of all passerine and other small bird species, 10 species had at least 20 groups observed flying; and only red-winged blackbird, brown-headed cowbird, and barn swallow (*Hirundo rustica*) were recorded flying within the RSH during at least 10% of the initial observations (20.1%, 18.5%, and 11.5%, respectively; Table 7b).

*Bird Exposure Index*

A relative index of collision exposure (exposure index) was calculated for each bird species (Tables 7a and 7b). This index is only based on initial flight height observations and bird use, and does not account for other possible collision risk factors (e.g., foraging or courtship behavior). Canada goose (*Branta canadensis*) had a higher exposure index (0.09) than any other

large bird species, followed by turkey vulture (0.05) and American crow (0.02), while red-tailed hawk had the fourth highest exposure index (0.02). Northern harrier (*Circus cyaneus*), Cooper's hawk (*Accipiter cooperii*), and bald eagle each had an exposure index of less than 0.01. All other raptor species had exposure indices of zero (Table 7a).

For small birds, based on observations within 100-m, the red-winged blackbird had the highest exposure index (0.18), followed by brown-headed cowbird (0.09; Table 7b).

*Spatial Use*

Waterfowl use was much higher in the spring than in the fall and winter and use was observed to be highest at point 14, which is located along Hillery Creek, a tributary of South Edwards River. Waterfowl use was also higher at point three, which is located in the southwestern portion of the BHWP along an unnamed tributary of Pope Creek (Figure 6a). Relatively moderate shorebird use was observed throughout the BHWP, with slightly higher use in the western portion of the study area (points five and seven) and relatively low shorebird use in the east (Figure 6b). Raptor use was relatively low to moderate through most of the study area, with higher use at points 15 and 26 in the northern portion of the study area. Use by raptors was relatively low in the western portions of the study area (Figure 6c). Buteo use was highest in the northwestern portion of the study area, with use gradually decreasing to lower levels in the east and southeast (Figure 6d). The highest falcon use was recorded through the central section of the study area (points 15, 25, 26, and 33), and use was generally low to the east or west of these points (Figure 6e). Use by passerines was highest use at point two (Figure 6f).

A 1-mile (1.6-km) buffer was investigated around the SER to compare bird use within the buffer to bird use of the rest of the BHWP. Use of the BHWP by avian subtypes was evaluated for each study season both inside and outside the 1-mile (1.6-km) buffer surrounding the SER (Table 8). Use by season and subtype was not significantly different between the two areas (p-value greater than 0.10). Use by birds in the project area was not strongly related to topographic features within the project area (Figures 7a-g).

*Sensitive Species Observations*

Four sensitive species were recorded during fixed-point bird use surveys (Table 9). Three Illinois state endangered species were observed: two loggerhead shrikes were observed during the spring (*Lanius ludovicianus*), seven northern harriers (four in the fall and three in the spring) and two upland sandpipers (*Bartramia longicauda*; both in the spring;). A single bald eagle was recorded during fixed-point surveys in the spring. While the bald eagle is not listed as a species of concern by the US Fish and Wildlife Service (USFWS) or by the Illinois Department of Natural Resources (IDNR), this species is legally protected under the federal Bald and Golden Eagle Protection Act (BGEPA 1940; MSU 1990). The number of state endangered species observations may represent repeated observations of the same individual.

**Breeding Songbird Surveys**

A total of 460 5-min breeding songbird surveys were conducted at the BHWP during three visits between May 26 and June 15, 2010 (Table 10).

Seventy-three species were identified during the breeding songbird surveys and the mean number of species observed per survey (species richness) was 5.79 (Table 10). A total of 5,402 individual bird observations within 3,609 separate groups were recorded (Table 11). Red-winged blackbird (1.4% of all species observed during the breeding songbird surveys) composed more than 34.9% of the observations. All other species composed less than 7% of the observations individually (Table 11).

*Sensitive Species*

Two sensitive species were recorded during breeding songbird surveys (Table 9). Nineteen upland sandpipers, and a single common moorhen (both state-endangered [IDNR 2009]) were observed at the BHWP (Table 9). The number of birds observed may represent repeat observations of the same individual, since the same point count locations were surveyed three times during the breeding season. Upland sandpiper observations were concentrated in the south-central portion of the BHWP (Figure 8).

## Raptor Nest Surveys

Eight active red-tailed hawk nests, two active great horned owl nests (*Bubo virginianus*), and 40 inactive potential raptor nests were located in the BHWP (Figure 9). An additional great horned owl nest and three inactive raptor nests were located within 1.0 mile (1.6 km) of the BHWP boundary. Within the entire BHWP, overall nesting density (active and inactive nests) was 0.28 nests/mi$^2$. Overall nest density within 1.0 mile (1.6 km) of the SER was higher (0.86 nests/ mi$^2$) than overall nest density within the rest of the BHWP (0.20 nests/ mi$^2$; Table 12).

Based on the size of the nests observed and relative abundance of raptor species in the area, the majority of inactive nests were likely constructed by red-tailed hawks. However, inactive nests could also be used by other raptor species.

## Landcover Mapping

The dominant landcover type was tilled agriculture, primarily corn and soybean crops, which comprised 84.9% (153.4 mi$^2$ [98,169.70 acres]) of the BHWP (Tables 1 and 2, Figure 3). Developed areas were the next most common landcover type observed and comprised 4.5% (8.1 mi$^2$ [5,188.23 acres]) of the study area. Woodlots comprised 3.8% (6.8 mi$^2$ [4,377.27 acres]), unmowed grassland 2.3% (4.1 mi$^2$ [2,617.36 acres]) and pasture 1.8% (3.2 mi$^2$ [2,049.83 acres]) of the BHWP. The remaining area was comprised of small amounts of mowed grasslands, savannah, shelterbelts with trees and shrubs, native grasslands, open water, and a railroad verge (Table 1 and Figure 3). One Illinois Natural Inventory Area, the Keener Prairie, is present within the project area. The Keener Prairie is a small remnant of native tall-grass prairie and will not be impacted by the project.

## Incidental Wildlife Observations

Seventeen bird species were recorded as incidental observations at the BHWP, totaling 173 birds within 99 separate groups (Table 13). Seven mammal species and one reptile species were also observed incidentally at the BHWP.

*Bird Observations*

The most abundant bird species recorded as incidental wildlife observations were Canada goose (56 observations), red-tailed hawk (40), and American kestrel (39). All other species had 11 or fewer individuals observed incidentally (Table 13). Two species were only observed incidentally at the BHWP: blue grosbeak (*Guiraca caerulea*) and sharp-shinned hawk (*Accipiter striatus*).

*Mammal Observations*

A total of 25 mammals were observed in 23 groups, and white-tailed deer (*Odocoileus virginianus*) was the most abundant mammal observed at the BHWP (nine observations; Table 13). Seven individual thirteen-lined ground squirrels (*Spermophilus tridecemlineatus*), three single raccoons (*Procyon lotor*), and one each of coyote (*Canis latrans*), striped skunk (*Mephitis mephitis*), Virginia opossum (*Didelphis virginiana*), and woodchuck (*Marmota monax*) were also recorded as incidental observations at the BHWP.

*Reptile Observations*

Two eastern garter snakes (*Thamnophis sirtalis*) were recorded as incidental observations at the BHWP (Table 13).

*Sensitive Species Observations*

Four sensitive species were recorded incidentally at the BHWP (Table 9). A single loggerhead shrike (state-endangered species [IDNR 2009]) was recorded outside of standardized surveys. Two state-endangered species (IDNR 2009), northern harrier (five observations) and upland sandpiper (four), were observed incidentally. In addition, a single bald eagle was observed, which is legally protected under the BGEPA (1940).

# DISCUSSION AND IMPACT ASSESSMENT

## Potential Impacts

Impacts to wildlife resources from wind-energy facilities can be direct or indirect. Direct impacts include the potential for fatalities from construction and operation of the proposed wind-energy facility. Indirect impacts include the potential to displace, either temporarily or permanently, wildlife during construction of or during the operational period of a wind-energy facility.

Project construction could affect birds through loss of habitat, potential fatalities from construction equipment, and disturbance/displacement effects from construction activities. Impacts from the decommissioning of the facility are anticipated to be similar to construction in terms of noise, disturbance, and equipment. Potential mortality from construction equipment is expected to be very low. Equipment used in wind facility construction generally moves at slow rates or is stationary for long periods (e.g., cranes). The risk of direct mortality to birds from construction is most likely potential destruction of a nest for ground- and shrub-nesting species during initial site clearing. Impacts from the construction of the proposed BHWP to wildlife are not expected to jeopardize the continued existence of most bird populations based on the preponderance of tilled agriculture within the study area, and the placement of wind turbines within tilled agriculture. However; some potential exists for individual state listed species to be impacted if construction occurs within non-tilled areas.

Ongoing operation of the proposed facility has some potential to affect wildlife. Effects of operation on wildlife are discussed further below.

## Direct Impacts

Data collected during this study show that the potential for collisions to occur is not equal between groups of diurnally active birds. Bird types or species that were observed flying more often within heights similar to proposes turbines include raptors, waterfowl, turkey vultures, and passerines

*Raptors*

Typically, wind-energy facilities that have shown the highest raptor fatality rates have also shown the highest raptor use rates. One approach for estimating potential impacts is to compare raptor use at the BHWP to wind-energy facilities where estimates of raptor use and raptor fatality rates have been calculated. Overall raptor use at the BHWP was relatively low compared to wind-energy facilities where raptor use is considered high (Figure 10).

The exposure index analysis provides a relative ranking of which species spend more time flying at heights similar to proposed turbine. However, the index only considers relative probability of exposure based on abundance, proportion of observations flying, and proportion of flight height of each species within the RSH for turbines likely to be used at the wind-energy facility. This analysis is based on observations of birds during the surveys and does not take into consideration behavior (e.g. foraging, courtship), habitat selection, the varying ability among species to detect and avoid turbines, and other factors that may vary among species and influence likelihood for turbine collision. For these reasons, the index is only a relative index among species observed during the surveys and within the study area. Actual risk for some species may be lower or higher than indicated by these data. The red-tailed hawk was the raptor species with the highest exposure index compared to other raptors observed at the BHWP. Red-tailed hawk is a very common raptor species observed across the US and at wind-energy facilities. Smallwood et al. (2009) reports that the red-tailed hawk has been observed demonstrating behaviors at other wind-energy facilities that may increase their risk of collision with turbines (flights 164 ft [50 m] from turbines and many flights through the RSH). Other raptor species observed during surveys, including northern harrier, American kestrel, and rough-legged hawk (*Buteo lagopus*), have been found as casualties at other wind-energy facilities and may also have some risk of turbine collision.

The data collected at the BHWP indicate that a low number of raptors utilized the study area during the study period compared to most other wind-energy facilities. Overall mean raptor use at the BHWP was similar to raptor use reported from four other wind-energy facilities in the Midwest and Illinois (Table 14). To date, relatively few raptor fatalities have been reported at wind-energy facilities in the Midwest located within landscapes dominated by tilled agriculture. A total of eight raptors (including three incidental finds) were recorded as fatalities at studies of six wind-energy facilities located in tilled agriculture landscapes in Wisconsin (three facilities), Minnesota, Iowa, and Illinois (Howe et al. 2002, Johnson et al. 2002b, Jain 2005, Kerlinger et al.

2007, BHE Environmental 2009, Gruver et al. 2009; Table 15). Raptor fatality rates at the BHWP are expected to be similar to those observed at other Midwest wind-energy facilities.

*Waterfowl*

Canada goose was observed flying within the RSH during approximately 44.6% of initial observations and this species had the highest exposure index of all large birds observed within the BHWP, which may indicate that this species is vulnerable to turbine collisions. However, thus far, waterfowl have not been shown to be especially vulnerable to turbine collisions at other wind-energy projects. Approximately one million goose-use days and 120,000 duck-use days were recorded in the Wildlife Management Areas (WMAs) near the Top of Iowa project during the fall and early winter, and no waterfowl fatalities were documented during concurrent and standardized wind-energy facility fatality studies (Jain 2005). Similar findings were observed at the Buffalo Ridge wind-energy facility in southwestern Minnesota and Grand Ridge wind-energy facility in LaSalle County in Illinois. Both of these facilities were located in areas with relatively high waterfowl use. Snow goose, Canada goose, and mallards were the most common waterfowl observed within the project areas. Three of the 55 fatalities observed during the Buffalo Ridge fatality monitoring studies were waterfowl, including two mallards and one blue-winged teal (*Anas discors*; Johnson et al. 2002b). No Canada goose were found as fatalities at the Grand Ridge wind-energy facility, despite relatively high levels of use by this species (WEST, unpublished data). Based on the results of the studies at the Top of Iowa, Buffalo Ridge and Grand Ridge facilities, Canada goose appear to be able to detect and avoid wind turbines, decreasing the potential for Canada goose fatalities to occur. Other species of waterfowl, waterbirds, and shorebirds that were observed flying within the BHWP were observed in the RSH less than 10% of the time. Of bird carcasses reported at US wind-energy facilities prior to 2007, waterbirds comprised about 1%, waterfowl comprised about 2%, and shorebirds comprised less than 1% (NRC 2007).

*Turkey Vultures*

Despite the fact that turkey vulture are commonly observed near wind-energy facilities, turkey vultures are rarely observed as fatalities at most wind-energy facilities (Erickson et al. 2001a). One notable exception is the Buffalo Gap wind-energy facility in Texas (Tierney 2007), where higher rates of turkey vulture fatalities were observed compared to other wind-energy facilities. The landscape of the Buffalo Gap wind-energy facility differs greatly from the BHWP and is dominated by dense thickets of Ashe's juniper (*Juniperus ashei*), post oak (*Quercus stellata*), and mesquite (*Prosopsis glandulosa*), with small inclusions of grassland and dryland agricultural fields. A total of 24 groups of turkey vulture were observed flying during surveys in the BHWP. Based on flight height data, turkey vultures were recorded within the RSH for approximately 56% of observations, and some potential exists for turkey vulture fatalities to occur at the BHWP.

*Passerines*

The majority of passerine species observed during the study were recorded as flying below the potential RSH of turbines, indicating that most passerine species have a relatively low risk of collision during daylight hours. Many passerine species migrate at night, and at heights greater than observed during this study, and have some risk of collision with turbines. While some risk exists, most passerine species typically migrate at heights greater than the heights of turbines,

except during periods of inclement weather (NRC 2007). Passerines may be more vulnerable to turbine collisions when ascending or descending from stopover habitats during migration. Some woodlots and grasslands are present in the study area that could provide stopover habitat for migrating passerine species. Typically, small forest fragments are not considered high-quality nesting habitat due to their size and abundance of edge habitat, which is associated with higher incidence of nest predation and parasitism (Askins et al. 1987, Robinson et al. 1995, Brawn and Robinson 1996). However, forest fragments do receive higher levels of use during migration as stopover habitat (Packett and Dunning 2009). Migrating small birds and other species may be more at risk of turbine collision when ascending and descending from these stopover habitats, if turbines are placed near forest or grassland areas.

While this may indicate some risk of collision from turbines placed near suitable stopover habitat, to date, overall fatality rates for birds (including nocturnal migrants) at wind-energy facilities have been relatively low in the Midwest. The range of overall bird fatality estimates at five Midwest wind-energy facilities that were studied using comparable methods in similar habitats have ranged from 0.6 to 7.17 bird fatalities per megawatt (MW) per year (Howe et al. 2002, Johnson et al. 2002b, Jain 2005, Kerlinger et al. 2007, BHE Environmental 2009, Gruver et al. 2009; Table 15). Bird fatality rates have typically been shown to be higher in the eastern US, especially within largely forested landscapes (NRC 2007). The majority of potential stopover habitat for passerines is located along the South Edwards River. Invenergy has committed to placing turbines in tilled agriculture. Invenergy has also committed a minimum of a ½ mile (800 m) setback from the South Edwards River, which will reduce the potential for collisions to occur as birds are ascending or descending from stopover habitat.

### Indirect Impacts

*Displacement Impacts*

The presence of wind turbines may alter the landscape so that wildlife use patterns are affected, displacing wildlife away from the wind-energy facilities and suitable habitat. Some studies from wind-energy facilities in Europe consider displacement effects to have a greater impact on birds than collision mortality (Gill et al. 1996). The greatest concern with displacement impacts for wind-energy facilities in the US has been where these facilities have been constructed in grassland or other native habitats (Leddy et al. 1999, Mabey and Paul 2007). Although Crockford (1992) suggests that disturbance appears to impact feeding, resting, and migrating birds, rather than breeding birds, results from studies in the US suggest that breeding birds are also affected by wind-energy facility operations (e.g., Johnson et al. 2000a, Erickson et al. 2004).

Studies concerning displacement of most bird species have concentrated on grassland passerines and waterfowl/waterbirds (Winkelman 1990, Larsen and Madsen 2000, Mabey and Paul 2007). Wind-energy facility construction appears to cause small-scale local displacement of grassland passerines during the breeding season and is likely due to the birds avoiding turbine noise and maintenance activities. Construction also reduces habitat effectiveness because of the presence of access roads and large gravel pads surrounding turbines (Leddy 1996, Johnson et al. 2000a). Leddy et al. (1999) surveyed bird densities in Conservation Reserve Program (CRP) grasslands at the Buffalo Ridge wind-energy facility in Minnesota, and found mean densities of ten grassland bird species were four times higher at areas located 591-ft (180-m) from turbines than they were at grasslands closer to turbines. Johnson et al. (2000a) found reduced use of habitat by

seven of 22 grassland-breeding birds following construction of the Buffalo Ridge wind-energy facility. Results from the Stateline wind-energy facility in Oregon and Washington (Erickson et al. 2004), and the Combine Hills wind-energy facility in Oregon (Young et al. 2005), suggest a relatively small impact of the wind-energy facilities on grassland nesting passerines. Transect surveys conducted prior to and after construction of the wind-energy facilities found that grassland passerine use was significantly reduced within approximately 50 m of turbine strings, but areas further away from turbine strings did not have reduced bird use.

Habitats that may potentially be utilized by grassland and passerine birds for nesting (unmowed grasslands, native grasslands, Illinois State Acres for Wildlife Enhancement [SAFE] areas, woodlots, savannah, pasture and hayfields) encompass approximately 15.8 $mi^2$ (10,103 acres; 8.7%) of the BHWP. Invenergy has committed to placing turbines within tilled and un-tilled agricultural areas, and avoiding placing turbines within pasture and grassland habitats. Invenergy has also committed to placing turbines a minimum of ½ mile from the SER, where much of the wildlife habitat in the project is located. Placement of turbines within agricultural areas and away from the SER will reduce the potential for grassland songbirds to be displaced by turbines. Reduced densities of songbirds at other wind-energy facilities in the US have been limited to areas near turbines, with the maximum recorded reduction in breeding densities being within 591 ft (180-m of the turbines (Leddy et al. 1999).

Displacement effects of wind-energy facilities on waterfowl and shorebirds appear to be mixed. Studies from the Netherlands and Denmark suggest that densities of these types of species near turbines were lower compared to densities in similar habitats away from turbines (Winkelman 1990, Pedersen and Poulsen 1991). However, a study from a wind-energy facility in England, found no effect of wind turbines on populations of cormorant (*Phalacrcorax xarbo*), purple sandpipers (*Calidris maritima*), eiders (*Somateria mollissima*), or gulls, although the cormorants were temporarily displaced during construction (Lawrence et al. 2007). At the Buffalo Ridge wind-energy facility in Minnesota, use by several bird types, including shorebirds and waterfowl, were found to be significantly lower at survey plots with turbines than at reference plots without turbines (Johnson et al. 2000a). The report concluded that the area of reduced use was limited primarily to those areas within 328-ft (100-m) of the turbines. However, studies conducted at wind-energy facilities in Iowa and Illinois have not shown avoidance by Canada goose, despite relatively high levels of use recorded prior to construction (Jain 2005, Derby et al. 2009).

Indirect effects caused to raptors by disturbance-type impacts, such as construction activity near an active nest or primary foraging area also have a potential impact on diurnal and nocturnal raptor species. Active diurnal and nocturnal raptor density within the BHWP was 0.06 nests/$mi^2$, which is relatively low compared to most other wind-energy facilities (Erickson et al 2002a), so potential impacts on nesting raptors is expected to be low because the project is sited in an area with low nest density . Most studies on raptor displacement at wind-energy facilities, indicate effects to be negligible (Howell and Noone 1992; Johnson et al. 2000a, 2003b; Madders and Whitfield 2006). Notable exceptions to this include a study in Scotland that described territorial golden eagles avoiding the entire wind-energy facility area, except when intercepting non-territorial birds (Walker et al. 2005). A study at the Buffalo Ridge wind-energy facility in Minnesota found evidence of northern harriers avoiding turbines on both a small scale (less than 328-ft [100-m] from turbines) and a larger scale in the year following construction (Johnson et

al. 2000a). Two years following construction, however, no large-scale displacement of northern harriers was detected.

**Threatened, Endangered, and Sensitive Species**

No federally-listed threatened or endangered species were observed during surveys within BHWP. Upland sandpiper, northern harrier, loggerhead shrike and common moorhen are all state endangered species. One bald eagle, protected under the federal BGEPA (1940) was also observed during surveys (Table 9). All of these species are also protected under the Migratory Bird Treaty Act (MBTA 1918).

*Upland Sandpiper*

Nineteen upland sandpiper observations were recorded within the BHWP during the breeding songbird surveys, indicating that upland sandpipers nest within the BHWP. The BHWP contains suitable nesting habitat for upland sandpipers, including hayfields, mowed grasslands, grass buffer strips in crop fields, native grasslands, and unmowed grasslands.

Upland sandpipers may nest within small grass buffer strips in tilled agricultural fields, some of which may be located near a turbine within an adjacent agricultural field. Upland sandpipers may also nest within no-till soybean fields, and some turbines are likely located within no-till soybean fields. The nesting habitat preferences of the upland sandpiper may result in birds nesting close to turbine locations. The typical flight pattern of the upland sandpiper does not include regular flights within proposed blade heights, however; upland sandpiper aerial courtship displays may involve flights near blade height. The effects of an operational wind-energy facility on breeding upland sandpipers have not been well studied. We are only aware of one published study of wind-energy facilities where upland sandpipers were present. Johnson et al. (2000a) conducted a fatality monitoring and grassland songbird displacement study at the Buffalo Ridge wind-energy facility in Minnesota. Upland sandpiper use of the facility during operation was similar to use measured prior to construction, and no upland sandpiper fatalities were documented at Buffalo Ridge. Photographs of upland sandpiper taken in 2008 just over a mile from an existing wind-energy facility in Illinois may indicate that visibility and motion at that distance may not be an issue (K. Shank, IDNR, pers. comm.), but more research is needed regarding upland sandpiper behavioral responses to wind turbines.

Upland sandpipers may be impacted by the construction phase of the BHWP if construction takes place during the breeding season in occupied nesting habitat. If construction takes place outside of the breeding season, or within areas not occupied by active upland sandpiper nests, no direct impacts from construction to nesting upland sandpiper would occur, although the potential is reduced due to the placement of wind turbines in tilled agriculture. The potential for operation of the facility to effect upland sandpipers is more difficult to assess, given the lack of projects operating and monitored of projects within areas occupied by upland sandpipers. The flight habits of the upland sandpiper, and the results of Johnson et al. (2000a) suggest that upland sandpipers are not be especially vulnerable to collisions with wind turbines. The results of Johnson et al. (2000a) also suggest that upland sandpipers may not be displaced by wind turbines. While the presence of upland sandpipers during the breeding season results in some potential for the species to be found as a collision fatality, the results of Johnson et al. (2000a), and flight behavior of the species suggest the risk of collision is low.

*Northern Harrier*

A total of 12 northern harriers were observed during all surveys at the BHWP. Northern harriers were observed during fixed-point bird use surveys in the fall and spring, and no northern harriers were observed during summer breeding bird surveys. Most observations of northern harriers likely represent individuals migrating through the study area.

All northern harriers were observed flying and the majority of observations were below the RSH (85.7%), with only 14.3% observed flying within the RSH. The hunting habits of northern harriers typically involve low, coursing flights over grassland habitats (MacWhirter and Bildstein 1996), which likely decreases the potential for this species to collide with a wind turbine. Northern harriers may fly higher and within the potential RSH when conducting aerial courtship displays, and this species may occasionally fly within the RSH during migration. However, the data collected at the BHWP and other wind-energy facilities (Smallwood et al. 2009, Johnson et al. 2000b, Kerlinger 2002) indicate that northern harriers spend the majority of their time flying below blade height. Northern harriers have been documented as fatalities at other wind-energy facilities (Erickson et al. 2001a), and the potential exists for northern harriers to be found as fatalities at the BHWP, particularly during migration. However, the overall level northern harrier fatalities are typically comparatively low when compared to their relative abundance at other wind-energy facilities (Erickson et al. 2001a), indicating that their typically low flight heights likely reduces their risk of collision when compared to other raptor species.

Northern harriers require large undisturbed wetlands, pastures, old fields, marshes, and upland habitats for breeding. Suitable breeding habitat is limited in Illinois (Kleen et al. 2004). However, there is some potential for northern harriers to nest within the BHWP. Research regarding northern harrier response to wind turbines is limited, and has showed mixed results. In Europe, hen harriers (*Circus cyaneus*) appeared to be displaced by construction activities as well as operational facilities (Madders and Whitfield 2006, Pearce-Higgins et al. 2009). Madders and Whitfield (2006) found harriers nesting 656 – 984-ft (200 – 300-m) (from an operational wind turbine, and Pearce-Higgins et al. (2009) found foraging northern harriers to be less abundant within 820-ft (250-m) of operating turbines compared to control areas. The BHWP is comprised of 5.0% of habitats that northern harrier may find suitable for nesting (unmowed grassland, native grassland, railroad verge, pasture and savannah), which may reduce the likelihood of northern harriers nesting in the BHWP. The potential for northern harriers to nest near turbine locations is further reduced by the placement of turbines within tilled and un-tilled agroculture, and placement of turbines away from the SER. No northern harriers were observed during breeding bird surveys, which indicates that areas near proposed turbines do not provide highly suitable nesting habitat. There are no records of breeding northern harriers in Henry County (Kleen et al 2004). Given that no turbines will be placed within grassland habitats, and the lack of northern harriers observed during the breeding season, the proposed project is unlikely to displace nesting northern harriers. For these same reasons, construction activities are also unlikely to impacts nesting northern harriers.

*Loggerhead Shrike*

Two loggerhead shrikes were observed within the BHWP during fixed-point bird use surveys and one was observed incidentally during the summer breeding bird surveys. Loggerhead shrikes inhabit open areas with short vegetation and hedgerows, scattered trees and bushes (Kleen et al.

2004). There is some potential for loggerhead shrike to utilize pastures with nearby shelterbelts, fence lines, and hedgerows within the BHWP for foraging and nesting, and pastures could also be used by spring migrants as stopover habitat. There are three possible breeding records for loggerhead shrike in Henry County (Kleen et al. 2004). Observations of loggerhead shrike during the summer may indicate the species nests within the study area, although at relatively low densities based on the relative lack of observations during the breeding bird surveys. If shelterbelts are cleared during the breeding season, some potential exists for loggerhead shrike nests and young to be impacted by construction activities. Wind turbines also have the potential to cause loggerhead shrike fatalities (Smallwood and Karas 2009), although the generally lower heights at which loggerhead shrikes fly during the breeding season is below the RSH of modern turbines, and reduces the potential for collision. Given the comparatively low abundance of loggerhead shrikes within the BHWP, some potential exists for collision fatalities to occur during the summer and migration seasons, although the overall potential is considered low based on the low numbers of birds observed and flight behavior of loggerhead shrike.

*Bald Eagle*

The bald eagle is federally protected under the MBTA (1918) and the BGEPA (1940). Bald eagles inhabit undisturbed areas near large rivers, lakes, and coastal areas, and nest in large trees in these areas. There are no records of breeding bald eagles in Henry County (Kleen et al. 2004). A bald eagle was observed flying through the BHWP during the migration season, and this species is considered to be a fairly common migrant and winter resident in Illinois (Kleen et al. 2004). The bald eagle observed during the fixed-point bird use surveys was observed flying within the RSH, and some potential of collision does exist for this species. The BHWP does not contain large amounts of suitable habitat that may attract bald eagles, and based on the comparatively low abundance of bald eagles at the BHWP, the potential for a bald eagle fatality to occur is low.

*Common Moorhen*

One common moorhen was observed during breeding songbird surveys in the BHWP. This species is typically found in permanent marshes with thick emergent vegetation (Kleen et al. 2004). There are no records of breeding common moorhen in Henry County and the species is considered an uncommon migrant and rare to uncommon summer resident.

The potential for common moorhen collisions is considered low based on the relatively low numbers observed in the study area. The placement of turbines within tilled agriculture further reduces the potential for common moorhen collisions to occur.

## CONCLUSION

The USFWS (2003) interim guidelines for wind-energy development suggest that wind-energy projects should be sited within previously altered habitats. The proposed project is dominated by tilled agriculture, and developed areas, which comprise 89.4 % of the area. Invenergy has committed to placing turbines within tilled and un-tilled agricultural areas, and avoiding placing turbines within pasture and grassland habitats. The area with the highest diversity of landcover is located along the South Edwards River. Invenergy has proposed placing turbines a minimum of ½ mile from the South Edwards River, with turbines placed at greater distances where potential

wildlife habitat extends beyond ½ mile from the South Edwards River. The results of bird studies within the project area show that raptor use rates are lower than observed at other wind-energy facilities. Fatality rates of birds are expected to be similar to those observed at other wind-energy facilities in the Midwest, based on data collected during this study, placement of wind turbines within agricultural areas, and placement of turbines away from the South Edwards River.

Some species listed as threatened or endangered under the Illinois endangered species act, or the bald and golden eagle protection act were observed within the project area. Two species (bald eagle and common moorhen), were recorded only once during the study. One species (loggerhead shrike) was recorded on three occasions. These species occurred at relatively low densities, and risks of collisions are considered low based on their low abundance. Northern harrier and upland sandpiper were more commonly observed during the study. These species may have a higher potential to be affected by the proposed project; however, the overall potential for collision or displacement impacts to occur during operation are still considered low based on each species biology, studies of impacts at other wind-energy facilities, and the placement of turbines within tilled agriculture areas. Some potential exists for construction activities associated with project infrastructure to affect individual state-listed bird species if construction occurs within occupied habitats. This potential can be reduced or eliminated by monitoring for state-listed bird species nests during construction, and avoiding construction activities within occupied habitats while state-listed bird species are incubating eggs or brooding young.

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**Table 1. Results of land cover mapping within the Bishop Hill Wind Project.**

| Habitat | Acres | Percentage |
|---|---|---|
| Agriculture | 98,169.70 | 84.9 |
| Developed | 5,188.23 | 4.5 |
| Illinois SAFE Area | 42.50 | <0.1 |
| Mowed Grassland | 993.04 | 0.9 |
| Native Grassland | 203.00 | 0.2 |
| Open Water | 65.73 | 0.1 |
| Pasture | 2,049.83 | 1.8 |
| Railroad Verge | 108.04 | 0.1 |
| Savannah | 813.47 | 0.7 |
| Shelterbelt with Shrubs | 259.68 | 0.2 |
| Shelterbelt with Trees | 794.13 | 0.7 |
| Unmowed Grassland | 2,617.36 | 2.3 |
| Woodlot | 4,377.27 | 3.8 |
| **Total** | **115,681.96** | **100** |

**Table 2 Descriptions of habitats mapped at the Bishop Hill Wind Project by Western EcoSystems Technology, Inc.**

| Habitat | Habitat Description |
|---|---|
| Tilled Agriculture | Areas with planted crops (typically soybean [*Glycine max*], corn [*Zea mays*]). |
| Un-tilled Agriculture | Area with untilled agriculture (hay or alfalfa [*Medicago sativa*]). |
| Developed | House, barn, building, city, major highways. |
| Abandoned Structure | Dilapidated structure. |
| Pasture | Areas with planted grasses used for livestock grazing. |
| Mowed Grassland | Area of planted grass that is mowed regularly. |
| Unmowed Grassland | Grasslands that are planted and not mowed regularly dominated by non-native grassland species such as fescue (*Festuca* spp.) and smooth bromegrass (*Bromus inermis*). |
| Illinois SAFE Area | Small area of mature woodlot designated as an Illinois SAFE area. |
| Native Grassland | Unmowed grassland areas dominated by native species such as big bluestem (*Andropogon gerardii*) and little blue stem (*Schizachyrium scoparium*). |
| Savannah | Unmowed non-native planted grassland with interspersed trees/shrubs. |
| Woodlot | Areas with a group of deciduous trees present (does not include areas smaller than one acre [43,560 $ft^2$]). |
| Shelterbelt with trees | Barriers of medium to large trees (more than 25-centimeter [cm; 0.8-ft] diameter at breast height [dbh] and more than 7-m [23-ft] tall) between fields. |
| Shelterbelt with shrubs/grass | Barriers of shrubs or grass between agriculture fields. |
| Railroad verge | Active railroad track with planted non-native grass/shrub dominated margins that extend at least 10 m (33 ft). |
| Open water | Ponds or lakes. |

**Table 3. Summary of species richness (species/plot[a]/20-minute survey) and sample size, by season and overall, during the fixed-point bird use surveys at the Bishop Hill Wind Project, August 18, 2009 – May 25, 2010.**

| Season | Number of Visits | # Surveys Conducted | # Unique Species | Species Richness | |
|---|---|---|---|---|---|
| | | | | Large Birds | Small Birds |
| Fall | 7 | 238 | 45 | 0.55 | 1.45 |
| Winter | 3 | 85 | 15 | 0.22 | 0.45 |
| Spring | 7 | 221 | 55 | 0.92 | 3.61 |
| **Overall** | **17** | **544** | **65** | **0.55** | **1.77** |

[a] 800-meter (m) radius for large birds and 100-m radius for small birds.

**Table 4a. Total number of individuals and groups observed, regardless of distance from the observer, for each bird type and species, by season and overall, during the fixed-point bird use surveys at the Bishop Hill Wind Project, August 18, 2009 – May 25, 2010.**

| | | Fall | | Winter | | Spring | | Total | |
|---|---|---|---|---|---|---|---|---|---|
| **Bird Type/Species** | **Scientific Name** | **# grps** | **# obs** | **# grps** | **# obs** | **# grps** | **# obs** | **# grps** | **# obs** |
| **Waterbirds** | | **2** | **2** | **0** | **0** | **4** | **4** | **6** | **6** |
| great blue heron | *Ardea herodias* | 0 | 0 | 0 | 0 | 4 | 4 | 4 | 4 |
| great egret | *Ardea alba* | 2 | 2 | 0 | 0 | 0 | 0 | 2 | 2 |
| **Waterfowl** | | **5** | **68** | **0** | **0** | **18** | **611** | **23** | **679** |
| Canada goose | *Branta canadensis* | 5 | 68 | 0 | 0 | 16 | 89 | 21 | 157 |
| greater white-fronted goose | *Anser albifrons* | 0 | 0 | 0 | 0 | 1 | 22 | 1 | 22 |
| snow goose | *Chen caerulescens* | 0 | 0 | 0 | 0 | 1 | 500 | 1 | 500 |
| **Shorebirds** | | **28** | **108** | **0** | **0** | **70** | **90** | **98** | **198** |
| killdeer | *Charadrius vociferus* | 28 | 108 | 0 | 0 | 67 | 85 | 95 | 193 |
| lesser yellowlegs | *Tringa flavipes* | 0 | 0 | 0 | 0 | 1 | 3 | 1 | 3 |
| upland sandpiper | *Bartramia longicauda* | 0 | 0 | 0 | 0 | 2 | 2 | 2 | 2 |
| **Raptors** | | **46** | **49** | **6** | **6** | **28** | **31** | **80** | **86** |
| *Accipiters* | | *5* | *5* | *0* | *0* | *0* | *0* | *5* | *5* |
| Cooper's hawk | *Accipiter cooperii* | 5 | 5 | 0 | 0 | 0 | 0 | 5 | 5 |
| *Buteos* | | *22* | *22* | *5* | *5* | *16* | *18* | *43* | *45* |
| red-tailed hawk | *Buteo jamaicensis* | 22 | 22 | 5 | 5 | 16 | 18 | 43 | 45 |
| *Northern Harrier* | | *4* | *4* | *0* | *0* | *3* | *3* | *7* | *7* |
| northern harrier | *Circus cyaneus* | 4 | 4 | 0 | 0 | 3 | 3 | 7 | 7 |
| *Eagles* | | *0* | *0* | *0* | *0* | *1* | *1* | *1* | *1* |
| bald eagle | *Haliaeetus leucocephalus* | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| *Falcons* | | *15* | *18* | *1* | *1* | *8* | *9* | *24* | *28* |
| American kestrel | *Falco sparverius* | 15 | 18 | 1 | 1 | 8 | 9 | 24 | 28 |
| **Owls** | | **0** | **0** | **1** | **2** | **0** | **0** | **1** | **2** |
| barred owl | *Strix varia* | 0 | 0 | 1 | 2 | 0 | 0 | 1 | 2 |
| **Vultures** | | **20** | **36** | **0** | **0** | **22** | **33** | **42** | **69** |
| turkey vulture | *Cathartes aura* | 20 | 36 | 0 | 0 | 22 | 33 | 42 | 69 |

**Table 4a. Total number of individuals and groups observed, regardless of distance from the observer, for each bird type and species, by season and overall, during the fixed-point bird use surveys at the Bishop Hill Wind Project, August 18, 2009 – May 25, 2010.**

| | | Fall | | Winter | | Spring | | Total | |
|---|---|---|---|---|---|---|---|---|---|
| **Bird Type/Species** | **Scientific Name** | **# grps** | **# obs** | **# grps** | **# obs** | **# grps** | **# obs** | **# grps** | **# obs** |
| **Upland Game Birds** | | **4** | **4** | **0** | **0** | **26** | **29** | **30** | **33** |
| northern bobwhite | *Colinus virginianus* | 2 | 2 | 0 | 0 | 9 | 10 | 11 | 12 |
| ring-necked pheasant | *Phasianus colchicus* | 2 | 2 | 0 | 0 | 16 | 16 | 18 | 18 |
| wild turkey | *Meleagris gallopavo* | 0 | 0 | 0 | 0 | 1 | 3 | 1 | 3 |
| **Doves/Pigeons** | | **25** | **40** | **4** | **7** | **26** | **46** | **55** | **93** |
| mourning dove | *Zenaida macroura* | 20 | 27 | 1 | 1 | 25 | 44 | 46 | 72 |
| rock pigeon | *Columba livia* | 5 | 13 | 3 | 6 | 1 | 2 | 9 | 21 |
| **Large Corvids** | | **15** | **29** | **8** | **12** | **19** | **24** | **42** | **65** |
| American crow | *Corvus brachyrhynchos* | 15 | 29 | 8 | 12 | 19 | 24 | 42 | 65 |
| **Passerines** | | **467** | **2,210** | **51** | **183** | **959** | **1,999** | **1,477** | **4,392** |
| American goldfinch | *Carduelis tristis* | 94 | 178 | 0 | 0 | 36 | 48 | 130 | 226 |
| American robin | *Turdus migratorius* | 29 | 78 | 0 | 0 | 99 | 146 | 128 | 224 |
| American tree sparrow | *Spizella arborea* | 0 | 0 | 5 | 19 | 1 | 1 | 6 | 20 |
| barn swallow | *Hirundo rustica* | 37 | 134 | 0 | 0 | 44 | 75 | 81 | 209 |
| blue-gray gnatcatcher | *Polioptila caerulea* | 0 | 0 | 0 | 0 | 1 | 2 | 1 | 2 |
| blue jay | *Cyanocitta cristata* | 25 | 65 | 5 | 6 | 2 | 2 | 32 | 73 |
| brown-headed cowbird | *Molothrus ater* | 14 | 94 | 0 | 0 | 107 | 281 | 121 | 375 |
| brown thrasher | *Toxostoma rufum* | 0 | 0 | 0 | 0 | 7 | 7 | 7 | 7 |
| cedar waxwing | *Bombycilla cedrorum* | 1 | 4 | 0 | 0 | 1 | 1 | 2 | 5 |
| chipping sparrow | *Spizella passerina* | 3 | 11 | 0 | 0 | 18 | 20 | 21 | 31 |
| cliff swallow | *Petrochelidon pyrrhonota* | 15 | 81 | 0 | 0 | 0 | 0 | 15 | 81 |
| common grackle | *Quiscalus quiscula* | 24 | 423 | 0 | 0 | 66 | 168 | 90 | 591 |
| common yellowthroat | *Geothlypis trichas* | 0 | 0 | 0 | 0 | 3 | 4 | 3 | 4 |
| dark-eyed junco | *Junco hyemalis* | 0 | 0 | 5 | 26 | 0 | 0 | 5 | 26 |
| dickcissel | *Spiza americana* | 0 | 0 | 0 | 0 | 4 | 5 | 4 | 5 |
| eastern bluebird | *Sialia sialis* | 2 | 10 | 0 | 0 | 3 | 4 | 5 | 14 |
| eastern kingbird | *Tyrannus tyrannus* | 8 | 15 | 0 | 0 | 3 | 3 | 11 | 18 |

**Table 4a. Total number of individuals and groups observed, regardless of distance from the observer, for each bird type and species, by season and overall, during the fixed-point bird use surveys at the Bishop Hill Wind Project, August 18, 2009 – May 25, 2010.**

| | | Fall | | Winter | | Spring | | Total | |
|---|---|---|---|---|---|---|---|---|---|
| **Bird Type/Species** | **Scientific Name** | **# grps** | **# obs** | **# grps** | **# obs** | **# grps** | **# obs** | **# grps** | **# obs** |
| eastern meadowlark | *Sturnella magna* | 24 | 28 | 0 | 0 | 106 | 120 | 130 | 148 |
| eastern phoebe | *Sayornis phoebe* | 2 | 2 | 0 | 0 | 1 | 1 | 3 | 3 |
| eastern towhee | *Pipilo erythrophthalmus* | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| European starling | *Sturnus vulgaris* | 44 | 578 | 5 | 35 | 42 | 198 | 91 | 811 |
| field sparrow | *Spizella pusilla* | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 |
| gray catbird | *Dumetella carolinensis* | 2 | 2 | 0 | 0 | 1 | 1 | 3 | 3 |
| horned lark | *Eremophila alpestris* | 25 | 72 | 18 | 41 | 88 | 116 | 131 | 229 |
| house sparrow | *Passer domesticus* | 30 | 121 | 2 | 18 | 20 | 79 | 52 | 218 |
| house wren | *Troglodytes aedon* | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| indigo bunting | *Passerina cyanea* | 14 | 14 | 0 | 0 | 4 | 4 | 18 | 18 |
| Lapland longspur | *Calcarius lapponicus* | 3 | 31 | 7 | 28 | 2 | 25 | 12 | 84 |
| loggerhead shrike | *Lanius ludovicianus* | 0 | 0 | 0 | 0 | 2 | 2 | 2 | 2 |
| northern cardinal | *Cardinalis cardinalis* | 7 | 8 | 3 | 5 | 8 | 8 | 18 | 21 |
| northern rough-winged swallow | *Stelgidopteryx serripennis* | 1 | 4 | 0 | 0 | 0 | 0 | 1 | 4 |
| red-winged blackbird | *Agelaius phoeniceus* | 27 | 143 | 0 | 0 | 236 | 612 | 263 | 755 |
| savannah sparrow | *Passerculus sandwichensis* | 2 | 2 | 0 | 0 | 1 | 1 | 3 | 3 |
| snow bunting | *Plectrophenax nivalis* | 0 | 0 | 1 | 5 | 0 | 0 | 1 | 5 |
| song sparrow | *Melospiza melodia* | 8 | 8 | 0 | 0 | 19 | 24 | 27 | 32 |
| tree swallow | *Tachycineta bicolor* | 5 | 50 | 0 | 0 | 7 | 12 | 12 | 62 |
| unidentified blackbird | | 1 | 5 | 0 | 0 | 0 | 0 | 1 | 5 |
| unidentified passerine | | 4 | 17 | 0 | 0 | 0 | 0 | 4 | 17 |
| unidentified sparrow | | 5 | 8 | 0 | 0 | 0 | 0 | 5 | 8 |
| unidentified swallow | | 1 | 10 | 0 | 0 | 0 | 0 | 1 | 10 |
| vesper sparrow | *Pooecetes gramineus* | 7 | 9 | 0 | 0 | 24 | 26 | 31 | 35 |
| western meadowlark | *Sturnella neglecta* | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| white-throated sparrow | *Zonotrichia albicollis* | 2 | 4 | 0 | 0 | 0 | 0 | 2 | 4 |

**Table 4a. Total number of individuals and groups observed, regardless of distance from the observer, for each bird type and species, by season and overall, during the fixed-point bird use surveys at the Bishop Hill Wind Project, August 18, 2009 – May 25, 2010.**

| | | Fall | | Winter | | Spring | | Total | |
|---|---|---|---|---|---|---|---|---|---|
| **Bird Type/Species** | **Scientific Name** | **# grps** | **# obs** | **# grps** | **# obs** | **# grps** | **# obs** | **# grps** | **# obs** |
| **Cuckoos** | | **0** | **0** | **0** | **0** | **1** | **1** | **1** | **1** |
| yellow-billed cuckoo | *Coccyzus americanus* | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| **Swifts/Hummingbirds** | | **1** | **1** | **0** | **0** | **8** | **13** | **9** | **14** |
| chimney swift | *Chaetura pelagica* | 1 | 1 | 0 | 0 | 8 | 13 | 9 | 14 |
| **Woodpeckers** | | **7** | **8** | **0** | **0** | **5** | **5** | **12** | **13** |
| downy woodpecker | *Picoides pubescens* | 3 | 3 | 0 | 0 | 0 | 0 | 3 | 3 |
| northern flicker | *Colaptes auratus* | 2 | 2 | 0 | 0 | 3 | 3 | 5 | 5 |
| red-headed woodpecker | *Melanerpes erythrocephalus* | 2 | 3 | 0 | 0 | 2 | 2 | 4 | 5 |
| **Overall** | | **620** | **2,555** | **70** | **210** | **1,186** | **2,886** | **1,876** | **5,651** |

**Table 4b. Total number of individuals and groups observed with the plots (2,654 ft [800 m] from the point for large birds and 328 ft [100 m] for small birds) for each bird type and species, by season and overall, during the fixed-point bird use surveys at the Bishop Hill Wind Project, August 18, 2009 – May 25, 2010.**

| | | Fall | | Winter | | Spring | | Total | |
|---|---|---|---|---|---|---|---|---|---|
| **Bird Type/Species** | **Scientific Name** | **# grps** | **# obs** | **# grps** | **# obs** | **# grps** | **# obs** | **# grps** | **# obs** |
| **Waterbirds** | | **1** | **1** | **0** | **0** | **4** | **4** | **5** | **5** |
| great blue heron | *Ardea herodias* | 0 | 0 | 0 | 0 | 4 | 4 | 4 | 4 |
| great egret | *Ardea alba* | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 |
| **Waterfowl** | | **5** | **68** | **0** | **0** | **18** | **611** | **23** | **679** |
| Canada goose | *Branta canadensis* | 5 | 68 | 0 | 0 | 16 | 89 | 21 | 157 |
| greater white-fronted goose | *Anser albifrons* | 0 | 0 | 0 | 0 | 1 | 22 | 1 | 22 |
| snow goose | *Chen caerulescens* | 0 | 0 | 0 | 0 | 1 | 500 | 1 | 500 |
| **Shorebirds** | | **28** | **108** | **0** | **0** | **70** | **90** | **98** | **198** |
| killdeer | *Charadrius vociferus* | 28 | 108 | 0 | 0 | 67 | 85 | 95 | 193 |
| lesser yellowlegs | *Tringa flavipes* | 0 | 0 | 0 | 0 | 1 | 3 | 1 | 3 |
| upland sandpiper | *Bartramia longicauda* | 0 | 0 | 0 | 0 | 2 | 2 | 2 | 2 |
| **Raptors** | | **45** | **48** | **6** | **6** | **28** | **31** | **79** | **85** |
| *Accipiters* | | *5* | *5* | *0* | *0* | *0* | *0* | *5* | *5* |
| Cooper's hawk | *Accipiter cooperii* | 5 | 5 | 0 | 0 | 0 | 0 | 5 | 5 |
| *Buteos* | | *21* | *21* | *5* | *5* | *16* | *18* | *42* | *44* |
| red-tailed hawk | *Buteo jamaicensis* | 21 | 21 | 5 | 5 | 16 | 18 | 42 | 44 |
| *Northern Harrier* | | *4* | *4* | *0* | *0* | *3* | *3* | *7* | *7* |
| northern harrier | *Circus cyaneus* | 4 | 4 | 0 | 0 | 3 | 3 | 7 | 7 |
| *Eagles* | | *0* | *0* | *0* | *0* | *1* | *1* | *1* | *1* |
| bald eagle | *Haliaeetus leucocephalus* | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| *Falcons* | | *15* | *18* | *1* | *1* | *8* | *9* | *24* | *28* |
| American kestrel | *Falco sparverius* | 15 | 18 | 1 | 1 | 8 | 9 | 24 | 28 |
| **Owls** | | **0** | **0** | **1** | **2** | **0** | **0** | **1** | **2** |
| barred owl | *Strix varia* | 0 | 0 | 1 | 2 | 0 | 0 | 1 | 2 |
| **Vultures** | | **15** | **23** | **0** | **0** | **22** | **33** | **37** | **56** |
| turkey vulture | *Cathartes aura* | 15 | 23 | 0 | 0 | 22 | 33 | 37 | 56 |

**Table 4b. Total number of individuals and groups observed with the plots (2,654 ft [800 m] from the point for large birds and 328 ft [100 m] for small birds) for each bird type and species, by season and overall, during the fixed-point bird use surveys at the Bishop Hill Wind Project, August 18, 2009 – May 25, 2010.**

| | | Fall | | Winter | | Spring | | Total | |
|---|---|---|---|---|---|---|---|---|---|
| **Bird Type/Species** | **Scientific Name** | **# grps** | **# obs** | **# grps** | **# obs** | **# grps** | **# obs** | **# grps** | **# obs** |
| **Upland Game Birds** | | **4** | **4** | **0** | **0** | **26** | **29** | **30** | **33** |
| northern bobwhite | *Colinus virginianus* | 2 | 2 | 0 | 0 | 9 | 10 | 11 | 12 |
| ring-necked pheasant | *Phasianus colchicus* | 2 | 2 | 0 | 0 | 16 | 16 | 18 | 18 |
| wild turkey | *Meleagris gallopavo* | 0 | 0 | 0 | 0 | 1 | 3 | 1 | 3 |
| **Doves/Pigeons** | | **25** | **40** | **4** | **7** | **26** | **46** | **55** | **93** |
| mourning dove | *Zenaida macroura* | 20 | 27 | 1 | 1 | 25 | 44 | 46 | 72 |
| rock pigeon | *Columba livia* | 5 | 13 | 3 | 6 | 1 | 2 | 9 | 21 |
| **Large Corvids** | | **15** | **29** | **8** | **12** | **19** | **24** | **42** | **65** |
| American crow | *Corvus brachyrhynchos* | 15 | 29 | 8 | 12 | 19 | 24 | 42 | 65 |
| **Passerines** | | **385** | **1,965** | **47** | **173** | **959** | **1,999** | **1,391** | **4,137** |
| American goldfinch | *Carduelis tristis* | 81 | 155 | 0 | 0 | 36 | 48 | 117 | 203 |
| American robin | *Turdus migratorius* | 19 | 61 | 0 | 0 | 99 | 146 | 118 | 207 |
| American tree sparrow | *Spizella arborea* | 0 | 0 | 5 | 19 | 1 | 1 | 6 | 20 |
| barn swallow | *Hirundo rustica* | 37 | 134 | 0 | 0 | 44 | 75 | 81 | 209 |
| blue-gray gnatcatcher | *Polioptila caerulea* | 0 | 0 | 0 | 0 | 1 | 2 | 1 | 2 |
| blue jay | *Cyanocitta cristata* | 12 | 47 | 3 | 4 | 2 | 2 | 17 | 53 |
| brown-headed cowbird | *Molothrus ater* | 10 | 63 | 0 | 0 | 107 | 281 | 117 | 344 |
| brown thrasher | *Toxostoma rufum* | 0 | 0 | 0 | 0 | 7 | 7 | 7 | 7 |
| cedar waxwing | *Bombycilla cedrorum* | 1 | 4 | 0 | 0 | 1 | 1 | 2 | 5 |
| chipping sparrow | *Spizella passerina* | 3 | 11 | 0 | 0 | 18 | 20 | 21 | 31 |
| cliff swallow | *Petrochelidon pyrrhonota* | 15 | 81 | 0 | 0 | 0 | 0 | 15 | 81 |
| common grackle | *Quiscalus quiscula* | 19 | 412 | 0 | 0 | 66 | 168 | 85 | 580 |
| common yellowthroat | *Geothlypis trichas* | 0 | 0 | 0 | 0 | 3 | 4 | 3 | 4 |
| dark-eyed junco | *Junco hyemalis* | 0 | 0 | 5 | 26 | 0 | 0 | 5 | 26 |
| dickcissel | *Spiza americana* | 0 | 0 | 0 | 0 | 4 | 5 | 4 | 5 |
| eastern bluebird | *Sialia sialis* | 1 | 8 | 0 | 0 | 3 | 4 | 4 | 12 |
| eastern kingbird | *Tyrannus tyrannus* | 8 | 15 | 0 | 0 | 3 | 3 | 11 | 18 |
| eastern meadowlark | *Sturnella magna* | 15 | 16 | 0 | 0 | 106 | 120 | 121 | 136 |
| eastern phoebe | *Sayornis phoebe* | 2 | 2 | 0 | 0 | 1 | 1 | 3 | 3 |

**Table 4b. Total number of individuals and groups observed with the plots (2,654 ft [800 m] from the point for large birds and 328 ft [100 m] for small birds) for each bird type and species, by season and overall, during the fixed-point bird use surveys at the Bishop Hill Wind Project, August 18, 2009 – May 25, 2010.**

| | | Fall | | Winter | | Spring | | Total | |
|---|---|---|---|---|---|---|---|---|---|
| **Bird Type/Species** | **Scientific Name** | **# grps** | **# obs** | **# grps** | **# obs** | **# grps** | **# obs** | **# grps** | **# obs** |
| eastern towhee | *Pipilo erythrophthalmus* | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| European starling | *Sturnus vulgaris* | 35 | 506 | 4 | 30 | 42 | 198 | 81 | 734 |
| field sparrow | *Spizella pusilla* | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 |
| gray catbird | *Dumetella carolinensis* | 1 | 1 | 0 | 0 | 1 | 1 | 2 | 2 |
| horned lark | *Eremophila alpestris* | 25 | 72 | 17 | 38 | 88 | 116 | 130 | 226 |
| house sparrow | *Passer domesticus* | 22 | 95 | 2 | 18 | 20 | 79 | 44 | 192 |
| house wren | *Troglodytes aedon* | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| indigo bunting | *Passerina cyanea* | 13 | 13 | 0 | 0 | 4 | 4 | 17 | 17 |
| Lapland longspur | *Calcarius lapponicus* | 3 | 31 | 7 | 28 | 2 | 25 | 12 | 84 |
| loggerhead shrike | *Lanius ludovicianus* | 0 | 0 | 0 | 0 | 2 | 2 | 2 | 2 |
| northern cardinal | *Cardinalis cardinalis* | 6 | 6 | 3 | 5 | 8 | 8 | 17 | 19 |
| northern rough-winged swallow | *Stelgidopteryx serripennis* | 1 | 4 | 0 | 0 | 0 | 0 | 1 | 4 |
| red-winged blackbird | *Agelaius phoeniceus* | 23 | 118 | 0 | 0 | 236 | 612 | 259 | 730 |
| savannah sparrow | *Passerculus sandwichensis* | 2 | 2 | 0 | 0 | 1 | 1 | 3 | 3 |
| snow bunting | *Plectrophenax nivalis* | 0 | 0 | 1 | 5 | 0 | 0 | 1 | 5 |
| song sparrow | *Melospiza melodia* | 8 | 8 | 0 | 0 | 19 | 24 | 27 | 32 |
| tree swallow | *Tachycineta bicolor* | 4 | 49 | 0 | 0 | 7 | 12 | 11 | 61 |
| unidentified blackbird | | 1 | 5 | 0 | 0 | 0 | 0 | 1 | 5 |
| unidentified passerine | | 4 | 17 | 0 | 0 | 0 | 0 | 4 | 17 |
| unidentified sparrow | | 5 | 8 | 0 | 0 | 0 | 0 | 5 | 8 |
| unidentified swallow | | 1 | 10 | 0 | 0 | 0 | 0 | 1 | 10 |
| vesper sparrow | *Pooecetes gramineus* | 6 | 8 | 0 | 0 | 24 | 26 | 30 | 34 |
| western meadowlark | *Sturnella neglecta* | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| white-throated sparrow | *Zonotrichia albicollis* | 1 | 2 | 0 | 0 | 0 | 0 | 1 | 2 |
| **Cuckoos** | | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| yellow-billed cuckoo | *Coccyzus americanus* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Overall** | | **523** | **2,286** | **66** | **200** | **1,172** | **2,867** | **1,761** | **5,353** |

**Table 5a. Mean bird use (number of birds/800-meter plot/20-minute survey), percent of total composition (%), and frequency of occurrence (%) for each large bird type and species by season during the fixed-point bird use surveys at the Bishop Hill Wind Project, August 18, 2009 – May 25, 2010.**

| | Mean Use | | | % Composition | | | % Frequency | | |
|---|---|---|---|---|---|---|---|---|---|
| **Bird Type/Species** | **Fall** | **Winter** | **Spring** | **Fall** | **Winter** | **Spring** | **Fall** | **Winter** | **Spring** |
| **Waterbirds** | **<0.01** | **0** | **0.02** | **0.3** | **0** | **0.4** | **0.4** | **0** | **1.7** |
| great blue heron | 0 | 0 | 0.02 | 0 | 0 | 0.4 | 0 | 0 | 1.7 |
| great egret | <0.01 | 0 | 0 | 0.3 | 0 | 0 | 0.4 | 0 | 0 |
| **Waterfowl** | **0.29** | **0** | **2.58** | **21.2** | **0** | **68.8** | **1.7** | **0** | **7.6** |
| Canada goose | 0.29 | 0 | 0.38 | 21.2 | 0 | 10.2 | 1.7 | 0 | 6.7 |
| greater white-fronted goose | 0 | 0 | 0.09 | 0 | 0 | 2.5 | 0 | 0 | 0.4 |
| snow goose | 0 | 0 | 2.10 | 0 | 0 | 56.1 | 0 | 0 | 0.4 |
| **Shorebirds** | **0.45** | **0** | **0.42** | **33.6** | **0** | **11.1** | **11.3** | **0** | **30.3** |
| killdeer | 0.45 | 0 | 0.39 | 33.6 | 0 | 10.5 | 11.3 | 0 | 29.4 |
| lesser yellowlegs | 0 | 0 | 0.01 | 0 | 0 | 0.3 | 0 | 0 | 0.4 |
| upland sandpiper | 0 | 0 | <0.01 | 0 | 0 | 0.2 | 0 | 0 | 0.8 |
| **Raptors** | **0.20** | **0.08** | **0.13** | **15.0** | **26.7** | **3.5** | **17.2** | **5.9** | **11.8** |
| *Accipiters* | *0.02* | *0* | *0* | *1.6* | *0* | *0* | *2.1* | *0* | *0* |
| Cooper's hawk | 0.02 | 0 | 0 | 1.6 | 0 | 0 | 2.1 | 0 | 0 |
| *Buteos* | *0.09* | *0.06* | *0.08* | *6.5* | *20.0* | *2.0* | *8.8* | *5.9* | *6.7* |
| red-tailed hawk | 0.09 | 0.06 | 0.08 | 6.5 | 20.0 | 2.0 | 8.8 | 5.9 | 6.7 |
| *Northern Harrier* | *0.02* | *0* | *0.01* | *1.2* | *0* | *0.3* | *1.7* | *0* | *1.3* |
| northern harrier | 0.02 | 0 | 0.01 | 1.2 | 0 | 0.3 | 1.7 | 0 | 1.3 |
| *Eagles* | *0* | *0* | *<0.01* | *0* | *0* | *0.1* | *0* | *0* | *0.4* |
| bald eagle | 0 | 0 | <0.01 | 0 | 0 | 0.1 | 0 | 0 | 0.4 |
| *Falcons* | *0.08* | *0.02* | *0.04* | *5.6* | *6.7* | *1.0* | *5.5* | *2.0* | *3.4* |
| American kestrel | 0.08 | 0.02 | 0.04 | 5.6 | 6.7 | 1.0 | 5.5 | 2.0 | 3.4 |
| **Owls** | **0** | **0.02** | **0** | **0** | **6.7** | **0** | **0** | **1.0** | **0** |
| barred owl | 0 | 0.02 | 0 | 0 | 6.7 | 0 | 0 | 1.0 | 0 |
| **Vultures** | **0.10** | **0** | **0.15** | **7.2** | **0** | **3.9** | **5.5** | **0** | **9.7** |
| turkey vulture | 0.10 | 0 | 0.15 | 7.2 | 0 | 3.9 | 5.5 | 0 | 9.7 |

**Table 5a. Mean bird use (number of birds/800-meter plot/20-minute survey), percent of total composition (%), and frequency of occurrence (%) for each large bird type and species by season during the fixed-point bird use surveys at the Bishop Hill Wind Project, August 18, 2009 – May 25, 2010.**

| | Mean Use | | | % Composition | | | % Frequency | | |
|---|---|---|---|---|---|---|---|---|---|
| **Bird Type/Species** | **Fall** | **Winter** | **Spring** | **Fall** | **Winter** | **Spring** | **Fall** | **Winter** | **Spring** |
| **Upland Game Birds** | **0.02** | **0** | **0.14** | **1.2** | **0** | **3.7** | **1.7** | **0** | **9.7** |
| northern bobwhite | <0.01 | 0 | 0.05 | 0.6 | 0 | 1.5 | 0.8 | 0 | 4.2 |
| ring-necked pheasant | <0.01 | 0 | 0.07 | 0.6 | 0 | 1.9 | 0.8 | 0 | 7.1 |
| wild turkey | 0 | 0 | 0.01 | 0 | 0 | 0.3 | 0 | 0 | 0.4 |
| **Doves/Pigeons** | **0.17** | **0.07** | **0.22** | **12.5** | **23.3** | **5.8** | **10.5** | **3.9** | **11.3** |
| mourning dove | 0.11 | <0.01 | 0.21 | 8.4 | 3.3 | 5.6 | 8.4 | 1.0 | 10.9 |
| rock pigeon | 0.05 | 0.06 | <0.01 | 4.0 | 20.0 | 0.2 | 2.1 | 2.9 | 0.4 |
| **Large Corvids** | **0.12** | **0.13** | **0.10** | **9.0** | **43.3** | **2.7** | **6.3** | **8.8** | **7.1** |
| American crow | 0.12 | 0.13 | 0.10 | 9.0 | 43.3 | 2.7 | 6.3 | 8.8 | 7.1 |
| **Overall** | **1.35** | **0.29** | **3.74** | **100** | **100** | **100** | | | |

**Table 5b. Mean bird use (number of birds/100-m plot/20-minute survey), percent of total composition (%), and frequency of occurrence (%) for each small bird type and species by season during the fixed-point bird use surveys at the Bishop Hill Wind Project, August 18, 2009 – May 25, 2010.**

| | Mean Use | | | % Composition | | | % Frequency | | |
|---|---|---|---|---|---|---|---|---|---|
| **Bird Type/Species** | **Fall** | **Winter** | **Spring** | **Fall** | **Winter** | **Spring** | **Fall** | **Winter** | **Spring** |
| **Passerines** | **8.26** | **1.79** | **9.28** | **99.8** | **100** | **99.1** | **69.3** | **37.3** | **93.3** |
| American goldfinch | 0.65 | 0 | 0.23 | 7.9 | 0 | 2.4 | 30.7 | 0 | 13.4 |
| American robin | 0.26 | 0 | 0.71 | 3.1 | 0 | 7.6 | 6.7 | 0 | 36.6 |
| American tree sparrow | 0 | 0.21 | <0.01 | 0 | 11.5 | <0.1 | 0 | 4.9 | 0.4 |
| barn swallow | 0.56 | 0 | 0.40 | 6.8 | 0 | 4.3 | 12.6 | 0 | 19.3 |
| blue-gray gnatcatcher | 0 | 0 | 0.02 | 0 | 0 | 0.2 | 0 | 0 | 0.8 |
| blue jay | 0.20 | 0.05 | <0.01 | 2.4 | 2.7 | <0.1 | 4.2 | 3.9 | 0.8 |
| brown-headed cowbird | 0.26 | 0 | 1.28 | 3.2 | 0 | 13.6 | 3.8 | 0 | 37.8 |
| brown thrasher | 0 | 0 | 0.03 | 0 | 0 | 0.4 | 0 | 0 | 3.4 |
| cedar waxwing | 0.02 | 0 | <0.01 | 0.2 | 0 | <0.1 | 0.4 | 0 | 0.8 |
| chipping sparrow | 0.05 | 0 | 0.09 | 0.6 | 0 | 1.0 | 1.3 | 0 | 8.4 |
| cliff swallow | 0.34 | 0 | 0 | 4.1 | 0 | 0 | 5.5 | 0 | 0 |
| common grackle | 1.73 | 0 | 0.76 | 20.9 | 0 | 8.2 | 5.5 | 0 | 22.7 |
| common yellowthroat | 0 | 0 | 0.03 | 0 | 0 | 0.3 | 0 | 0 | 1.7 |
| dark-eyed junco | 0 | 0.25 | 0 | 0 | 14.2 | 0 | 0 | 4.9 | 0 |
| dickcissel | 0 | 0 | 0.04 | 0 | 0 | 0.4 | 0 | 0 | 2.5 |
| eastern bluebird | 0.03 | 0 | 0.02 | 0.4 | 0 | 0.2 | 0.4 | 0 | 1.3 |
| eastern kingbird | 0.06 | 0 | 0.02 | 0.8 | 0 | 0.2 | 2.5 | 0 | 1.7 |
| eastern meadowlark | 0.07 | 0 | 0.56 | 0.8 | 0 | 6.0 | 6.3 | 0 | 43.3 |
| eastern phoebe | <0.01 | 0 | <0.01 | 0.1 | 0 | <0.1 | 0.8 | 0 | 0.4 |
| eastern towhee | 0 | 0 | <0.01 | 0 | 0 | <0.1 | 0 | 0 | 0.4 |
| European starling | 2.13 | 0.29 | 0.86 | 25.7 | 16.4 | 9.2 | 12.6 | 3.9 | 16.0 |
| field sparrow | <0.01 | 0 | 0 | <0.1 | 0 | 0 | 0.4 | 0 | 0 |
| gray catbird | <0.01 | 0 | <0.01 | <0.1 | 0 | <0.1 | 0.4 | 0 | 0.4 |
| horned lark | 0.30 | 0.44 | 0.53 | 3.7 | 24.6 | 5.6 | 10.1 | 16.7 | 37.0 |
| house sparrow | 0.40 | 0.18 | 0.40 | 4.8 | 9.8 | 4.3 | 8.8 | 2.0 | 8.8 |
| house wren | 0 | 0 | <0.01 | 0 | 0 | <0.1 | 0 | 0 | 0.4 |

**Table 5b. Mean bird use (number of birds/100-m plot/20-minute survey), percent of total composition (%), and frequency of occurrence (%) for each small bird type and species by season during the fixed-point bird use surveys at the Bishop Hill Wind Project, August 18, 2009 – May 25, 2010.**

| | Mean Use | | | % Composition | | | % Frequency | | |
|---|---|---|---|---|---|---|---|---|---|
| **Bird Type/Species** | **Fall** | **Winter** | **Spring** | **Fall** | **Winter** | **Spring** | **Fall** | **Winter** | **Spring** |
| indigo bunting | 0.05 | 0 | 0.03 | 0.7 | 0 | 0.4 | 4.6 | 0 | 3.4 |
| Lapland longspur | 0.13 | 0.27 | 0.11 | 1.6 | 15.3 | 1.1 | 1.3 | 5.9 | 0.8 |
| loggerhead shrike | 0 | 0 | 0.01 | 0 | 0 | 0.1 | 0 | 0 | 1.3 |
| northern cardinal | 0.03 | 0.05 | 0.03 | 0.3 | 2.7 | 0.4 | 2.5 | 2.0 | 3.4 |
| northern rough-winged swallow | 0.02 | 0 | 0 | 0.2 | 0 | 0 | 0.4 | 0 | 0 |
| red-winged blackbird | 0.50 | 0 | 2.79 | 6.0 | 0 | 29.8 | 8.0 | 0 | 63.4 |
| savannah sparrow | <0.01 | 0 | <0.01 | 0.1 | 0 | <0.1 | 0.8 | 0 | 0.4 |
| snow bunting | 0 | 0.05 | 0 | 0 | 2.7 | 0 | 0 | 1.0 | 0 |
| song sparrow | 0.03 | 0 | 0.12 | 0.4 | 0 | 1.3 | 3.4 | 0 | 9.2 |
| tree swallow | 0.21 | 0 | 0.05 | 2.5 | 0 | 0.5 | 1.7 | 0 | 2.9 |
| unidentified blackbird | 0.02 | 0 | 0 | 0.3 | 0 | 0 | 0.4 | 0 | 0 |
| unidentified passerine | 0.07 | 0 | 0 | 0.9 | 0 | 0 | 1.7 | 0 | 0 |
| unidentified sparrow | 0.03 | 0 | 0 | 0.4 | 0 | 0 | 2.1 | 0 | 0 |
| unidentified swallow | 0.04 | 0 | 0 | 0.5 | 0 | 0 | 0.4 | 0 | 0 |
| vesper sparrow | 0.03 | 0 | 0.12 | 0.4 | 0 | 1.3 | 2.5 | 0 | 10.5 |
| western meadowlark | 0 | 0 | <0.01 | 0 | 0 | <0.1 | 0 | 0 | 0.4 |
| white-throated sparrow | <0.01 | 0 | 0 | 0.1 | 0 | 0 | 0.4 | 0 | 0 |
| **Swifts/Hummingbirds** | **<0.01** | **0** | **0.06** | **<0.1** | **0** | **0.7** | **0.4** | **0** | **4.2** |
| chimney swift | <0.01 | 0 | 0.06 | <0.1 | 0 | 0.7 | 0.4 | 0 | 4.2 |
| **Woodpeckers** | **<0.01** | **0** | **0.02** | **0.1** | **0** | **0.2** | **0.4** | **0** | **2.1** |
| downy woodpecker | <0.01 | 0 | 0 | <0.1 | 0 | 0 | 0.4 | 0 | 0 |
| northern flicker | 0 | 0 | 0.01 | 0 | 0 | 0.1 | 0 | 0 | 1.3 |
| red-headed woodpecker | <0.01 | 0 | <0.01 | <0.1 | 0 | <0.1 | 0.4 | 0 | 0.8 |
| **Overall** | **8.27** | **1.79** | **9.36** | **100** | **100** | **100** | | | |

**Table 6. Flight height characteristics by bird type during fixed-point bird use surveys at the Bishop Hill Wind Project, August 18, 2009 – May 25, 2010. Large bird observations were limited to within 800 meters (m) and small birds were limited to within 100 m.**

| Bird Type | # Groups Flying | # Obs Flying | Mean Flight Height (m) | % Obs Flying | % within Flight Height Categories | | |
|---|---|---|---|---|---|---|---|
| | | | | | 0 - 35 m | 35 - 130 m[a] | > 130 m |
| Waterbirds | 5 | 5 | 16.60 | 100 | 100 | 0 | 0 |
| Waterfowl | 18 | 670 | 126.72 | 98.7 | 9.1 | 9.9 | 81.0 |
| Shorebirds | 60 | 145 | 14.12 | 73.2 | 96.6 | 2.1 | 1.4 |
| Raptors | 71 | 76 | 45.15 | 89.4 | 72.4 | 15.8 | 11.8 |
| *Accipiters* | *5* | *5* | *18.80* | *100* | *80.0* | *20.0* | *0* |
| *Buteos* | *40* | *42* | *67.67* | *95.5* | *57.1* | *21.4* | *21.4* |
| *Northern Harrier* | *7* | *7* | *22.57* | *100* | *85.7* | *14.3* | *0* |
| *Eagles* | *1* | *1* | *60.00* | *100* | *0* | *100* | *0* |
| *Falcons* | *18* | *21* | *10.39* | *75.0* | *100* | *0* | *0* |
| Owls | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vultures | 37 | 56 | 113.54 | 100 | 16.1 | 58.9 | 25.0 |
| Upland Game Birds | 3 | 3 | 1.00 | 9.1 | 100 | 0 | 0 |
| Doves/Pigeons | 47 | 76 | 9.28 | 81.7 | 97.4 | 2.6 | 0 |
| Large Corvids | 26 | 47 | 21.19 | 72.3 | 72.3 | 27.7 | 0 |
| **Large Birds Overall** | **267** | **1,078** | **43.48** | **88.7** | **35.3** | **12.0** | **52.7** |
| Passerines | 958 | 3,544 | 8.27 | 85.7 | 91.9 | 8.1 | 0 |
| Swifts/Hummingbirds | 7 | 11 | 25.57 | 78.6 | 81.8 | 18.2 | 0 |
| Woodpeckers | 4 | 4 | 6.75 | 57.1 | 100 | 0 | 0 |
| **Small Birds Overall** | **969** | **3,559** | **8.39** | **85.6** | **91.9** | **8.1** | **0** |

[a] the likely rotor-swept height (RSH),, or 115 - 427 ft (35-130 m) above ground level (AGL) for potential collision with a turbine blade.

**Table 7a. Relative exposure index and flight characteristics for large bird species during the fixed-point bird use surveys at the Bishop Hill Wind Project, August 18, 2009 – May 25, 2010.**

| Species | # Groups Flying | Overall Mean Use | % Flying | % Flying within RSH[a] based on initial obs | Exposure Index | % Within RSH[a] at anytime |
|---|---|---|---|---|---|---|
| Canada goose | 16 | 0.21 | 94.3 | 44.6 | 0.09 | 45.9 |
| turkey vulture | 37 | 0.08 | 100 | 58.9 | 0.05 | 67.9 |
| American crow | 26 | 0.12 | 72.3 | 27.7 | 0.02 | 27.7 |
| red-tailed hawk | 40 | 0.07 | 95.5 | 21.4 | 0.02 | 23.8 |
| killdeer | 60 | 0.27 | 75.1 | 2.1 | <0.01 | 2.8 |
| rock pigeon | 8 | 0.04 | 71.4 | 13.3 | <0.01 | 13.3 |
| northern harrier | 7 | <0.01 | 100 | 14.3 | <0.01 | 14.3 |
| Cooper's hawk | 5 | <0.01 | 100 | 20.0 | <0.01 | 20.0 |
| bald eagle | 1 | <0.01 | 100 | 100 | <0.01 | 100 |
| snow goose | 1 | 0.67 | 100 | 0 | 0 | 0 |
| mourning dove | 39 | 0.11 | 84.7 | 0 | 0 | 0 |
| American kestrel | 18 | 0.04 | 75.0 | 0 | 0 | 4.8 |
| greater white-fronted goose | 1 | 0.03 | 100 | 0 | 0 | 0 |
| ring-necked pheasant | 2 | 0.03 | 11.1 | 0 | 0 | 0 |
| northern bobwhite | 1 | 0.02 | 8.3 | 0 | 0 | 0 |
| barred owl | 0 | <0.01 | 0 | 0 | 0 | 0 |
| great blue heron | 4 | <0.01 | 100 | 0 | 0 | 0 |
| lesser yellowlegs | 0 | <0.01 | 0 | 0 | 0 | 0 |
| wild turkey | 0 | <0.01 | 0 | 0 | 0 | 0 |
| upland sandpiper | 0 | <0.01 | 0 | 0 | 0 | 0 |
| great egret | 1 | <0.01 | 100 | 0 | 0 | 100 |

[a] RSH = the likely rotor-swept height for potential collision with a turbine blade or 115 - 427 feet (35 - 130 meters) above ground level (AGL).

**Table 7b. Relative exposure index and flight characteristics for small bird species during the fixed-point bird use surveys at the Bishop Hill Wind Project, August 18, 2009 – May 25, 2010.**

| Species | # Groups Flying | Overall Mean Use | % Flying | % Flying within RSH[a] based on initial obs | Exposure Index | % Within RSH[a] at anytime |
|---|---|---|---|---|---|---|
| red-winged blackbird | 200 | 1.05 | 85.8 | 20.1 | 0.18 | 21.1 |
| brown-headed cowbird | 104 | 0.49 | 94.2 | 18.5 | 0.09 | 18.5 |
| European starling | 78 | 1.06 | 95.1 | 4.6 | 0.05 | 4.6 |
| barn swallow | 80 | 0.31 | 99.5 | 11.5 | 0.04 | 12.5 |
| common grackle | 83 | 0.79 | 99.7 | 3.3 | 0.03 | 3.3 |
| unidentified swallow | 1 | 0.01 | 100 | 100 | 0.01 | 100 |
| unidentified passerine | 4 | 0.02 | 100 | 58.8 | 0.01 | 58.8 |
| American goldfinch | 70 | 0.28 | 73.4 | 4.7 | <0.01 | 4.7 |
| chimney swift | 7 | 0.02 | 78.6 | 18.2 | <0.01 | 18.2 |
| horned lark | 52 | 0.42 | 58.8 | 0 | 0 | 0 |
| house sparrow | 39 | 0.32 | 92.2 | 0 | 0 | 0 |
| American robin | 78 | 0.31 | 75.8 | 0 | 0 | 0 |
| eastern meadowlark | 34 | 0.20 | 27.2 | 0 | 0 | 0 |
| Lapland longspur | 9 | 0.17 | 95.2 | 0 | 0 | 0 |
| cliff swallow | 15 | 0.11 | 100 | 0 | 0 | 37.0 |
| dark-eyed junco | 4 | 0.09 | 96.2 | 0 | 0 | 0 |
| blue jay | 11 | 0.08 | 79.2 | 0 | 0 | 0 |
| tree swallow | 11 | 0.08 | 100 | 0 | 0 | 0 |
| American tree sparrow | 2 | 0.08 | 55.0 | 0 | 0 | 0 |
| song sparrow | 8 | 0.05 | 31.2 | 0 | 0 | 0 |
| vesper sparrow | 17 | 0.05 | 58.8 | 0 | 0 | 0 |
| chipping sparrow | 10 | 0.04 | 64.5 | 0 | 0 | 0 |
| northern cardinal | 8 | 0.04 | 52.6 | 0 | 0 | 0 |
| indigo bunting | 6 | 0.03 | 35.3 | 0 | 0 | 0 |
| eastern kingbird | 8 | 0.03 | 66.7 | 0 | 0 | 0 |
| snow bunting | 1 | 0.02 | 100 | 0 | 0 | 0 |
| eastern bluebird | 3 | 0.02 | 91.7 | 0 | 0 | 0 |

**Table 7b. Relative exposure index and flight characteristics for small bird species during the fixed-point bird use surveys at the Bishop Hill Wind Project, August 18, 2009 – May 25, 2010.**

| Species | # Groups Flying | Overall Mean Use | % Flying | % Flying within RSH[a] based on initial obs | Exposure Index | % Within RSH[a] at anytime |
|---|---|---|---|---|---|---|
| dickcissel | 1 | 0.01 | 20.0 | 0 | 0 | 0 |
| brown thrasher | 3 | 0.01 | 42.9 | 0 | 0 | 0 |
| unidentified sparrow | 4 | 0.01 | 87.5 | 0 | 0 | 0 |
| cedar waxwing | 2 | <0.01 | 100 | 0 | 0 | 0 |
| common yellowthroat | 0 | <0.01 | 0 | 0 | 0 | 0 |
| unidentified blackbird | 1 | <0.01 | 100 | 0 | 0 | 0 |
| blue-gray gnatcatcher | 0 | <0.01 | 0 | 0 | 0 | 0 |
| northern rough-winged swallow | 1 | <0.01 | 100 | 0 | 0 | 0 |
| eastern phoebe | 2 | <0.01 | 66.7 | 0 | 0 | 0 |
| loggerhead shrike | 2 | <0.01 | 100 | 0 | 0 | 0 |
| northern flicker | 2 | <0.01 | 66.7 | 0 | 0 | 0 |
| red-headed woodpecker | 2 | <0.01 | 66.7 | 0 | 0 | 0 |
| savannah sparrow | 2 | <0.01 | 66.7 | 0 | 0 | 0 |
| gray catbird | 1 | <0.01 | 50.0 | 0 | 0 | 0 |
| white-throated sparrow | 1 | <0.01 | 100 | 0 | 0 | 0 |
| downy woodpecker | 0 | <0.01 | 0 | 0 | 0 | 0 |
| eastern towhee | 1 | <0.01 | 100 | 0 | 0 | 0 |
| field sparrow | 0 | <0.01 | 0 | 0 | 0 | 0 |
| house wren | 0 | <0.01 | 0 | 0 | 0 | 0 |
| western meadowlark | 1 | <0.01 | 100 | 0 | 0 | 0 |

[a] RSH = the likely rotor-swept height for potential collision with a turbine blade, or 115 - 427 ft (35 - 130 m) above ground level (AGL).

**Table 8. Paired t-test results comparing bird use by visit for stations outside of the 1-mile buffer versus areas within the 1-mile buffer of the South Edwards River. Negative differences in means represent higher use rates within the 1-mile buffer of the South Edwards River. A p-value of more than 0.10 was not considered significant.**

| Bird Type | Season | Average of the mean difference (outside-inside) | Sample size (*n*) | Test statistic | p-value |
|---|---|---|---|---|---|
| Raptors | Fall | -0.093 | 7 | -0.969 | 0.370 |
| | Winter | < 0.001 | 3 | 0.003 | 0.998 |
| | Spring | -0.017 | 7 | -0.365 | 0.728 |
| | Overall | -0.045 | 17 | -1.019 | 0.323 |
| Large Birds | Fall | -0.050 | 7 | -0.718 | 0.500 |
| | Winter | -0.009 | 3 | -0.851 | 0.485 |
| | Spring | 0.277 | 7 | 0.990 | 0.361 |
| | Overall | 0.092 | 17 | 0.769 | 0.453 |
| Small Birds | Fall | 1.860 | 7 | 1.469 | 0.192 |
| | Winter | -0.796 | 3 | -0.441 | 0.702 |
| | Spring | -0.941 | 7 | -0.647 | 0.541 |
| | Overall | 0.238 | 17 | 0.272 | 0.789 |
| Waterfowl | Fall | 0.389 | 7 | 1.890 | 0.108 |
| | Winter | 0 | 3 | NA | NA |
| | Spring | 3.104 | 7 | 0.971 | 0.369 |
| | Overall | 1.438 | 17 | 1.101 | 0.287 |
| Shorebirds | Fall | -0.764 | 7 | -0.802 | 0.453 |
| | Winter | 0 | 3 | NA | NA |
| | Spring | -0.029 | 7 | -0.221 | 0.832 |
| | Overall | -0.327 | 17 | -0.840 | 0.413 |

**Table 9. Summary of sensitive species observed at the Bishop Hill Wind Project during fixed-point bird use surveys (FP), breeding songbird survey (BSS), and as incidental wildlife observations (Inc.), August 18, 2009 – June 15, 2010.**

| | | | FP | | BSS | | Inc. | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Species** | **Scientific Name** | **Status** | **# of grps** | **# of obs** | **# of grps** | **# of obs** | **# of grps** | **# of obs** | **# of grps** | **# of obs** |
| upland sandpiper | *Bartramia longicauda* | SE | 2 | 2 | 17 | 19 | 4 | 4 | 23 | 25 |
| northern harrier | *Circus cyaneus* | SE | 7 | 7 | 0 | 0 | 4 | 5 | 11 | 12 |
| loggerhead shrike | *Lanius ludovicianus* | SE | 2 | 2 | 0 | 0 | 1 | 1 | 3 | 3 |
| bald eagle | *Haliaeetus leucocephalus* | EA | 1 | 1 | 0 | 0 | 1 | 1 | 2 | 2 |
| common moorhen | *Gallinula chloropus* | SE | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| **Total** | **7 species** | | **12** | **12** | **18** | **20** | **10** | **11** | **40** | **43** |

SE = state endangered (ILDNR 2009);
EA = federal Bald and Golden Eagle Protection Act (BGEPA 1940; MSU 1990).

**Table 10. Summary of overall bird use (number of birds/plot/five-minute survey), species richness (species/five-minute survey), and sample size during the breeding songbird surveys in the Bishop Hill Wind Project, May 26 – June 15, 2010.**

| Season | # of Visits | Mean Use | # Species /Survey | # of Species | # Surveys Conducted |
|---|---|---|---|---|---|
| Summer | 3 | 11.76 | 5.79 | 73 | 460 |

**Table 11. Total number of groups (# grps) and individuals (# obs) for each bird type and species during summer breeding songbird surveys in the Bishop Hill Wind Project, May 26 – June 15, 2010.**

| Bird Type/Species | Scientific Name | # grps | # obs |
|---|---|---|---|
| **Waterbirds** | | **5** | **5** |
| great blue heron | *Ardea herodias* | 4 | 4 |
| green heron | *Butorides virescens* | 1 | 1 |
| **Waterfowl** | | **10** | **168** |
| Canada goose | *Branta canadensis* | 5 | 160 |
| mallard | *Anas platyrhynchos* | 5 | 8 |
| **Shorebirds** | | **140** | **220** |
| killdeer | *Charadrius vociferus* | 123 | 201 |
| upland sandpiper | *Bartramia longicauda* | 17 | 19 |
| **Rails/Coots** | | **1** | **1** |
| common moorhen | *Gallinula chloropus* | 1 | 1 |
| **Raptors** | | **12** | **15** |
| American kestrel | *Falco sparverius* | 2 | 2 |
| Cooper's hawk | *Accipiter cooperii* | 2 | 2 |
| red-tailed hawk | *Buteo jamaicensis* | 8 | 11 |
| **Vultures** | | **3** | **3** |
| turkey vulture | *Cathartes aura* | 3 | 3 |
| **Upland Game Birds** | | **85** | **88** |
| northern bobwhite | *Colinus virginianus* | 66 | 67 |
| ring-necked pheasant | *Phasianus colchicus* | 18 | 20 |
| wild turkey | *Meleagris gallopavo* | 1 | 1 |
| **Doves/Pigeons** | | **73** | **94** |
| mourning dove | *Zenaida macroura* | 73 | 94 |
| **Passerines** | | **3,245** | **4,761** |
| *Blackbirds/Orioles* | | *1,636* | *2,752* |
| Baltimore oriole | *Icterus galbula* | 8 | 9 |
| bobolink | *Dolichonyx oryzivorus* | 14 | 20 |
| brown-headed cowbird | *Molothrus ater* | 164 | 263 |
| common grackle | *Quiscalus quiscula* | 116 | 227 |
| eastern meadowlark | *Sturnella magna* | 272 | 284 |
| European starling | *Sturnus vulgaris* | 17 | 62 |
| orchard oriole | *Icterus spurius* | 1 | 1 |
| red-winged blackbird | *Agelaius phoeniceus* | 1,043 | 1,885 |
| western meadowlark | *Sturnella neglecta* | 1 | 1 |
| *Creepers/Nuthatches* | | *4* | *4* |
| brown creeper | *Certhia americana* | 3 | 3 |
| white-breasted nuthatch | *Sitta carolinensis* | 1 | 1 |
| *Finches* | | *78* | *105* |
| American goldfinch | *Carduelis tristis* | 77 | 103 |
| house finch | *Carpodacus mexicanus* | 1 | 2 |

**Table 11. Total number of groups (# grps) and individuals (# obs) for each bird type and species during summer breeding songbird surveys in the Bishop Hill Wind Project, May 26 – June 15, 2010.**

| Bird Type/Species | Scientific Name | # grps | # obs |
|---|---|---|---|
| *Flycatchers* | | *89* | *104* |
| eastern kingbird | *Tyrannus tyrannus* | 44 | 57 |
| eastern phoebe | *Sayornis phoebe* | 10 | 11 |
| eastern wood-pewee | *Contopus virens* | 7 | 7 |
| great crested flycatcher | *Myiarchus crinitus* | 2 | 2 |
| willow flycatcher | *Empidonax traillii* | 26 | 27 |
| *Gnatcatchers/Kinglet* | | *1* | *1* |
| blue-gray gnatcatcher | *Polioptila caerulea* | 1 | 1 |
| *Grassland/Sparrows* | | *760* | *846* |
| chipping sparrow | *Spizella passerina* | 28 | 36 |
| dickcissel | *Spiza americana* | 292 | 330 |
| eastern towhee | *Pipilo erythrophthalmus* | 2 | 3 |
| field sparrow | *Spizella pusilla* | 6 | 6 |
| horned lark | *Eremophila alpestris* | 49 | 58 |
| house sparrow | *Passer domesticus* | 13 | 27 |
| indigo bunting | *Passerina cyanea* | 136 | 140 |
| northern cardinal | *Cardinalis cardinalis* | 46 | 49 |
| savannah sparrow | *Passerculus sandwichensis* | 3 | 3 |
| song sparrow | *Melospiza melodia* | 162 | 171 |
| vesper sparrow | *Pooecetes gramineus* | 23 | 23 |
| *Mimids* | | *74* | *79* |
| brown thrasher | *Toxostoma rufum* | 43 | 47 |
| gray catbird | *Dumetella carolinensis* | 27 | 28 |
| northern mockingbird | *Mimus polyglottos* | 4 | 4 |
| *Swallows* | | *125* | *259* |
| bank swallow | *Riparia riparia* | 1 | 6 |
| barn swallow | *Hirundo rustica* | 116 | 208 |
| cliff swallow | *Petrochelidon pyrrhonota* | 3 | 36 |
| purple martin | *Progne subis* | 1 | 1 |
| tree swallow | *Tachycineta bicolor* | 4 | 8 |
| *Tanagers/Grosbeaks/Crossbills* | | *4* | *4* |
| rose-breasted grosbeak | *Pheucticus ludovicianus* | 3 | 3 |
| scarlet tanager | *Piranga olivacea* | 1 | 1 |
| *Thrushes* | | *233* | *305* |
| American robin | *Turdus migratorius* | 232 | 304 |
| eastern bluebird | *Sialia sialis* | 1 | 1 |
| *Vireos* | | *3* | *3* |
| white-eyed vireo | *Vireo griseus* | 3 | 3 |
| *Warblers* | | *142* | *149* |
| common yellowthroat | *Geothlypis trichas* | 121 | 125 |
| Wilson's warbler | *Wilsonia pusilla* | 1 | 1 |

**Table 11. Total number of groups (# grps) and individuals (# obs) for each bird type and species during summer breeding songbird surveys in the Bishop Hill Wind Project, May 26 – June 15, 2010.**

| Bird Type/Species | Scientific Name | # grps | # obs |
|---|---|---|---|
| yellow-rumped warbler | *Dendroica coronata* | 14 | 17 |
| yellow warbler | *Dendroica petechia* | 4 | 4 |
| *Waxwings* | | *33* | *81* |
| cedar waxwing | *Bombycilla cedrorum* | 35 | 83 |
| *Wrens* | | *42* | *43* |
| Carolina wren | *Thryothorus ludovicianus* | 1 | 1 |
| house wren | *Troglodytes aedon* | 41 | 42 |
| *Corvids* | | *21* | *26* |
| American crow | *Corvus brachyrhynchos* | 2 | 2 |
| blue jay | *Cyanocitta cristata* | 19 | 24 |
| **Cuckoos** | | **1** | **1** |
| yellow-billed cuckoo | *Coccyzus americanus* | 1 | 1 |
| **Swifts/Hummingbirds** | | **24** | **36** |
| chimney swift | *Chaetura pelagica* | 24 | 36 |
| **Woodpeckers** | | **10** | **10** |
| downy woodpecker | *Picoides pubescens* | 3 | 3 |
| northern flicker | *Colaptes auratus* | 4 | 4 |
| red-bellied woodpecker | *Melanerpes carolinus* | 2 | 2 |
| red-headed woodpecker | *Melanerpes erythrocephalus* | 1 | 1 |
| **Overall** | | **3,609** | **5,402** |

**Table 12. Nesting raptor and owl species and nest density for the Bishop Hill Wind Project and within a one-mile buffer.**

| Species | # of nests within BHWP | # of nests within one-mile buffer of BHWP | Nest Density within BHWP (nests/mi$^2$) | Nest Density within one-mile buffer of BHWP (nests/mi$^2$) |
|---|---|---|---|---|
| red-tailed hawk | 8 | 8 | 0.04 | 0.03 |
| great horned owl | 2 | 3 | 0.02 | 0.01 |
| unknown/inactive | 40 | 43 | 0.22 | 0.17 |
| **Overall** | **50** | **54** | **0.28** | **0.21** |

**Table 13. Incidental wildlife observed while conducting all surveys at the Bishop Hill Wind Project; August 18, 2009 – June 15, 2010.**

| Species | Scientific Name | # grps | # obs |
|---|---|---|---|
| Canada goose | *Branta canadensis* | 6 | 56 |
| red-tailed hawk | *Buteo jamaicensis* | 38 | 40 |
| American kestrel | *Falco sparverius* | 31 | 39 |
| northern bobwhite | *Colinus virginianus* | 1 | 11 |
| northern harrier | *Circus cyaneus* | 4 | 5 |
| upland sandpiper | *Bartramia longicauda* | 4 | 4 |
| turkey vulture | *Cathartes aura* | 3 | 4 |
| great horned owl | *Bubo virginianus* | 2 | 3 |
| mallard | *Anas platyrhynchos* | 1 | 2 |
| bald eagle | *Haliaeetus leucocephalus* | 1 | 1 |
| blue grosbeak | *Guiraca caerulea* | 1 | 1 |
| great blue heron | *Ardea herodias* | 1 | 1 |
| loggerhead shrike | *Lanius ludovicianus* | 1 | 1 |
| red-headed woodpecker | *Melanerpes erythrocephalus* | 1 | 1 |
| red-winged blackbird | *Agelaius phoeniceus* | 1 | 1 |
| ring-necked pheasant | *Phasianus colchicus* | 1 | 1 |
| sharp-shinned hawk | *Accipiter striatus* | 1 | 1 |
| unidentified shrike | | 1 | 1 |
| **Bird Subtotal** | **17 species** | **99** | **173** |
| white-tailed deer | *Odocoileus virginianus* | 7 | 9 |
| thirteen-lined ground squirrel | *Spermophilus tridecemlineatus* | 7 | 7 |
| raccoon | *Procyon lotor* | 3 | 3 |
| coyote | *Canis latrans* | 1 | 1 |
| striped skunk | *Mephitis mephitis* | 1 | 1 |
| Virginia opossum | *Didelphis virginiana* | 1 | 1 |
| woodchuck | *Marmota monax* | 1 | 1 |
| **Mammal Subtotal** | **7 species** | **21** | **22** |
| eastern garter snake | *Thamnophis sirtalis* | 2 | 2 |
| **Reptile Subtotal** | **1 species** | **2** | **2** |
| **Total** | **26 species** | **122** | **198** |

**Table 14. Comparison of seasonal raptor use at other wind-energy facilities in the Midwestern region to the Bishop Hill Wind Project.**

| | Raptor Use (# raptors/plot/20-min survey) | | | | |
|---|---|---|---|---|---|
| **Site** | **Fall** | **Winter** | **Spring** | **Summer** | **Reference** |
| Bishop Hill, IL | 0.20 | 0.08 | 0.13 | - | This study |
| Buffalo Ridge, MN | 0.78 | 0.22 | 0.64 | 0.60 | Johnson et al. 2000a |
| Black Fork, OH | 0.13 | - | 0.26 | - | Ecology and Environment 2009 |
| Grand Ridge, IL | 0.20 | 0.10 | 0.32 | - | Derby et al. 2009 |
| Buckeye Wind, OH | 0.11 | - | 0.20 | - | Stantec 2009 |

**Table 15. Avian mortality associated with other wind-energy facilities in the Midwestern region.**

| Location | Per Megawatt Mortality Estimates | Source |
|---|---|---|
| Worth County, IA | 0.7 | Jain 2005 |
| Buffalo Ridge, MN | 3.4 | Johnson et al. 2000a, 2002b |
| Bureau County, IL | 0.6 | Kerlinger et al. 2007 |
| Kewaunee County, WI | 2.0 | Howe et al. 2002 |
| Cedar Ridge, WI | 6.55 | BHE Environmental 2009 |
| Fond du Lac County, WI | 7.17 | Gruver et al. 2009 |
| **Mean** | **3.5** | |

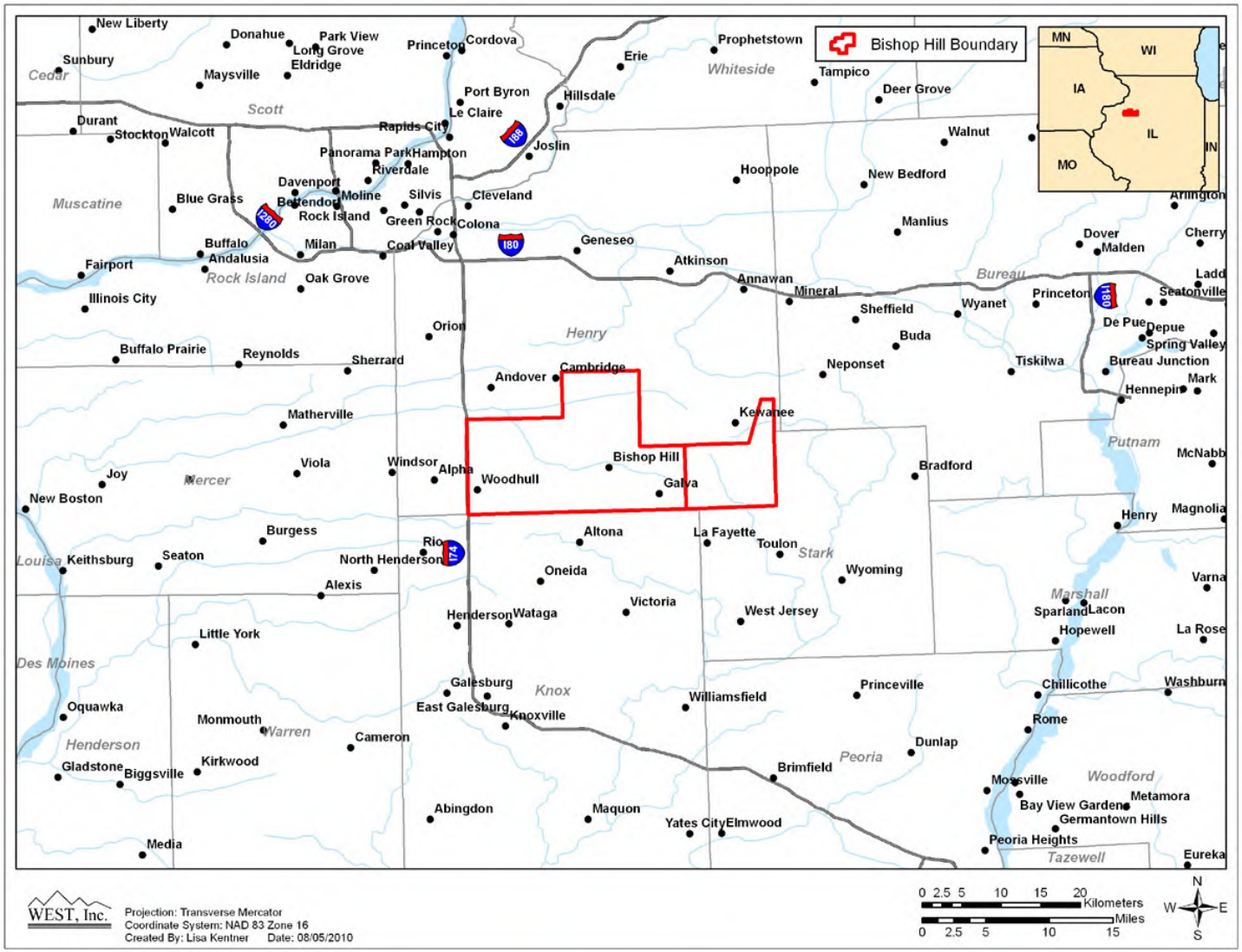


**Figure 1. Location of the Bishop Hill Wind Project.**

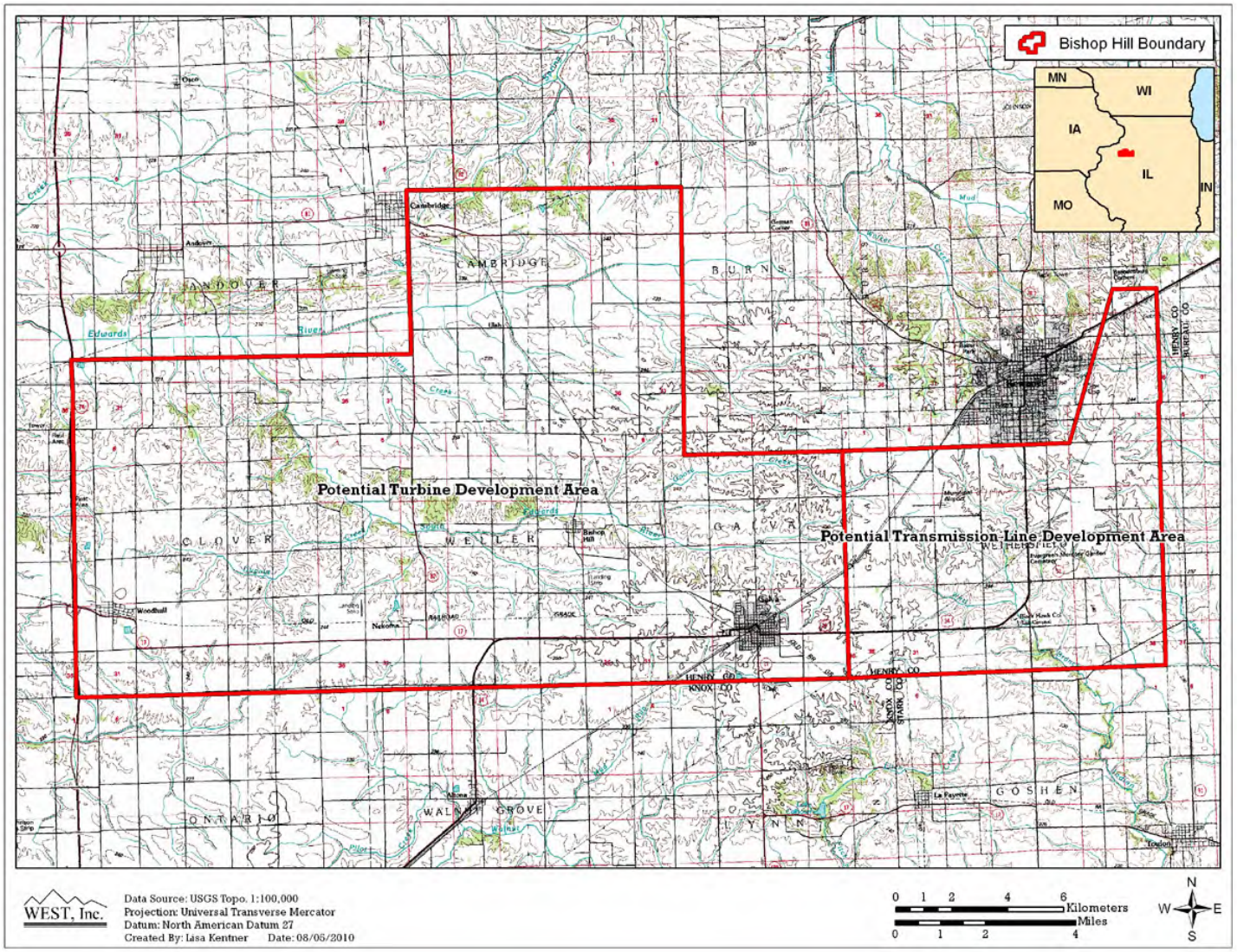


**Figure 2. Overview of the Bishop Hill Wind Project.**

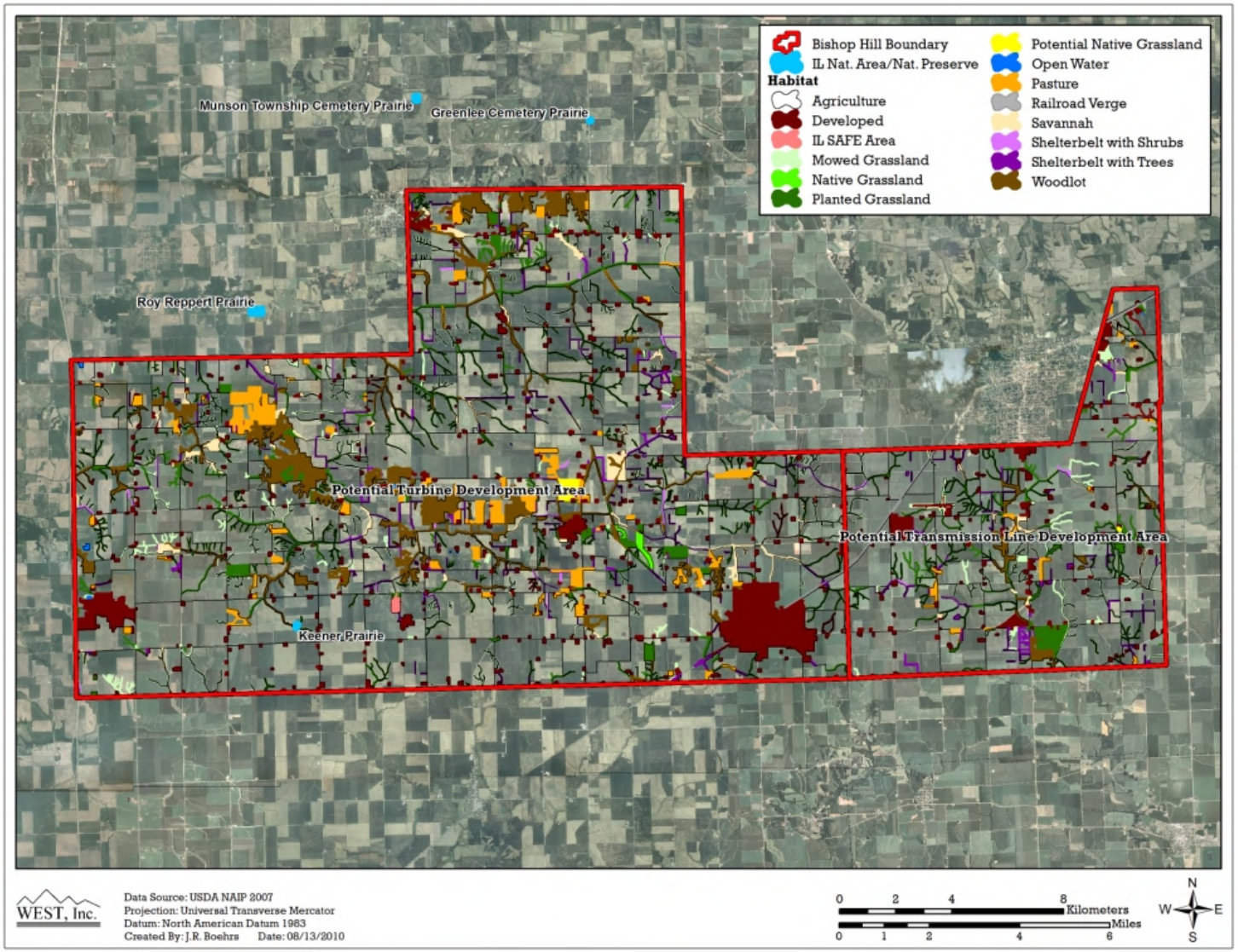


**Figure 3. The land cover types and coverage within the Bishop Hill Wind Project.**

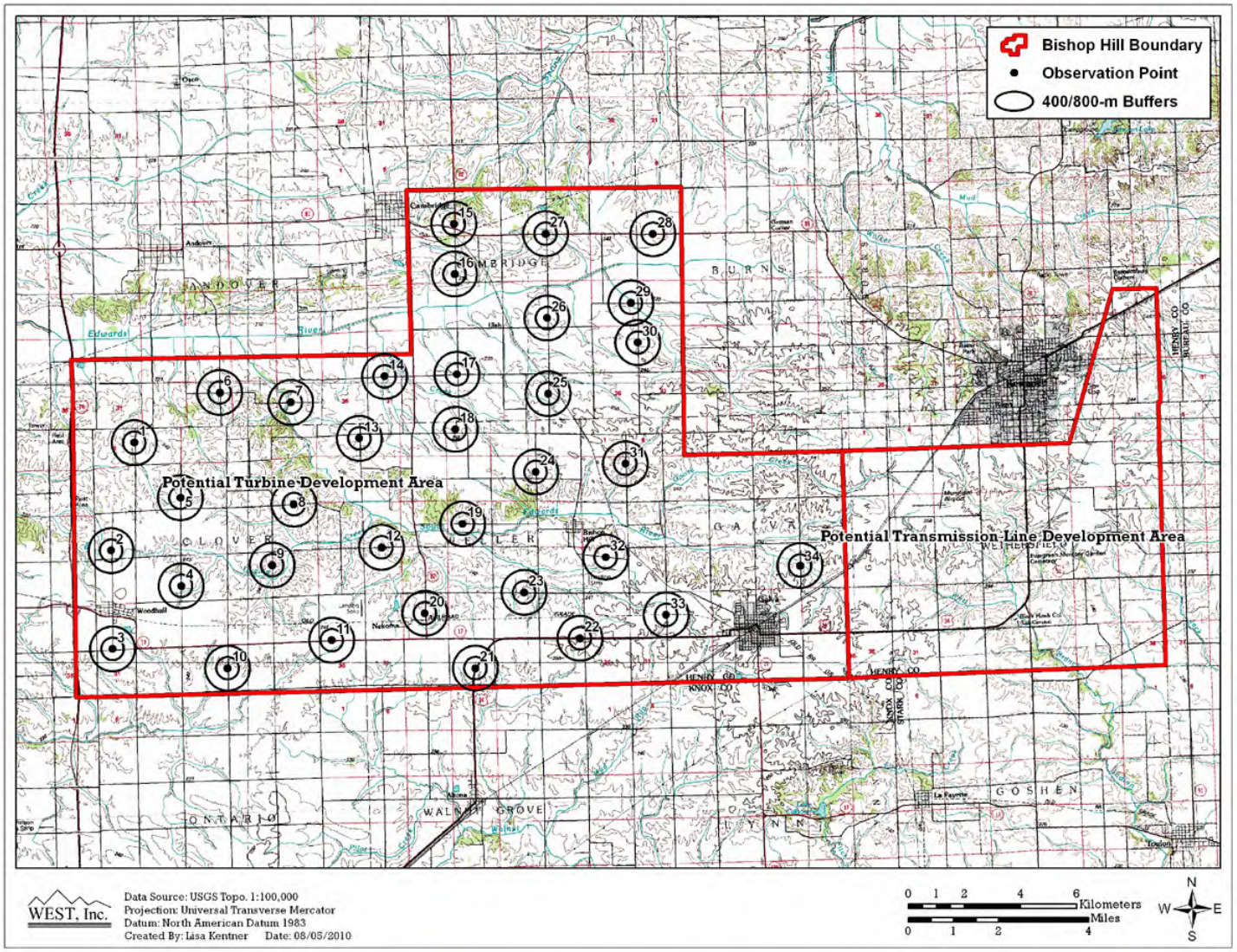


**Figure 4. Fixed-point bird use points at the Bishop Hill Wind Project.**

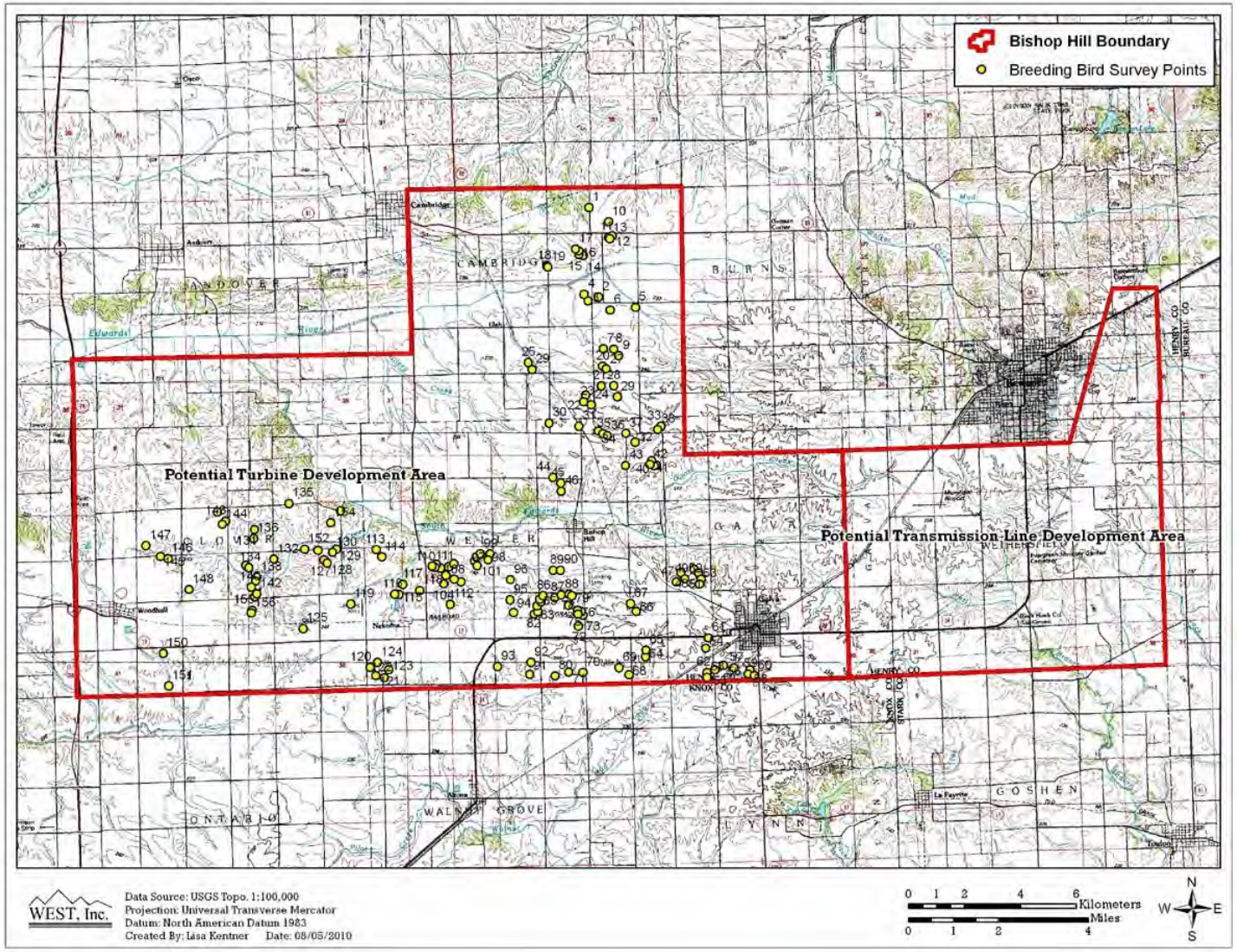


**Figure 5. Breeding songbird points at the Bishop Hill Wind Project.**

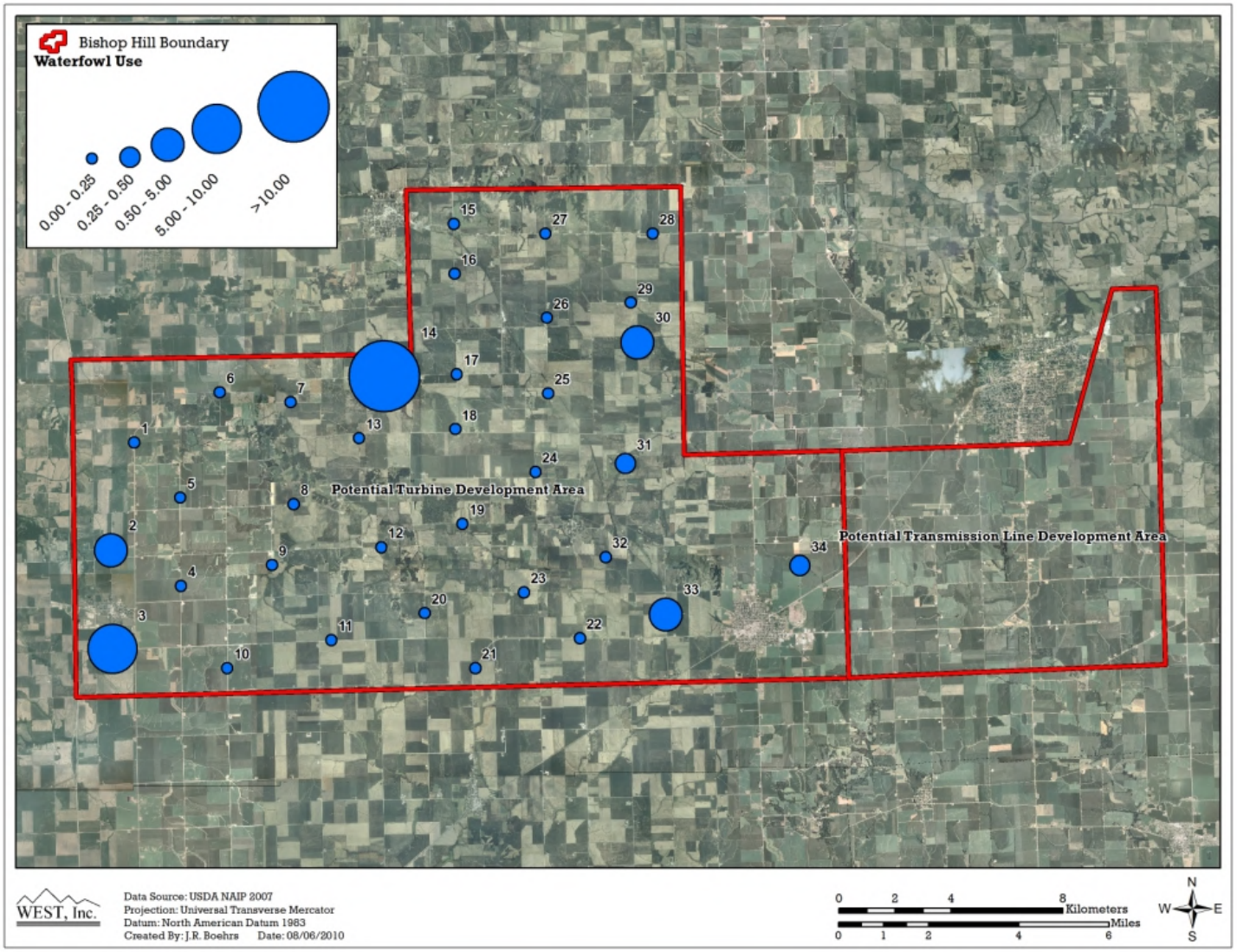


**Figure 6a. Waterfowl use during the fixed-point bird use surveys at the Bishop Hill Wind Project.**

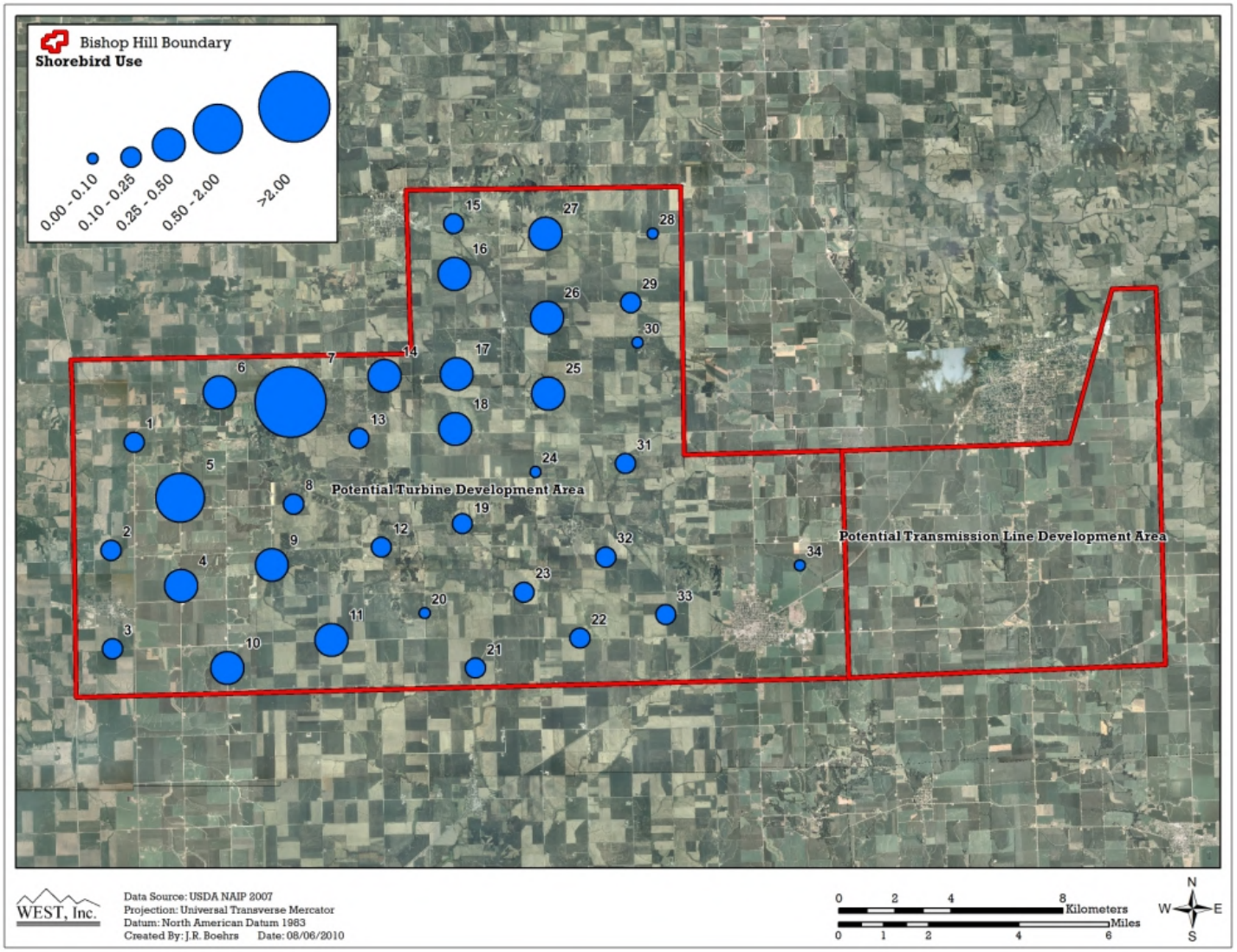


**Figure 6b. Shorebird use during the fixed-point bird use surveys at the Bishop Hill Wind Project.**

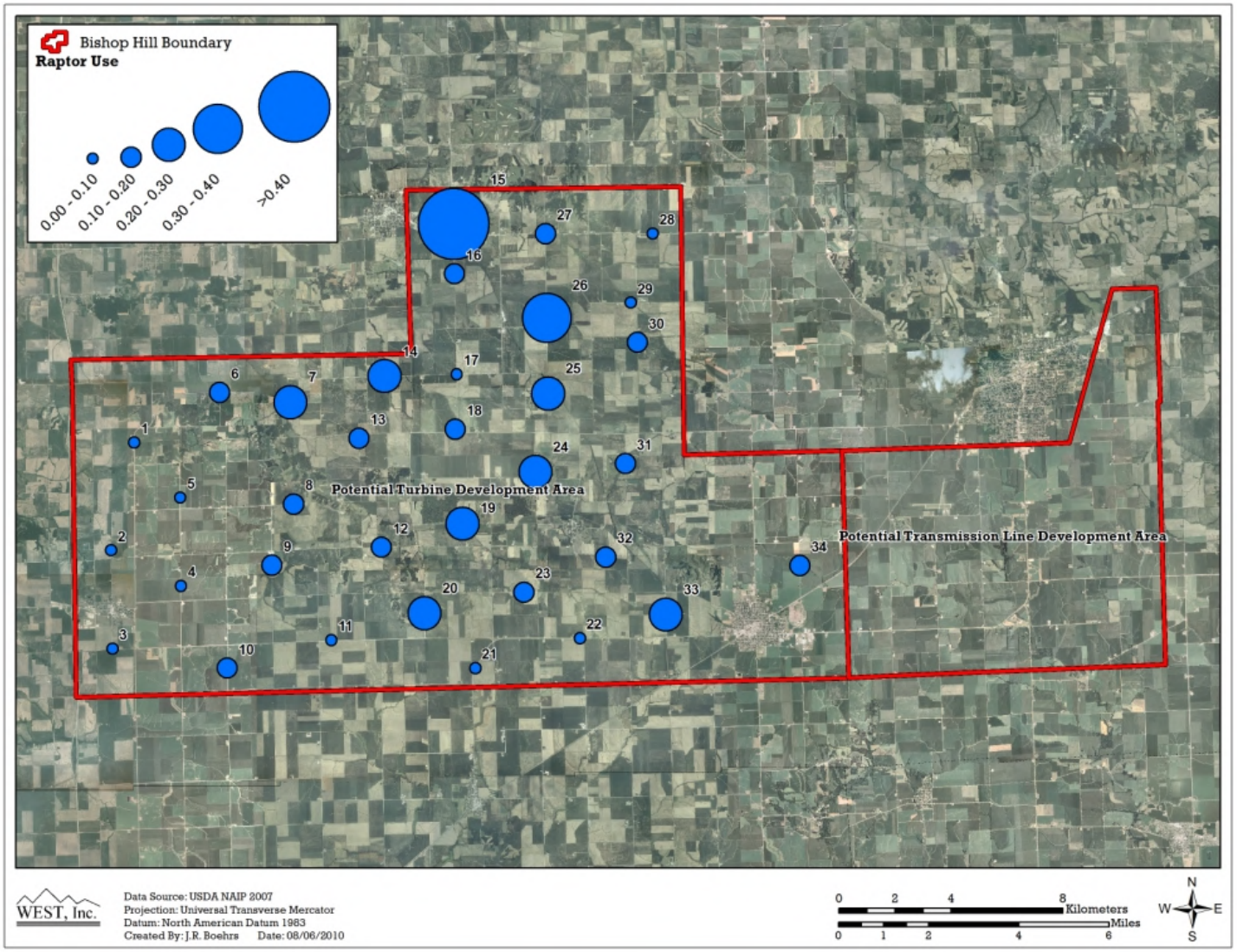


**Figure 6c. Raptor use during the fixed-point bird use surveys at the Bishop Hill Wind Project.**

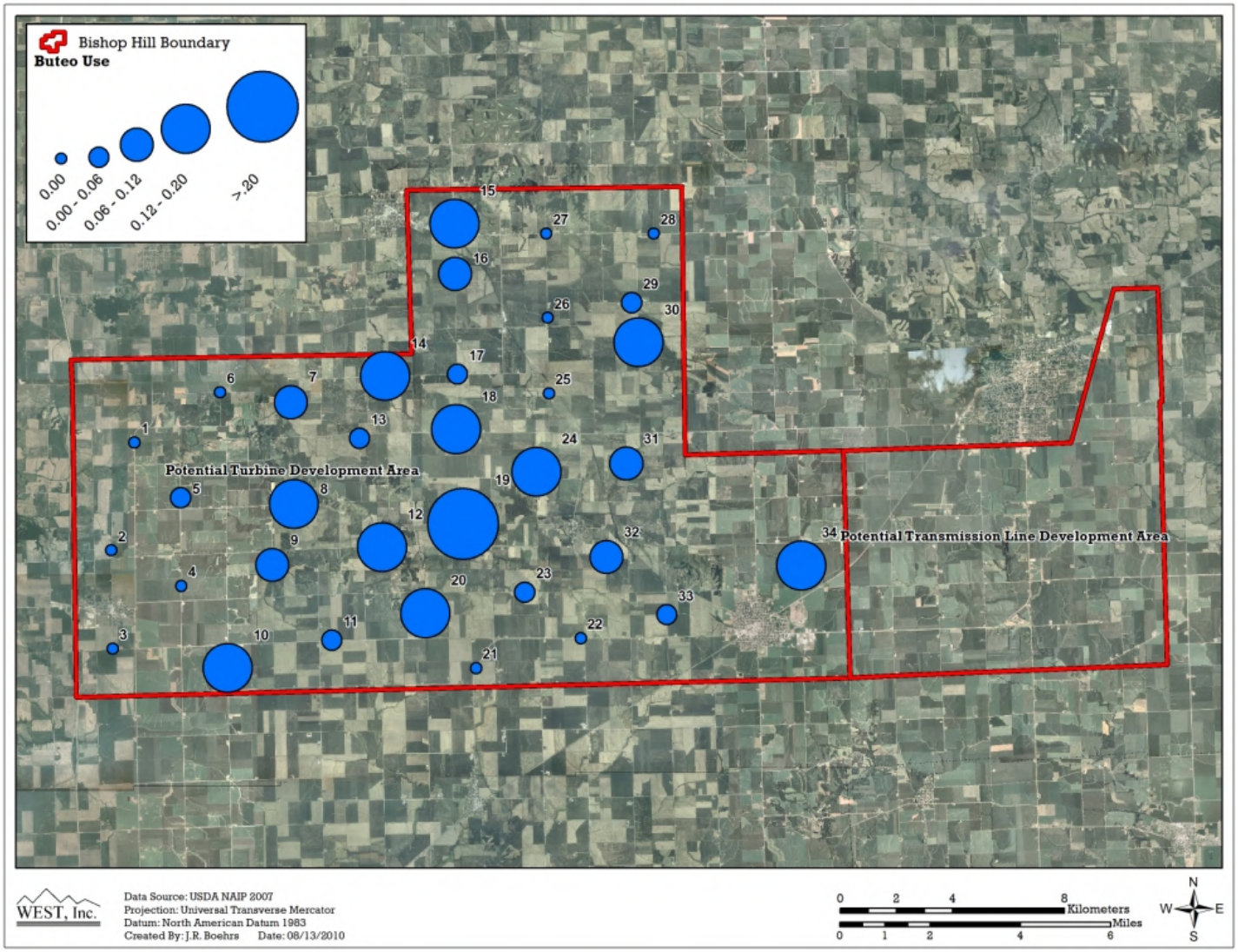


**Figure 6d. Buteo use during the fixed-point bird use surveys at the Bishop Hill Wind Project.**

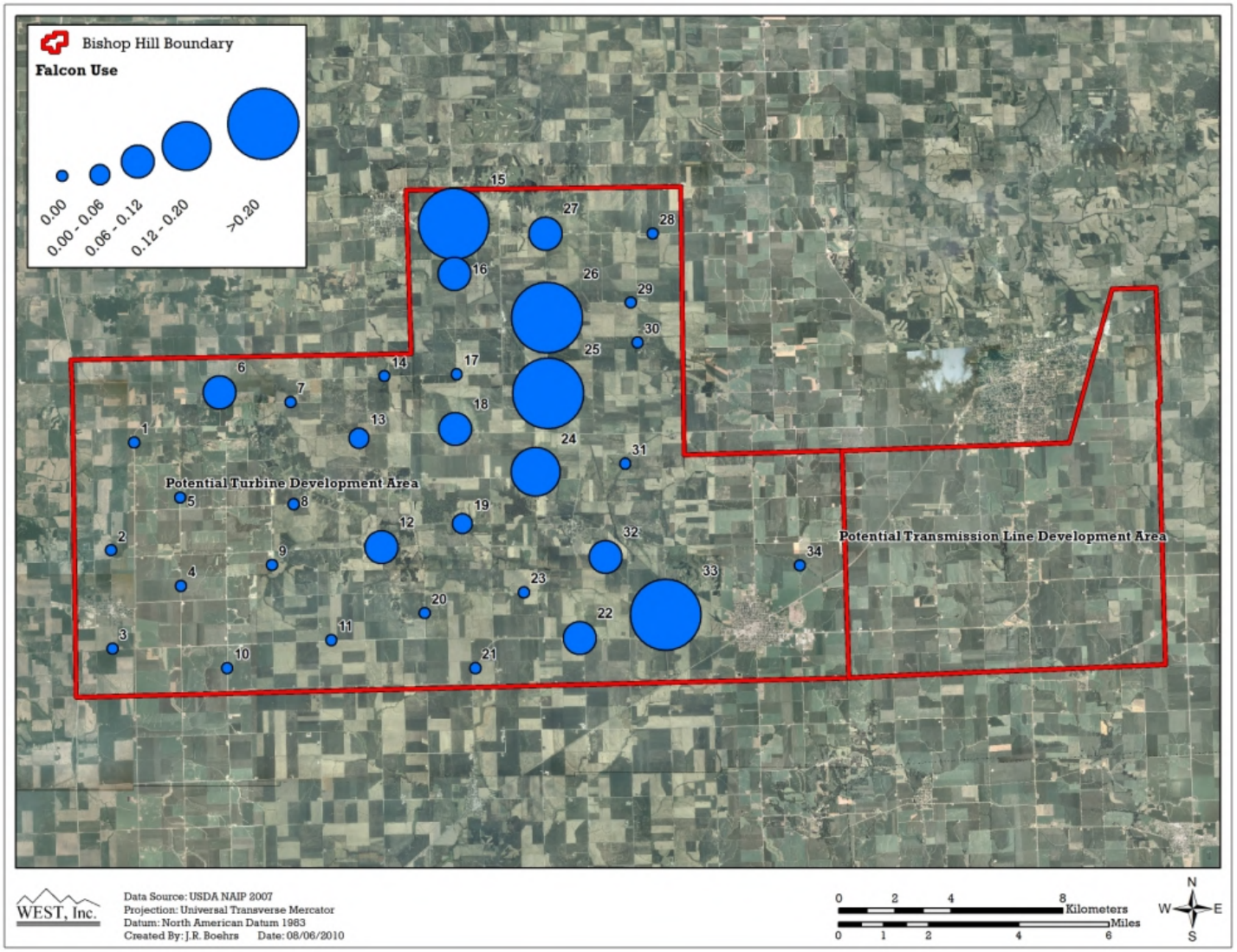


**Figure 6e. Falcon use during the fixed-point bird use surveys at the Bishop Hill Wind Project.**

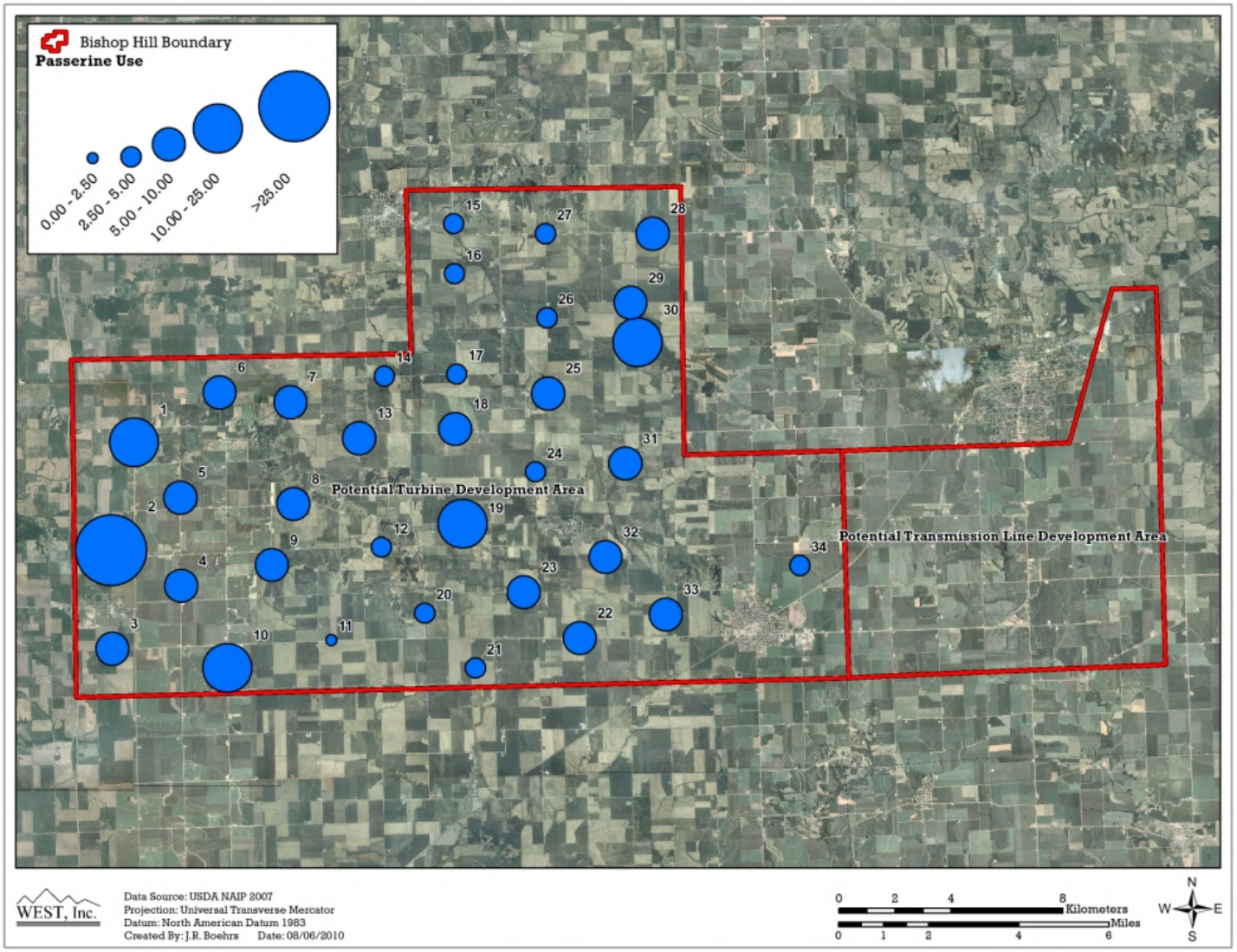


**Figure 6f. Passerine use during the fixed-point bird use surveys at the Bishop Hill Wind Project.**

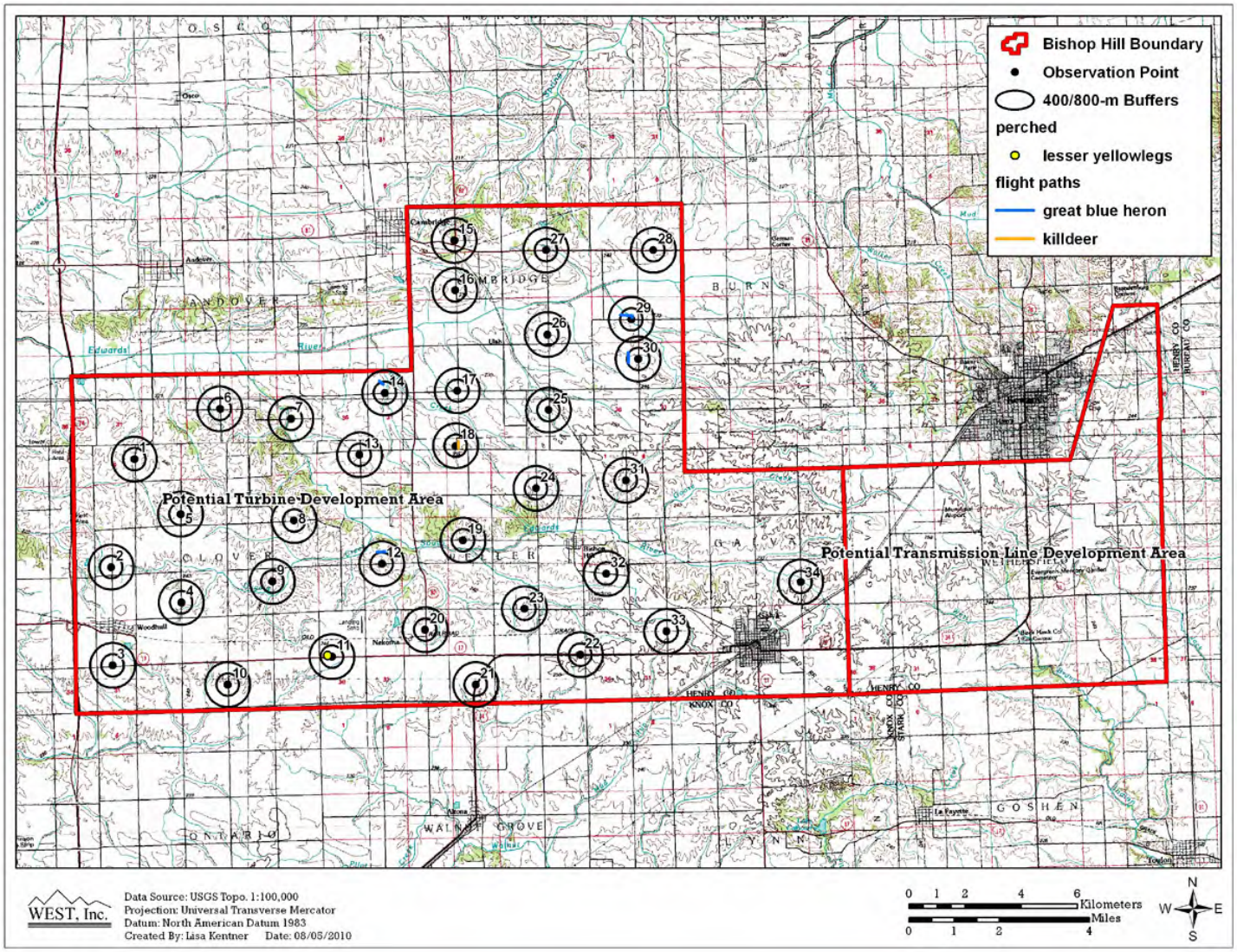


**Figure 7a. Flight paths of waterbirds and shorebirds at the Bishop Hill Wind Project.**

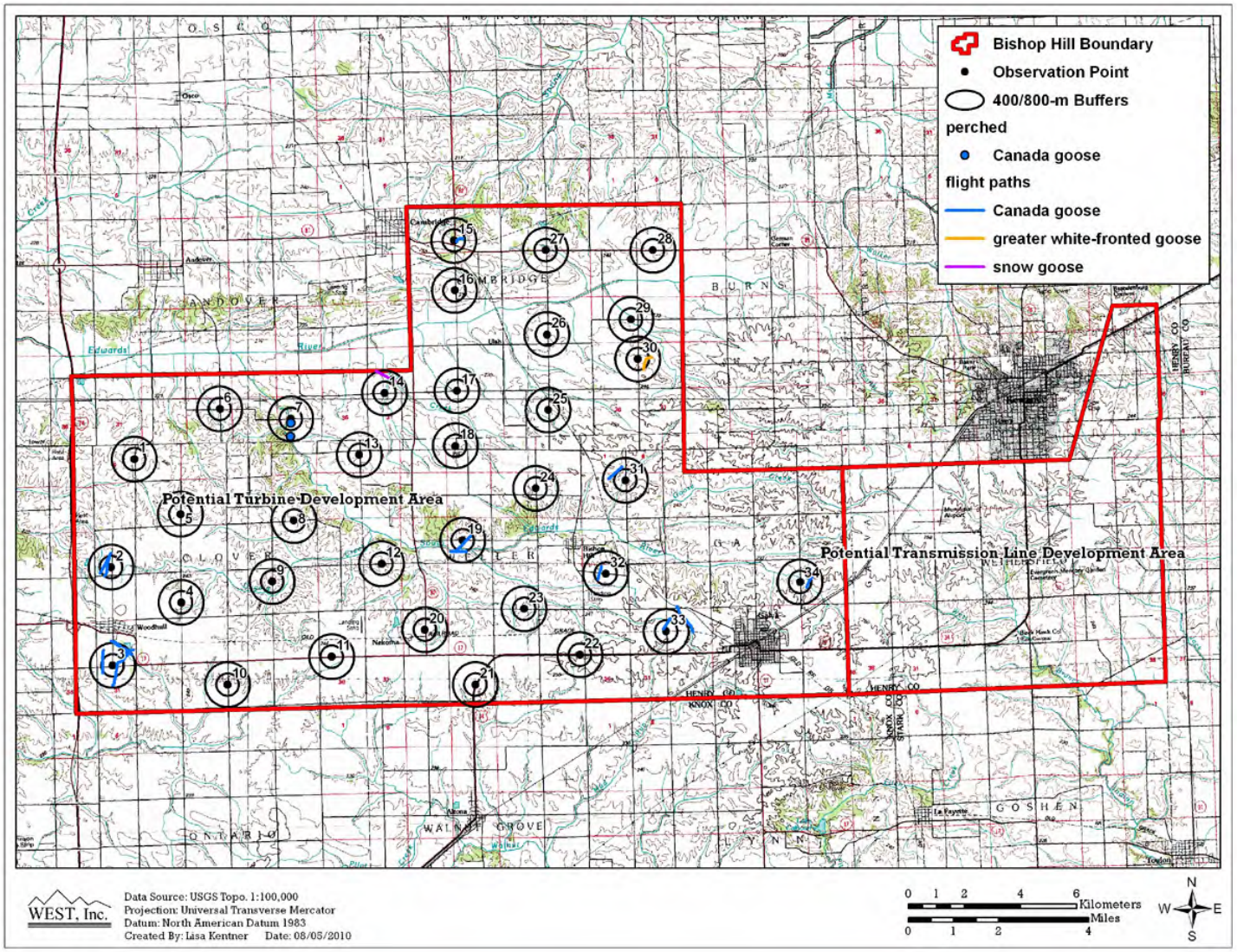


**Figure 7b. Flight paths of waterfowl at the Bishop Hill Wind Project.**

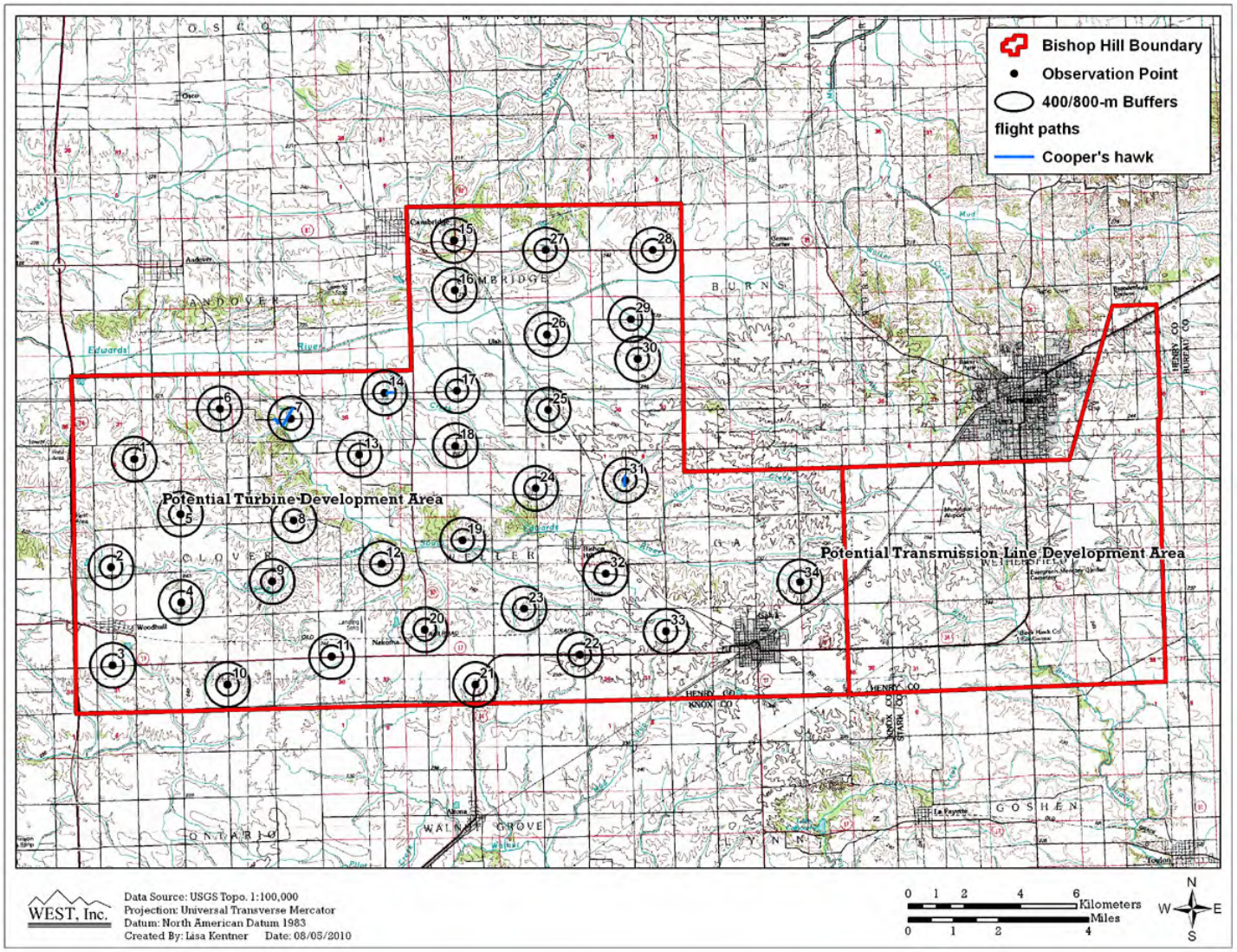


**Figure 7c. Flight paths of accipiters at the Bishop Hill Wind Project.**

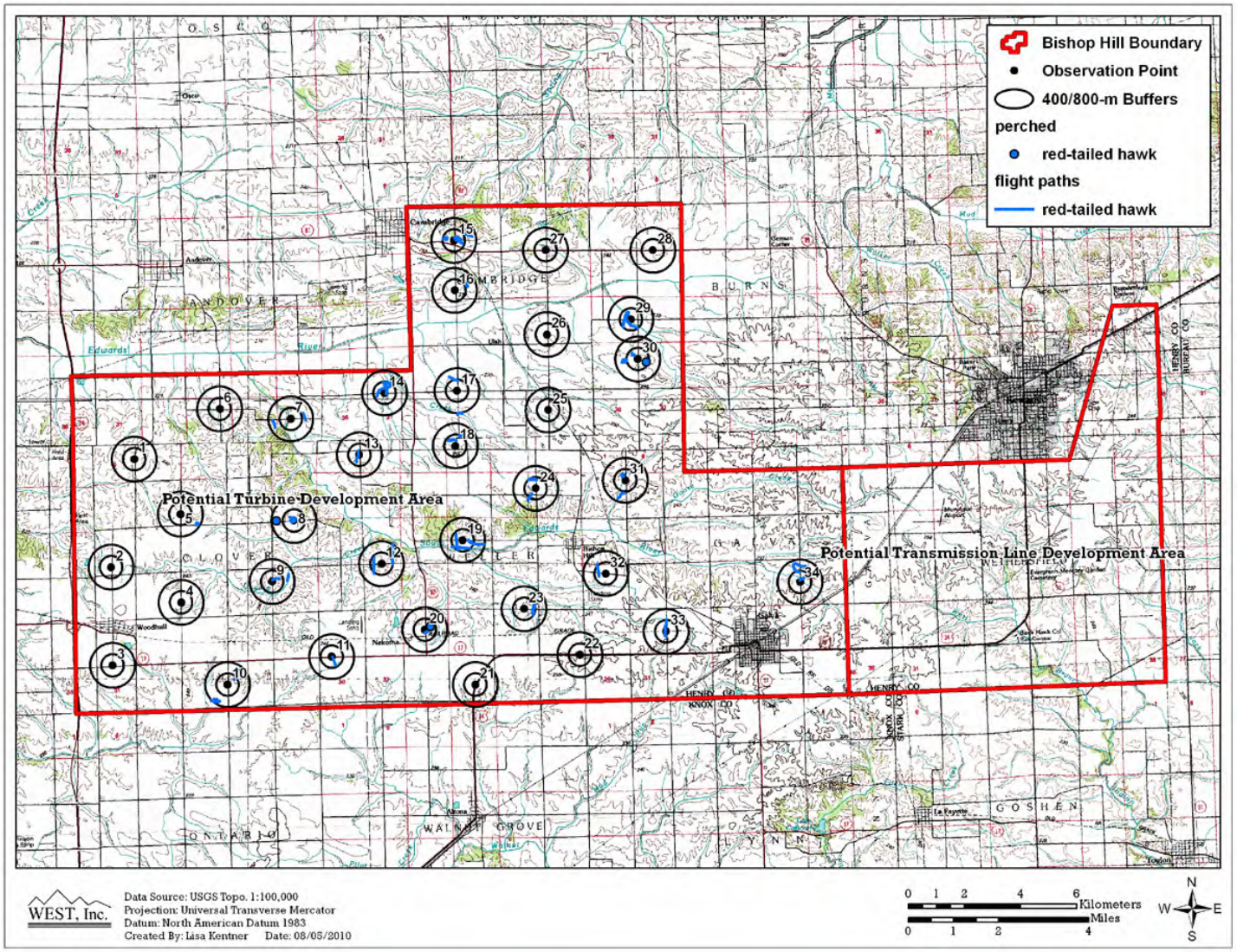


**Figure 7d. Flight paths of buteos at the Bishop Hill Wind Project.**

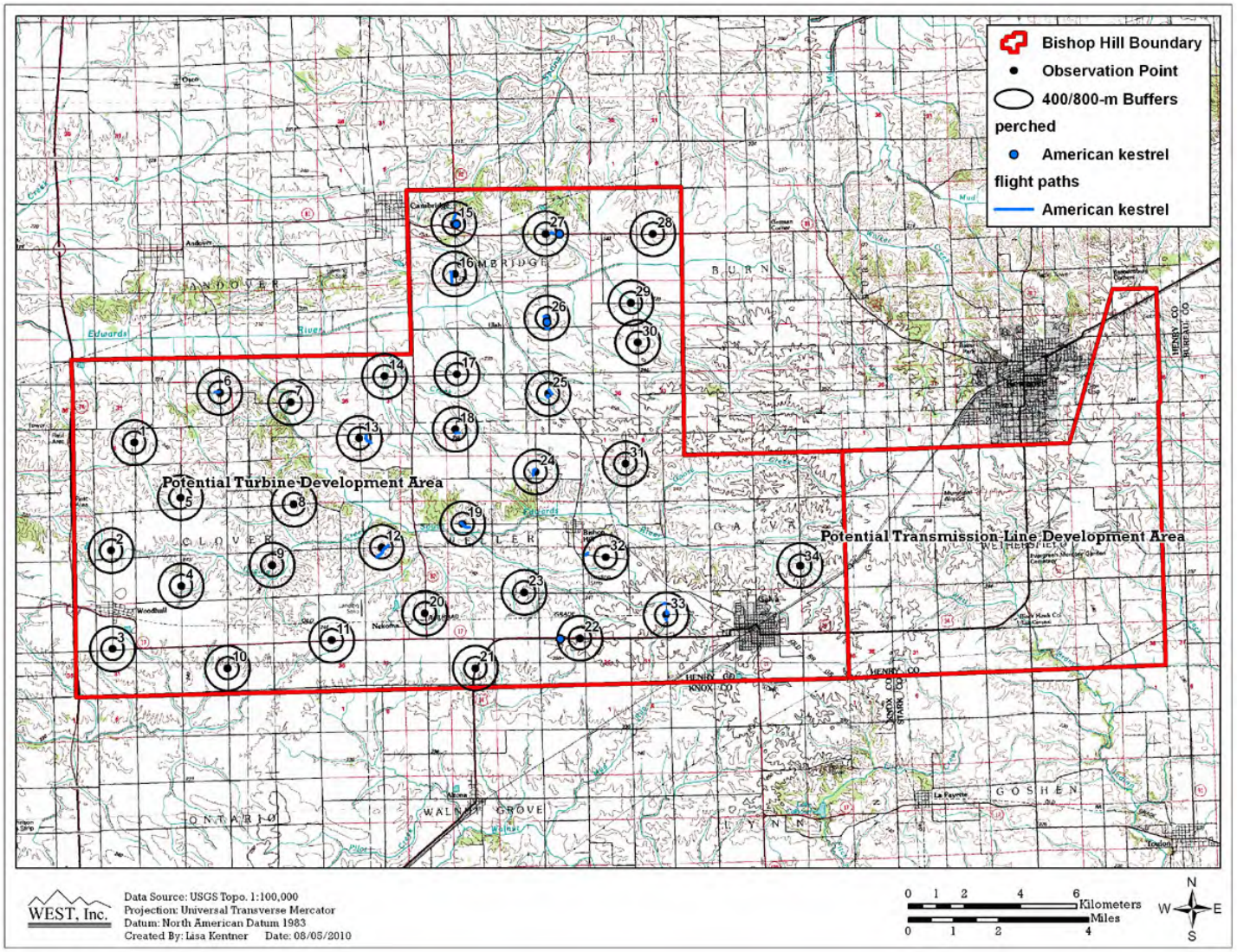


**Figure 7e. Flight paths of falcons at the Bishop Hill Wind Project.**

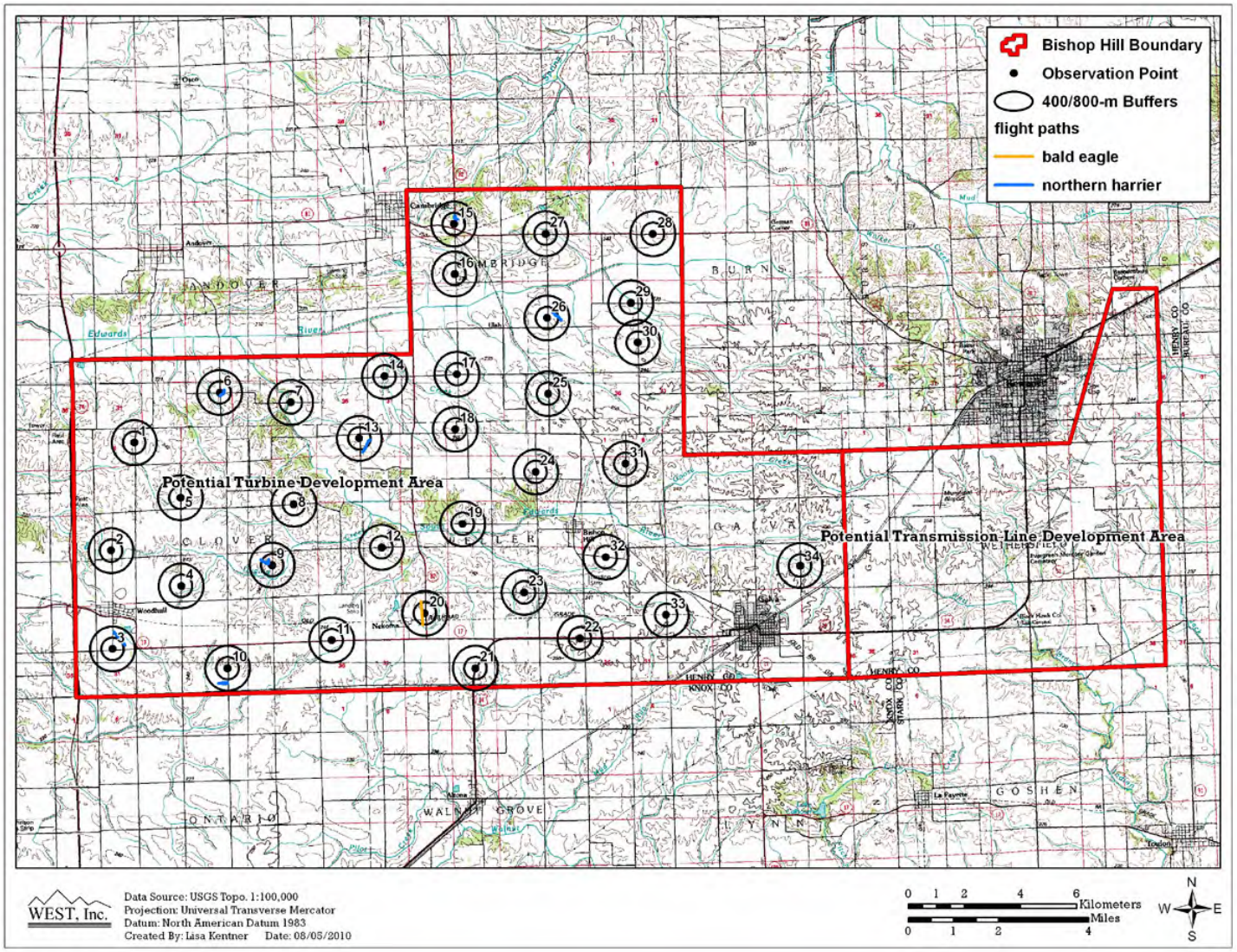


**Figure 7f. Flight paths of northern harriers and eagles at the Bishop Hill Wind Project.**

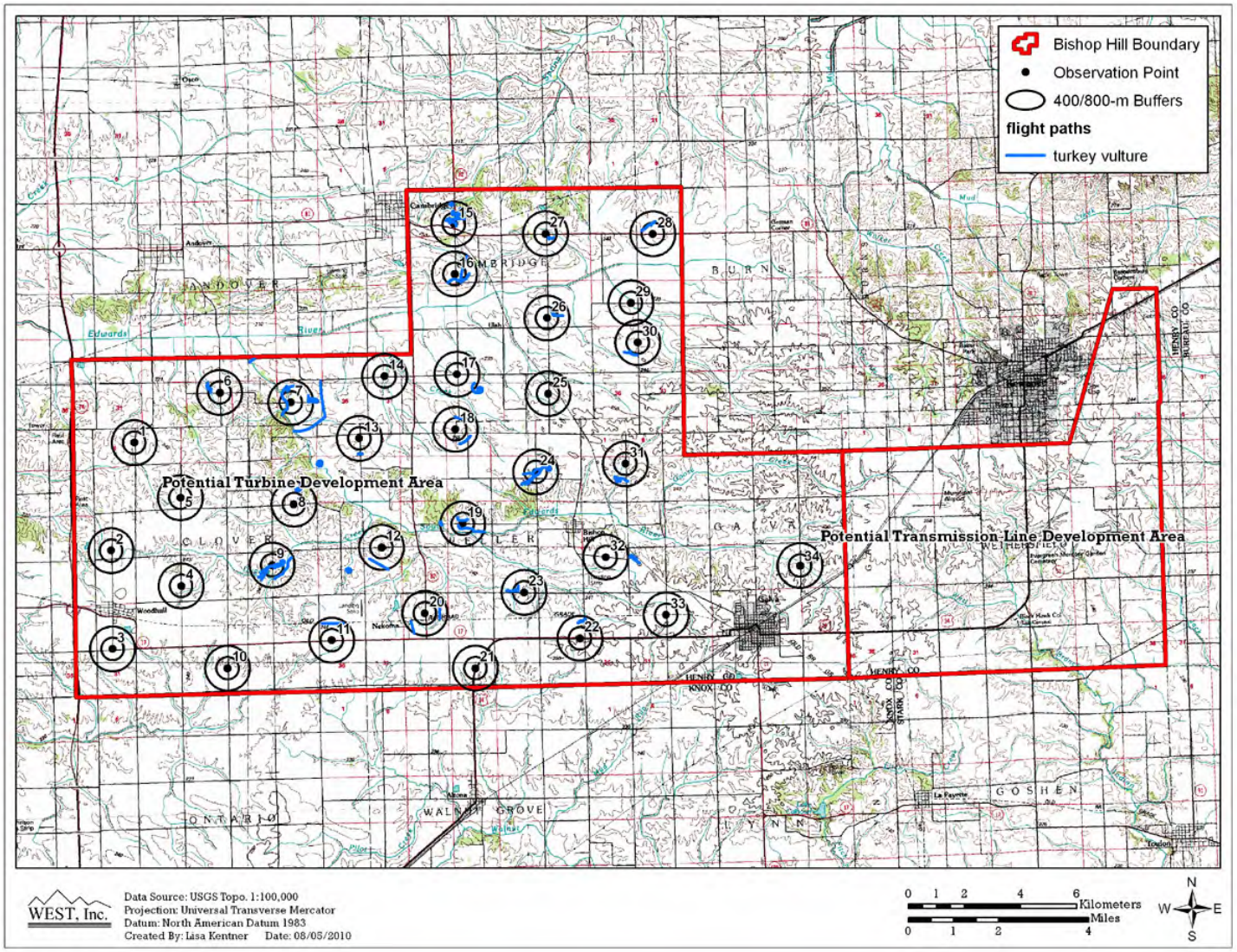


**Figure 7g. Flight paths of vultures at the Bishop Hill Wind Project.**

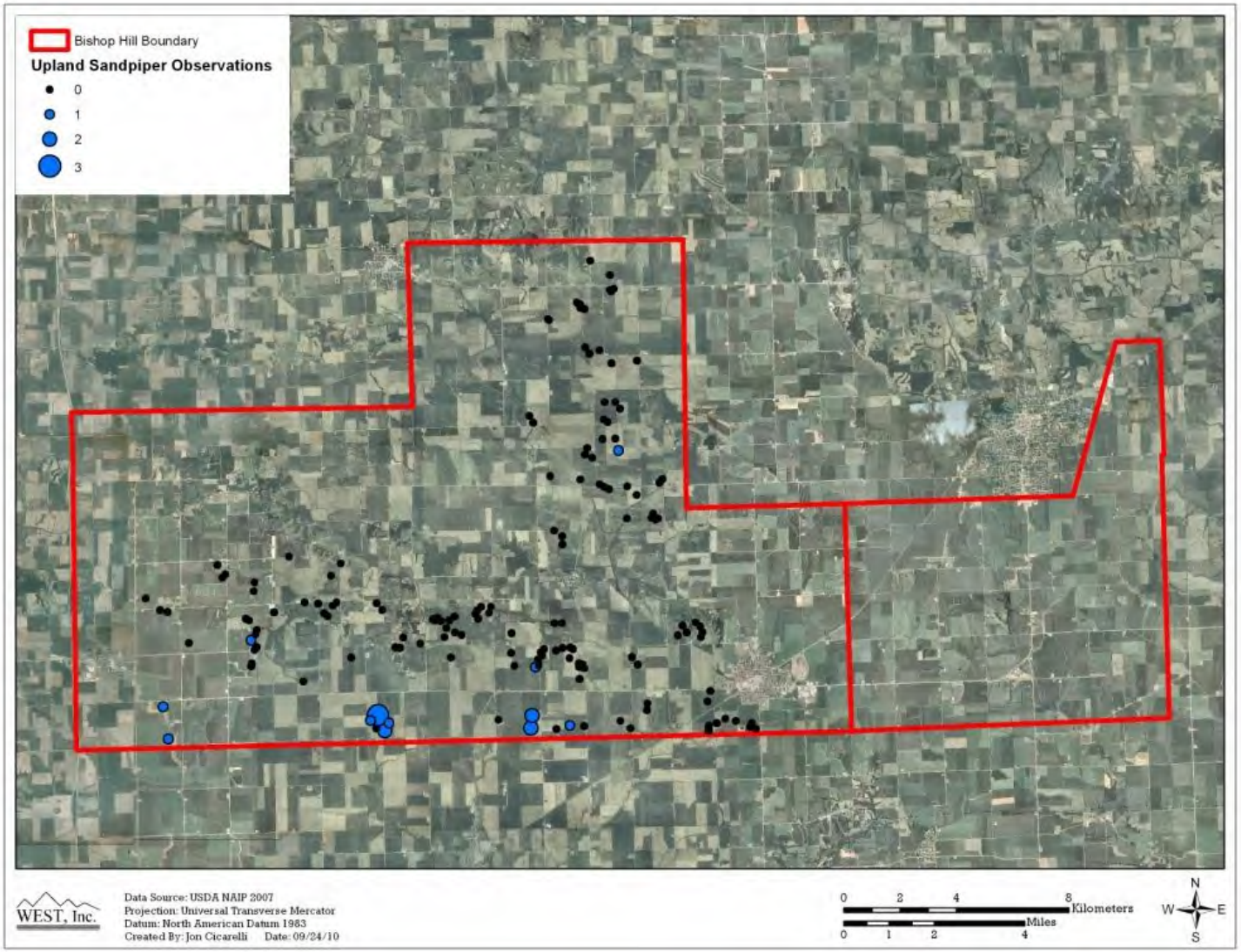


**Figure 8. Upland sandpipers observed during the breeding songbird surveys at the Bishop Hill Wind Project.**

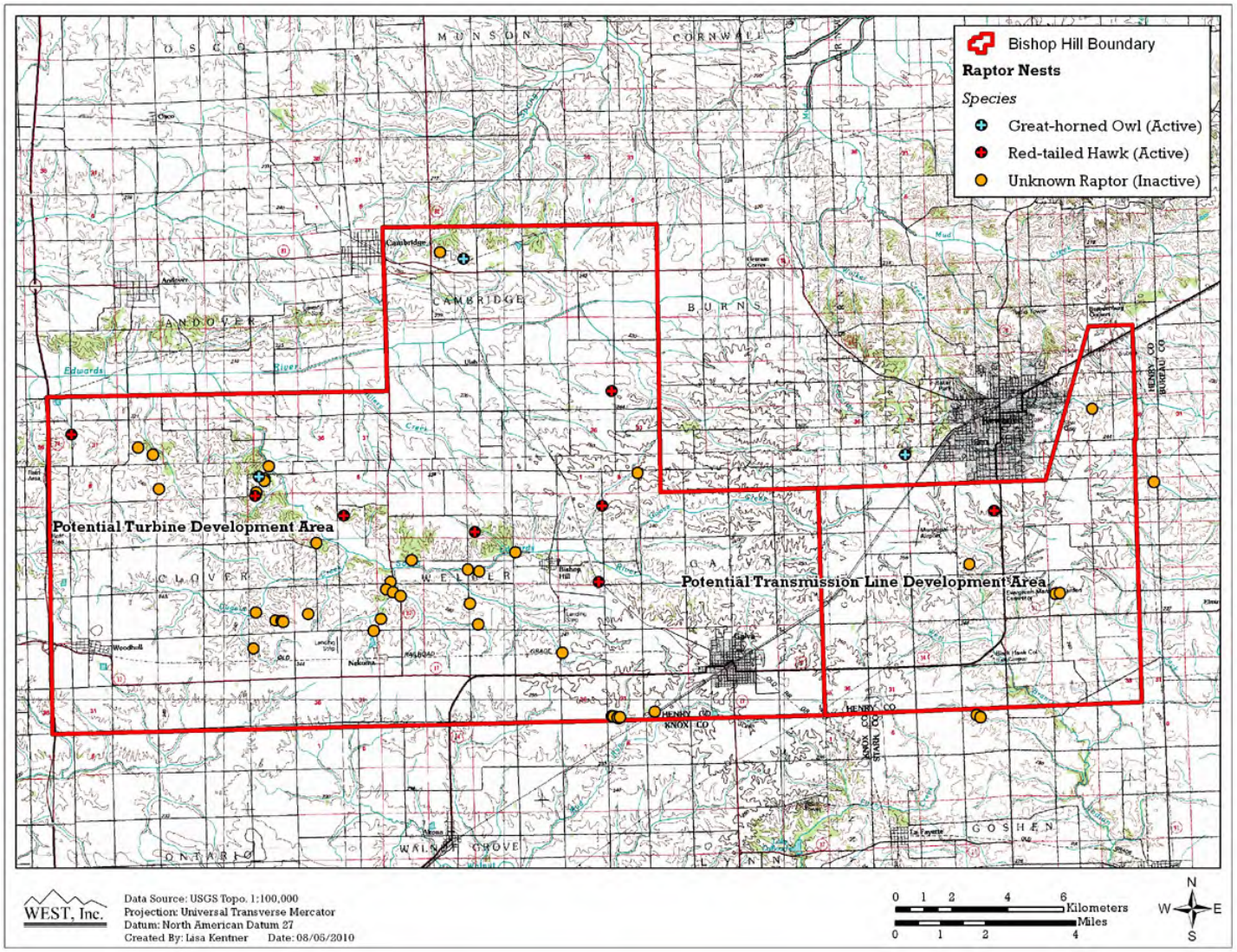


**Figure 9. Location of raptor and owl nests at the Bishop Hill Wind Project.**

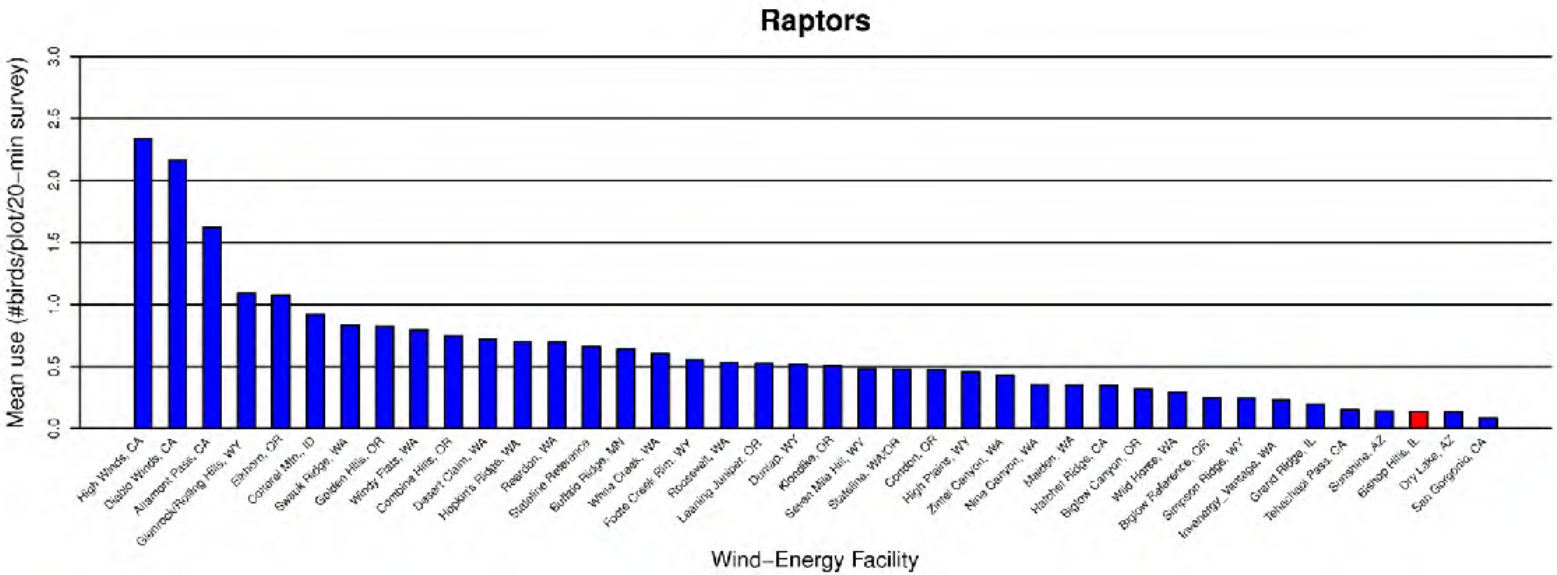


**Figure 10. Comparison of annual raptor use between the Bishop Hill Wind Project and other United States wind-energy facilities.**

Data from the following sources:

| Wind-Energy Facility | Reference | Wind-Energy Facility | Reference | Wind-Energy Facility | Reference |
|---|---|---|---|---|---|
| Bishop Hill, IL | This study. | | | | |
| High Winds, CA | Kerlinger et al. 2005 | Stateline Reference | URS et al. 2001 | Nine Canyon, WA | Erickson et al. 2001b |
| Diablo Winds, CA | WEST 2006 | Buffalo Ridge, MN | Erickson et al. 2002c | Maiden, WA | Erickson et al. 2002c |
| Altamont Pass, CA | Erickson et al. 2002c | White Creek, WA | NWC and WEST 2005 | Hatchet Ridge, CA | Young et al. 2007a |
| Glenrock/Rolling Hills, WY | Johnson et al. 2008a | Foote Creek Rim, WY | Erickson et al. 2002c | Biglow Canyon, OR | WEST 2005c |
| Elkhorn, OR | WEST 2005a | Roosevelt, WA | NWC and WEST 2004 | Wild Horse, WA | Erickson et al. 2003b |
| Cotterel Mtn., ID | BLM 2006 | Leaning Juniper, OR | Kronner et al. 2005 | Biglow Reference, OR | WEST 2005c |
| Swauk Ridge, WA | Erickson et al. 2003a | Dunlap, WY | Johnson et al. 2009a | Simpson Ridge, WY | Johnson et al. 2000b |
| Golden Hills, OR | Jeffrey et al. 2008 | Klondike, OR | Johnson et al. 2002a | Invenergy_Vantage, WA | WEST 2007 |
| Windy Flats, WA | Johnson et al. 2007 | Seven Mile Hill, WY | Johnson et al. 2008b | Grand Ridge, IL | Derby et al. 2009 |
| Combine Hills, OR | Young et al. 2003c | Stateline, WA/OR | Erickson et al. 2002c | Tehachapi Pass, CA | Erickson et al. 2002c |
| Desert Claim, WA | Young et al. 2003b | Condon, OR | Erickson et al. 2002c | Sunshine, AZ | WEST and the CPRS 2006 |
| Hopkin's Ridge, WA | Young et al. 2003a | High Plains, WY | Johnson et al. 2009b | Dry Lake, AZ | Young et al. 2007b |
| Reardon, WA | WEST 2005b | Zintel Canyon, WA | Erickson et al. 2002b | San Gorgonio, CA | Erickson et al. 2002c |

# Appendix D. Post-Construction Survey Reports

# Bird Carcass Monitoring Report for the Bishop Hill Wind Energy Facility

## Fall 2012

**Prepared for:**

**Invenergy LLC**

**Prepared by:**

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**February 12, 2014**

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| Andrea Palochak | Technical Editor |
| Sandra Simon | Research Biologist |

CONFIDENTIAL BUSINESS INFORMATION

## TABLE OF CONTENTS

1.0 INTRODUCTION ..... 1

2.0 METHODS ..... 1

2.1 Carcass Monitoring ..... 1
2.2 Statistical Analysis ..... 3
2.2.1 Carcass Monitoring ..... 3
2.2.2 Definition of Variables ..... 3
2.2.3 Observed Number of Fatalities ..... 4
2.2.4 Estimation of Carcass Non-Removal Rates ..... 4
2.2.5 Estimation of Searcher Efficiency Rates ..... 4
2.2.6 Estimation of Facility-Related Fatality Rates ..... 4

3.0 RESULTS ..... 5

3.1 Carcass Monitoring ..... 5
3.2 Fatality Estimates ..... 10

4.0 REFERENCES ..... 10

## LIST OF TABLES

Table 1. Number and percent composition of bird carcasses found during post-construction carcass monitoring at the Bishop Hill Wind Energy Facility from August 1 – September 30, 2012. ..... 6

Table 3. Estimated time since death of bird carcasses at the Bishop Hill Wind Energy Facility from August 1 – September 30, 2012. ..... 6

Table 4. Distribution of distances from turbines of all bird carcasses found during scheduled searches and incidentally on turbine search plots at the Bishop Hill Wind Energy Facility from August 1 – September 30, 2012. ..... 7

Table 5. Bird fatality Shoenfeld estimates for Bishop Hill Wind Energy Facility from August 1 to September 30, 2012. ..... 10

## LIST OF FIGURES

Figure 1. Turbine and search plot locations of the Bishop Hill Wind Energy Facility. ..... 2

Figure 2. Timing of bird carcasses per turbine found during scheduled searches or incidentally on turbine search plots at the Bishop Hill Wind Energy Facility from August 1 – September 30, 2012. ..... 8

Figure 3. Carcass removal rates at the Bishop Hill Wind Energy Project from August 1 – September 30, 2012. ..... 9

CONFIDENTIAL BUSINESS INFORMATION

## LIST OF APPENDICES

Appendix A. Complete carcass listing for the Bishop Hill Wind Energy Facility

Appendix B. Complete estimated Shoenfeld and Emperical bird fatality rates for the Bishop Hill Wind Energy Facility for studies conducted from August 1 – September 30, 2012

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# 1.0 INTRODUCTION

The Bishop Hill Wind Energy Facility (BHWEF) is owned by Bishop Hill Energy LLC and other Invenergy affiliates (BHE), and is located in Henry County, Illinois (Figure 1). Phase I of the project consists of 133 wind turbines (with a total capacity of 200 megawatts [MW]), including 34 1.5-MW and 99 1.6-MW turbines. Phase II (80 MW) is also operational, but is owned by another entity and is not included in this study. Subsequent phases, up to 120 MW in capacity, are proposed for development, for a total project nameplate capacity of 400 MW. BHE designed a study to investigate relationships between various high cut-in speeds, temperature, and bat mortality. The results of the bat research study were included in a separate report. This report includes bird results from the post-construction monitoring study at BHWEF from August 1 – September 30, 2012. Bird carcass monitoring was conducted in compliance with the BHE Avian and Bat Protection Plan (ABPP; BHE 2011).

The two primary objectives for the 2012 bird monitoring study included:

1. Estimate the facility-wide bird fatality rate; and
2. Provide a baseline estimate of bird carcasses for comparison with the results of future studies conducted throughout the life of the BHWEF.

# 2.0 METHODS

## 2.1 Carcass Monitoring

Carcass searches were conducted per the methods outlined in the New Recovery Permit (No. TE1464A-0). Sixty-one turbines (45% of the total turbines) were included in the study (Figure 1). Study turbines were selected using a systematic sample with a random start. Carcass searches at 44 turbines (72% of searched turbines) were conducted along access roads and turbine pads within 80 m (262 ft) of the turbine. Seventeen turbines (28% of searched turbines) had a square 78 x 78 m (256 ft x 256 ft) plots searched. Square plots were cleared of vegetation to increase searcher efficiency rates. The forty-four turbine roads and pads and 12 square plots were searched twice per week. The remaining five square plots were searched daily as part of the temperature study. Observers searching plots walked at a rate of 45 to 60 m per minute (about 148 to 197 ft per minute) scanning the ground out to three m (10 ft) on either side of the transect for carcasses. Search plots included cropland scraped bare of vegetation and roads and pads; which resulted in similar visibility classes throughout the project area.

All bird and bat carcasses located within areas surveyed, regardless of species, were recorded. Total number of carcasses were estimated by adjusting for search frequency, removal bias (length of stay in the field), area searched, and searcher efficiency bias (percent found).

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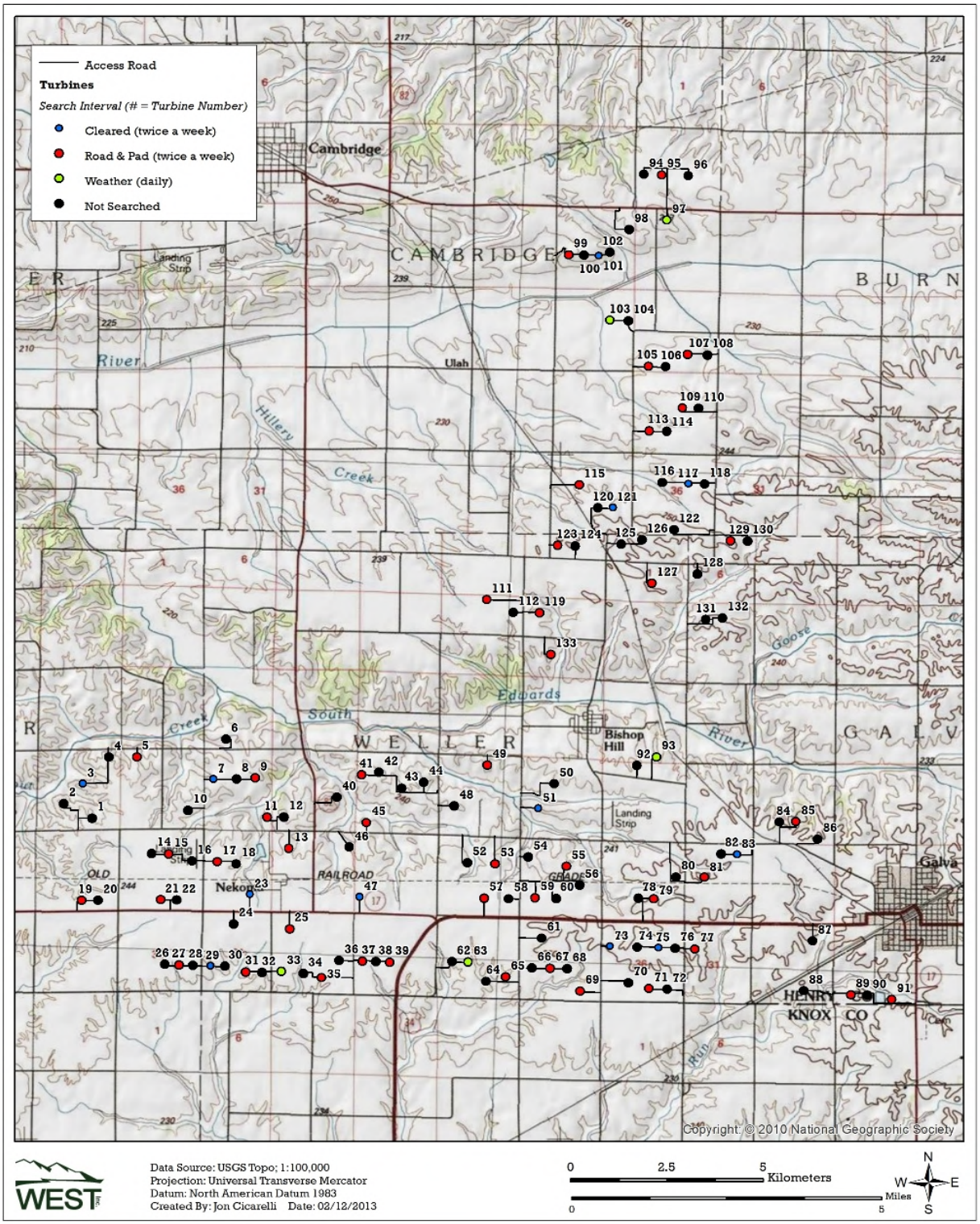


**Figure 1. Turbine and search plot locations of the Bishop Hill Wind Energy Facility.**

Two carcass removal and two searcher efficiency bias trials were conducted throughout the study period at randomly selected turbines. Trial carcasses were randomly placed on all plot types (twice per week cleared plot, twice per week road and pad plot, and daily weather plots).

Trial bird carcasses used in the study included house sparrows (*Passer domesticus*) for small birds and rock pigeons (*Columba livia*) for large birds. Trial bird carcasses were placed at search turbines by a biologist not involved in the carcass searches. Carcasses were placed throughout the study period at predetermined randomly selected points (random azimuth and distance from the turbine) within any given turbine's searchable area. Searchers had no knowledge of the number, placement, or timing of bias trial carcasses.

Data recorded for each trial carcass at the time of placement included date of placement, species, turbine number, and the distance to and direction from the turbine. Carcasses were identified as bias trial carcasses through the placement of small, inconspicuous black zip ties on the birds' legs. Trial carcasses were placed prior to searches being conducted on a given day by a biologist not involved in carcass searches. Carcasses were checked by a biologist not involved in the search effort at the end of a survey day, to ensure carcasses were available to be detected. Carcasses were checked on days one through seven, then on days 10, 14, 20, and 30. Each carcass was left in the field until removed by a scavenger, until it became decomposed such that is was beyond recognition, or for a maximum of 30 days; at which time the number of days after placement until removal, decomposition, or the end of the trial period was recorded.

## 2.2 Statistical Analysis

### *2.2.1 Carcass Monitoring*

Statistical methods for estimating mortality rates were based on:

1. Observed number of bat and bird carcasses found during standardized searches during the monitoring period;
2. Searcher efficiency;
3. Scavenger removal rates

### *2.2.2 Definition of Variables*

The following variables are used in the equations below:

$c_i$ the number of carcasses detected at plot *i* for the study period

$n$ the number of search plots

$k$ the number of turbines searched

$\bar{c}$ the average number of carcasses observed per turbine

$s$ the number of carcasses used in removal trials

$s_c$ the number of carcasses in removal trials that remain in the study area after 30 days

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$t_j$ the time (in days) carcass *j* remains in the study area before it is removed, as determined by the removal trials

$\bar{t}$ the average time (in days) a carcass remains in the study area before it is removed, as determined by the removal trials

*p* the estimated proportion of detectable carcasses found by searchers, as determined by the searcher efficiency trials

*I* the average interval between standardized carcass searches, in days

A proportion of the search area of a turbine actually searched

$\hat{\pi}_S$ the Shoenfeld (2004) estimate for the probability that a carcass is both available to be found during a search and is found, as determined by the removal trials and the searcher efficiency trials

$m_s$ the estimated annual average number of fatalities per turbine per year, adjusted for removal and searcher efficiency bias with Shoenfeld pi

*2.2.3 Observed Number of Fatalities*

The estimated average number of carcasses ($\bar{c}$) observed per turbine for the study period was:

$$\bar{c} = \frac{\sum_{i=1}^{n} c_i}{k \cdot A}$$

*2.2.4 Estimation of Carcass Non-Removal Rates*

Estimates of carcass non-removal rates were used to adjust carcass counts for removal bias. Mean carcass removal time ($\bar{t}$) was the average length of time a carcass remains in the study area before it is removed:

$$\bar{t} = \frac{\sum_{j=1}^{n} t_j}{n - n_0}$$

*2.2.5 Estimation of Searcher Efficiency Rates*

Searcher efficiency rates were expressed as *p,* the proportion of trial carcasses that were detected by searchers in the searcher efficiency trials. These rates were estimated by carcass size and season.

*2.2.6 Estimation of Facility-Related Fatality Rates*

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The estimated per turbine fatality rate (*m*) was calculated by:

$$m = \frac{\bar{c}}{\hat{\pi}}$$

where $\hat{\pi}$ includes adjustments for both carcass removal (from scavenging and other means) and searcher efficiency bias. In this study, the Shoenfeld estimator was used to estimate the probability carcass was available and detected ($\hat{\pi}$):

$\hat{\pi}_S$, the Shoenfeld estimator, was calculated by:

$$\hat{\pi}_S = \frac{\bar{t} \cdot p}{I} \cdot \left[ \frac{\exp\left( I / \bar{t} \right) - 1}{\exp\left( I / \bar{t} \right) - 1 + p} \right]$$

Shoenfeld estimates for the cleared plots were combined using a weighted average of the number of turbines in the two search interval categories (5 turbines searched daily, and 12 turbines searched every 3 days).

The variance and 90% confidence intervals of each estimator was calculated using bootstrapping (Manly 1997). Bootstrapping is a computer simulation technique that is used to calculate variance and confidence intervals for complicated statistics. The bootstrapping technique assumes that the variance present in the sample is equivalent to the variance in the population. The original sample data is then re-sampled 1000 times to simulate the variance of the estimators.

For each bootstrap sample, $\bar{c}$, $\bar{t}$, p, $\hat{\pi}_s$, $\hat{\pi}_e$, $m_s$ and were calculated. The standard deviation of the bootstrap estimates is the estimated standard error. The lower 5$^{th}$ and upper 95$^{th}$ percentiles of the 1,000 bootstrap estimates are taken as the estimates of the lower limit and upper limit of 90% confidence intervals.

## 3.0 RESULTS

### 3.1 Carcass Monitoring

A total of 1,197 turbine searches were conducted from August 1 – September 30, 2012. Overall, 20 bird carcasses were found during study; 17 were carcasses found during scheduled searches. Three bird carcasses were considered incidental discoveries: two were found outside of the search plots and one was found prior to the start of the study (Table1). Eight of the twenty carcasses were found on roads and pads, the remaining 12 were found on cleared plots. The most commonly found bird species was killdeer (*Charadrius vociferous*; 4 carcasses, 20% of all

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carcasses; Table 1). One bird species found prior to the start of the study, black-billed cuckoo (*Coccyzus erythropthalmus*), is listed as a threatened species by the state of Illinois (Illinois Natural Heritage Database, Illinois Department of Natural Resources [IDNR] 2011). No bird species listed under the federal Endangered Species Act (ESA 1973, USFWS 2011a) were found.

**Table 1. Number and percent composition of bird carcasses found during post-construction carcass monitoring at the Bishop Hill Wind Energy Facility from August 1 – September 30, 2012.**

| | Carcasses Found during Scheduled Searches | | Carcasses Found Incidentally at Search Plots* | | Other Incidental Finds** | | Total | |
|---|---|---|---|---|---|---|---|---|
| **Species** | **Total** | **% Comp.** | **Total** | **% Comp.** | **Total** | **% Comp.** | **Total** | **% Comp.** |
| killdeer | 4 | 23.5 | 0 | 0 | 0 | 0 | 4 | 20.0 |
| brown creeper | 2 | 11.8 | 0 | 0 | 0 | 0 | 2 | 10.0 |
| black-throated green warbler | 1 | 5.9 | 0 | 0 | 0 | 0 | 1 | 5.0 |
| chestnut-sided warbler | 1 | 5.9 | 0 | 0 | 0 | 0 | 1 | 5.0 |
| European starling | 1 | 5.9 | 0 | 0 | 0 | 0 | 1 | 5.0 |
| golden-crowned kinglet | 1 | 5.9 | 0 | 0 | 0 | 0 | 1 | 5.0 |
| Henslow's sparrow | 1 | 5.9 | 0 | 0 | 0 | 0 | 1 | 5.0 |
| red-breasted nuthatch | 1 | 5.9 | 0 | 0 | 0 | 0 | 1 | 5.0 |
| red-eyed vireo | 1 | 5.9 | 0 | 0 | 0 | 0 | 1 | 5.0 |
| rock pigeon | 1 | 5.9 | 0 | 0 | 0 | 0 | 1 | 5.0 |
| ruby-throated hummingbird | 1 | 5.9 | 0 | 0 | 0 | 0 | 1 | 5.0 |
| Tennessee warbler | 1 | 5.9 | 0 | 0 | 0 | 0 | 1 | 5.0 |
| unidentified sparrow | 1 | 5.9 | 0 | 0 | 0 | 0 | 1 | 5.0 |
| black-billed cuckoo | 0 | 0 | 0 | 0 | 1 | 100 | 1 | 5.0 |
| eastern kingbird | 0 | 0 | 1 | 50.0 | 0 | 0 | 1 | 5.0 |
| mourning dove | 0 | 0 | 1 | 50.0 | 0 | 0 | 1 | 5.0 |
| **Total** | **17** | **100** | **2** | **100** | **1** | **100** | **20** | **100** |

*Carcasses found incidentally on turbine search plots were included in analyses.
**Carcasses found prior to the start of the study.

Most bird carcasses were estimated to have died 2 – 3 days prior to a scheduled search (47.4%). Seven carcasses had an undetermined estimated time of death accounting for 36.8% of carcasses found during the study period (Table 3). Bird carcasses were found sporadically throughout the study period (Figure 2). Eighty percent of all bird carcasses were found within 40 m (131 ft) of turbines, with the highest percentage (25.0%) of carcasses found between 30 – 40 m (98 – 131 ft), followed by 20% of birds carcasses found between both 0 -10 m (0 – 33 ft) and 10 – 20 m (Table 4). Bird carcasses revealed no discernible distribution throughout the project area.

**Table 3. Estimated time since death of bird carcasses at the Bishop Hill Wind Energy Facility from August 1 – September 30, 2012.**

| Estimated Time Since Death | Number of Carcasses | Percent Composition |
|---|---|---|

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| | | |
|---|---|---|
| last night | 2 | 10.5 |
| 2-3 days | 9 | 47.4 |
| 4-7 days | 1 | .05 |
| 7-14 days | 0 | 0 |
| >2 weeks | 0 | 0 |
| >month | 0 | 0 |
| Unknown | 7 | 36.8 |

[a:] Estimated time since death criteria described in Appendix A.

**Table 4. Distribution of distances from turbines of all bird carcasses found during scheduled searches and incidentally on turbine search plots at the Bishop Hill Wind Energy Facility from August 1 – September 30, 2012.**

| Distance to Turbine (m) | % Bird Carcasses |
|---|---|
| 0 to 10 | 20 |
| 10 to 20 | 20 |
| 20 to 30 | 15 |
| 30 to 40 | 25 |
| 40 to 50 | 5 |
| 50 to 60 | 5 |
| 60 to 70 | 5 |
| 70 to 80 | 0 |

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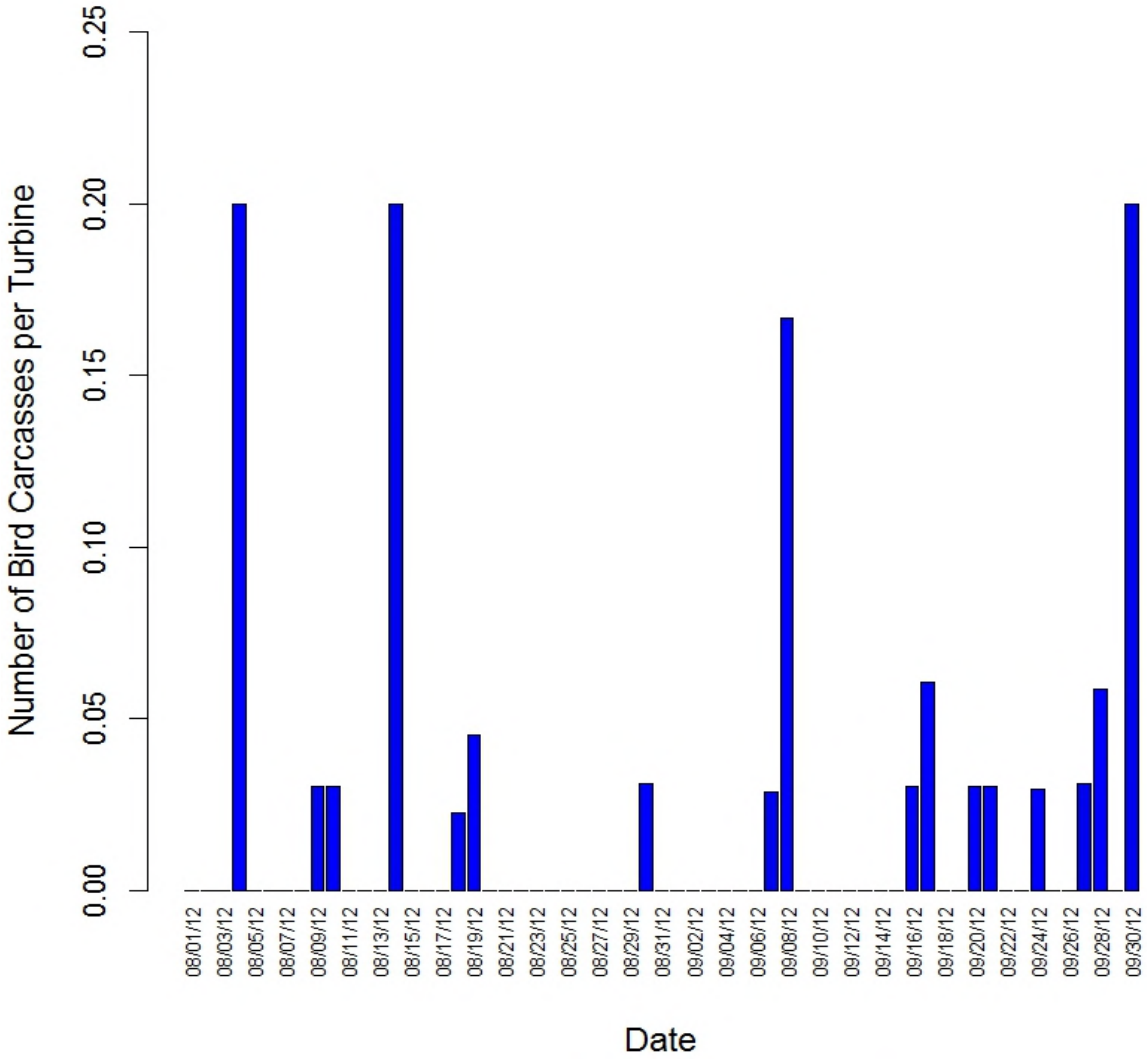


**Figure 2. Timing of bird carcasses per turbine found during scheduled searches or incidentally on turbine search plots at the Bishop Hill Wind Energy Facility from August 1 – September 30, 2012.**

Thirty large bird and 35 small bird carcasses were used during the scavenger removal trials. Two large birds and two small birds remained for the full 30-day trial. Mean removal time was 9.3 days for large birds and 8.0 days for small birds (Figure 3).

On cleared plots, 18 large birds and 24 small birds were placed for searcher efficiency trials. Thirteen of the 15 available large birds were found on the first scheduled search, resulting in searcher efficiency rate of 86.7% for large birds on cleared plots. Of 21 available small birds on cleared plots, 14 were found for a searcher efficiency rate of 66.7%.

On road and pad search plots, 15 large birds and 18 small birds were placed for searcher efficiency trials. Ten of the 11 available large birds were found on the road and pad turbines for a searcher efficiency rate of 90.9%. For small birds, 14 of 16 available were found, resulting in searcher efficiency rate of 87.5%.

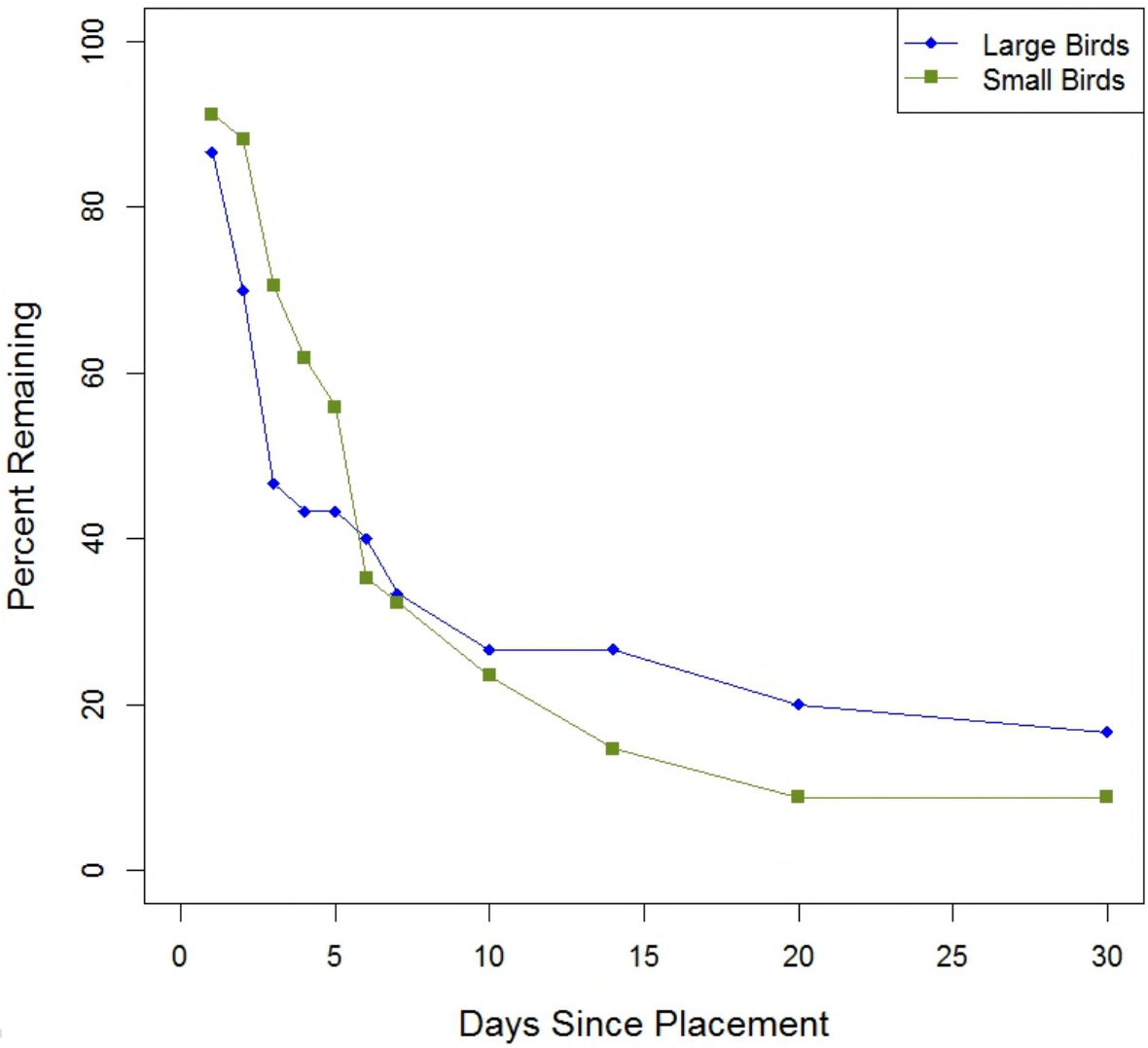


**Figure 3. Carcass removal rates at the Bishop Hill Wind Energy Project from August 1 – September 30, 2012.**

### 3.2 Fatality Estimates

There were too few bird carcasses found to estimate reliable corrections for birds falling on roads and pads versus cleared plots. Fatality estimates presented here were based only on cleared plots.

Bird fatality estimates based on Shoenfeld for all bird four bird types are shown below (Table 5).

**Table 5. Bird fatality Shoenfeld estimates for Bishop Hill Wind Energy Facility from August 1 to September 30, 2012.**

| | Corrected Fatality Estimate (90% CI) |
|---|---|
| ***# fatalities/turbine/study period*** | |
| Small Birds | 0.50 (0.24-0.79) |
| Large Birds | 0.33 (0.12-0.59) |
| Raptors | 0 |
| All Birds | 0.84 (0.49, 1.21) |
| ***# fatalities/MW/study period*** | |
| Small Birds | 0.34 (0.16, 0.52) |
| Large Birds | 0.22 (0.08, 0.40) |
| Raptors | 0 |
| All Birds | 0.56 (0.32, 0.81) |

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## Appendix A. Complete carcass listing for the Bishop Hill Wind Energy Facility

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**Appendix A. Complete carcass listing for the Bishop Hill Wind Energy Facility.**

| Date | Common Name | Location | Distance from Turbine | Type of Find | Search Type | Condition |
|---|---|---|---|---|---|---|
| 8/30/2012 | killdeer | 75 | 17 | carcass search | Weekly | feather spot |
| 9/7/2012 | chestnut-sided warbler | 89 | 46 | carcass search | Weekly | intact |
| 9/8/2012 | killdeer | 63 | 18 | carcass search | Daily | feather spot |
| 9/16/2012 | red-eyed vireo | 25 | 2 | carcass search | Weekly | scavenged |
| 9/17/2012 | ruby-throated hummingbird | 47 | 39 | carcass search | Weekly | dismembered |
| 9/17/2012 | Tennessee warbler | 97 | 26 | carcass search | Daily | scavenged |
| 8/4/2012 | killdeer | 33 | 32 | carcass search | Daily | feather spot |
| 8/9/2012 | European starling | 63 | 35 | carcass search | Daily | feather spot |
| 7/26/2012 | black-billed cuckoo | 119 | 55 | incidental find | Weekly | dismembered |
| 8/10/2012 | unidentified sparrow | 19 | 26 | carcass search | Weekly | feather spot |
| 8/14/2012 | killdeer | 33 | 20 | carcass search | Daily | feather spot |
| 8/18/2012 | mourning dove | 85 | 7 | incidental find | Weekly | scavenged |
| 8/19/2012 | eastern kingbird | 123 | 82 | incidental find | Weekly | intact |
| 9/20/2012 | golden-crowned kinglet | 109 | 68 | carcass search | Weekly | intact |
| 9/21/2012 | Henslow's sparrow | 97 | 38 | carcass search | Daily | dismembered |
| 9/24/2012 | brown creeper | 81 | 1 | carcass search | Weekly | intact |
| 9/27/2012 | rock pigeon | 83 | 31 | carcass search | Weekly | dismembered |
| 9/28/2012 | red-breasted nuthatch | 29 | 27 | carcass search | Weekly | intact |
| 9/28/2012 | black-throated green warbler | 7 | 20 | carcass search | Weekly | intact |
| 9/30/2012 | brown creeper | 103 | 6 | carcass search | Daily | intact |

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**Appendix B. Complete estimated Shoenfeld bird fatality rates for the Bishop Hill Wind Energy Facility for studies conducted from August 1 – September 30, 2012**

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**Appendix B. Complete estimated bird fatality table for the Bishop Hill Wind Energy Facility for studies conducted from August 1 to September 30, 2012.**

| Parameter | Shoenfeld Mean | SE | CI |
|---|---|---|---|
| **Observer Detection** | | | |
| *A (small birds)* | 0.76 | 0.07 | 0.63-0.87 |
| *A (large birds)* | 0.92 | 0.05 | 0.84-1.00 |
| **Mean Carcass Removal Time (days)** | | | |
| $\bar{t}$ *(small birds)* | 7.97 | 1.69 | 5.58-11.07 |
| $\bar{t}$ *(large birds)* | 9.32 | 2.67 | 5.81-14.41 |
| **Observed Fatality Rates (Fatalities/turbine/study period)** | | | |
| *Small birds-daily* | 0.80 | 0.33 | 0.20-1.40 |
| *Small birds-weekly* | 0.25 | 0.12 | 0.08-0.42 |
| *Large birds- daily* | 0.60 | 0.35 | 0-1.20 |
| *Large birds-weekly* | 0.17 | 0.11 | 0-0.33 |
| **Average Probability of Carcass Availability and Detected** | | | |
| *Small birds-daily* | 0.91 | 0.02 | 0.86-0.93 |
| *Small birds-weekly* | 0.73 | 0.05 | 0.63-0.80 |
| *Large birds- daily* | 0.94 | 0.02 | 0.90-0.96 |
| *Large birds- weekly* | 0.81 | 0.05 | 0.71-0.87 |

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# Carcass Monitoring Report for the Bishop Hill Wind Energy Facility

## Spring 2013

**Prepared for:**

**Bishop Hill Energy LLC**


**Prepared by:**

**Jason P. Ritzert, Rhett Good, and Michelle Ritzert**

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**December 13, 2013**

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CONFIDENTIAL BUSINESS INFORMATION

## TABLE OF CONTENTS

1.0 INTRODUCTION ..... 1

2.0 METHODS ..... 1

2.1 Carcass Monitoring ..... 1
2.2 Statistical Analysis ..... 4
2.2.1 Carcass Monitoring ..... 4
2.2.2 Definition of Variables ..... 4
2.2.3 Observed Number of Fatalities ..... 5
2.2.4 Estimation of Carcass Non-Removal Rates ..... 5
2.2.5 Estimation of Searcher Efficiency Rates ..... 5
2.2.6 Estimation of Facility-Related Fatality Rates ..... 5

3.0 RESULTS ..... 6

3.1 Carcass Monitoring ..... 6
3.2 Fatality Estimates ..... 7

4.0 REFERENCES ..... 8

## LIST OF TABLES

Table 1. Searcher efficiency results at the Bishop Hills Wind Energy Facility as a function of date and carcass size. ..... 6

Table 2. Bird and bat fatality estimates for Bishop Hills Wind Energy Facility from April 15 to May 15, 2012 ..... 8

## LIST OF FIGURES

Figure 1. Facility layout of Phase I at the Bishop Hill Wind Energy Project and search plots. ..... 3

Figure 2. Carcass removal rates at the Bishop Hill Wind Energy Project. ..... 7

## LIST OF APPENDICES

Appendix A. Complete bird fatality estimate table for the Bishop Hill Wind Energy Facility for studies conducted from April 15 to May 14, 2013.

Appendix B. Complete bat fatality estimate table for the Bishop Hill Wind Energy Facility for studies conducted from April 15 to May 14, 2013.

CONFIDENTIAL BUSINESS INFORMATION

# 1.0 INTRODUCTION

The Bishop Hill Wind Energy Facility (the Project) in Henry County, Illinois, is owned by Bishop Hill Energy LLC (BHE) and Phase I of the Project consists of 133 wind turbines (with a total capacity of 200 megawatts [MW]), including 34 1.5-MW and 99 1.6-MW turbines. BHE contracted with WEST to complete a carcass survey following methods outlined within BHE's Avian and Bat Protection Plan (ABPP; BHE 2011). This report presents the findings of spring surveys conducted from April 15 to May 15, 2013.

# 2.0 METHODS

## 2.1 Carcass Monitoring

Standardized carcass searches were conducted per the methods outlined in the ABPP (BHE 2011). Thirty of the 133 turbines (22.6% of all turbines; Figure 1) were monitored weekly using 78 meter (m) x 78 m (256 feet [ft] x 256 ft) square plots centered on the turbine. Within each plot, 13 transects were spaced at approximately six-m (20-ft) intervals and searchers walked at a rate of 45 to 60 m per minute (about 148 to 197 ft per minute) scanning the ground out to three m (10 ft) on either side of the transect for carcasses.

All bird and bat carcasses located within search plots, regardless of species, were recorded. Total number of carcasses were estimated by adjusting for search frequency, removal bias (length of stay in the field), area searched, and searcher efficiency bias (percent found).

One carcass removal and one searcher efficiency bias trial was conducted at randomly selected turbines. Trials were conducted using commercially purchased large bird carcasses (hen ring-neck pheasant [*Phasianus colchicus*]), non-native small bird carcasses (house sparrow [*Passer domesticus*]), and previously salvaged big brown bat carcasses (*Eptesicus fuscus*). Trial bird carcasses were placed at search turbines by a biologist not involved in the carcass searches. Carcasses were at predetermined randomly selected points (random azimuth and distance from the turbine) within any given turbine's searchable area. Searchers had no knowledge of the number, placement, or timing of bias trial carcasses.

Data recorded for each trial carcass at the time of placement included date of placement, species, turbine number, and the distance to and direction from the turbine. Carcasses were identified as bias trial carcasses through the placement of small, inconspicuous black zip ties on the birds' legs. Trial carcasses were placed zero to four days prior to scheduled searches. Carcasses were checked by a biologist not involved in the search effort, prior to the first day of a scheduled search to track availability and removal rates. Carcasses were checked on days one through seven, then on days 10, 14, 20, and 30. Each carcass was left in the field until removed by a scavenger, until it became decomposed such that is was beyond recognition, or for a

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maximum of 30 days; at which time the number of days after placement until removal, decomposition, or the end of the trial period was recorded.

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**Figure 1. Facility layout of Phase I at the Bishop Hill Wind Energy Project and search plots.**

## 2.2 Statistical Analysis

### *2.2.1 Carcass Monitoring*

Statistical methods for estimating mortality rates were based on:

1. Observed number of bat and bird carcasses found during standardized searches during the monitoring period;
2. Searcher efficiency; and
3. Scavenger removal rates.

### *2.2.2 Definition of Variables*

The following variables were used in the equations below:

$c_i$ the number of carcasses detected at plot *i* for the entire study period

$n$ the number of search plots

$\bar{c}$ the average number of carcasses observed per turbine per monitoring period

$s$ the number of carcasses used in the carcass removal trials

$s_c$ the number of carcasses in the carcass removal trials that remained in the study area at Day 30

$t_i$ the time (in days) a carcass remained in the study area before it was removed, as determined by the carcass removal trials

$\bar{t}$ the average time (in days) a carcass remained in the study area before it was removed, as determined by the carcass removal trials

$d$ the total number of carcasses placed in the searcher efficiency trials

$p$ the estimated proportion of detectable carcasses found by observers, as determined by the searcher efficiency trials

$I$ the average interval between standardized fatality searches, in days

$\hat{\pi}$ the estimated probability that a fatality was both available to be found during a search and was found, as determined by the carcass removal trials and the searcher efficiency trials (i.e., detection probability)

$m$ the estimated annual average number of carcasses per turbine per year, adjusted for carcass removal and searcher efficiency bias

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### *2.2.3 Observed Number of Fatalities*

The estimated average number of fatalities ($\bar{c}$) observed per turbine per monitoring period was:

$$\bar{c} = \frac{\sum_{i=1}^{n} c_i}{n} \qquad (1)$$

### *2.2.4 Estimation of Carcass Non-Removal Rates*

Estimates of carcass non-removal rates were used to adjust carcass counts for carcass removal bias. Mean carcass removal time ($\bar{t}$) was the average length of time a carcass remained in the study area before it was removed:

$$\bar{t} = \frac{\sum_{i=1}^{s} t_i}{s - s_c} \qquad (2)$$

### *2.2.5 Estimation of Searcher Efficiency Rates*

Searcher efficiency rates were expressed as *p*, the proportion of trial carcasses that were detected by observers in the searcher efficiency trials. These rates were estimated by carcass size.

### *2.2.6 Estimation of Facility-Related Fatality Rates*

The estimated per turbine fatality rate (*m*) was calculated by:

$$m = \frac{\bar{c}}{\hat{\pi}} \qquad (3)$$

where $\hat{\pi}$ included adjustments for carcass removal (from scavenging and other means) and searcher efficiency bias.

This formula has been independently verified by Shoenfeld (2004). The final reported estimates of *m* were calculated according to the formula above. Associated standard errors and 90 percent confidence intervals were calculated using bootstrapping (Manly 1997). Bootstrapping is a computer simulation technique that is useful for calculating variances, and confidence intervals for complicated test statistics. For each bootstrap sample, $\bar{c}$, $\bar{t}$, p, $\hat{\pi}$, and *m* were

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calculated. A total of 1,000 bootstrap samples were used for each estimate. The standard deviation of the bootstrap estimates was reported as the estimated standard error. The lower fifth and upper ninety-fifth percentiles of the 1,000 bootstrap estimates were taken as estimates of the lower limit and upper limit of the 90 percent confidence intervals.

# 3.0 RESULTS

## 3.1 Carcass Monitoring

A total of 148 turbine searches were conducted from April 15 to May 14, 2013. The only carcass found during surveys was one turkey vulture (*Cathartes aura*). The bird was found on April 23 at turbine 131 and was between 10 and 20 m from the turbine.

One searcher efficiency trial with 60 carcasses (12 large birds, 13 small birds, and 35 bats) was completed. The overall searcher efficiency rate for small birds was 50%, compared to 100% for large birds, and 76% for bats (Table 1).

**Table 1. Searcher efficiency results at the Bishop Hills Wind Energy Facility as a function of carcass size.**

| Size | # Placed | # Available | # Found | % Found |
|---|---|---|---|---|
| Small Birds | 13 | 10 | 5 | **50.0** |
| Large Birds | 12 | 8 | 8 | **100.0** |
| Bats | 35 | 25 | 19 | **76.0** |

One carcass removal trial was conducted at the Project. The mean carcass removal rate was 7.50 days for large birds, 11.95 days for small birds, and 7.4 days for bats. By day ten, roughly 30% of small birds, 25% of large birds, and 37% of bats remained where they were placed. By day 30, no large carcasses remained, less than 5% of bats remained, and approximately 18% of small birds remained (Figure 2).

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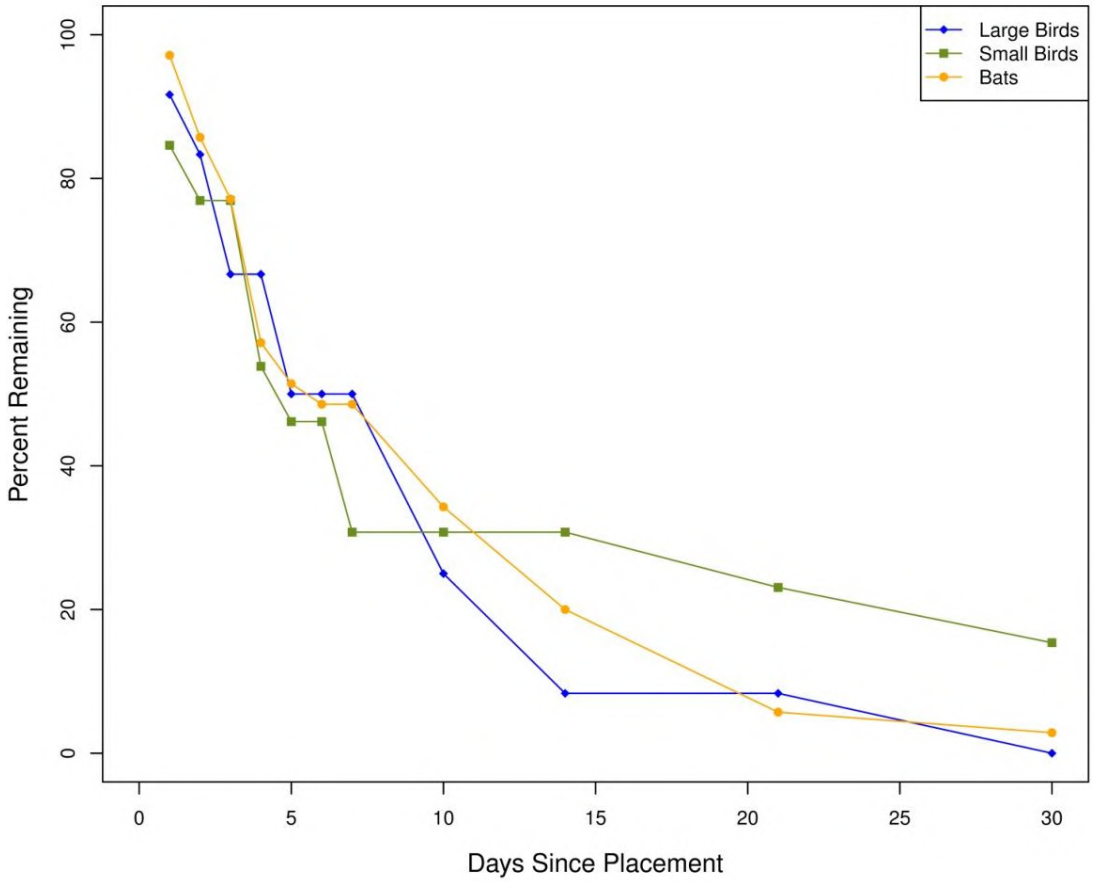


**Figure 2. Carcass removal rates at the Bishop Hill Wind Energy Project.**

### 3.2 Fatality Estimates

Fatality estimates and 90% confidence intervals were calculated for birds and bats (Table 2; Appendix A; Appendix B). No bats or small birds were found during surveys, therefore the calculated fatality estimates are zero. The large bird fatality estimate was adjusted based on the corrections for carcass removal and observer detection bias. Estimates are provided per turbine and per MW based on the 1.5-MW capacity of the turbines at the Project (Table 2; Appendix A; Appendix B).

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**Table 2. Bird and bat fatality estimates for Bishop Hills Wind Energy Facility from April 15 to May 15, 2012.**

| | Corrected Fatality Estimate |
|---|---|
| ***# fatalities/turbine/study period*** | |
| Small Birds | 0 |
| Large Birds | 0.05 |
| Raptors | 0 |
| All Birds | 0.05 |
| Bats | 0 |
| ***# fatalities/MW/study period*** | |
| Small Birds | 0 |
| Large Birds | 0.03 |
| Raptors | 0 |
| All Birds | 0.03 |
| Bats | 0 |

## 4.0 REFERENCES

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**Appendix A. Complete bird fatality estimate table for the Bishop Hill Wind Energy Facility for studies conducted from April 15 to May 14, 2013.**

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**Appendix A. Complete bird fatality estimate table for the Bishop Hill Wind Energy Facility for studies conducted from April 15 to May 14, 2013.**

| Parameter | Mean | 90% CI |
|---|---|---|
| **Observer Detection** | | |
| *P (small birds)* | 0.50 | 0.30 - 0.80 |
| *P (large birds)* | 1 | - |
| **Mean Carcass Removal Time (days)** | | |
| $\bar{t}$ *(small birds)* | 11.95 | 5.5 - 22.2 |
| $\bar{t}$ *(large birds)* | 7.50 | 4.7 – 10.8 |
| **Observed Fatality Rates (Fatalities/turbine/study period)** | | |
| *Small birds* | 0 | - |
| *Large birds* | 0.03 | - |
| *Raptors* | 0 | - |
| **Average Probability of Carcass Availability and Detected** | | |
| *Small birds* | 0.52 | 0.24 -0.73 |
| *Large birds* | 0.65 | 0.52 -0.73 |
| **Adjusted Fatality Estimates (Fatalities/turbine/study period)** | | |
| *Small birds* | 0 | |
| *Large birds* | 0.05 | 0.05 - 0.06 |
| *Raptors* | 0 | - |
| *All birds* | 0.05 | 0.05 - 0.06 |

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**Appendix B. Complete bat fatality estimate table for the Bishop Hill Wind Energy Facility for studies conducted from April 15 to May 14, 2013.**

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**Appendix B. Complete bat fatality table for the Bishop Hill Wind Energy Facility for studies conducted from April 15 to May 14 , 2013.**

| Parameter | Mean | 90% CI |
|---|---|---|
| **Observer Detection** | | |
| *P (bats)* | 0.76 | 0.60 - 0.88 |
| **Mean Carcass Removal Time (days)** | | |
| $\bar{t}$ *(bats)* | 7.40 | 5.63 – 9.33 |
| **Observed Fatality Rates (Fatalities/turbine/study period)** | | |
| *Bats* | 0 | - |
| **Average Probability of Carcass Availability and Detected** | | |
| *Bats* | 0.54 | 0.43 – 0.62 |
| **Adjusted Fatality Estimates (Fatalities/turbine/study period)** | | |
| *Bats* | 0 | - |

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# Bird Carcass Monitoring Report for the Bishop Hill Wind Energy Facility

## Fall 2013

**Prepared for:**

**Invenergy LLC**

**Prepared by:**


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**April 1, 2014**


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*Draft Pre-Decisional Document - Privileged and Confidential - Not For Distribution*

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## REPORT REFERENCE

Simon, S., R. Good, S. Howlin, and M. Ritzert 2014. Bird Carcass Monitoring Report for the Bishop Hill Wind Energy Facility, Fall 2013. Prepared for Invenergy LLC. Prepared by Western EcoSystems Technology, Inc. (WEST), Bloomington, Indiana.

## TABLE OF CONTENTS

1.0 INTRODUCTION ..... 1
2.0 METHODS ..... 1
2.1 Carcass Monitoring ..... 1
2.2 Statistical Analysis ..... 3
2.2.1 Carcass Monitoring ..... 3
2.2.2 Definition of Variables ..... 3
2.2.3 Observed Number of Carcasses ..... 4
2.2.4 Estimation of Carcass Non-Removal Rates ..... 4
2.2.5 Estimation of Searcher Efficiency Rates ..... 4
2.2.6 Estimated Fatality Rates ..... 5
3.0 RESULTS ..... 5
3.1 Carcass Monitoring ..... 5
3.2 Fatality Estimates ..... 10
4.0 REFERENCES ..... 10

## LIST OF TABLES

Table 1. Number and percent composition of bird carcasses found during post-construction carcass monitoring at the Bishop Hill Wind Energy Facility from August 1 – September 30, 2013. ..... 6
Table 2. Estimated time since death of bird carcasses at the Bishop Hill Wind Energy Facility from August 1 – September 30, 2013. ..... 6
Table 3. Distribution of distances from turbines of all bird carcasses found during scheduled searches and incidentally on turbine search plots at the Bishop Hill Wind Energy Facility from August 1 – September 30, 2013. ..... 7
Table 4. Bird fatality Shoenfeld estimates for the Bishop Hill Wind Energy Facility from August 1 to September 30, 2013. ..... 10

## LIST OF FIGURES

Figure 1. Turbine and search plot locations of the Bishop Hill Wind Energy Facility. ..... 2

Figure 2. Timing of bird carcasses per turbine found during scheduled searches or incidentally on turbine search plots at the Bishop Hill Wind Energy Facility from August 1 – September 30, 2013. ..... 7

Figure 3. Number of bird carcasses by turbine found during scheduled searches or incidentally on turbine search plots at the Bishop Hill Wind Energy Facility from August 1 – September 30, 2013. Turbines where no bird carcasses were found are not shown in this figure. ..... 8

Figure 4. Carcass removal rates at the Bishop Hill Wind Energy Facility from August 1 – September 30, 2013. ..... 9

## LIST OF APPENDICES

Appendix A. Complete Carcass Listing for the Bishop Hill Wind Energy Facility

Appendix B. Complete Estimated Bird Fatality Table for the Bishop Hill Wind Energy Facility for Studies Conducted from August 1 to September 30, 2013

# 1.0 INTRODUCTION

The Bishop Hill Wind Energy Facility (BHWEF or Project), located in Henry County, Illinois (Figure 1), is owned by Bishop Hill Energy LLC (BHE) and other Invenergy LLC affiliates. Phase I of the Project consists of 133 wind turbines (with a total nameplate capacity of 200 megawatts [MW]), including 34 1.5-MW and 99 1.6-MW turbines. Phase II (80 MW) is also operational, but is owned by another entity and is not included in this study. Subsequent phases, up to 120 MW in capacity, are proposed for development, for a total Project capacity of 400 MW.

This report includes the results of bird carcass monitoring conducted as part of a larger post-construction monitoring study at the BHWEF from August 1 – September 30, 2013[1]. Study turbines were operated at raised cut-in speeds of 4.5 m/s (10.1 mph), 5.5 m/s (12.5 mph), and 6.9 m/s (15.5 mph) during the fall migration period (August 1- September 30) to test the effects of different cut-in speeds on estimated bat fatality rates. Bird carcass monitoring was conducted to comply with the BHE Avian and Bat Protection Plan (ABPP; BHE 2011).

# 2.0 METHODS

## 2.1 Carcass Monitoring

Carcass searches were conducted per the methods outlined in the New Recovery Permit (No. TE1464A-0). The 62 turbines (over 46% of the total turbines) included in the study (Figure 1) were selected using a systematic sample with a random start. Carcass searches at 45 turbines (73% of searched turbines) were conducted along access roads and turbine pads within 80 meters (m; 262 feet [ft]) of the turbine. Seventeen turbines (27% of searched turbines) were searched within square 78 x 78 m (256 x 256 ft) plots that were cleared of vegetation to increase searcher efficiency rates. The 45 turbine roads and pads and 12 square plots were searched twice per week. The other five square plots were searched daily as part of a study investigating the effects of temperature on bat fatality rates (results of this study were included in a separate report).

Observers searching plots walked at a rate of 45 to 60 m per minute (approximately 148 to 197 ft per minute) scanning the ground out to 3 m (10 ft) on either side of the transect for carcasses. Search plots included cropland scraped bare of vegetation and roads and pads, which resulted in similar visibility classes throughout the Project area. All bird carcasses located within surveyed areas, regardless of species, were recorded.

[1] Post-construction monitoring was also conducted for a bat research study to investigate relationships between various raised cut-in speeds, temperature, and bat mortality. The results of the bat research study were included in a separate report.

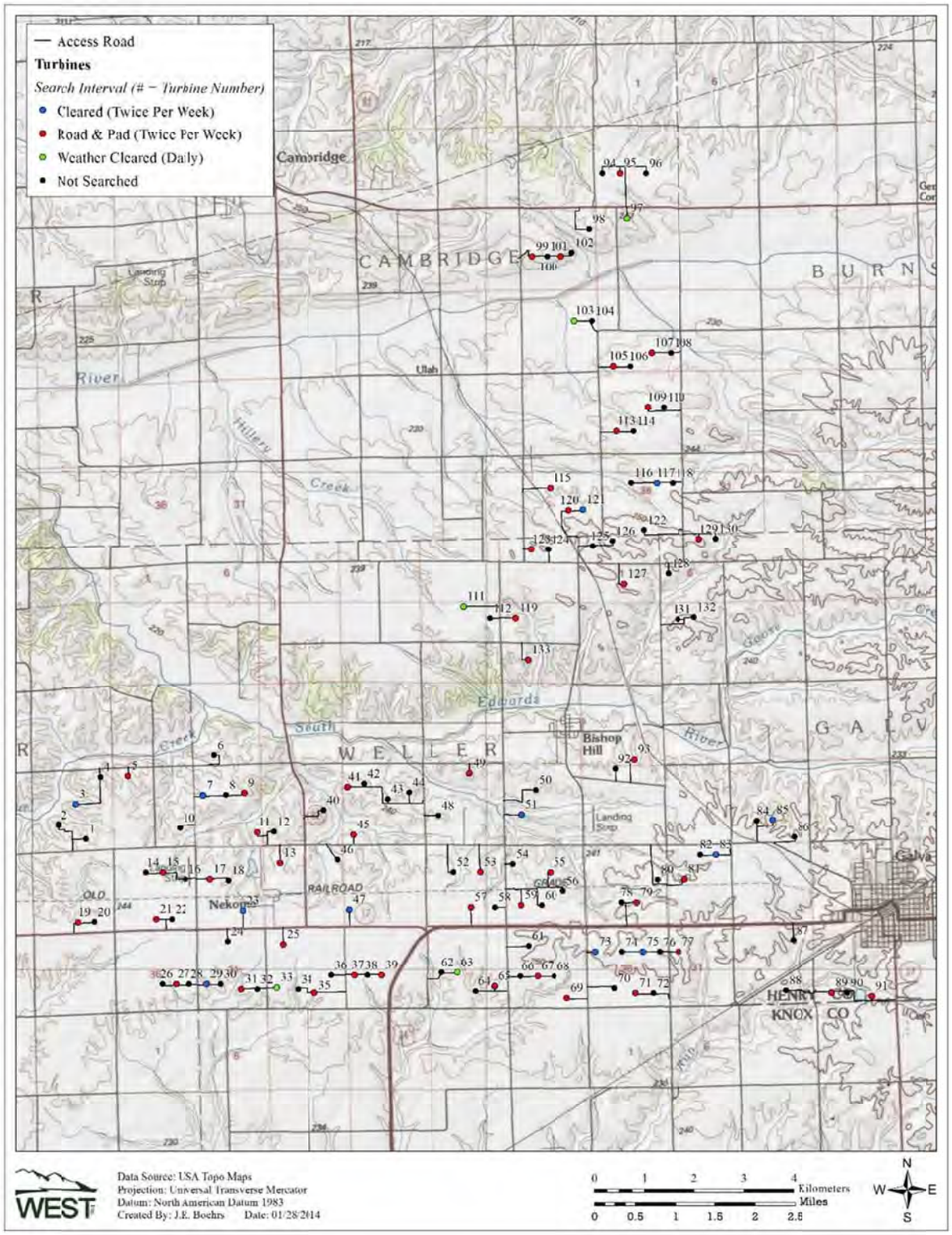


**Figure 1. Turbine and search plot locations of the Bishop Hill Wind Energy Facility.**

Fatality estimates were calculated by adjusting the number of found carcasses for the following biases: search frequency, carcass removal (length of stay in the field), area searched, and searcher efficiency (percent found). It is important to note that the cause of death of each carcass discovered was not determined, and therefore all of the carcasses found may not have been attributable to the Project (e.g., some carcasses may have perished due to reasons not related to wind-energy production, such as predation).

Nine carcass removal and 10 searcher efficiency bias trials were conducted throughout the study period at randomly selected turbines. Trial carcasses were randomly placed on all plot types (twice per week cleared plots, twice per week road and pad plots, and daily plots). Trial bird carcasses used in the study included house sparrows (*Passer domesticus*) and Coturnix quail (*Coturnix spp.*) for small birds, and rock pigeons (*Columba livia*), mallards (*Anas platyrhynchos*), and ring-necked pheasants (*Phasianus colchicus*) for large birds. Trial bird carcasses were placed at search turbines by a biologist not involved in the carcass searches. Carcasses were placed throughout the study period at predetermined randomly selected points (random azimuth and distance from the turbine) within any given turbine's searchable area. Searchers had no knowledge of the number, placement, or timing of bias trial carcasses.

Data recorded for each trial carcass at the time of placement included date of placement, species, turbine number, and the distance to and direction from the turbine. Bias trial carcasses were identified through the placement of small, inconspicuous black zip ties on the birds' legs. Trial carcasses were placed prior to searches being conducted on a given day. Carcasses were checked at the end of a survey day, to ensure carcasses were available to be detected. Carcasses were checked on days one through seven, then on days 10, 14, 20, and 30. Each carcass was left in the field until removed by a scavenger, until it became decomposed such that it was beyond recognition, or for a maximum of 30 days. The number of days from placement until removal, decomposition, or the end of the trial period was then recorded.

## 2.2 Statistical Analysis

### *2.2.1 Carcass Monitoring*

Statistical methods for estimating mortality rates were based on:

1. Observed number of bird carcasses found during standardized searches;
2. Searcher efficiency; and
3. Scavenger removal rates.

### *2.2.2 Definition of Variables*

The following variables are used in the equations below:

$c_i$ number of carcasses detected at plot *i* for the study period

$n$ number of search plots

$k$ number of turbines searched

$\bar{c}$ average number of carcasses observed per turbine

$s$ number of carcasses used in removal trials

$s_c$ number of carcasses in removal trials that remain in the study area after 30 days

$t_j$ time (in days) carcass *j* remains in the study area before it is removed, as determined by removal trials

$\bar{t}$ average time (in days) a carcass remains in study area before it is removed, as determined by removal trials

$p$ estimated proportion of detectable carcasses found by searchers, as determined by searcher efficiency trials

$I$ average interval between standardized carcass searches, in days

A proportion of search area actually searched

$\hat{\pi}_S$ Shoenfeld (2004) estimate for probability that a carcass is both available to be found during a search and is found, as determined by removal and searcher efficiency trials

$m_s$ estimated annual average number of fatalities per turbine per year, adjusted for removal and searcher efficiency bias with Shoenfeld pi

### *2.2.3 Observed Number of Carcasses*

The estimated average number of carcasses ($\bar{c}$) observed per turbine for the study period was:

$$\bar{c} = \frac{\sum_{i=1}^{n} c_i}{k \cdot A}$$

### *2.2.4 Estimation of Carcass Non-Removal Rates*

Estimates of carcass non-removal rates were used to adjust carcass counts for removal bias. Mean carcass removal time ($\bar{t}$) was the average length of time a carcass remained in the study area before it is removed:

$$\bar{t} = \frac{\sum_{j=1}^{s} t_j}{s - s_c}$$

### *2.2.5 Estimation of Searcher Efficiency Rates*

Searcher efficiency rates were expressed as *p,* the proportion of trial carcasses that were detected by searchers in searcher efficiency trials. These rates were estimated by carcass size and season.

*2.2.6 Estimated Fatality Rates*

The estimated per turbine fatality rate (*m*) was calculated by:

$$m = \frac{\bar{c}}{\hat{\pi}}$$

where $\hat{\pi}$ includes adjustments for both carcass removal (from scavenging and other means) and searcher efficiency bias.

The Shoenfeld estimator (Shoenfeld 2004) was used to estimate the probability a carcass was available and detected ($\hat{\pi}$):

$\hat{\pi}_S$, the Shoenfeld estimator, was calculated by:

$$\hat{\pi}_S = \frac{\bar{t} \cdot p}{I} \cdot \left[ \frac{\exp\left( I / \bar{t} \right) - 1}{\exp\left( I / \bar{t} \right) - 1 + p} \right]$$

Shoenfeld estimates for the cleared plots were combined using a weighted average of the number of turbines in the two search interval categories (five turbines searched daily and 12 turbines searched every three days).

The variance and 90% confidence intervals of each estimator was calculated using bootstrapping (Manly 1997). Bootstrapping is a computer simulation technique that is used to calculate variance and confidence intervals for complicated statistics. The bootstrapping technique assumes that the variance present in the sample is equivalent to the variance in the population. The original sample data is re-sampled 1,000 times to simulate the variance of the estimators. For each bootstrap sample, $\bar{c}$, $\bar{t}$, p, $\hat{\pi}_s$, $\hat{\pi}_e$, and $m_s$ are calculated. The standard deviation of the bootstrap estimates is the estimated standard error. The lower 5$^{th}$ and upper 95$^{th}$ percentiles of the 1,000 bootstrap estimates are taken as the estimates of the lower limit and upper limit of 90% confidence intervals.

# 3.0 RESULTS

## 3.1 Carcass Monitoring

A total of 1,054 turbine searches were conducted from August 1 – September 30, 2013. A total of 27 bird carcasses were found during the study; 26 carcasses were found during scheduled searches and one was found outside of search plots and considered an incidental discovery (Table 1, Appendix A). Six of the 27 carcasses were found on roads and pads, 20 were found on cleared plots, and one carcass was found incidentally at a turbine that was not searched.

The most commonly found bird species was killdeer (*Charadrius vociferous*; 14 carcasses, 51.9% of all carcasses; Table 1).

Two Canada geese (*Branta canadensis*) were recorded as carcasses during the study. However, it is possible that these two observations were not actually carcasses – they were recorded based on feather spots, which could have been the result of preening activity by Canada geese that were observed in large flocks in search plots. No bird species listed as threatened or endangered by the state of Illinois (Illinois Natural Heritage Database, Illinois Department of Natural Resources [IDNR] 2014) or under the federal Endangered Species Act (ESA 1973, USFWS 2014) was found.

**Table 1. Number and percent composition of bird carcasses found during post-construction carcass monitoring at the Bishop Hill Wind Energy Facility from August 1 – September 30, 2013.**

| | Carcasses found during scheduled searches | | Other incidental finds* | | Total | |
|---|---|---|---|---|---|---|
| **Species** | **Total** | **% Comp.** | **Total** | **% Comp.** | **Total** | **% Comp.** |
| killdeer | 14 | 53.8 | 0 | 0 | 14 | 51.9 |
| unidentified bird (small) | 6 | 23.1 | 0 | 0 | 6 | 22.2 |
| Canada goose** | 2 | 7.7 | 0 | 0 | 2 | 7.4 |
| turkey vulture | 2 | 7.7 | 0 | 0 | 2 | 7.4 |
| house sparrow | 1 | 3.8 | 0 | 0 | 1 | 3.7 |
| mourning dove | 1 | 3.8 | 0 | 0 | 1 | 3.7 |
| field sparrow | 0 | 0 | 1 | 100.0 | 1 | 3.7 |
| **Total** | **26** | **100.0** | **1** | **100.0** | **27** | **100.0** |

*Carcasses found prior to the start of the study.
**Feather spots are potentially the result of preening activity and not actual carcasses.

For most bird carcasses, the estimated time of death was undetermined (80.8%; Table 2). For carcasses where an estimated time of death could be determined, the majority were estimated to have died the night prior to a scheduled search (15.4%). Bird carcasses were found sporadically throughout the study period with no clear temporal pattern (Figure 2). Approximately 82% of all bird carcasses were found within 40 m (131 ft) of turbines, with the highest percentage (61.5%) of carcasses found between 20 – 30 m (66 – 98 ft), followed by 19.2% of birds carcasses found between 30 – 40 m (98 – 131 ft; Table 3). Bird carcasses revealed no discernible distribution throughout the Project area (Figure 3).

**Table 2. Estimated time since death of bird carcasses at the Bishop Hill Wind Energy Facility from August 1 – September 30, 2013.**

| Estimated Time Since Death | Number of Carcasses | Percent Composition |
|---|---|---|
| last night | 4 | 15.4 |
| 2-3 days | 0 | 0 |
| 4-7 days | 0 | 0 |
| 7-14 days | 0 | 0 |
| >2 weeks | 1 | 3.8 |
| >month | 0 | 0 |
| Unknown | 21 | 80.8 |

**Table 3. Distribution of distances from turbines of all bird carcasses found during scheduled searches and incidentally on turbine search plots at the Bishop Hill Wind Energy Facility from August 1 – September 30, 2013.**

| Distance to Turbine (m) | % Bird Carcasses |
|---|---|
| 0 to 10 | 3.8 |
| 10 to 20 | 7.7 |
| 20 to 30 | 61.5 |
| 30 to 40 | 19.2 |
| 40 to 50 | 3.8 |
| 50 to 60 | 0 |
| 60 to 70 | 0 |
| 70 to 80 | 3.8 |

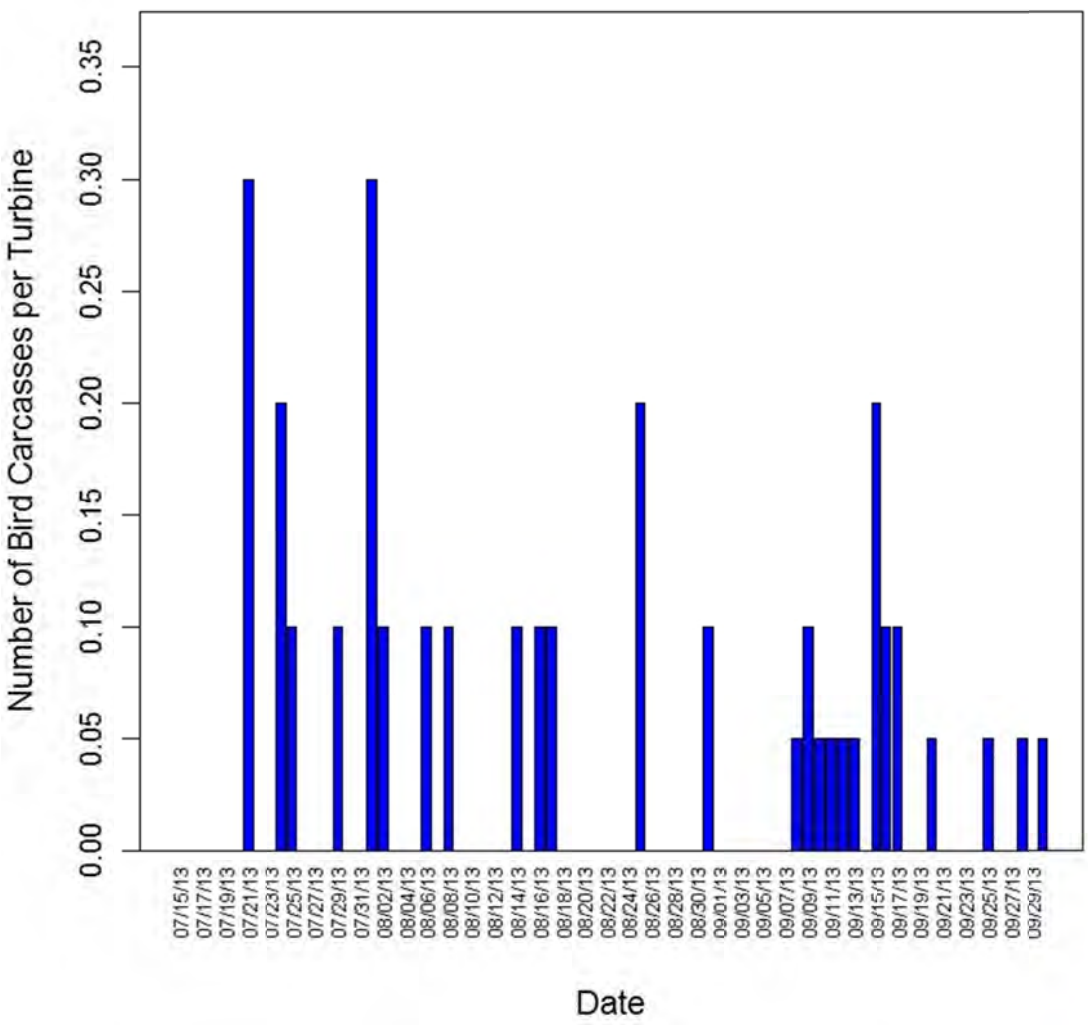


**Figure 2. Timing of bird carcasses per turbine found during scheduled searches or incidentally on turbine search plots at the Bishop Hill Wind Energy Facility from August 1 – September 30, 2013.**

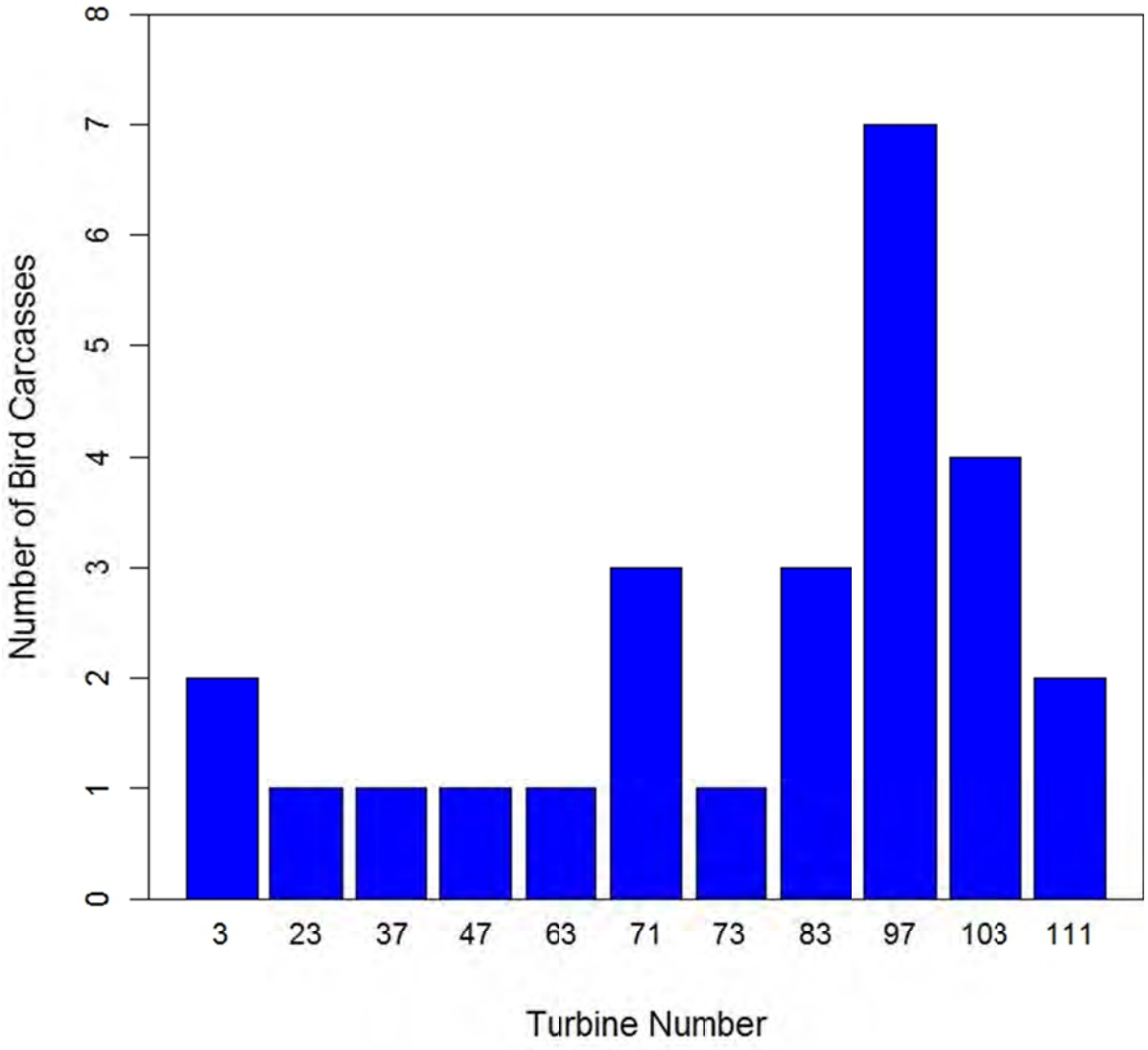


**Figure 3. Number of bird carcasses by turbine found during scheduled searches or incidentally on turbine search plots at the Bishop Hill Wind Energy Facility from August 1 – September 30, 2013. Turbines where no bird carcasses were found are not shown in this figure.**

Thirty-six large bird and small bird carcasses were used during scavenger removal trials. Mean removal time was 7.8 days for large birds and 2.4 days for small birds (Figure 4).

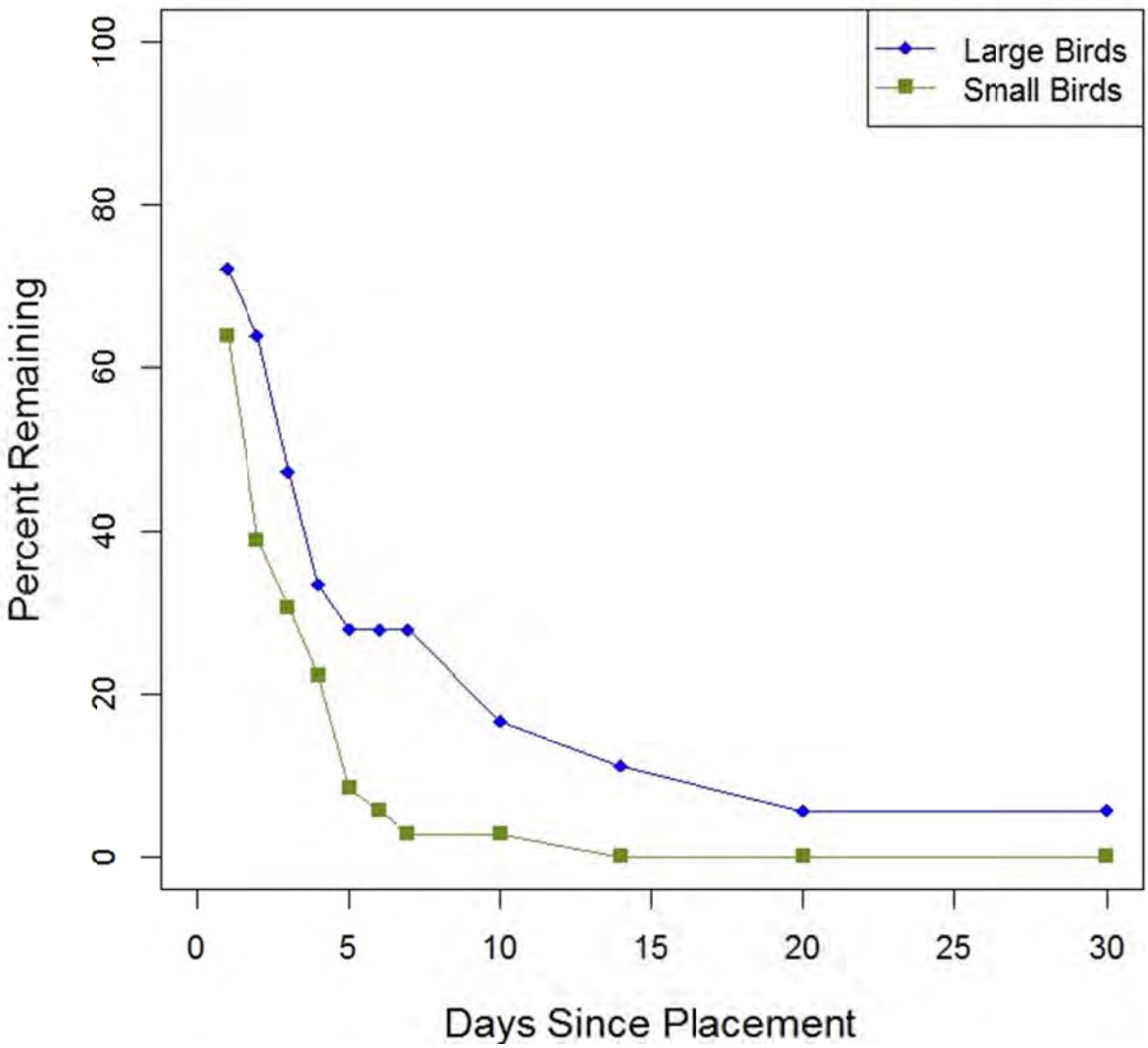


**Figure 4. Carcass removal rates at the Bishop Hill Wind Energy Facility from August 1 – September 30, 2013.**

On cleared plots, 10 large birds and 16 small birds were placed for searcher efficiency trials. Nine of the 10 available large birds were found on the first scheduled search, resulting in a searcher efficiency rate of 90% for large birds. Of 14 available small birds on cleared plots, 10 were found, resulting in a searcher efficiency rate of 71.4%.

On road and pad search plots, 28 large birds and 22 small birds were placed for searcher efficiency trials. All of the available large birds were found, resulting in a searcher efficiency rate of 100%. For small birds, 16 of the 19 available were found, resulting in a searcher efficiency rate of 84.2%.

### 3.2 Fatality Estimates

There were too few bird carcasses found to estimate reliable corrections for birds falling on roads and pads versus cleared plots. As a result, fatality estimates were based only on cleared plots.

Bird fatality estimates and 90% confidence intervals for cleared plots were calculated for all bird types (Table 4, Appendix B). Fatality estimates were adjusted based on the corrections for carcass removal and observer detection bias. Fatality estimates are provided per turbine and per MW (Table 4; Appendices A and B).

**Table 4. Bird fatality Shoenfeld estimates for the Bishop Hill Wind Energy Facility from August 1 to September 30, 2013.**

| | Corrected Fatality Estimate (90% CI) |
|---|---|
| **Estimated # fatalities/turbine/study period** | |
| Small Birds | 0.52 (0.18-0.97) |
| Large Birds | 1.12 (0.58-1.87) |
| All Birds | 1.65 (0.98, 2.55) |
| **Estimated # fatalities/MW/study period** | |
| Small Birds | 0.33 (0.11, 0.62) |
| Large Birds | 0.72 (0.37, 1.19) |
| All Birds | 1.05 (0.62, 1.62) |

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**Appendix A. Complete Carcass Listing for the Bishop Hill Wind Energy Facility**

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**Appendix A. Complete carcass listing for the Bishop Hill Wind Energy Facility.**

| Date | Common Name | Location | Distance from Turbine | Type of Find | Search Type | Condition |
|---|---|---|---|---|---|---|
| 8/01/2013 | killdeer | 71 | 73 | carcass search | twice per week | feather spot |
| 8/03/2013 | killdeer | 103 | 26 | carcass search | daily | feather spot |
| 8/03/2013 | unidentified bird (small) | 71 | 48 | carcass search | twice per week | feather spot |
| 8/04/2013 | killdeer | 37 | 23 | carcass search | twice per week | feather spot |
| 8/04/2013 | killdeer | 73 | 16 | carcass search | twice per week | feather spot |
| 8/06/2013 | unidentified bird (small) | 97 | 31 | carcass search | daily | feather spot |
| 8/08/2013 | killdeer | 83 | 25 | carcass search | twice per week | feather spot |
| 8/09/2013 | turkey vulture | 103 | 28 | carcass search | daily | dismembered |
| 8/11/2013 | killdeer | 97 | 20 | carcass search | daily | feather spot |
| 8/11/2013 | unidentified bird (small) | 71 | 22 | carcass search | twice per week | feather spot |
| 8/16/2013 | killdeer | 97 | 22 | carcass search | daily | feather spot |
| 8/18/2013 | killdeer | 97 | 31 | carcass search | daily | feather spot |
| 8/18/2013 | unidentified bird (small) | 47 | 37 | carcass search | twice per week | feather spot |
| 8/18/2013 | unidentified bird (small) | 111 | 28 | carcass search | daily | feather spot |
| 8/23/2013 | killdeer | 97 | 37 | carcass search | daily | feather spot |
| 8/25/2013 | killdeer | 63 | 24 | carcass search | daily | feather spot |
| 8/29/2013 | killdeer | 111 | 23 | carcass search | daily | feather spot |
| 9/03/2013 | unidentified bird (small) | 97 | 27 | carcass search | daily | feather spot |
| 9/04/2013 | Canada goose | 3 | 3 | carcass search | twice per week | feather spot |
| 9/06/2013 | killdeer | 97 | 21 | carcass search | daily | feather spot |
| 9/07/2013 | Canada goose | 3 | 30 | carcass search | twice per week | feather spot |
| 9/18/2013 | killdeer | 83 | 26 | carcass search | twice per week | feather spot |
| 9/20/2013 | mourning dove | 103 | 35 | carcass search | daily | feather spot |
| 9/20/2013 | turkey vulture | 103 | 26 | carcass search | daily | feather spot |
| 9/25/2013 | killdeer | 83 | 26 | carcass search | twice per week | feather spot |
| 9/29/2013 | field sparrow | 104 | 114 | incidental find | not searched | intact |
| 9/30/2013 | house sparrow | 23 | 26 | carcass search | twice per week | intact |

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**Appendix B. Complete Estimated Bird Fatality Table for the Bishop Hill Wind Energy Facility for Studies Conducted from August 1 to September 30, 2013**

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**Appendix B. Complete estimated bird fatality table for the Bishop Hill Wind Energy Facility for studies conducted from August 1 to September 30, 2013.**

| Parameter | Shoenfeld Estimate Mean | CI |
|---|---|---|
| **Observer Detection** | | |
| A (small birds) | 0.79 | 0.67-0.91 |
| A (large birds) | 0.97 | 0.92-1.00 |
| **Mean Carcass Removal Time (days)** | | |
| $\bar{t}$ (small birds) | 2.44 | 1.72-3.35 |
| $\bar{t}$ (large birds) | 7.78 | 4.56 -11.71 |
| **Estimated Fatality Rates (Fatalities/turbine/study period)** | | |
| Small birds-daily | 0.60 | 0.20-1.40 |
| Small birds-weekly | 0.17 | 0.8-0.42 |
| Large birds- daily | 2.20 | 0.80-3.80 |
| Large birds-weekly | 0.50 | 0.8-1.00 |
| **Average Probability of Carcass Availability and Detected** | | |
| Small birds-daily | 0.75 | 0.65-0.81 |
| Small birds-weekly | 0.45 | 0.34-0.55 |
| Large birds- daily | 0.93 | 0.84-0.94 |
| Large birds- weekly | 0.80 | 0.60-0.82 |

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# Carcass Monitoring Report for the Bishop Hill Wind Energy Facility Henry County, Illinois

## April 15, 2014 – May 15, 2014

**Prepared for:**

**Invenergy LLC**

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**July 21, 2014**

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## REPORT REFERENCE

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## TABLE OF CONTENTS

**1.0** INTRODUCTION ..... 1

**2.0** METHODS ..... 1

2.1 Plot Selection and Condition ..... 4

2.2 Search Methods ..... 4

2.3 Bias Trials ..... 5

2.4 Fatality Rate Estimation ..... 6

*2.4.1 Definition of Variables* ..... 6

*2.4.2 Observed Number of Carcasses* ..... 6

*2.4.3 Estimation of Carcass Removal Rates* ..... 7

*2.4.4 Estimation of Searcher Efficiency Rates* ..... 7

*2.4.5 Estimation of Facility-Related Fatality Rates* ..... 7

**3.0** RESULTS ..... 7

**4.0** REFERENCES ..... 9

## LIST OF TABLES

Table 1. Searcher efficiency results at the Bishop Hills Wind Energy Facility as a function of carcass size ..... 8

Table 2. Bird and bat fatality estimates for Bishop Hills Wind Energy Facility from April 15 to May 15, 2014 ..... 9

## LIST OF FIGURES

Figure 1. Location of the Bishop Hill Wind Energy Facility. ..... 2

Figure 2. Location of turbines and search plots at the Bishop Hill Wind Energy Facility. ..... 3

Figure 3. Carcass removal rates at the Bishop Hill Wind Energy Project. ..... 8

## LIST OF APPENDICES

Appendix A. Complete Bat Carcass Listing, April 15 to May 15, 2014, at the Bishop Hill Wind Energy Facility

Appendix B. Complete Estimated Shoenfeld Bat Fatality Rates for the Bishop Hill Wind Energy Facility for Studies Conducted from April 15 to May 15, 2014

Appendix C. Complete Estimated Shoenfeld Bird Fatality Rates for the Bishop Hill Wind Energy Facility for Studies Conducted from April 15 to May 15, 2014

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# 1.0 INTRODUCTION

The Bishop Hill Wind Energy Facility (BHWEF or Project), located in Henry County, Illinois (Figure 1), is owned by Bishop Hill Energy LLC (BHE) and other Invenergy LLC affiliates. Phase I of the Project consists of 133 wind turbines (with a total nameplate capacity of 200 megawatts [MW]), including 34 1.5-MW and 99 1.6-MW turbines. Phase II (80 MW) is also operational, but is owned by another entity and is not included in this study. Subsequent phases, up to 120 MW in capacity, are proposed for development, for a total Project capacity of 400 MW. Bird and bat carcass monitoring was conducted to comply with the BHE Avian and Bat Protection Plan (ABPP; BHE 2011).

## 1.1 Study Area

The BHWEF is approximately 16.6 kilometers (km, 10.3 miles [mi]) east to west and approximately 17.0 km (10.6 mi) north to south (Figure 1). Corn and soy bean production is the dominant land use in the Project area; trees are sparsely distributed and typically restricted to small clumps, generally associated with homes and patches along the South Edward River and other small riparian areas. The South Edwards runs through the center of the BHWEF and is approximately 0.8 km (0.5 mi) from the nearest turbine at its closest point.

# 2.0 METHODS

The study design followed carcass monitoring procedures in BHE's ABPP (BHE 2011) that included weekly searches at 30 turbines with cleared plots (Figure 2). While the bird and bat fatality rates were estimated based on the number of carcasses found in turbines searches, it is important to note that the cause of death of each carcass discovered was not determined, and therefore all of the carcasses found may not have been attributable to the Project (e.g., some carcasses may have perished due to reasons not related to wind-energy production, such as predation).

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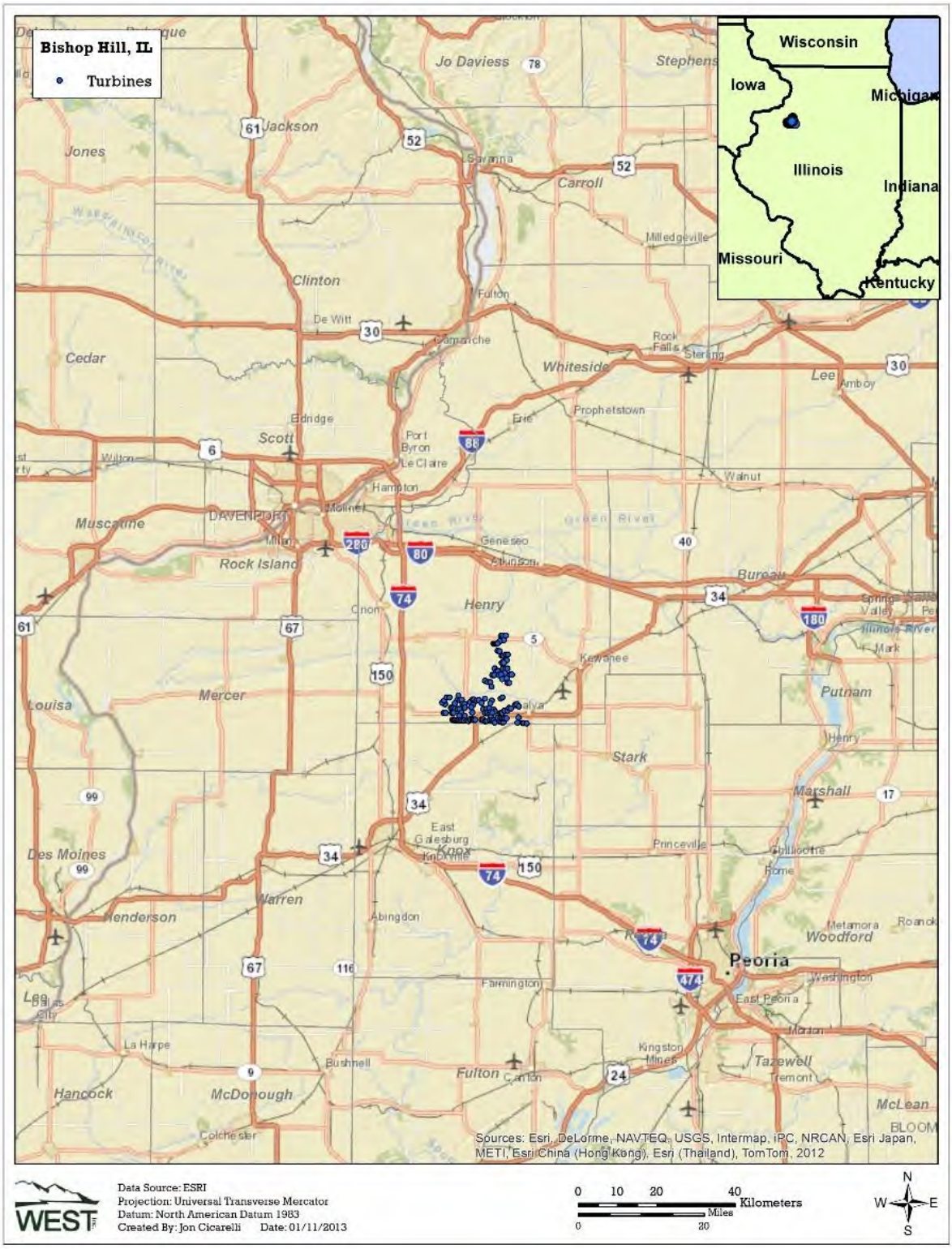


**Figure 1. Location of the Bishop Hill Wind Energy Facility.**

**Figure 2. Location of turbines and search plots at the Bishop Hill Wind Energy Facility.**

## 2.1 Plot Selection and Condition

Thirty turbines were selected using a systematic random sampling approach, which helped to ensure that study turbines were distributed across the BHWEF (Figure 2). The turbines were searched within square 78 x 78 m (256 x 256 ft) plots centered on the turbine. Plots were delineated prior to planting so that farmers could avoid seeding. Plots were monitored and mowed if necessary to remove any stray cultivated crops or weeds during the study. Therefore, plots contained areas with little or no vegetation (e.g., access roads and turbine pads), bare ground, or varying levels of dead or regenerating low vegetation.

## 2.2 Search Methods

Carcass search methods were consistent with those described in BHE's APBB (BHE 2011). Technicians were trained in proper search techniques, including walking speed, search images, and data collection. Plots were searched following transects oriented perpendicular to plot edges and spaced 5 to 6 m (16 to 20 ft) apart. Technicians walked transects while scanning the ground ahead of them 2 to 3 m (7 to 10 ft) on either side of transects. Walking rates were generally 45 to 60 m (148 to 197 ft) per minute, but were sometimes slower depending on plot conditions (e.g. searches were slower after hard rains due to muddy conditions). All 30 plots were searched weekly during the study period.

When a carcass was found by a technician, the location was marked using a pin flag. After the plot was completely searched, technicians went back to any marked carcasses to record data. For each carcass discovered, technicians assigned a unique carcass identification (ID) that consisted of the date, 4-letter species code, plot ID, and carcass number (e.g., 071513-EUST-19-1). Technicians also recorded the following information on data forms: carcass ID, plot ID, date, technician's initials, estimated time since death (in days), species, sex and age (when possible), physical condition (e.g., intact, scavenged, dismembered), state of decomposition, distance and bearing from turbine, and Universal Transverse Mercator (UTM) coordinates. Technicians also marked the location of the carcass on a grid map representing the plot and took at least four photos of each carcass, with at least two close-ups of the carcass, and two showing the location relative to the turbine and plot conditions.

After all data were recorded, searchers collected the carcass, placed it in a plastic bag along with an identification tag that included the unique carcass ID. All carcasses found each day were placed in a freezer located at the on-site operations and maintenance building. A binder kept at the freezer included a log in which technicians recorded all carcasses deposited in the freezer. The binder also included copies of all relevant permits needed to legally collect and hold carcasses.

Carcasses were collected under the following permits: Illinois Department of Natural Resources (IDNR) Salvage Permit, No. NH13.5223; IDNR Endangered or Threatened Species Permit, No. 11-14Sa; and/or USFWS Special Purpose Utility Permit for Migratory Bird Mortality Monitoring, No. MB72234A-0.

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## 2.3 Bias Trials

Scavenger removal and searcher efficiency trials (bias trials) were conducted to assess sources of bias and to improve the accuracy of fatality rate estimation. Bias trials were designed to estimate the proportion of carcasses removed by scavengers prior to scheduled searches and the proportion of remaining carcasses that were missed by searchers during scheduled searches. One searcher efficiency and one carcass removal bias trials was conducted during the study period using house sparrows (*Passer domesticus*) and Coturnix quail (*Coturnix spp.*) for small birds, mallards (*Anas platyrhynchos*), and ring-necked pheasants (*Phasianus colchicus*) for large birds, and previously salvaged bat species (big brown bat [E*ptesicus fuscus]*, eastern red bat [*Lasiurus borealis]*, hoary bat [*Lasiurus cinereus]*, and silver-haired bat [*Lasionycteris noctivagans])*. The scavenger removal trial lasted 30 days or until all placed carcasses were removed by scavengers, whichever came first.

For the bias trials, carcasses were randomly placed on search plots. The locations of the placed carcasses (i.e., distance and bearing from turbine) were randomly assigned prior to the start of bias trials. Trial carcasses were discreetly marked so that technicians, who were blind to the presence and location of trial carcasses, could identify them when they were found. When technicians located a bias trial carcass they recorded the location, species, and time of the discovery. Found carcasses were left in place for use in the concurrent scavenger removal trial. As such, each bias trial carcass was used to estimate both searcher efficiency and scavenger removal rates.

During the scavenger removal trial, technicians checked each carcass every day during days 1-7, then on days 10, 14, 20, and 30. During checks, technicians recorded whether the carcass remained, and if so, the condition of the carcass (e.g., intact – no scavenging, evidence of scavenging, whole carcass, partial carcass, etc.) and the source of scavenging, if it could be determined. If the carcass was not found in its previous location during a check, bias trial technicians were instructed to search within a 5-m (16-ft) radius circle of the previous carcass location. If after three visits the carcass was not located by the technician, it was assumed to have been scavenged and was noted as having been removed by a scavenger prior to the first visit during which it was not found. Any bias trial carcasses remaining after 30 days were disposed of.

Using data from these trials, the number of days that passed until a carcass was first found during a scheduled search was estimated, as was the number of days that a carcass persisted and was available to be found. These mean durations were used to estimate searcher efficiency and scavenger removal rates.

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## 2.4 Fatality Rate Estimation

Estimated bird and bat fatality rates were calculated based on:

1. Observed number of bat and bird carcasses found during standardized searches during the monitoring period;
2. Searcher efficiency; and
3. Scavenger removal rates.

### *2.4.1 Definition of Variables*

The following variables were used in the equations below:

| | |
|---|---|
| $c_i$ | the number of carcasses detected at plot *i* for the entire study period |
| $n$ | the number of search plots |
| $\bar{c}$ | the average number of carcasses observed per turbine per monitoring period |
| $s$ | the number of carcasses used in the carcass removal trials |
| $s_c$ | the number of carcasses in the carcass removal trials that remained in the study area at Day 30 |
| $t_i$ | the time (in days) a carcass remained in the study area before it was removed, as determined by the carcass removal trials |
| $\bar{t}$ | the average time (in days) a carcass remained in the study area before it was removed, as determined by the carcass removal trials |
| $d$ | the total number of carcasses placed in the searcher efficiency trials |
| $p$ | the estimated proportion of detectable carcasses found by observers, as determined by the searcher efficiency trials |
| $I$ | the average interval between standardized carcass searches, in days |
| $\hat{\pi}$ | the estimated probability that a carcass was both available to be found during a search and was found, as determined by the carcass removal trials and the searcher efficiency trials (i.e., detection probability) |
| $m$ | the estimated annual average number of carcasses per turbine per year, adjusted for carcass removal and searcher efficiency bias |

### *2.4.2 Observed Number of Carcasses*

The average number of carcasses ( $\bar{c}$ ) observed per turbine per monitoring period was:

$$\bar{c} = \frac{\sum_{i=1}^{n} c_i}{n}$$

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*2.4.3 Estimated Carcass Removal Rates*

Estimates of carcass removal rates were used to adjust carcass counts for carcass removal bias. Mean carcass removal time ( $\bar{t}$ ) was the average length of time a carcass remained in the study area before it was removed:

$$\bar{t} = \frac{\sum_{i=1}^{s} t_i}{s - s_c}$$

*2.4.4 Estimated Searcher Efficiency Rates*

Searcher efficiency rates were expressed as *p,* the proportion of trial carcasses that were detected by observers in the searcher efficiency trials. These rates were estimated by carcass size. No visibility classes were mapped since the plots were all in tilled agriculture and had similar visibility classes.

*2.4.5 Estimation of Facility-Related Fatality Rates*

The estimated per turbine fatality rate (*m*) was calculated by:

$$m = \frac{\bar{c}}{\hat{\pi}} \qquad (3)$$

where $\hat{\pi}$ included adjustments for carcass removal (from scavenging and other means) and searcher efficiency bias.

This formula has been independently verified by Shoenfeld (2004). The final reported estimates of m were calculated according to the formula above. Associated standard errors and 90 percent confidence intervals were calculated using bootstrapping (Manly 1997). Bootstrapping is a computer simulation technique that is useful for calculating variances, and confidence intervals for complicated test statistics. For each bootstrap sample, $\bar{c}$, $\bar{t}$, p, $\hat{\pi}$, and m were calculated. A total of 1,000 bootstrap samples were used for each estimate. The standard deviation of the bootstrap estimates was reported as the estimated standard error. The lower fifth and upper ninety-fifth percentiles of the 1,000 bootstrap estimates were taken as estimates of the lower limit and upper limit of the 90 percent confidence intervals. In addition, all areas within all surveyed plots were searchable and no correction factors were needed.

## 3.0 RESULTS

One hundred fifty turbine searches were conducted from April 15 – May 15, 2014. The only carcass found was one silver-haired bat during a scheduled search (Appendix A). The bat was found on May 8 at turbine 121 approximately 37 m from the turbine and TOD was estimated to be the previous night.

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One searcher efficiency trial with 50 carcasses (10 large birds, 12 small birds, and 28 bats) was placed on April 15. The overall searcher efficiency rate for small birds was 83%, compared to 90% for large birds, and 79% for bats (Table 1).

**Table 1. Searcher efficiency results at the Bishop Hills Wind Energy Facility as a function of carcass size.**

| Size | # Placed | # Available | # Found | % Found |
|---|---|---|---|---|
| Small Birds | 12 | 12 | 10 | **83.3** |
| Large Birds | 10 | 10 | 9 | **90.0** |
| Bats | 28 | 28 | 22 | **78.6** |

One carcass removal trials was placed on April 15 at the Project. The mean carcass removal rate was 12.15 days for large birds, 9.12 days for small birds, and 12.74 days for bats. By day ten, roughly 38% of small birds, 25% of large birds, and 30% of bats remained where they were placed. By day 30, no small bird carcasses remained and roughly 18% of large birds and bats remained (Figure 3).

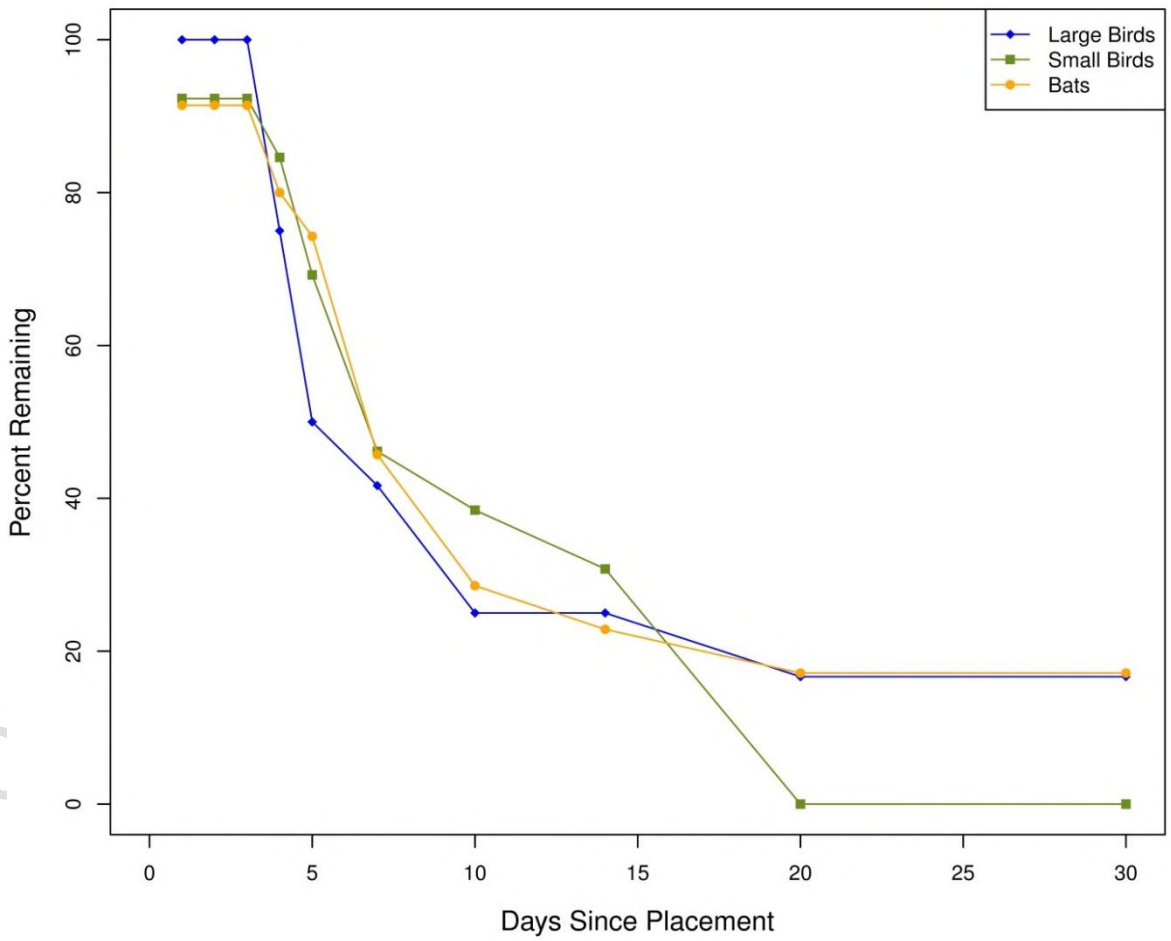


**Figure 3. Carcass removal rates at the Bishop Hill Wind Energy Project.**

Estimated bat fatality rates per turbine and per MW and 90% confidence intervals for the study period are reported (Table 2: Appendix B). No bird carcasses were found, thus the fatality estimate is zero (Table 2; Appendix C).

**Table 2. Bird and bat fatality estimates for Bishop Hills Wind Energy Facility from April 15 to May 15, 2014.**

| | Corrected Fatality Estimate | 90% Confidence Interval |
|---|---|---|
| ***# fatalities/turbine/study period*** | | |
| Small Birds | 0 | 0 |
| Large Birds | 0 | 0 |
| Raptors | 0 | 0 |
| All Birds | 0 | 0 |
| Bats | 0.05 | 0 – 0.16 |
| ***# fatalities/MW/study period*** | | |
| Small Birds | 0 | 0 |
| Large Birds | 0 | 0 |
| Raptors | 0 | 0 |
| All Birds | 0 | 0 |
| Bats | 0.03 | 0 - .0.07 |

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## Appendix A. Complete Bat Carcass Listing, April 15 to May 15, 2014, at the Bishop Hill Wind Energy Facility

**Appendix A. Complete carcass listing, April 15 to May 15, 2014, at the Bishop Hill Wind Energy Facility.**

| Date | Common Name | Turbine | Distance from Turbine (m) | Type of Find | Condition |
|---|---|---|---|---|---|
| 5/8/2014 | silver-haired bat | 121 | 37 | carcass search | intact |

## Appendix B. Complete Estimated Shoenfeld Bat Fatality Rates for the Bishop Hill Wind Energy Facility for Studies Conducted from April 15 to May 15, 2014

**Appendix B. Complete bat fatality estimate table for the Bishop Hill Wind Energy Facility for studies conducted from April 15 to May 15, 2014.**

| Parameter | Mean | 90% CI |
|---|---|---|
| **Observer Detection** | | |
| *P (bats)* | 0.79 | 0.64 – 0.9. |
| **Mean Carcass Removal Time (days)** | | |
| $\bar{t}$ *(bats)* | 12.74 | 8.22 - 19.46 |
| **Observed Fatality Rates (Fatalities/turbine/study period)** | | |
| *Bats* | 0.03 | 0 – 0.10 |
| **Average Probability of Carcass Availability and Detected** | | |
| *Bats* | 0.68 | 0.55 - 0.78 |
| **Adjusted Fatality Estimates (Fatalities/turbine/study period)** | | |
| *Bats* | 0.05 | 0 – 0.16 |

**Appendix C. Complete Estimated Shoenfeld Bird Fatality Rates for the Bishop Hill Wind Energy Facility for Studies Conducted from April 15 to May 15, 2014**

**Appendix C. Complete bird fatality estimate table for the Bishop Hill Wind Energy Facility for studies conducted from April 15 to May 15, 2014.**

| Parameter | Mean | 90% CI |
|---|---|---|
| **Observer Detection** | | |
| *P (small birds)* | 0.83 | 0.58 – 1.00 |
| *P (large birds)* | 0.90 | 0.70 – 1.00 |
| **Mean Carcass Removal Time (days)** | | |
| $\bar{t}$ *(small birds)* | 9.12 | 6.04 - 12.39 |
| $\bar{t}$ *(large birds)* | 12.15 | 5.37 - 27.57 |
| **Observed Fatality Rates (Fatalities/turbine/study period)** | | |
| *Small birds* | 0 | - |
| *Large birds* | 0 | - |
| *Raptors* | 0 | - |
| **Average Probability of Carcass Availability and Detected** | | |
| *Small birds* | 0.62 | 0.46 - 0.72 |
| *Large birds* | 0.71 | 0.49 - 0.86 |
| **Adjusted Fatality Estimates (Fatalities/turbine/study period)** | | |
| *Small birds* | 0 | - |
| *Large birds* | 0 | - |
| *Raptors* | 0 | - |
| *All birds* | 0 | - |

# 2014 Avian Fatality Monitoring Report

## Bishop Hill Wind Energy Facility
## Henry County, Illinois

January 22, 2014


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# Table of Contents

**1.0 INTRODUCTION ..... 2**

**2.0 METHODS ..... 2**

**2.1 PROJECT AREA ..... 2**

**2.2 FATALITY MONITORING ..... 2**
*2.2.1 Selection of Turbines ..... 2*
*2.2.2 Study Schedule ..... 2*
*2.2.3 Search Plots, Visibility Classes, and Habitats ..... 3*
*2.2.4 Search Methods ..... 4*
*2.2.5 Documentation of Incidental Carcasses ..... 5*
*2.2.6 Alive and Injured Specimens ..... 5*

**2.3 SEARCH BIAS CORRECTIONS ..... 5**
*2.3.1 Searcher Efficiency Field Methods ..... 6*
*2.3.2 Scavenger/Carcass Removal Field Methods ..... 7*
*2.3.3 Searchable Area Corrections ..... 7*

**2.4 ANALYSIS ..... 7**
*2.4.1 Bird Carcass Data ..... 7*
*2.4.2 Temporal and Spatial Patterns ..... 7*
*2.4.3 Age, Species, and Sex ..... 8*
*2.4.4 Fatality Estimation ..... 8*

**3.0 RESULTS ..... 9**

**3.1 SUMMARY OF SEARCH EFFORT ..... 9**

**3.2 BIRD CARCASS SUMMARY ..... 10**
*3.2.1 Bird Carcasses by Species ..... 10*
*3.2.2 Bird Carcasses by Turbine ..... 11*
*3.2.3 Temporal Patterns ..... 11*
*3.2.4 Spatial Patterns ..... 12*
*3.2.5 Incidental Bird Carcass Recoveries ..... 13*
*3.2.6 Alive and Injured Specimens ..... 13*

**3.3 FATALITY ESTIMATION ..... 13**
*3.3.1 Searcher Efficiency ..... 13*
*3.3.2 Carcass Removal ..... 14*
*3.3.3 Searchable Area Corrections ..... 14*
*3.3.4 Estimated Bird Fatalities ..... 15*

**4.0 REFERENCES ..... 16**

## List of Tables

TABLE 1: AVERAGE SEARCH TIME, NUMBER OF DAYS SEARCHED, AND PERCENTAGE OF SURVEYS COMPLETED FOR EACH TURBINE .....10
TABLE 2: BIRD CARCASSES BY SPECIES .....10
TABLE 3: BIRD CARCASSES FOUND BY TURBINE .....11
TABLE 4: BIRD CARCASS RECOVERIES BY MONTH.....11
TABLE 5: BIRD CARCASS RECOVERIES BY DISTANCE (M).....12
TABLE 6: INCIDENTAL BIRD CARCASSES BY SPECIES.....13
TABLE 7: SEARCHER EFFICIENCY TRIALS BY DATE.....13
TABLE 8: OVERALL CARCASS REMOVAL.....14
TABLE 9: SEARCHABLE AREA CORRECTIONS BY TURBINE.....14
TABLE 10: BIRD FATALITY ESTIMATES FOR THE BISHOP HILL WIND ENERGY FACILITY.....15

## List of Figures

FIGURE 1. DIAGRAM OF A TYPICAL SEARCH PLOT.....4
FIGURE 2: BIRD CARCASS RECOVERIES BY WEEK.....12
FIGURE 3: PROPORTION OF BIRD CARCASS RECOVERIES BY DISTANCE (M). .....13

## Attachments

ATTACHMENT A: SITE VICINITY AND TURBINE LOCATION MAPS
ATTACHMENT B: SEARCH PLOT AND VISIBILITY CLASS MAPS
ATTACHMENT C: SAMPLE FIELD DATA FORMS
ATTACHMENT D: SEARCH DATA, CARCASS DATA, AND TRIAL DATA*

## EXECUTIVE SUMMARY

Avian carcass monitoring was conducted at the Bishop Hill Wind Energy Facility (BHWEF), Henry County, Illinois, from August 18 through October 4, 2014. Twelve (12) turbines were randomly selected for monitoring twice, weekly. Technicians were instructed to search for any bird carcasses within circular 90-meter radius plots centered beneath each of the 12 turbines. Seven (7) bird carcasses were recovered during standardized searches.

During carcass monitoring, search crews were assessed for search efficiency using 27 bird carcasses that were placed around the turbines on 7 specific dates. Searchers were targeted for a single search, after which the trial placement crew checked whether carcasses that were not found had been removed by scavengers. Carcasses remaining after the 1-day search were collected. Of the 27 carcasses placed on the plots, 9 were recovered, resulting in an overall search efficiency of 0.33. In addition to the search efficiency testing, 20 bird carcasses were placed around the turbines to assess scavenger removal rates. These carcasses were placed in 4, 5-carcass trials of 20 days each. During these trials, technicians were informed of the location of each carcass, and were instructed to confirm the presence or absence of each carcass during standard monitoring. Using a maximum likelihood estimator, an average length of time of 9.5 days was calculated for the removal of carcasses.

These bias adjustments, along with adjustments accounting for missed searches and imperfect search areas, were used to estimate total bird fatality at BHWEF. An estimate of 178 bird fatalities (95% confidence interval of 78 – 430 birds) was generated. This equated to a point estimate of 1.3 birds per turbine (0.6 – 3.2 birds/turbine) or 0.8 birds per nameplate Megawatt (0.4 – 2.0 birds/MW). The 95% confidence intervals were generated using a bootstrap method with 5,000 iterations.

# 1.0 INTRODUCTION

The Bishop Hill Wind Energy Facility (BHWEF) is owned by Bishop Hill Energy LLC and other Invenergy affiliates, and is located in Henry County, Illinois. Phase I of BHWEF is a 200 megawatt (MW) facility with 133 turbines (99 General Electric 1.6 MW turbines and 34 General Electric 1.5 MW turbines). Phase II carries an 80 MW capacity; however, it is owned by another entity and is not included in this study. The objectives of this monitoring program were to assess the levels of avian fatality in compliance with the guidelines/recommendations of the Illinois Department of Natural Resources (IDNR) and the US Fish and Wildlife Service.

# 2.0 METHODS

The 2014 bird carcass monitoring program was conducted as a subset of a larger experiment that included an assessment of temporal changes in carcass detection probabilities, which was conducted at an additional 6 turbines, searched daily to 60 meters from the turbine base. The results of the larger experimental design are reported elsewhere. The bird carcass monitoring search protocol followed an ordered rotation of 12 pre-selected turbines that were searched twice weekly from August 18 through October 4, 2014. The plots consisted of circular 90-meter plots with 6-meter spacing between transects.

## *2.1 Project Area*

BHWEF lies within the Interior River Valleys and Hills Ecoregion (Woods et al. 2006). The landscape consists of gently rolling hills, and is dominated by agricultural fields consisting of mostly corn and soybean, in addition to sparsely distributed oak-hickory wood lots. The majority of BHWEF is privately owned land that is sparsely populated with farms and residential units. Towns located within the study area included Bishop Hill, Woodhull, and Galva. Attachment A provides an overview of the project area.

## *2.2 Fatality Monitoring*

### 2.2.1 Selection of Turbines

Twelve (12) turbines were randomly selected for inclusion in the fatality monitoring and covered the extent of the project area. The turbines were identified as: 19, 26, 31, 36, 46, 71, 76, 86, 101, 116, 121, and 131 (Attachment A).

### 2.2.2 Study Schedule

Surveys were conducted from August 18 through October 4, 2014, resulting in a total of 48 search days. Turbines were scheduled to be searched twice per week during this period. The rotation of the turbines was stratified such that each turbine was scheduled to be searched in each part of the day (morning, mid-day, and afternoon). Decisions to not search turbines were made by Shoener Field Crew Supervisor (Elizabeth Karczynski/Brad Romano) or the Site Supervisor (Ryan Irving). Searches were canceled if weather or site conditions precluded safe search efforts. When a search could not be conducted, it was recorded in the “Comments” section of the daily search summary sheet.

For the purpose of maintaining consistent search conditions, the search days commenced at 7:00 am, weather and site conditions permitting. When a search could not be started within this period of time, it was recorded in the "Comments" section of the daily search summary sheet.

### 2.2.3 Search Plots, Visibility Classes, and Habitats

Ninety-meter (90 m) radius circular search plots were established beneath each of the monitored turbines (Figure 1). North and south transect boundaries were established using wooden stakes, and, to aid search orientation, the center line of each plot running east to west was also marked with stakes. This center line was set at 6 meter spacing. Between marker stakes, marking paint (color coded to specific transect lines) was used to keep the searcher crews oriented. In total, there were 30 transects per turbine, as shown in Figure 1. Plots were mowed and sprayed with herbicide in an effort to maximize carcass detectability. These methods were utilized throughout the season on areas that became difficult to search. Due to intensive plot condition maintenance, habitat conditions varied across the season. The visibility class for placed and recovered carcasses (including both actual carcasses and searcher efficiency/carcass removal trials) was determined at the time of carcass placement/discovery, not when the plot conditions were mapped.

The search conditions in each plot encompassing the 12 selected turbines were defined and mapped into 3 visibility classes. Classification was completed at the end of the search period.

The visibility classes identified within the plots were defined as the following:

**Class 1** (easy): Bare ground (i.e., gravel pad/road, bare dirt), 90% or greater; all vegetation ground cover sparse and 6 inches or less in height.

**Class 2** (moderate): Bare ground, 25% or greater; all vegetation ground cover sparse and 6 inches or less in height and mostly sparse.

**Class 3** (difficult): Bare ground, 25% or less; vegetation ranging up to 12 inches in height.

Figure 1 contains a map of the turbine search area, while Attachment B shows the visibility class of each plot, for the beginning and end of the study period, divided into the 3 searched visibility classes.

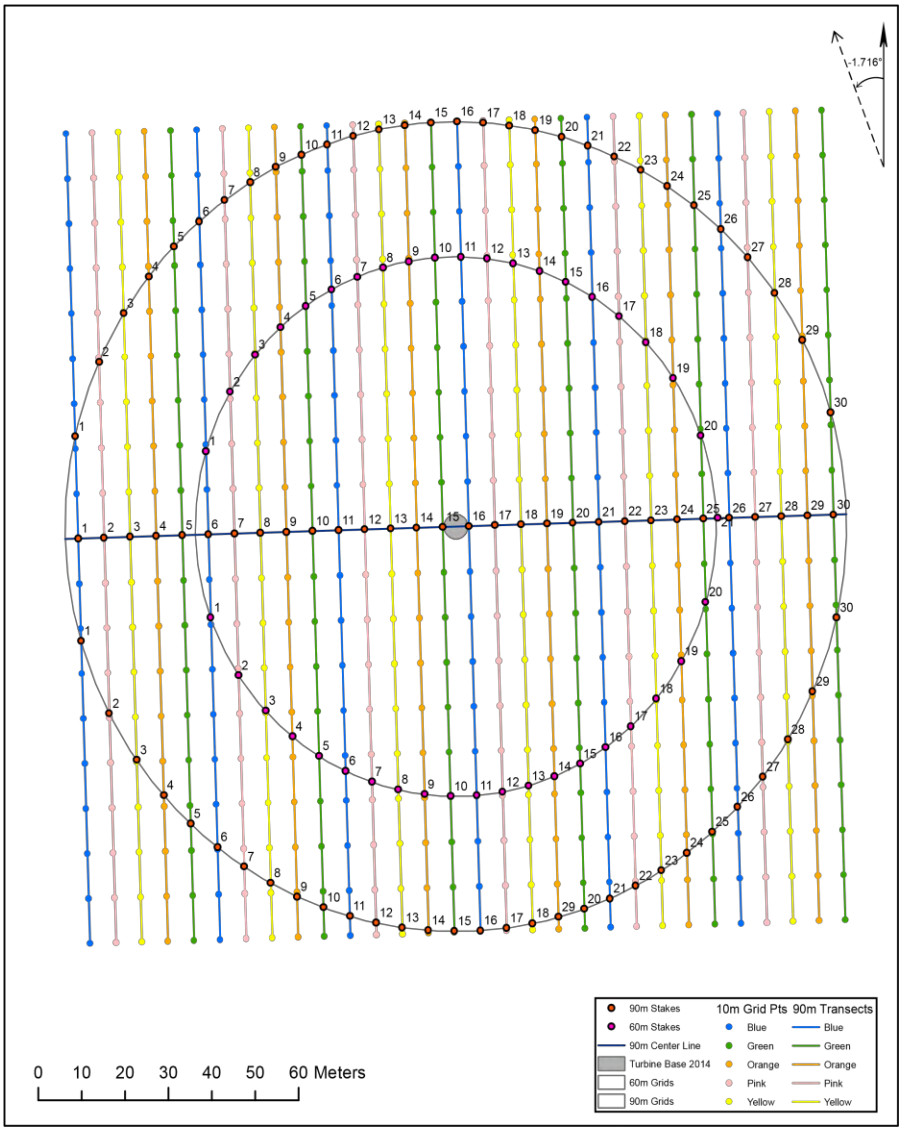


**Figure 1. Diagram of a Typical Search Plot.**

### 2.2.4 Search Methods

Searches were conducted by a team of 2 observers. The search plot was examined by each observer walking along and between each transect through the search plots and visually searching for bird carcasses. Searches were conducted starting from the center 2 transects (15 and 16). Searchers were pre-assigned to "A" and "B" sides based on the orientation of their names on the schedule. "A" side started on transect 15 and searched west toward transect 1, "B" side started on transect 16 and searched east toward transect 30. Search crews started on the north side of the plots on even days and the south side on odd days. Searchers and turbines to be searched were determined by a stratified random process to minimize systematic bias.

Searches were conducted at a slow pace, while looking left to right for carcasses. When a searcher discovered a carcass, he/she would flag its location and continue until the entire plot had been surveyed. This ensured that each plot was searched at a consistent rate. After the turbine was completely searched, the searcher bagged the carcass using gloves or by inverting the collection bag. All carcasses were collected using this method, as a safety precaution and to reduce any possible human scent bias on carcasses later used in trials. The bags were labeled with a unique identification number. Carcasses were handled in accordance with the IDNR Scientific Permit and the IDNR Permit for the Possession of Endangered or Threatened Species. A laser rangefinder (Nikon ProStaff 550 or similar) was used to determine the approximate distance to the turbine, and an azimuth to the tower was taken with a compass. This information, along with time, weather data, transect number, and visibility class, was recorded on a standardized form (see Attachment C). Carcasses were temporarily stored in a freezer at the site maintenance facility.

When found, each carcass was assigned a unique specimen number. The specimen number was made up of 5 parts: capital letters representing the wind farm, the date, the turbine number, the searcher's initials, and a sequential specimen number for carcasses found that day by the searcher. For example, a Specimen Number of Q09241402JS02 denotes that the carcass was found at Wind Farm "Q" on September 24, 2014, at Turbine 2 by John Smith, and is the second carcass John found during searches on that date.

#### 2.2.5 Documentation of Incidental Carcasses

Incidental carcasses were defined in this study as those that were found outside of a search plot or those that were found in the search plot but outside the regular survey period. Incidental carcasses were reported to the Shoener Field Crew Supervisor or Wildlife Monitoring Technicians on site that day. If a carcass was found by personnel other than a searcher, the carcass was left in place for retrieval by a Technician or Field Supervisor. Upon retrieval, a Carcass Data Form (Attachment C) was completed, which gave the carcass a unique identification number, identified the carcass species, and recorded its location, date, and time of retrieval, in addition to any other pertinent information regarding the nature of the fatality. The carcass was then tagged and stored in the freezer on site. Carcasses were handled in accordance with the IDNR Special Use Permit. Incidental carcasses were not factored into the fatality statistics as they were found outside the standard search parameters.

#### 2.2.6 Alive and Injured Specimens

If an alive or injured bird was discovered during the searches, the Shoener Field Crew Supervisor was to be immediately alerted. An additional protocol included notification of IDNR to request further instructions on how to handle the specimen. No birds were to be euthanized during the monitoring period without authorization from the IDNR.

### *2.3 Search Bias Corrections*

The number of carcasses found during the standardized searches is normally lower than the overall number of bird fatalities likely to have occurred at the site. Therefore, to adjust for inherent bias in the searches, correction factors were applied to the raw number of retrieved carcasses. Searcher efficiency (SE) and carcass/scavenger (CR) removal trials were conducted to adjust the carcass counts for observer

and carcass removal bias, respectively. Observer bias may occur during the standardized searches if the searchers have difficulty locating carcasses due to the amount of vegetative growth or size/color of the bird species. Carcass removal bias may occur if the carcasses are removed by scavengers prior to the time the searchers arrive for the next scheduled survey. Other adjustments to the carcass counts were made to account for the percentage of unsearchable area within the search plots, and the proportion of turbines within the wind farm that were searched during the study. For the purpose of fatality estimation, the number of the turbines that were considered searched was 12 out of 133.

Searcher efficiency trials and carcass removal trials were performed throughout the monitoring season. Carcasses found during searches were used in the SE and CR trials once they were validated and deemed suitable for use. Carcasses of threatened or endangered species were not used for the SE or CR trials, nor were any carcasses in fair or poor overall condition. Searcher efficiency and CR trials were conducted under various weather conditions, and were distributed proportionally among the visibility classes within the delineated search areas.

### 2.3.1 Searcher Efficiency Field Methods

A total of 27 individual trials were performed to determine searcher efficiency during the monitoring season. Searcher efficiency trials commenced in the first week of September and ended in the last week of September, 2014. A combination of toe, wing, and finger clipping was used to mark the carcasses in a way that was anonymous to the searchers during the trials. The distribution of carcasses among the visibility classes varied in approximately equal proportion to the available amount of each visibility class within each plot.

The 6 bird species used in searcher efficiency trials included house sparrow (*Passer domesticus*), black-throated green warbler (*Setophaga virens*), golden-crowned kinglet (*Regulus satrapa*), Northern bobwhite (*Colinus virginianus*), rock pigeon (*Columba livia*), and Tennessee warbler (*Oreothlypis peregrina*).

All searchers were tested in proportion to the amount of search time they were conducting (for example, searchers who searched multiple times per week were tested more frequently than searchers who searched less than once per week). Trials were unannounced, and were set up near dusk after daily searches were completed. Carcasses were marked discreetly in an effort to keep searchers blind to the trials. Trials were placed around the turbines 12 to 24 hours prior to a targeted search, in an attempt to best simulate the conditions of actual bird/bat carcasses, as well as to minimize the scavenging of trial carcasses. Any recovered carcasses were collected and checked for identifying marks by the trial placement manager. Any carcasses that could not be recovered were considered scavenged and were not included in statistical analysis. When preparing the tests, all carcass distances and azimuths were generated using the Microsoft® Office Excel random number function before arriving at the wind farm to avoid bias. Carcasses were tossed into the air to determine position (face up or face down, wings in/wings out, etc.), simulating a bird falling from the turbine. Gloves were worn at all times while handling and preparing the carcasses.

#### 2.3.2 Scavenger/Carcass Removal Field Methods

A total of 20 bird carcasses were placed around the turbines to measure carcass removal during the monitoring season. Due to conflicting data regarding removal time, one Northern bobwhite carcass was removed from the analysis, thereby bringing the number of carcasses used to calculate average carcass removal to 19 birds. The trial carcasses were placed in all searched visibility classes. The carcasses were placed around dusk and monitored for removal once every 24 hours for 20 days; after which any remains were collected. Each carcass was marked with a discreetly placed black zip tie to identify the carcass as a test carcass. At the end of the trial, remains were collected and stored until the end of the search year. To avoid bias, all carcass distances and azimuths were generated using the Excel random number function before arriving at the wind farm. Carcasses were tossed into the air to determine position, simulating a bird falling from the turbine. Gloves were worn at all times while handling and preparing the carcasses.

The 6 species used in CR trials included brown creeper (*Certhia americana*), house sparrow, Northern bobwhite, red-breasted nuthatch (*Sitta canadensis*), rock pigeon, and red-tailed hawk (*Buteo jamaicensis*).

#### 2.3.3 Searchable Area Corrections

Searchable area corrections were made by dividing fatality counts for each turbine by the proportion of the total area (90 meter radius circle) that was searched for that turbine. The percentage of searchable area at each turbine was estimated through the analysis of the visibility class maps, presented in Attachment B, in ArcGIS.

### *2.4 Analysis*

#### 2.4.1 Bird Carcass Data

All analysis of fatality data was completed in Excel or Program R (R Development Core Team 2008). Statistical significance values were based on an alpha of 0.05, meaning only p-values less than this alpha were deemed significant. Some temporal and spatial patterns were analyzed using graphs and tables created in Excel. Other patterns were analyzed using descriptive statistics, such as averages, percentages, and ranges also calculated in Excel.

#### 2.4.2 Temporal and Spatial Patterns

Temporal patterns were analyzed within the study period by breaking down the carcass data by weeks. Tables and graphs created in Excel were used to view fluctuations in fatality over the entire search period.

A histogram created in Excel was used to assess the frequency of carcasses within 10-meter distance classes starting at the turbine base. Averages and percentages were calculated using Excel.

### 2.4.3 Age, Species, and Sex

Bird carcasses found on site were identified by Brad Romano or Michael David, Shoener Environmental Ornithologists. During this validation process, species, age, and sex were verified.

All species found on the site were compared to the prioritization listing in Illinois' Wildlife Action Plan (IDNR 2005, IDNR 2012). Wildlife Action Plan species are those that are being proactively managed to prevent their populations from entering further decline.

### 2.4.4 Fatality Estimation

An estimate of total avian fatalities for the monitoring season was computed using Excel and Program R. For this method, carcass counts were adjusted for searchable area and for the proportion of surveys completed at each turbine. A 3.5-day search interval was used to estimate fatality (as this was the average of the actual twice-weekly search interval) through the fatality estimation formula of Erickson et al. (2004):

$$m = \frac{\bar{c}}{\hat{\pi}} \quad \text{and} \quad \hat{\pi} = \frac{\bar{t} \cdot p}{I}\left[\frac{e^{\frac{I}{\bar{t}}} - 1}{e^{\frac{I}{\bar{t}}} - 1 + p}\right]$$

The adjusted counts were then summed by turbine and adjusted for the proportion of turbines searched to calculate overall avian fatalities.

The per-turbine annual fatality rate, (*m*), is the quotient of the mean number of carcasses observed per turbine (c) and pi-hat, which is the fatality adjustment value based upon search interval (*I)*, mean carcass removal time ($\bar{t}$), and overall mean searcher efficiency (*p*). The following sections present details of how searcher efficiency, carcass removal, search area, and missed search days were calculated and included in this method of fatality estimation.

*Searcher Efficiency and Carcass Removal Corrections*

Searcher efficiency and carcass removal (SECR) corrections were completed by Shoener Environmental. The probability that a carcass would be detected by searchers given that it was available to be found, *p*, was assessed through the searcher efficiency trials. The estimate of *p* was calculated as the number of trial carcasses found by searchers divided by the total number of successful trials (excluding trials where the carcasses were not found by searchers and were also not found later that day by testers; these carcasses were assumed to have been scavenged). Excel was used to create tables and to perform all statistical analysis on searcher efficiency data. This analysis included calculating basic descriptive statistics, such as the averages and ranges of searcher efficiencies, in addition to calculating p-values and confidence intervals.

To estimate the time that carcasses persisted in the study plots, the average time a carcass was present in carcass removal trials, *t*, was calculated. Because the daily trial checks were halted after 20 days, the

data are right-censored at 20 days. This right-censoring was compensated for by estimating the mean time to removal using a maximum likelihood estimator for *t* with the following formula:

$$\bar{t} = \frac{\sum_{i=1}^{s} t_i}{s - s_c}$$

where $s$ = the number of test carcasses used in search trials, $s_c$ = the number of test carcasses that remained in the study area at the end of the 20-day removal trial period, and $t_i$ = the number of days carcass $i$ remained in the search area (censored at 20 days for this purpose). Excel was used to determine descriptive statistics, such as averages and ranges.

*Searchable Area Corrections*

Searchable area corrections were made by dividing carcass counts for each turbine by the proportion of the total area (90 meter radius circle) that was searchable for that turbine. The percentage of searchable area at each turbine was estimated through the analysis of the visibility class maps in ArcGIS.

*Adjustment for Proportion of Surveys Completed per Turbine*

Searches were scheduled to be conducted twice per week. If a day within the season was missed (due to site maintenance or unsafe weather, for instance), searches were resumed on the next scheduled day. Corrections to the fatality estimate were made by dividing carcass counts for each turbine by the proportion of scheduled surveys that were completed. The Erickson et al. (2004) estimator directly accounts for the average search interval ($I$) in the estimation of fatality.

*Bootstrapping Method*

A bootstrapping analysis was conducted to determine the 95% confidence interval for the fatality estimate. The bootstrapping analysis was completed in Program R by Shoener Environmental. The bootstrapping confidence intervals for the fatality estimate were obtained by bootstrapping (1) searcher efficiency trials, (2) carcass removal trials, and (3) the sampled turbines to model each source of error. This bootstrapping process included 5,000 iterations of the above factors.

# 3.0 RESULTS

## *3.1 Summary of Search Effort*

Turbines were scheduled to be searched twice a week throughout the survey period. Out of the 168 plot surveys scheduled during the survey period, 79.2% of surveys were completed. Incomplete searches were due to turbine maintenance, unsafe weather conditions, or personnel issues.

Turbine 86 required the shortest overall search time. On average, searches by the 2-person team at Turbine 86 were completed in 36.6 minutes. The longest average search time for a plot was 59.6 minutes, at Turbine 26. The average search time across all turbines and months was 52.0 minutes. Table

1 displays the average search times and number of days searched in each month as well as the overall percentage of the 14 scheduled searches which were completed in 2014.

**Table 1: Average Search Time, Number of Days Searched, and Percentage of Surveys Completed for Each Turbine**

| Turbine | August | | September | | October | | Total | | Total No. Days Scheduled | % Surveys Completed |
|---|---|---|---|---|---|---|---|---|---|---|
| | Minutes | No. Days Searched | Minutes | No. Days Searched | Minutes | No. Days Searched | Minutes | No. Days Searched | | |
| **19** | 55.8 | 3 | 54.2 | 8 | 50.0 | 1 | 54.3 | 12 | 14 | 85.7 |
| **26** | 64.5 | 3 | 58.4 | 8 | 55.0 | 1 | 59.6 | 12 | 14 | 85.7 |
| **31** | 49.3 | 3 | 53.5 | 8 | 49.0 | 1 | 52.1 | 12 | 14 | 85.7 |
| **36** | 41.5 | 3 | 56.3 | 9 | 44.0 | 1 | 51.9 | 13 | 14 | 92.9 |
| **46** | 60.3 | 3 | 55.5 | 3 | --* | 0 | 57.9 | 6 | 14 | 42.9 |
| **71** | 51.0 | 2 | 50.8 | 8 | 48.5 | 1 | 50.6 | 11 | 14 | 78.6 |
| **76** | 21.5 | 1 | 55.4 | 8 | 42.0 | 1 | 50.7 | 10 | 14 | 71.4 |
| **86** | 50.0 | 1 | 36.9 | 7 | 27.5 | 1 | 36.6 | 9 | 14 | 64.3 |
| **101** | 49.8 | 2 | 57.0 | 8 | 54.8 | 2 | 55.4 | 12 | 14 | 85.7 |
| **116** | 43.5 | 2 | 52.5 | 8 | 54.5 | 2 | 51.4 | 12 | 14 | 85.7 |
| **121** | 39.7 | 3 | 51.8 | 8 | 53.8 | 2 | 49.3 | 13 | 14 | 92.9 |
| **131** | 49.5 | 2 | 53.4 | 8 | 56.5 | 1 | 53.0 | 11 | 14 | 78.6 |
| **All** | **49.7** | **28** | **53.0** | **91** | **49.9** | **14** | **52.0** | **133** | **168** | **79.2** |

*Due to Turbine Maintenance, Turbine 46 w as not searched in October

## *3.2 Bird Carcass Summary*

Seven (7) bird carcasses were recovered during standard searches during the August 18 through October 4, 2014, monitoring season. Seven (7) species were recovered during standard searches, and predominantly represented the passerine order. Bird carcasses were recovered during searches at 6 of the 12 searched turbines. Eight incidental bird carcasses were found.

### 3.2.1 Bird Carcasses by Species

A total of 7 species were recovered during standard monitoring at the BHWEF. All species were found only once. Table 2 presents the bird species data for 2014.

**Table 2: Bird Carcasses by Species**

| Scientific Name | Common Name | Number Found | Percent of Total | Illinois and/or USFWS Status |
|---|---|---|---|---|
| *Eremophila alpestris* | Horned Lark | 1 | 14.3 | None |
| *Troglodytes aedon* | House Wren | 1 | 14.3 | None |
| *Setophaga magnolia* | Magnolia Warbler | 1 | 14.3 | None |
| *Oreothlypis ruficapilla* | Nashville Warbler | 1 | 14.3 | None |
| *Vireo philadelphicus* | Philadelphia Vireo | 1 | 14.3 | None |
| *Progne subis* | Purple Martin | 1 | 14.3 | None |
| *Vireo olivaceous* | Red-eyed Vireo | 1 | 14.3 | None |
| | **Total** | **7** | **100.0** | |

### 3.2.2 Bird Carcasses by Turbine

The greatest number of bird carcasses (n = 2) was found at Turbine 101. No birds were found at 6 of the searched turbines (26, 31, 36, 46, 76, and 86). An average of 0.58 bird carcasses were found per searched turbine. Table 3 shows the number of bird carcasses found by turbine.

**Table 3: Bird Carcasses Found by Turbine**

| Turbine Number | Number Found | Percent of Total |
|---|---|---|
| **19** | 1 | 14.3 |
| **26** | 0 | 0.0 |
| **31** | 0 | 0.0 |
| **36** | 0 | 0.0 |
| **46** | 0 | 0.0 |
| **71** | 1 | 14.3 |
| **76** | 0 | 0.0 |
| **86** | 0 | 0.0 |
| **101** | 2 | 28.6 |
| **116** | 1 | 14.3 |
| **121** | 1 | 14.3 |
| **131** | 1 | 14.3 |
| **Total** | **7** | **100.0** |

### 3.2.3 Temporal Patterns

The greatest number of birds (5, 71.4%) was recovered in September, which was the only month covered in its entirety by the monitoring season. Bird carcasses were recovered during each month of the 2014 monitoring season. Between 0 and 4 carcasses were recovered each week; there was no apparent trend in the weekly recoveries. Table 4 presents the bird carcasses recovered by month, and Figure 2 presents the counts of birds by week.

**Table 4: Bird Carcass Recoveries by Month**

| Month | Number Found | Percent of Total |
|---|---|---|
| August | 1 | 14.3 |
| September | 5 | 71.4 |
| October | 1 | 14.3 |
| **Total** | **7** | **100.0** |

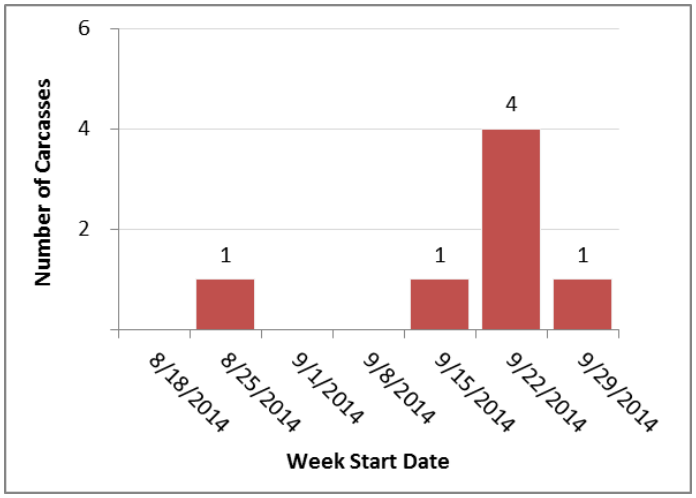


**Figure 2: Bird Carcass Recoveries by Week**

### 3.2.4 Spatial Patterns

The overall distance distribution of carcasses found showed no perceptible peak at any specific distance from the turbine. Carcasses were recovered between 2.5 and 40 meters from the turbine. Table 5 presents the carcass counts by 10-meter distance and Figure 3 presents the proportion of carcasses found in each distance class.

**Table 5: Bird Carcass Recoveries by Distance (m)**

| | Distance (m) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0-9.9 | 10-19.9 | 20-29.9 | 30-39.9 | 40-49.9 | 50-59.9 | 60-69.9 | 70-79.9 | 80-90 | Total |
| Number of Bird Carcasses Found | 1 | 2 | 1 | 2 | 1 | 0 | 0 | 0 | 0 | **7** |

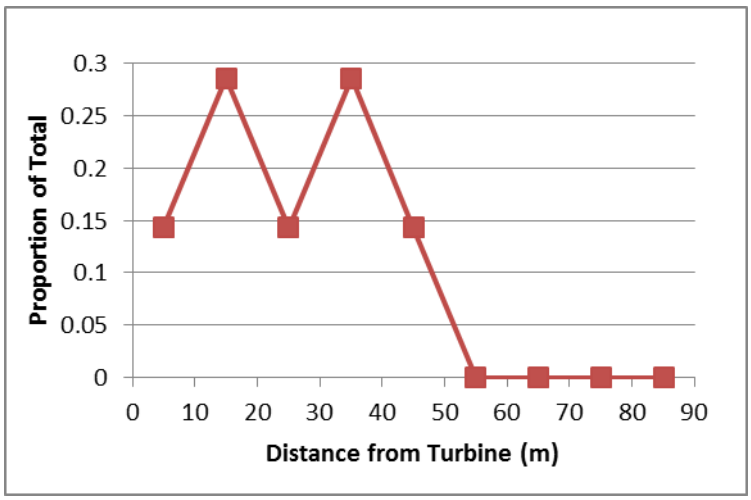

**Figure 3: Proportion of Bird Carcass Recoveries by Distance (m).**

### 3.2.5 Incidental Bird Carcass Recoveries

Eight (8) carcasses from 6 species were recovered incidentally to the standard searches, including those found during preparations outside the designated monitoring season. One Common Nighthawk (*Chordeiles minor*) was found, which is considered a "Rare or declining" species in the Illinois Wildlife Action Plan (IDNR 2005, 2012). Table 6 presents the incidental bird carcasses found. These carcasses are not included in the statistical analysis or fatality estimation.

**Table 6: Incidental Bird Carcasses by Species**

| Scientific Name | Common Name | Number Found | Illinois and/or USFWS Status |
|---|---|---|---|
| *Turdus migratorius* | American Robin | 1 | None |
| *Setophaga virens* | Black-throated Green Warbler | 1 | None |
| *Setophaga tigrina* | Cape May Warbler | 1 | None |
| *Chordeiles minor* | Common Nighthawk | 1 | Rare or declining |
| *Charadrius vociferus* | Killdeer | 3 | None |
| *Vireo olivaceous* | Red-eyed Vireo | 1 | None |
| | **Total** | **8** | |

### 3.2.6 Alive and Injured Specimens

No alive or injured birds were found during the study period.

## *3.3 Fatality Estimation*

### 3.3.1 Searcher Efficiency

Searcher efficiency trials were conducted on 7 days over the course of the monitoring season for a total of 27 successful trials (each non-scavenged carcass is considered a trial). The searchers found 9 out of the 27 carcasses, making the overall searcher efficiency 0.33 (95% confidence interval bounds of 0.16 and 0.51, respectively). The searcher efficiency for the 7 individual trial days ranged from 0.00 to 0.50. Table 7 displays the overall searcher efficiency and the searcher efficiency for each individual trial day.

**Table 7: Searcher Efficiency Trials by Date**

| Date of Trials | Carcasses Placed Successfully | Carcasses Found | Search Efficiency |
|---|---|---|---|
| 9/4/2014 | 2 | 0 | 0.00 |
| 9/5/2014 | 3 | 1 | 0.33 |
| 9/12/2014 | 5 | 2 | 0.40 |
| 9/18/2014 | 4 | 2 | 0.50 |
| 9/19/2014 | 5 | 2 | 0.40 |
| 9/25/2014 | 4 | 0 | 0.00 |
| 9/26/2014 | 4 | 2 | 0.50 |
| **Total** | **27** | **9** | **0.33** |

### 3.3.2 Carcass Removal

A total of 19 bird carcasses were successfully placed across 4 trial periods in 2014. These carcasses were checked daily for 20 days, after which any remains were collected. Due to the short monitoring season, these trial periods overlapped one another. A total of 5 carcasses were placed during each trial period, and no more than 2 carcasses were placed at any one turbine throughout the season. The overall average carcass persistence was 9.5 days before removal by scavengers. Carcass persistence for individual trial periods ranged from 5.8 to 13.7 days. Table 8 presents a summary of estimated carcass removal overall and within each period.

**Table 8: Overall Carcass Removal**

| Date of Trial Placement | Estimated Carcass Persistence (Days) |
|---|---|
| **8/31/2014** | 7.8 |
| **9/10/2014** | 13.7 |
| **9/13/2014** | 5.8 |
| **9/14/2014** | 13.7 |
| **Overall** | **9.5** |
| **Range** | 5.8 - 13.7 |

### 3.3.3 Searchable Area Corrections

Searchable area corrections were included for each turbine equal to the proportion of the potential 90 meter radius plot that could actually be searched. All plots, except for those established at Turbines 31 and 86, were fully searchable. The plot at Turbine 31 was 98.2% searchable because of a woodlot, while the plot at Turbine 86 was 99.0% searchable due to the presence of a dense Osage orange grove (Attachment B). The searchable area within these plots was maintained in a similar manner to all other plots for the duration of the season. Table 9 presents the searchable area correction factor for each turbine.

**Table 9: Searchable Area Corrections by Turbine**

| Turbine | Searchable Area Correction Factor |
|---|---|
| 19 | 1.000 |
| 26 | 1.000 |
| 31 | 0.982 |
| 36 | 1.000 |
| 46 | 1.000 |
| 71 | 1.000 |
| 76 | 1.000 |
| 86 | 0.990 |
| 101 | 1.000 |
| 116 | 1.000 |
| 121 | 1.000 |
| 131 | 1.000 |

### 3.3.4 Estimated Bird Fatalities

The total number of estimated bird fatalities for the August 18 through October 4, 2014, monitoring season at BHWEF was 178. The 95% confidence interval lower and upper bounds were 78 and 430, respectively. The estimated number of bird fatalities per turbine was 1.3 (95% confidence interval 0.6 – 3.2). The per-megawatt estimated bird fatality rate was 0.8 (95% confidence interval 0.4 – 2.0). The confidence interval limits were obtained through bootstrapping analysis. Table 10 presents the estimated number of bird fatalities for the monitoring season per turbine, MW, and square foot of rotor area.

**Table 10: Bird Fatality Estimates for the Bishop Hill Wind Energy Facility**

| | Estimated Bird Fatality | 95% Confidence Interval |
|---|---|---|
| **Total Birds** | 178 | 78 - 430 |
| **Birds per Turbine** | 1.3 | 0.6 - 3.2 |
| **Birds per MW** | 0.8 | 0.4 - 2.0 |

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# Post-Construction Bird and Bat Carcass Monitoring
# Fall 2015 Final Report

## Bishop Hill Wind Energy Facility
## Henry County, Illinois

**December 3, 2015**

*Technical Report Submitted To:*

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# Table of Contents

**EXECUTIVE SUMMARY** ..... **1**

**1.0 INTRODUCTION** ..... **2**

**2.0 METHODS** ..... **2**

**2.1 BIRD AND BAT MONITORING** ..... **2**

*2.1.1 Turbine Selection* ..... *2*

*2.1.2 Study Schedule* ..... *2*

*2.1.3 Search Plots and Visibility Classes* ..... *3*

*2.1.4 Search Methods* ..... *3*

*2.1.5 Documentation of Incidental Finds* ..... *4*

**2.2 BIAS CORRECTIONS** ..... **4**

*2.2.1 Searcher Efficiency Field Methods* ..... *4*

*2.2.2. Carcass Removal Field Methods* ..... *5*

**2.3 ANALYSIS** ..... **5**

*2.3.1 Carcass Data* ..... *5*

*2.3.2 Searcher Efficiency and Carcass Removal Corrections* ..... *5*

**3.0 RESULTS** ..... **6**

**3.1 CARCASS SEARCHES** ..... **6**

*3.1.1 Search Summary* ..... *6*

*3.1.2 Carcass Summary* ..... *7*

**3.2 SEARCHER EFFICIENCY** ..... **10**

*3.2.1 Small Plots* ..... *10*

*3.2.2 Large Plots* ..... *11*

**3.3 CARCASS REMOVAL** ..... **11**

**4.0 CONCLUSION ..... 12**

**5.0 REFERENCES ..... 13**

## List of Tables

Table 1. Summary of Recovered Bat Carcasses by Species and Plot Group. ..... 7
Table 2. Summary of Observed Bird Carcasses by Species and Plot Group. ..... 8
Table 3. Summary of Bird and Bat Carcass Data by Turbine. ..... 9
Table 4: Summary of Searcher Efficiency Trials Placed at Small Plots ..... 10
Table 5: Summary of Searcher Efficiency Trials Placed at Large Plots ..... 11
Table 6: Carcass Removal Trial Summary and Estimated Time until Removal. ..... 12

## List of Figures

Figure 1. Chart Depicting the Bird and Bat Carcass Tallies by Week ..... 9
Figure 2: Searcher Efficiency of Human Searchers across 3 Plot Conditions. ..... 11

## Attachments

Attachment A: Site Location Map
Attachment B: Search Plot Diagrams
Attachment C: Sample Monitoring Data Forms

## EXECUTIVE SUMMARY

Bird and bat carcass monitoring was conducted between July 20 and October 2, 2015 at the Bishop Hill Wind Energy Facility (BHWEF). The primary objective of the fall monitoring program was to assess components of the US Geological Survey's Evidence of Absence model (Dalthorp et al. 2014). This model allows the user to determine the likelihood a rare event occurred given a specific suite of environmental and program-driven parameters. The results of the research are reported under separate cover. This report summarizes the overall results in the context of a traditional monitoring program, as outlined in the BHWEF Bird and Bat Conservation Strategy (BHE 2011) and the US Fish and Wildlife Service's Land-based Wind Energy Guidelines (USFWS 2012). During the fall season, bird and bat carcasses were searched for within 8 78 x 78-meter (m) plots daily and 12 90-m plots twice per week.

A total of 264 bats and 30 birds were recovered. Six species of bats were recovered, including the hoary bat (*Lasiurus cinereus*), eastern red bat (*Lasiurus borealis*), silver-haired bat (*Lasionycteris noctivagans*), big brown bat (*Eptesicus fuscus*), tri-colored bat (*Perimyotis subflavus*), and little brown bat (*Myotis lucifugus*). In addition, 4 bat carcasses of unknown species were recovered. A total of 5 bat carcasses were recovered incidentally, including 3 hoary bat and 2 eastern red bats. No threatened or endangered bat species were encountered.

Eleven species of birds including: black-billed cuckoo (*Coccyzus erythropthalmus*), brown-headed cowbird (*Molothrus ater*), cliff swallow (*Petrochelidon pyrrhonota*), common yellowthroat (*Geothlypis trichas*), dickcissel (*Spiza americana*), horned lark (*Eremophila alpestris*), killdeer (*Charadrius vociferus*), mourning dove (*Zenaida macroura*), red-eyed vireo (*Vireo olivaceus*), sora (*Porzana carolina*), and tree swallow (*Tachycineta bicolor*) were observed as carcasses during the monitoring. Carcasses unidentifiable to species included 2 unknown warbler species, 1 unknown vireo species, and 2 that could only be identified as birds because of their poor condition. A total of 6 birds were found incidental to the monitoring, including 1 dickcissel, 2 European starling (*Sturnus vulgaris*), 1 horned lark, 1 red-winged blackbird (*Agelaius phoeniceus*), and 1 unknown bird species. One carcass of a state-threatened bird species, a juvenile black-billed cuckoo, was found during a scheduled search of Turbine 36 on September 18.

A total of 322 bat carcasses were used in SE trials targeting human searchers. Overall SE was 0.35 (95% CI 0.30 – 0.40). Human efficiency was dependent upon visibility class; trials placed in easy to search areas returned the highest SE (0.54, CI 0.46 – 0.63) and difficult areas the lowest (0.11, CI 0.03 – 0.19; $z=5.517$, $p<0.05$).

Searcher efficiency was higher for the dog and handler team (0.95, 95% CI 0.91 – 1.00) that was tested with 104 bat carcasses. Visibility class had no effect on the ability of the dog and handler to detect carcasses.

A total of 97 bat carcasses were used in assessment of carcass removal; all of the trials were placed within the 8 small plots. Removal rates within the individual trial periods varied between 4.0 and 8.2 days, overall the fall carcass removal rate was 6.6 days. Mean removal times appeared similar across the visibility classes, with carcasses removed fastest in moderate visibility class (5.0 d) and slowest in the easy visibility class (8.0 d).

# 1.0 INTRODUCTION

The Bishop Hill Wind Energy Facility (BHWEF) is owned by Bishop Hill Energy LLC, and is located in Henry County, Illinois (Attachment A). Phase I of BHWEF is a 200 megawatt (MW) facility with 133 turbines, including 99 General Electric 1.6 MW turbines and 34 General Electric 1.5 MW turbines. Phase II carries an 80 MW capacity; however, it is owned by another entity and is not included in this study.

The BHWEF lies within the Interior River Valleys and Hills Ecoregion (Woods et al. 2006). The landscape consists of gently rolling hills, and is dominated by agricultural fields consisting of mostly corn and soybean, in addition to sparsely distributed oak-hickory wood lots. The majority of BHWEF is privately owned land that is sparsely populated with farms and residential units. Towns located within the study area include Bishop Hill, Woodhull, and Galva.

This report details the results of a carcass monitoring survey conducted at the BHWEF during the fall of 2015. The primary objective of the field survey was to gather data useful in assessing 3 parameter inputs utilized in the US Geological Survey's (USGS) Evidence of Absence model (Dalthorp et al. 2014). The parameters included changes to carcass detection probabilities over repeated searches, carcass removal rates under variable plot conditions, and the spatial distribution of carcass falls. The research focused on bats, but bird carcass data was also recorded. For this report, the data was summarized in the context of the traditional monitoring program outlined within the BHWEF Bird and Bat Conservation Strategy (BHE 2011).

# 2.0 METHODS

## *2.1 Bird and Bat Monitoring*

### 2.1.1 Turbine Selection

The turbines were selected from the set utilized during prior monitoring seasons (Good et al. 2013, Good et al. 2014, Ritzert et al. 2014). Initially, turbines were selected at random; additional rounds of random selections were performed in order to exchange turbines that were deemed unsuitable for the monitoring. A turbine was considered unsuitable if large areas of unsearchable terrain were present or the landowner did not provide consent to clear vegetation on their property.

Eight small, 78 x 78 meter (m) square plots were placed at the following turbines: 22, 41, 61, 91, 96, 102, 105, and 124. Twelve larger, 90 m circular plots were placed at these turbines: 14, 21, 24, 36, 46, 51, 52, 86, 101, 116, 121, and 123 (Attachment A).

### 2.1.2 Study Schedule

Carcass monitoring was conducted daily between July 20 and October 2, 2015 at the small plots. The large plots were surveyed twice per week between August 1 and September 30, 2015. For the purpose of maintaining consistent search conditions, each search day commenced between approximately 6:00 and 8:00 am, weather and site conditions permitting. The order in which the plots were searched was stratified such that each plot was searched at a different time of day each week.

### 2.1.3 Search Plots and Visibility Classes

The 78 m square "small" search plots were established beneath each of the 8 selected turbines (Attachment B). Plots were cleared of vegetation and then marked with 13 painted and staked transects that were oriented north/south on a 6 m spacing. The "large" plots were centered beneath the 12 selected turbines and consisted of 90 m circular plots that were cleared of vegetation and delineated with survey stakes.

Vegetation growth was controlled through the use of periodic mowing. The average plot conditions were mapped once during the season; searchable area within the plot was designated into 3 visibility classes (below). All plots were considered 100% searchable; however they also contained at least 2 of the visibility classes.

Visibility classes for placed and found carcasses (including both actual carcasses and searcher efficiency/carcass removal trials) were determined at the time of placement or recovery.

Visibility classes were defined as follows:

**Easy (1)**: Bare ground 90% or greater; all ground cover sparse and 0.15 m or less in height (e.g., gravel pad/road, bare dirt)

**Moderate (2)**: Bare ground 25% or greater; all ground cover mostly sparse and 0.15 m or less in height.

**Difficult (3)**: Bare ground 25% or less; ground cover ranging up to 0.3 m in height.

### 2.1.4 Search Methods

Small-plot searches were conducted by a team of 2 humans, with each person assigned to search the eastern or western half of the plot. The observers walked along each transect while they visually searched side-to-side for carcasses. Searches were conducted with a pace of approximately 45 m per minute (1.6 mph). The order in which turbines were searched was varied daily.

The large plot search methods varied in response to each day's search conditions. In each case, a dog and handler team performed passes throughout the plot area, often working with or into the prevailing wind direction. The spacing between each pass was varied in response to the plot and weather conditions. For example, multiple closely-spaced passes were performed if vegetation was very tall and/or if the wind was calm. At the same plot, fewer, more distant passes were performed after a recent mowing and/or if wind was moderate and consistent.

When a searcher (either a human searcher or dog and handler team) discovered a bird or bat carcass, he/she would mark its location and then continue searching until the entire plot search was completed. After the search was finished, the searcher returned to each carcass for data collection. Bat carcasses were collected using gloves or by inverting the collection bag. Bird carcasses were left in place and not collected. Each carcass was assigned a unique ID that was written on a data tag retained with the carcass. Carcasses were handled in accordance with the IDNR Scientific Permit and the IDNR Permit for Possession of Endangered or Threatened Species. A laser rangefinder (Nikon ProStaff 550 or similar) was

used to determine the distance to the turbine, and an azimuth to the tower was taken with a compass. This information, along with time, weather data, transect number, and visibility class, were recorded using electronic data management software on Carcass Data Form (see Attachment C). Bat carcasses were stored in a freezer at the site's maintenance facility. All bird and bat carcasses were photographed; photographs were labeled with the carcass's respective unique ID.

#### 2.1.5 Documentation of Incidental Finds

Incidental carcass discoveries were defined as: carcasses found outside of the search plots or carcasses found within a plot but outside of a scheduled survey period. If a carcass was found by personnel other than a member of the search staff (i.e. turbine maintenance technician), the search staff was notified and subsequently retrieved the carcass at their earliest availability. Carcass data collection was identical for both incidental and non-incidental carcasses. Bat carcasses were tagged and stored in the freezer on site; bird carcasses were left in place and not collected. Carcasses were handled in accordance with the IDNR Special Use Permit and/or Threatened and Endangered Species Permit. Incidental carcasses are not factored into fatality estimates as they were found outside the standard searches, thus are reported separately.

### *2.2 Bias Corrections*

Searcher efficiency (SE) and carcass removal (CR) trials were conducted in order to account for observer and carcass removal bias, respectively.

Carcasses used in the bias trials included pre-frozen bat carcasses provided by the University of Illinois – Champaign-Urbana rabies testing repository. No birds, threatened or endangered species were used in the bias trial placements. A total of 426 bat carcasses were used during SE testing and a total of 97 bat carcasses were used in CR trials. The carcasses used in SE trials were placed randomly within the searchable area of all 20 search plots, while the CR trials were randomly placed within the 8 small plots. This was to ensure that the dogs would not be confused by bat carcasses left in place for long periods of time.

Species used in bias trials included big brown bat (*Eptesicus fuscus*), eastern red bat (*Lasiurus borealis*), hoary bat (*Lasiurus cinereus*), and silver-haired bat (*Lasionycteris noctavigans*).

#### 2.2.1 Searcher Efficiency Field Methods

SE carcasses were marked using small, discreetly placed zip ties. Trial carcasses were placed in all visibility classes within the plots, and trial carcass distribution generally reflected the amount of each visibility class present at the turbines. Trial carcass placement locations (distances and azimuths from turbines) were generated using the random number function on Microsoft® Office Excel before arriving at the wind farm. Carcasses were tossed into the air and allowed to fall into place. Gloves were worn at all times while handling and preparing the carcasses.

Trials were unannounced and were set up 12 to 24 hours prior to a search. After the search, the trial placement manager visited each carcass and checked for scavenging. Any carcasses that were not found

by searchers or by the trial manager were considered scavenged and were not included in the statistical analysis of SE.

#### 2.2.2. Carcass Removal Field Methods

A total of 97 bat carcasses were used to measure CR rates across 5, 20-day periods. Trial carcass locations were determined in a manner identical to the SE trials; field placement differed only in that the search staff was notified of a placement and the whereabouts of each carcass prior to placement. After placement, CR trial carcasses were monitored for removal daily. If, during a check, the staff was unable to locate a specific carcass, they were instructed to search the area within 5 meters of the original location for a few minutes. If they were unable to relocate the carcass, it was marked as scavenged for that day's check. If the carcass was relocated at a later time, the removal record was revised to reflect the change. Any carcasses remaining on the 20$^{th}$ day were retrieved.

### *2.3 Analysis*

#### 2.3.1 Carcass Data

All field data were transferred to Microsoft® Office Excel spreadsheets and reviewed for consistency and correctness. Data analysis was completed using Excel. Patterns were analyzed using descriptive statistics, such as averages, percentages, and ranges, which were also calculated in Excel.

*Temporal Patterns*

Using the data pooled across all searched turbines, carcasses were tallied by calendar week. Temporal trends were analyzed through use of figures created in Excel.

*Species, Age, and Sex*

All carcasses found on site were initially identified by search personnel, then reviewed by Tom Wallenfeldt and Brian Good, the bias trial and field crew leads, and finally by Brad Romano, the Shoener Environmental Project Manager. In this validation process, species, age, and sex were verified, where possible. Photographs of bird species were reviewed in a similar manner.

All species found at the site were compared to the prioritization listing in Illinois' Wildlife Action Plan. Wildlife Action Plan species are those species that are being proactively managed to prevent their populations from further decline (IDNR 2005, IDNR 2012).

#### 2.3.2 Searcher Efficiency and Carcass Removal Corrections

The probability that a carcass would be detected given that it was available to be found, *p*, was assessed through the SE trials. The estimate of *p* was calculated as the number of trial carcasses found by searchers divided by the total number of successful trials[1] using the data from the first search

[1] Successfully placed trials excluded trials where the carcass was not found by both the searchers AND the trial managers; these carcasses were assumed to have been scavenged.

opportunity. Excel was used to create tables and to perform all statistical analysis on SE data. This analysis included calculating basic descriptive statistics, such as averages and ranges of SEs as well as 95% confidence intervals of each calculated mean. SE probability was tested using a z-test associated p-value, assuming a normal distribution. Data considered for testing included testing between overall values for each trial period and pairwise testing between visibility classes. If the SE was significantly different ($p \leq 0.05$) between the trial periods, visibility class data was tested within each period. If SE for the placement periods was similar ($p>0.05$), the data were pooled by visibility class before analysis.

To estimate the time that carcasses persisted in the study plots, the average time a carcass was present in CR trials, *t*, was calculated. Because the trial checks were halted after 20 days, the data are right-censored at 20 days. This right-censoring was compensated for by estimating the mean time to removal using a maximum likelihood estimator for *t* with the following formula, excerpted from Erickson et al. (2004):

$$\bar{t} = \frac{\sum_{i=1}^{s} t_i}{s - s_c}$$

where $s$ is the number of test carcasses used in search trials, $s_c$ is the number of test carcasses that remained in the study area at the end of the 20-day removal trial period, and $t_i$ is the number of days carcass $i$ remains in the search area. Excel was used to determine descriptive statistics such as averages and ranges. Mean removal estimates are presented by each period, overall, and by visibility class.

## 3.0 RESULTS

### *3.1 Carcass Searches*

#### 3.1.1 Search Summary

*Small Plots*

Between July 20 and October 2, 2015, a total of 537 plot searches were conducted. Nine percent of the scheduled searches were missed either due to turbine maintenance schedules or crew illnesses. Average plot search times were between 19.9 minutes for Turbine 105 and 21.0 minutes for Turbine 102. All plot areas were fully searchable, but visibility classes varied within and across the plots (Attachment B).

*Large Plots*

A total of 180 plot searches were completed between August 1 and September 30, 2015. Twelve percent of the scheduled searches were missed due to schedule conflicts. Average plot search times were between 43.2 minutes for Turbine 36 and 50.6 minutes for Turbine 101. Plots were all fully searchable, but the visibility classes varied within and across the plots (Attachment B).

### 3.1.2 Carcass Summary

*Bat Species*

A total of 264 bat carcasses of 6 species and 1 "unknown" category were recovered during scheduled searches (Table 1). A majority of the carcasses (49%) were identified as eastern red bats (n=129). None of the recovered species are included in the IL Wildlife Action Plan as species of conservation concern (IDNR 2005, IDNR 2012). No carcasses of threatened or endangered bat species were recovered during the monitoring period.

**Table 1. Summary of Recovered Bat Carcasses by Species and Plot Group.**

| Scientific Name | Common Name | Plot Group | | | Illinois and/or USFWS Status |
|---|---|---|---|---|---|
| | | Small | Large | Total | |
| *Lasiurus cinereus* | Hoary Bat | 9 | 41 | **50** | None |
| *Lasiurus borealis* | Eastern Red Bat | 14 | 115 | **129** | None |
| *Lasionycteris noctivagans* | Silver-haired Bat | 10 | 56 | **66** | None |
| *Eptesicus fuscus* | Big Brown Bat | 1 | 6 | **7** | None |
| *Perimyotis subflavus* | Tri-colored Bat | 3 | 4 | **7** | None |
| *Myotis lucifugus* | Little Brown Bat | 0 | 1 | **1** | None |
| -- | Unknown Bat | 0 | 4 | **4** | -- |
| **All** | | **37** | **227** | **264** | |

*Bird Species*

Thirty carcasses of 11 species and 3 "unknown" categories were found. Horned lark (*Eremophila alpestris*, n= 8) was the bird species found most frequently (27%, Table 2). Carcasses unidentifiable to species included 2 warbler species (family *Parulidae*), 1 vireo species (family *Vireonidae*), and 2 identified as unknown bird species. No bird carcasses were collected during this study.

Only one state-threatened bird species, the black-billed cuckoo, was found during the monitoring. The juvenile black-billed cuckoo was found on September 18 at Turbine 36. No other carcasses of listed or conservation concern bird species were recovered (IDNR 2005, IDNR 2012).

**Table 2. Summary of Observed Bird Carcasses by Species and Plot Group.**

| Scientific Name | Common Name | Plot Group Small | Large | Total | Illinois and/or USFWS Status |
|---|---|---|---|---|---|
| *Coccyzus erythropthalmus* | Black-billed Cuckoo | 0 | 1 | **1** | IL Threatened |
| *Molothrus ater* | Brown-headed Cowbird | 0 | 1 | **1** | None |
| *Petrochelidon pyrrhonota* | Cliff Swallow | 0 | 1 | **1** | None |
| *Geothlypis trichas* | Common Yellowthroat | 0 | 1 | **1** | None |
| *Spiza americana* | Dickcissel | 0 | 1 | **1** | None |
| *Eremophila alpestris* | Horned Lark | 0 | 8 | **8** | None |
| *Charadrius vociferus* | Killdeer | 1 | 3 | **4** | None |
| *Zenaida macroura* | Mourning Dove | 0 | 3 | **3** | None |
| *Vireo olivaceus* | Red-eyed Vireo | 1 | 1 | **2** | None |
| *Porzana carolina* | Sora | 0 | 1 | **1** | None |
| *Tachycineta bicolor* | Tree Swallow | 0 | 2 | **2** | None |
| family *Parulidae* | Warbler sp. | 0 | 2 | **2** | None |
| family *Vireonidae* | Vireo sp. | 0 | 1 | **1** | None |
| -- | Unknown Bird | 0 | 2 | **2** | -- |
| **All** | | **2** | **28** | **30** | |

*Carcass Recoveries by Turbine*

Bird and bat carcass recoveries varied by turbine and by turbine group. A majority (87%) of the carcasses were recovered at the large plots (90-m radius circle), that were searched by the dog and handler team. An average of 18.9 bat and 2.3 bird carcasses were recovered at each turbine. Turbine 46 had the lowest bat carcass count (n= 7) and Turbine 121 the highest (n= 35). Turbine 46 and 51 had no bird carcasses observed, while Turbine 36 had the highest, at 5 bird carcasses (Table 3).

The small plots had fewer carcasses recovered, averaging 4.6 bat and 0.3 bird carcasses per turbine. The search staff found between 0 and 17 bats (Turbines 41 and 61, respectively) at each turbine. Only two bird carcasses were recovered at the small plots, one each at Turbines 61 and 124 (Table 3).

**Table 3. Summary of Bird and Bat Carcass Data by Turbine.**

| Small Plots | | | | Large Plots | | | |
|---|---|---|---|---|---|---|---|
| Turbine | Bats | Birds | Total Found | Turbine | Bats | Birds | Total Found |
| **22** | 2 | 0 | **2** | **14** | 20 | 1 | **21** |
| **41** | 0 | 0 | **0** | **21** | 12 | 2 | **14** |
| **61** | 17 | 1 | **18** | **24** | 30 | 3 | **33** |
| **91** | 7 | 0 | **7** | **36** | 22 | 5 | **27** |
| **96** | 3 | 0 | **3** | **46** | 7 | 0 | **7** |
| **102** | 1 | 0 | **1** | **51** | 19 | 0 | **19** |
| **105** | 3 | 0 | **3** | **52** | 15 | 3 | **18** |
| **124** | 4 | 1 | **5** | **86** | 20 | 4 | **24** |
| *Total* | *37* | *2* | ***39*** | **101** | 21 | 1 | **22** |
| | | | | **116** | 12 | 2 | **14** |
| | | | | **121** | 35 | 3 | **38** |
| | | | | **123** | 14 | 4 | **18** |
| | | | | *Total* | *227* | *28* | ***255*** |

*Temporal Patterns*

Bird carcasses were observed consistently throughout the monitoring weeks. Weekly bird carcass observations ranged between 0 (weeks of July 20 and September 28) and 7 (week of August 31). Weekly bat carcass recoveries ranged between 2 (weeks of July 20 and September 28) and 71 (week of September 7). Bat recoveries increased throughout the season and peaked the week of September 7, after which they decreased steadily (Fig. 1). It should be noted that the data from weeks 1 and 11 is only inclusive of the 8 small plots, as the large plot monitoring occurred between week 2 and week 10.

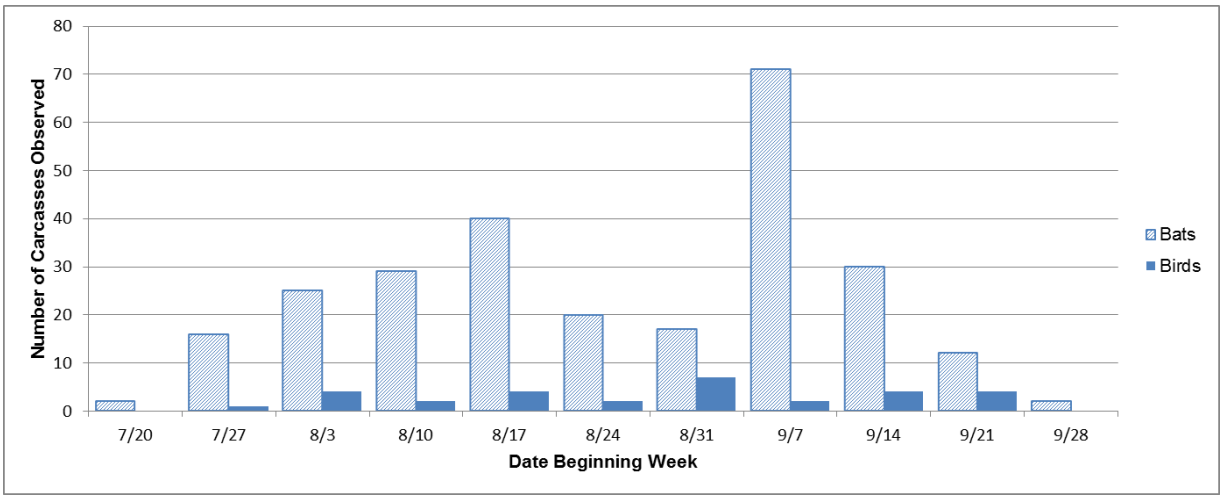


**Figure 1. Chart Depicting the Bird and Bat Carcass Tallies by Week**

*Incidental Carcasses*

A total of 5 bat carcasses including 3 hoary and 2 eastern red bats were recovered outside of scheduled searches. Six birds, including 1 dickcissel, 2 European starling (*Sturnus vulgaris*), 1 horned lark, 1 red-winged blackbird (*Agelaius phoeniceus*), and 1 unknown bird species were also recorded incidentally. No state-or federally-listed species were found as incidental carcasses.

## *3.2 Searcher Efficiency*

### 3.2.1 Small Plots

Small-plot SE trials were conducted with 322 bat carcasses placed across 10 occasions (Table 8). No more than 9 carcasses were placed on a single turbine plot in any given placement period. The data reported for the small plots represents results for a human-only visual search method.

The searchers found 112 of 322 trial carcasses for an overall SE of 0.35 (95% confidence interval [CI] bounds of 0.30 and 0.40, respectively). Individual trial SE ranged from 0.13 (CI 0.00 – 0.26, n=24) for the trials placed on September 17 to 0.61 (CI 0.44 – 0.78, n= 31) for the trials placed on August 03 (Table 4).

**Table 4: Summary of Searcher Efficiency Trials Placed at Small Plots**

| Place Date | No. Available Carcasses | No. Carcasses Found | Searcher Efficiency | CI Lower Bound | CI Upper Bound |
|---|---|---|---|---|---|
| 7/19/2015 | 34 | 14 | 0.41 | 0.25 | 0.58 |
| 7/26/2015 | 26 | 4 | 0.15 | 0.02 | 0.29 |
| 8/3/2015 | 31 | 19 | 0.61 | 0.44 | 0.78 |
| 8/10/2015 | 28 | 8 | 0.29 | 0.12 | 0.45 |
| 8/17/2015 | 36 | 17 | 0.47 | 0.31 | 0.64 |
| 8/24/2015 | 33 | 19 | 0.58 | 0.41 | 0.74 |
| 9/2/2015 | 34 | 11 | 0.32 | 0.17 | 0.48 |
| 9/10/2015 | 38 | 9 | 0.24 | 0.10 | 0.37 |
| 9/17/2015 | 24 | 3 | 0.13 | 0.00 | 0.26 |
| 9/24/2015 | 38 | 8 | 0.21 | 0.08 | 0.34 |
| **Total** | **322** | **112** | **0.35** | **0.30** | **0.40** |

Seventy four of the available bats (n=136) in easy visibility class were recovered (0.54, CI 0.46 – 0.63). SE for bats placed in moderate visibility class was 0.24 (CI 0.17 – 0.32, n= 131). SE was lowest within the difficult visibility class (0.11, CI 0.03 – 0.19, n= 55) (Fig. 2). The SE within easy visibility class was significantly higher than in moderate ($z=5.005$, $p<0.05$) and difficult ($z=5.518$, $p<0.05$). In addition, moderate visibility class areas had a higher SE than difficult areas ($z=2.087$, $p<0.05$).

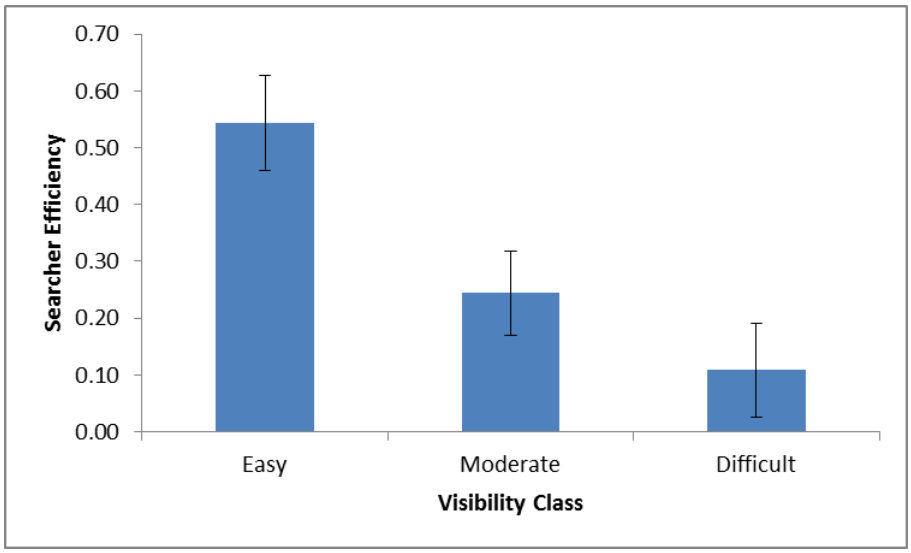


**Figure 2: Searcher Efficiency of Human Searchers across 3 Plot Conditions.**
Error bars represent 95% Confidence Intervals.

3.2.2 Large Plots

Large-plot SE trials were conducted with 104 bat carcasses placed on 6 occasions (Table 5). No more than 4 carcasses were placed on a single turbine plot in any given placement period. The data reported for the large plots represents results for a dog and handler team.

The dog and handler team found 99 of 104 trial carcasses for an SE of 0.95 (CI 0.91 and 1.00). Individual trial SE ranged from 0.82 (CI 0.64 – 1.00, n=17) for the trials placed on August 23 to 1.00 during 4 separate trials (Table 5). The SE of the dog and handler team did not differ significantly across the visibility classes.

**Table 5: Summary of Searcher Efficiency Trials Placed at Large Plots**

| Place Date | No. Available Carcasses | No. Carcasses Found | Searcher Efficiency | CI Lower Bound | CI Upper Bound |
|---|---|---|---|---|---|
| 8/16/2015 | 18 | 18 | 1.00 | 1.00 | 1.00 |
| 8/23/2015 | 17 | 14 | 0.82 | 0.64 | 1.00 |
| 8/30/2015 | 20 | 20 | 1.00 | 1.00 | 1.00 |
| 9/6/2015 | 15 | 15 | 1.00 | 1.00 | 1.00 |
| 9/13/2015 | 17 | 15 | 0.88 | 0.73 | 1.00 |
| 9/23/2015 | 17 | 17 | 1.00 | 1.00 | 1.00 |
| **Total** | **104** | **99** | **0.95** | **0.91** | **0.99** |

## *3.3 Carcass Removal*

CR was tracked using 97 bat carcasses placed throughout the small plot area between July 17 and September 12. Placements were performed 5 times, with 17-20 carcasses in each placement group. The fall CR trials indicated a mean removal time of 6.6 days; removal times for individual placements were between 4.0 and 8.2 days (August 30 and September 12, respectively; Table 6). Mean time until removal

was similar across the visibility classes, with carcasses remaining the longest (8.0 d, n= 48) in easy areas and carcasses remaining the shortest in moderate areas (5.0 d, n= 34).

**Table 6: Carcass Removal Trial Summary and Estimated Time until Removal.**

| Trial Date | Carcasses Placed | Mean Carcass Persistence (Days) |
|---|---|---|
| 7/17/2015 | 20 | 7.4 |
| 8/6/2015 | 17 | 6.7 |
| 8/20/2015 | 20 | 7.0 |
| 8/30/2015 | 20 | 4.0 |
| 9/12/2015 | 20 | 8.2 |
| **Overall** | **97** | **6.6** |

## 4.0 CONCLUSION

The objective of the monitoring at the BHWEF was to assess components of the USGS Evidence of Absence model (Dalthorp et al. 2014). This report summarizes the results of the monitoring in the context of traditional monitoring, providing the metrics in a similar format to what was prescribed in the BHWEF Bird and Bat Conservation Strategy (BHE 2011).

Daily monitoring of 8 78 x 78 m square plots for bat and bird carcasses occurred between July 20 and October 2, 2015. Searches of these plots were conducted visually by a team of human searchers. In addition to these plots, 12 90 m radius circular plots were monitored twice per week between August 1 and September 30 by a dog and handler team.

A total of 264 bats and 30 birds were recovered during searches. Six species and 1 “unknown” category of bat were recovered; the most frequently (49%) recovered species was the eastern red bat. A total of 5 bat carcasses were recovered incidentally, including 3 hoary bat and 2 eastern red bats. No threatened or endangered bat species were encountered during this monitoring.

Eleven species of birds and 3 “unknown” categories were recovered; the most frequently recovered (27%) bird was the horned lark. A total of 6 birds of 5 species were found incidental to the monitoring. One carcass of a state-threatened bird species, a juvenile black-billed cuckoo, was found during a search of Turbine 36 on September 18.

A total of 322 bat carcasses were used in assessing the SE of human searchers. Overall SE was 0.35 (95% CI 0.30 – 0.40). Human efficiency was dependent upon visibility class, with trials placed in easy to search areas returning the highest SE (0.54, CI 0.46 – 0.63) and difficult areas the lowest (0.11, CI 0.03 – 0.19). Searcher efficiency was higher for the dog and handler team (0.95, CI 0.91 – 1.00) that was tested with 104 bat carcasses. Visibility class had no effect on the ability of the dog and handler to detect carcasses.

A total of 97 bat carcasses were used in carcass removal trials; all of the trials were placed within the 8 small plots. Removal rates within the individual trial periods varied between 4.0 and 8.2 days; the overall autumn carcass removal rate was 6.6 days. Mean removal times appeared similar across the visibility classes, with carcasses removed fastest in moderate visibility class (5.0 d) and slowest in the easy visibility class (8.0 d).

## 5.0 REFERENCES

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Attachment A:
Site Location Map

Attachment B:
Search Plot Diagrams

Attachment C:
Sample Monitoring Data Forms

# Appendix E. Natural Resources Permits

DEPARTMENT OF THE INTERIOR
U.S. FISH AND WILDLIFE SERVICE

# FEDERAL FISH AND WILDLIFE PERMIT

2. AUTHORITY-STATUTES
16 USC 703-712

REGULATIONS
50 CFR Part 13
50 CFR 21.27

1. PERMITTEE

WESTERN ECOSYSTEMS TECHNOLOGY
dba WEST, INC
804 N COLLEGE AVENUE, SUITE 103
BLOOMINGTON, IN 47404
U.S.A.

3. NUMBER
**MB22090A-2** AMENDMENT

4. RENEWABLE
[X] YES
[ ] NO

5. MAY COPY
[X] YES
[ ] NO

6. EFFECTIVE
10/13/2011

7. EXPIRES
03/31/2013

8. NAME AND TITLE OF PRINCIPAL OFFICER *(If #1 is a business)*
RHETT E GOOD
PROJECT MANAGER

9. TYPE OF PERMIT
SPECIAL PURPOSE - MISCELLANEOUS

10. LOCATION WHERE AUTHORIZED ACTIVITY MAY BE CONDUCTED

11. CONDITIONS AND AUTHORIZATIONS:

A. GENERAL CONDITIONS SET OUT IN SUBPART D OF 50 CFR 13, AND SPECIFIC CONDITIONS CONTAINED IN FEDERAL REGULATIONS CITED IN BLOCK #2 ABOVE, ARE HEREBY MADE A PART OF THIS PERMIT. ALL ACTIVITIES AUTHORIZED HEREIN MUST BE CARRIED OUT IN ACCORD WITH AND FOR THE PURPOSES DESCRIBED IN THE APPLICATION SUBMITTED. CONTINUED VALIDITY, OR RENEWAL, OF THIS PERMIT IS SUBJECT TO COMPLETE AND TIMELY COMPLIANCE WITH ALL APPLICABLE CONDITIONS, INCLUDING THE FILING OF ALL REQUIRED INFORMATION AND REPORTS.

B. THE VALIDITY OF THIS PERMIT IS ALSO CONDITIONED UPON STRICT OBSERVANCE OF ALL APPLICABLE FOREIGN, STATE, LOCAL, TRIBAL, OR OTHER FEDERAL LAW.

C. VALID FOR USE BY PERMITTEE NAMED ABOVE.

D. Authorized to retrieve, transport and temporarily possess carcasses of migratory birds found on company/utility property, right-of-ways, and throughout the States of Indiana, Illinois, Iowa, and MInnesota.

Carcasses from each site to be stored in freezers at the wind-energy facility offices at each site location with logs maintained at each site in respective freezers.

Auithorized to conduct bird fatalitiy studies via salvage at several wind-energy facilities in Region 3. Locations of sites is per application dated 09/10/2010.

Permittee must submit an annual report containing the following information to USFWS Migratory Bird Permit Office, 1 Federal Drive, Ft Snelling, MN 55111, with the following information:

location (including proximity to and description of the nearest company facility), species of bird, and details of its discovery.

Specimens collected may be disposed of via any of the following methods: burial or incineration; donation to a public scientific or educational institution.

E. Any person who is

(1) employed by or under contract to you for the activities specified in this permit, or
(2) otherwise designated a subpermittee by you in writing, may exercise the authority of this permit.

[X] ADDITIONAL CONDITIONS AND AUTHORIZATIONS ALSO APPLY

12. REPORTING REQUIREMENTS

**ANNUAL REPORT DUE: 01/31**

ISSUED BY

TITLE
CHIEF, MIGRATORY BIRD PERMIT OFFICE - REGION 3

DATE
10/13/2011

For list of authorized subpermittees, see application dated 09/10/2010.

F. Authorized to collect, stabilize and immediately transport sick and injured migratory birds found on company property, facilities, or right-of-ways to federally licensed rehabilitators for care. All rehabilitation costs are the responsibility of the permittee.

All injured birds collected must be reported to the Migratory Bird Permit Office within 3 working days via fax to 612-713-5393 with the following information:

a general description of the extent of the injury; species of bird; location (including proximity to, and description of the nearest company facility); details of its discovery.

G. Authorized to humanely euthanize migratory birds with injuries that compromise survival. This includes but is not limited to birds that have sustained severe injuries to wings, legs or feet.

H. Authorized in emergency situations occurring on company property or right-of-ways to conduct the following activities:

trap and/or relocate migratory birds; remove and/or relocate active nests with eggs and/or young except for endangered/threatened species, bald and/or golden eagles.

These methods may be used when birds or nests are posing a direct threat to human health and safety or when the safety of the bird is at risk if the nest and/or birds are not removed. Emergency activity must be reported to the Migratory Bird Permit Office within 3 working days via fax to 612-713-5393.

Nothing in this permit authorizes the take of uninjured, healthy birds, and active nests with eggs and/or young in non-emergency situations without additional permits.

I. Personnel must maintain records in accordance with 50 CFR 13.46 and 50 CFR 21.27.

J. Personnel must carry in their company vehicle a copy of this permit when engaging in permitted activities.

K. All required records relating to permitted activity shall be kept at the location indicated by the permittee to the Migratory Bird Permit Office.

L. All banded birds must be reported to the Bird Banding Laboratory at <www.reportband.gov> or 1-800-327-BAND.

M. **(Amended 08/08/2011)**. Amend Condition D above for the following:

Add as an authorized location the Timber Road II wind farm project in Paulding County, Ohio. Per email received 07/28/2011, permittee has obtained required ODNR state permits (Scientific Collection Wild Animal Permit 12-148 issued 6/1/2011 and authorization from ODNR via separate letter of authorization dated July 28, 2011 for work on ESA species to include state endangered and threatened species to include bat species.

Also, in Condition D, change location for annual reporting to USFWS to new regional office location at:

USFWS, Migratory Bird Permit Office, 5600 American Blvd West, Bloomington, MN 55437 (effective May 31, 2011)

N. **(Amended 10/13/2011)**: Amend to add authorized activity at the Blue Creek wind energy facility in Paulding and Van Wert counties, Ohio. Permittee has ODNR and Ohio Power Siting Board approval with appropriate certificates/permits/letters of authorization.

DEPARTMENT OF THE INTERIOR
U.S. FISH AND WILDLIFE SERVICE

# FEDERAL FISH AND WILDLIFE PERMIT

2. AUTHORITY-STATUTES
16 USC 1539(a)

REGULATIONS
50 CFR 17.22

50 CFR 13

1. PERMITTEE

BISHOP HILL ENERGY LLC
ONE SOUTH WACKER DRIVE
SUITE 1900
CHICAGO, IL 60606
U.S.A.

3. NUMBER
**TE71464A-0**

| 4. RENEWABLE | 5. MAY COPY |
|---|---|
| ☒ YES ☐ NO | ☒ YES ☐ NO |
| 6. EFFECTIVE 07/10/2012 | 7. EXPIRES 03/01/2014 |

8. NAME AND TITLE OF PRINCIPAL OFFICER *(If #1 is a business)*
BRYAN SCHUELER
VICE PRESIDENT

9. TYPE OF PERMIT
NATIVE ENDANGERED SP. RECOVERY - E WILDLIFE

10. LOCATION WHERE AUTHORIZED ACTIVITY MAY BE CONDUCTED

HENRY COUNTY, ILLINOIS

11. CONDITIONS AND AUTHORIZATIONS:

A. GENERAL CONDITIONS SET OUT IN SUBPART D OF 50 CFR 13, AND SPECIFIC CONDITIONS CONTAINED IN FEDERAL REGULATIONS CITED IN BLOCK #2 ABOVE, ARE HEREBY MADE A PART OF THIS PERMIT. ALL ACTIVITIES AUTHORIZED HEREIN MUST BE CARRIED OUT IN ACCORD WITH AND FOR THE PURPOSES DESCRIBED IN THE APPLICATION SUBMITTED. CONTINUED VALIDITY, OR RENEWAL, OF THIS PERMIT IS SUBJECT TO COMPLETE AND TIMELY COMPLIANCE WITH ALL APPLICABLE CONDITIONS, INCLUDING THE FILING OF ALL REQUIRED INFORMATION AND REPORTS.

B. THE VALIDITY OF THIS PERMIT IS ALSO CONDITIONED UPON STRICT OBSERVANCE OF ALL APPLICABLE FOREIGN, STATE, LOCAL, TRIBAL, OR OTHER FEDERAL LAW.

C. VALID FOR USE BY PERMITTEE NAMED ABOVE.

D. ACCEPTANCE OF THIS PERMIT SERVES AS EVIDENCE THAT THE PERMITTEE AND ITS AUTHORIZED AGENTS UNDERSTAND AND AGREE TO ABIDE BY THE TERMS OF THIS PERMIT AND ALL SECTIONS OF TITLE 50 CODE OF FEDERAL REGULATIONS, PARTS 13 AND 17, PERTINENT TO ISSUED PERMITS. SECTION 11 OF THE ENDANGERED SPECIES ACT OF 1973, AS AMENDED, PROVIDES FOR CIVIL AND CRIMINAL PENALTIES FOR FAILURE TO COMPLY WITH PERMIT CONDITIONS.

E. PERMITTEE IS AUTHORIZED TO TAKE AND SALVAGE INDIANA BAT (*MYOTIS SODALIS*) FOR SCIENTIFIC RESEARCH AIMED AT RECOVERY OF THE SPECIES: DETERMINATION OF SPECIES PRESENCE OR PROBABLE ABSENCE, STUDIES TO DOCUMENT HABITAT USE, AND TO EVALUATE POTENTIAL IMPACTS TO THE SPECIES. A MAXIMUM OF THREE (3) INDIANA BATS PER YEAR IS AUTHORIZED TO BE TAKEN DURING THE PERIOD AUGUST 1 - SEPTEMBER 30, AS CONDITIONED HEREIN.

F. ACTIVITIES ARE AUTHORIZED AT THE BISHOP HILL WIND ENERGY FACILITY, HENRY COUNTY, ILLINOIS.

G. YOU MAY CONDUCT RESEARCH AND MONITORING TO TEST **CURTAILMENT STRATEGIES** AS FOLLOWS:

G.1. YOUR RESEARCH MAY TEST THE OPERATIONS AT WIND SPEEDS OF 5.5 M/S, 6.0 M/S, 6.5 M/S, AND 6.9 M/S, WITH FEATHERING. EACH TREATMENT MAY BE APPLIED TO A 14-TURBINE GROUP FOR SEVEN (7) NIGHTS TWICE DURING THE STUDY PERIOD OF AUGUST 1 - SEPTEMBER 30.

G.2. IF AN INDIANA BAT IS DISCOVERED TO HAVE BEEN TAKEN UNDER A TURBINE THAT IS PART OF THE TEST, THE NEXT HIGHER CUT-IN SPEED FROM THE SPEED CAUSING FATALITY WILL BECOME THE OPERATING REGIME FOR THAT TREATMENT.

G.3. OF THE TURBINES IDENTIFIED FOR CURTAILMENT STUDY (A TOTAL OF 56 TURBINES), VEGETATION AT 12 TURBINES SHALL BE CLEARED/MOWED FOR MAXIMUM SEARCHING EFFORT (78 METER X 78 METER PLOT).

☒ ADDITIONAL CONDITIONS AND AUTHORIZATIONS ALSO APPLY

12. REPORTING REQUIREMENTS
ANNUAL REPORT DUE: 01/31

| ISSUED BY | TITLE | DATE |
|---|---|---|
| T J Miller | CHIEF - ENDANGERED SPECIES | 07/10/2012 |

G.4. FORTY-FOUR (44) TURBINES MAY BE SEARCHED ALONG ROADS AND PADS AT THE BASE OF THE TURBINE. SEARCHING MUST BE CONDUCTED TO A DISTANCE OF 78 METERS FROM THE TURBINE ALONG ANY ROADS/PADS/CLEARED AREAS.

H. YOU MAY CONDUCT RESEARCH TO STUDY **TEMPERATURE** AND WIND SPEED INTERACTIONS AS FOLLOWS:

H.1. YOU ARE AUTHORIZED TO OPERATE AN ADDITIONAL FIVE (5) TURBINES AT 5.5 M/S, WITH FEATHERING, DURING THE PERIOD OF AUGUST 1 - SEPTEMBER 30.

H.2. TURBINES IDENTIFIED FOR THE TEMPERATURE STUDY SHALL HAVE VEGETATION CLEARED/MOWED TO MAXIMIZE SEARCHER EFFICIENCY. CLEARING SHALL OCCUR TO A 78 METER X 78 METER PLOT.

I. **CARCASS SEARCHES** MUST BE CONDUCTED DURING THE STUDY PERIOD AS OUTLINED IN YOUR APPLICATION. IN ADDITION, THE FOLLOWING CONDITIONS APPLY TO YOUR SEARCHES:

I.1. INDIVIDUALS WHO ARE EMPLOYED BY BISHOP HILL TO COMPLETE THIS TASK MUST HAVE THE APPROPRIATE FEDERAL FISH AND WILDLIFE PERMITS TO SALVAGE AND IDENTIFY MYOTIS SPECIES.

I.2. SEARCH INTERVALS WILL BE SUCH THAT THERE IS AT LEAST AN 80 PERCENT CHANCE THAT A CARCASS HAS NOT BEEN SCAVENGED AND REMAINS TO BE DETECTED.

I.3. THE FOLLOWING INFORMATION MUST BE COLLECTED DURING FATALITY SEARCHES:

I.3.a. A DIGITAL PHOTO DOCUMENTING THE DISCOVERY OF THE CARCASS MUST BE TAKEN PRIOR TO COLLECTION.

I.3.b. THE SPECIMEN SHALL BE INDIVIDUALLY LABELED WITH A UNIQUE IDENTIFIER, BAGGED AND FROZEN.

I.3.c. COLLECTION DATA SHALL BE RECORDED FOR EACH INDIVIDUAL SALVAGED, INCLUDING:

- DATE AND TIME
- INITIAL SPECIES DETERMINATION
- SEX, AGE, REPRODUCTIVE CONDITION (IF POSSIBLE)
- GPS LOCATION
- TURBINE AT WHICH SPECIMEN IS DISCOVERED
- DISTANCE AND BEARING TO TURBINE
- SUBSTRATE/GROUND COVER CONDITIONS
- CONDITION OF SPECIMEN (INTACT, SCAVENGED)
- ESTIMATED TIME SINCE DEATH (NUMBER OF DAYS)
- NOTES ON PRESUMED CAUSE OF DEATH
- AIR TEMPERATURE ON THE NIGHT PRIOR TO COLLECTION AND NIGHT OF PRESUMED DEATH
- WIND SPEEDS, DIRECTION AND GENERAL WEATHER CONDITIONS FOR NIGHTS PRECEDING SEARCH

J. IN THE EVENT THAT AN INDIANA BAT IS FOUND, NOTIFICATION SHALL BE MADE TO THE USFWS (CONDITIONS L.1 AND L.2) WITHIN 24 HOURS OF VERIFIED DISCOVERY. YOUR INITIAL NOTICE MAY BE VIA TELEPHONE; HOWEVER, WRITTEN DOCUMENTATION OF THE DISCOVERY, INCLUDING WIND SPEED AND GENERAL WEATHER CONDITIONS ASSOCIATED WITH THE MORTALITY EVENT, MUST FOLLOW WITHIN FIVE DAYS.

K. AN ANNUAL REPORT OF YOUR ACTIVITIES IS DUE BY JANUARY 31 FOLLOWING EACH YEAR THAT YOUR PERMIT IS IN EFFECT. CONSISTENT WITH YOUR APPLICATION AND STUDY DESIGN, YOUR REPORT SHALL INCLUDE RESULTS OF THE TURBINE CURTAILMENT STUDY, TEMPERATURE STUDY, AND MORTALITY MONITORING. AT A MINIMUM, YOUR REPORT MUST INCLUDE:

K.1. A SUMMARY OF YOUR FINDINGS, INCLUDING OBSERVED AND ADJUSTED FATALITY RATES BY SPECIES, WHERE PRACTICAL, EXPRESSED IN TERMS OF FATALITIES/TURBINE/SEASON AND FATALITIES/MW/SEASON.

K.2. COPIES OF ALL DATA ANALYSES CONDUCTED BY BISHOP HILL LLC OR ITS CONTRACTOR, INCLUDING STATISTICAL TESTS, CORRELATIONS ANALYSES, AND FATALITY ESTIMATES.

K.3. A DISCUSSION OF THE RESULTS AND THEIR IMPLICATIONS FOR OPERATIONS AT BISHOP HILL WIND FACILITY, HENRY COUNTY, ILLINOIS.

K.4. ALL RAW DATA AND COPIES OF DATA COLLECTION SHEETS, PHOTOGRAPHS, AND FIELD NOTES, IF REQUESTED BY THE USFWS UPON REVIEW OF REPORTING INFORMATION PROVIDED UNDER CONDITIONS K.1. - K.3. FAILURE TO PROVIDE DATA MAY RESULT IN REVOKATION OF YOUR PERMIT OR MAY DISQUALIFY BISHOP HILL LLC FOR FUTURE PERMITS UNDER THE ENDANGERED SPECIES ACT.

L. REPORTS AND PUBLICATIONS MUST BE PROVIDED TO ALL OF THE OFFICES LISTED BELOW. IN LIEU OF HARD COPY, DOCUMENTS MAY BE PROVIDED ELECTRONICALLY IN MS WORD OR PORTABLE DOCUMENT FORMAT.

L.1. LISA MANDELL
REGIONAL RECOVERY PERMITS COORDINATOR
U.S. FISH AND WILDLIFE SERVICE
ECOLOGICAL SERVICES - ENDANGERED SPECIES
5600 AMERICAN BLVD. WEST, SUITE 990
BLOOMINGTON, MN 55437-1458
612-713-5343; FAX 612-713-5292
email: Lisa_Mandell@fws.gov

L.2. RICK NELSON
FIELD SUPERVISOR
U.S. FISH AND WILDLIFE SERVICE
1511 47TH AVENUE
MOLINE, IL 61265
309-757-5800 X201; FAX 309-757-1710
email: Richard_C_Nelson@fws.gov

L.3. JOE KATH
ENDANGERED SPECIES COORDINATOR
ILLINOIS DEPARTMENT OF NATURAL RESOURCES
DIVISION OF NATURAL HERITAGE
ONE NATURAL RESOURCE WAY
SPRINGFIELD, IL 62702-1271
217-785-8764; FAX 217-785-2438
email: joe.kath@illinois.gov

CC: FWS/ESFO - ROCK ISLAND, IL
FWS/OFFICE OF LAW ENFORCEMENT
FWS/MIGRATORY BIRDS
ILLINOIS DNR, ATTN: TE COORDINATOR

END

DEPARTMENT OF THE INTERIOR
U.S. FISH AND WILDLIFE SERVICE

# FEDERAL FISH AND WILDLIFE PERMIT

2. AUTHORITY-STATUTES
16 USC 1539(a)

REGULATIONS
50 CFR 17.22

50 CFR 13

1. PERMITTEE

BISHOP HILL ENERGY LLC
ONE SOUTH WACKER DRIVE
SUITE 1900
CHICAGO, IL 60606
U.S.A.

3. NUMBER
**TE71464A-1** AMENDMENT

4. RENEWABLE
☒ YES
☐ NO

5. MAY COPY
☒ YES
☐ NO

6. EFFECTIVE
08/01/2013

7. EXPIRES
03/01/2014

8. NAME AND TITLE OF PRINCIPAL OFFICER *(If #1 is a business)*
BRYAN SCHUELER
VICE PRESIDENT

9. TYPE OF PERMIT
NATIVE ENDANGERED SP. RECOVERY - E WILDLIFE

10. LOCATION WHERE AUTHORIZED ACTIVITY MAY BE CONDUCTED

HENRY COUNTY, ILLINOIS

11. CONDITIONS AND AUTHORIZATIONS:

A. GENERAL CONDITIONS SET OUT IN SUBPART D OF 50 CFR 13, AND SPECIFIC CONDITIONS CONTAINED IN FEDERAL REGULATIONS CITED IN BLOCK #2 ABOVE, ARE HEREBY MADE A PART OF THIS PERMIT. ALL ACTIVITIES AUTHORIZED HEREIN MUST BE CARRIED OUT IN ACCORD WITH AND FOR THE PURPOSES DESCRIBED IN THE APPLICATION SUBMITTED. CONTINUED VALIDITY, OR RENEWAL, OF THIS PERMIT IS SUBJECT TO COMPLETE AND TIMELY COMPLIANCE WITH ALL APPLICABLE CONDITIONS, INCLUDING THE FILING OF ALL REQUIRED INFORMATION AND REPORTS.

B. THE VALIDITY OF THIS PERMIT IS ALSO CONDITIONED UPON STRICT OBSERVANCE OF ALL APPLICABLE FOREIGN, STATE, LOCAL, TRIBAL, OR OTHER FEDERAL LAW.

C. VALID FOR USE BY PERMITTEE NAMED ABOVE.

D. ACCEPTANCE OF THIS PERMIT SERVES AS EVIDENCE THAT THE PERMITTEE AND ITS AUTHORIZED AGENTS UNDERSTAND AND AGREE TO ABIDE BY THE TERMS OF THIS PERMIT AND ALL SECTIONS OF TITLE 50 CODE OF FEDERAL REGULATIONS, PARTS 13 AND 17, PERTINENT TO ISSUED PERMITS. SECTION 11 OF THE ENDANGERED SPECIES ACT OF 1973, AS AMENDED, PROVIDES FOR CIVIL AND CRIMINAL PENALTIES FOR FAILURE TO COMPLY WITH PERMIT CONDITIONS.

E. PERMITTEE IS AUTHORIZED TO TAKE AND SALVAGE INDIANA BAT (*MYOTIS SODALIS*) FOR SCIENTIFIC RESEARCH AIMED AT RECOVERY OF THE SPECIES: DETERMINATION OF SPECIES PRESENCE OR PROBABLE ABSENCE, STUDIES TO DOCUMENT HABITAT USE, AND TO EVALUATE POTENTIAL IMPACTS TO THE SPECIES. A MAXIMUM OF THREE (3) INDIANA BATS PER YEAR IS AUTHORIZED TO BE TAKEN DURING THE PERIOD AUGUST 1 - SEPTEMBER 30, AS CONDITIONED HEREIN.

F. ACTIVITIES ARE AUTHORIZED AT THE BISHOP HILL WIND ENERGY FACILITY, HENRY COUNTY, ILLINOIS.

G. YOU MAY CONDUCT RESEARCH AND MONITORING TO TEST **CURTAILMENT STRATEGIES** AS FOLLOWS:

G.1. YOUR RESEARCH MAY TEST THE OPERATIONS AT WIND SPEEDS OF 4.5 M/S, 5.5 M/S, AND 6.9 M/S, WITH FEATHERING. EACH TREATMENT MAY BE APPLIED TO A 19-TURBINE GROUP FOR SEVEN (7) NIGHTS TWICE DURING THE STUDY PERIOD OF AUGUST 1 - SEPTEMBER 30.

G.2. IF AN INDIANA BAT IS DISCOVERED TO HAVE BEEN TAKEN UNDER A TURBINE THAT IS PART OF THE TEST, THE NEXT HIGHER CUT-IN SPEED FROM THE SPEED CAUSING FATALITY WILL BECOME THE OPERATING REGIME FOR THAT TREATMENT.

G.3. OF THE TURBINES IDENTIFIED FOR CURTAILMENT STUDY (A TOTAL OF 57 TURBINES), VEGETATION AT 12 TURBINES SHALL BE CLEARED/MOWED FOR MAXIMUM SEARCHING EFFORT (78 METER X 78 METER PLOT).

☒ ADDITIONAL CONDITIONS AND AUTHORIZATIONS ALSO APPLY

12. REPORTING REQUIREMENTS

ANNUAL REPORT DUE: 01/31

| ISSUED BY | TITLE | DATE |
|---|---|---|
| Lisa Mandell | ACTING CHIEF - ENDANGERED SPECIES | 08/01/2013 |

G.4. FORTY-FIVE (45) TURBINES MAY BE SEARCHED ALONG ROADS AND PADS AT THE BASE OF THE TURBINE. SEARCHING MUST BE CONDUCTED TO A DISTANCE OF 80 METERS FROM THE TURBINE ALONG ANY ROADS/PADS/CLEARED AREAS.

H. YOU MAY CONDUCT RESEARCH TO STUDY **TEMPERATURE** AND WIND SPEED INTERACTIONS AS FOLLOWS:

H.1. YOU ARE AUTHORIZED TO OPERATE AN ADDITIONAL FIVE (5) TURBINES AT 5.5 M/S. WITH FEATHERING, DURING THE PERIOD OF AUGUST 1 - SEPTEMBER 30.

H.2. TURBINES IDENTIFIED FOR THE TEMPERATURE STUDY SHALL HAVE VEGETATION CLEARED/MOWED TO MAXIMIZE SEARCHER EFFICIENCY. CLEARING SHALL OCCUR TO A 78 METER X 78 METER PLOT.

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I.3.b. THE SPECIMEN SHALL BE INDIVIDUALLY LABELED WITH A UNIQUE IDENTIFIER, BAGGED AND FROZEN.

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- SEX, AGE, REPRODUCTIVE CONDITION (IF POSSIBLE)
- GPS LOCATION
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- SUBSTRATE/GROUND COVER CONDITIONS
- CONDITION OF SPECIMEN (INTACT, SCAVENGED)
- ESTIMATED TIME SINCE DEATH (NUMBER OF DAYS)
- NOTES ON PRESUMED CAUSE OF DEATH
- AIR TEMPERATURE ON THE NIGHT PRIOR TO COLLECTION AND NIGHT OF PRESUMED DEATH
- WIND SPEEDS, DIRECTION AND GENERAL WEATHER CONDITIONS FOR NIGHTS PRECEDING SEARCH

J. IN THE EVENT THAT AN INDIANA BAT IS FOUND, NOTIFICATION SHALL BE MADE TO THE USFWS (CONDITIONS L.1 AND L.2) WITHIN 24 HOURS OF VERIFIED DISCOVERY. YOUR INITIAL NOTICE MAY BE VIA TELEPHONE; HOWEVER, WRITTEN DOCUMENTATION OF THE DISCOVERY, INCLUDING WIND SPEED AND GENERAL WEATHER CONDITIONS ASSOCIATED WITH THE MORTALITY EVENT, MUST FOLLOW WITHIN FIVE DAYS.

K. AN ANNUAL REPORT OF YOUR ACTIVITIES IS DUE BY JANUARY 31 FOLLOWING EACH YEAR THAT YOUR PERMIT IS IN EFFECT. CONSISTENT WITH YOUR APPLICATION AND STUDY DESIGN, YOUR REPORT SHALL INCLUDE RESULTS OF THE TURBINE CURTAILMENT STUDY, TEMPERATURE STUDY, AND MORTALITY MONITORING. AT A MINIMUM, YOUR REPORT MUST INCLUDE:

K.1. A SUMMARY OF YOUR FINDINGS, INCLUDING OBSERVED AND ADJUSTED FATALITY RATES BY SPECIES, WHERE PRACTICAL, EXPRESSED IN TERMS OF FATALITIES/TURBINE/SEASON AND FATALITIES/MW/SEASON.

K.2. COPIES OF ALL DATA ANALYSES CONDUCTED BY BISHOP HILL LLC OR ITS CONTRACTOR, INCLUDING STATISTICAL TESTS, CORRELATIONS ANALYSES, AND FATALITY ESTIMATES.

K.3. A DISCUSSION OF THE RESULTS AND THEIR IMPLICATIONS FOR OPERATIONS AT BISHOP HILL WIND FACILITY, HENRY COUNTY, ILLINOIS.

K.4. ALL RAW DATA AND COPIES OF DATA COLLECTION SHEETS, PHOTOGRAPHS, AND FIELD NOTES, IF REQUESTED BY THE USFWS UPON REVIEW OF REPORTING INFORMATION PROVIDED UNDER CONDITIONS K.1. - K.3. FAILURE TO PROVIDE DATA MAY RESULT IN REVOKATION OF YOUR PERMIT OR MAY DISQUALIFY BISHOP HILL LLC FOR FUTURE PERMITS UNDER THE ENDANGERED SPECIES ACT.

L. REPORTS AND PUBLICATIONS MUST BE PROVIDED TO ALL OF THE OFFICES LISTED BELOW. IN LIEU OF HARD COPY, DOCUMENTS MAY BE PROVIDED ELECTRONICALLY IN MS WORD OR PORTABLE DOCUMENT FORMAT.

L.1. LISA MANDELL
REGIONAL RECOVERY PERMITS COORDINATOR
U.S. FISH AND WILDLIFE SERVICE
ECOLOGICAL SERVICES - ENDANGERED SPECIES
5600 AMERICAN BLVD. WEST, SUITE 990
BLOOMINGTON, MN 55437-1458
612-713-5343; FAX 612-713-5292
email: Lisa_Mandell@fws.gov

L.2. RICK NELSON
FIELD SUPERVISOR
U.S. FISH AND WILDLIFE SERVICE
1511 47TH AVENUE
MOLINE, IL 61265
309-757-5800 X201; FAX 309-757-1710
email: Richard_C_Nelson@fws.gov

L.3. JOE KATH
ENDANGERED SPECIES COORDINATOR
ILLINOIS DEPARTMENT OF NATURAL RESOURCES
DIVISION OF NATURAL HERITAGE
ONE NATURAL RESOURCE WAY
SPRINGFIELD, IL 62702-1271
217-785-8764; FAX 217-785-2438
email: joe.kath@illinois.gov

CC: FWS/ESFO - ROCK ISLAND, IL
FWS/OFFICE OF LAW ENFORCEMENT
FWS/MIGRATORY BIRDS
ILLINOIS DNR, ATTN: TE COORDINATOR

**END**

# ILLINOIS DEPARTMENT OF NATURAL RESOURCES

**Authorization is hereby granted, under Section 5/3.22, Chapter 520 and Section 5/20-100, Chapter 515 of the Illinois compliled Statues to:**

Last Name: **Good** First Name: **Rhett** Permit Number: **NH13.5223**

Issued: **1/31/2013** **Expires: 12/31/2013**

Business Name: Western EcoSystems Technology Inc.

Street Address: 408 West Sixth Street

City: Bloomington State: IN Zip Code: 47404

for strictly scientific, educational or zoological purposes, to take the Illinois fauna identified below subject to the following provisions:

Applicant and all associates may salvage all listed and non-listed deceased birds and bats (and their parts) and deposit these specimens in a freezer for later analysis - there is no limit to the number of specimens that may be collected and this permit authorizes activities in all Illinois counties, with an initial emphasis on Woodford, Livingston, Henry, McLean, and LaSalle Counties [As listed on the accompanying Illinois Department of Natural Resources (IDNR) scientific permit application/project proposal (on file in Springfield, IL.)] strictly for scientific, educational, and/or zoological purposes.] Salvaged specimens may also be used during scavenger removal trials. This permit authorizes activities described in the: Avian and Bat Fatality Monitoring Plan-Grand Ridge Project (on file in Springfield, IL.). A federal permit is required for all projects involving federally regulated species, including migratory birds and their parts, including nests, feathers, etc. - this permit does not allow the collection of birds and/or their parts without the accompanying Federal Permit. Endangered and Threatened Species activities in Illinois are covered under Illinois E&T Permit #08-29S. Upon project completion, all salvaged animals shall be reported to both the IDNR and USFWS prior to disposal - these agencies may want certain specimens for analysis, etc. A report to the Illinois DNR (attn: Joseph Kath) shall be provided within 90 days of project completion.
This permit will also allow: live collection; photograph & handle for data collection; release unharmed near capture location; - for all non-listed mussels throughout Illinois.
Individuals working under direction of applicant include: Jason Ritzert, Michelle Ritzer, Sandra Simon, Kevin Murray

I agree to the following provisions and terms of this Scientific Permit.

Permittee's Signature: Rhett Good

(Permit not valid unless signed)

Approved By: J. Hall

Office of Resource Conservation

Date: 2/5/13

## TERMS FOR SCIENTIFIC PERMIT

1. Under no circumstances shall a scientific permit be used in lieu of sport or commercial licenses.
2. All taking shall be performed by or under the direct supervision of the permittee. Permitte must be present with persons involved in actual taking.
3. All gear left unattended must be tagged bearing name and scientific permit number of permittee.
4. Permittee must be at least eighteen (18) years of age.
5. Permits are not transferable and PERMITTE SHALL CARRY PERMIT AT ALL TIMES WHEN TAKING FAUNA.
6. Agency, company or institution listed on the application is responsible for the taking activities and reports of the individual issued this permit
7. Scientific permits will not be valid for taking any species appearing on official State List of Endangered and Threatened Vertebrate Species of Illinois (see attached Administrative Rule, Part 1010) without specific written approval from the Department of Natural Resources.
8. A federal Permit is required for the taking of species protected by the Federal Government in addition to the State Scientific Permit.
9. The Division of Wildlife Resources may require special conditions or provsions on any Scientific Permit.
10. Use of rotenone or any other toxic materials for taking must have special written approval from the Department of Natural Resources and may need a variance from the Illinois Environmental Protection Agency.
11. By january 31 of next year, an annual report of the permittee's activies must be submitted to the Division of Wildlife Resources. In addition, the permittee shall submit a copy of all written reports, etc. that result from the permitted activity. Permits will be renewed after these annual reports and appropriate publications have been received.
12. Any permit may be revoked or suspended at any time by the Department of Natural Resources.
13. Permits expire December 31 each calendar year unless otherwise specified.

The Department of Natural Resources is an equal opportunity employer.

# ILLINOIS DEPARTMENT OF NATURAL RESOURCES

**Authorization is hereby granted, under Section 5/3.22, Chapter 520 and Section 5/20-100, Chapter 515 of the Illinois compliled Statues to:**

Last Name: **Good** First Name: **Rhett** Permit Number: **NH14.5223**

Issued: **4/15/2014** **Expires: 12/31/2014**

Business Name: Western EcoSystems Technology Inc.

Street Address: 408 West Sixth Street

City: Bloomington State: IN Zip Code: 47404

for strictly scientific, educational or zoological purposes, to take the Illinois fauna identified below subject to the following provisions:

Applicant and all associates may salvage all listed and non-listed deceased birds and bats (and their parts) and deposit these specimens in a freezer for later analysis - there is no limit to the number of specimens that may be collected and this permit authorizes activities in all Illinois counties, with an initial emphasis on Woodford, Livingston, Henry, McLean, and LaSalle Counties [As listed on the accompanying Illinois Department of Natural Resources (IDNR) scientific permit application/project proposal (on file in Springfield, IL.)] strictly for scientific, educational, and/or zoological purposes.] Salvaged specimens may also be used during scavenger removal trials. This permit authorizes activities described in the: Avian and Bat Fatality Monitoring Plan-Grand Ridge Project (on file in Springfield, IL.). A federal permit is required for all projects involving federally regulated species, including migratory birds and their parts, including nests, feathers, etc. - this permit does not allow the collection of birds and/or their parts without the accompanying Federal Permit. Endangered and Threatened Species activities in Illinois are covered under Illinois E&T Permit #08-29S. Upon project completion, all salvaged animals shall be reported to both the IDNR and USFWS prior to disposal - these agencies may want certain specimens for analysis, etc. A report to the Illinois DNR (attn: Joseph Kath) shall be provided within 90 days of project completion. If live or deceased endangered and threatened species are encountered during the permitted activity, the occurrence needs to be documented (preferably with photographs of diagnostic characteristics and geographic location) and reported in writing to the IDNR Division of Natural Heritage, Endangered Species Coordinator within one (1) week.
Individuals working under direction of applicant include: Jason Ritzert, Michelle Ritzert, Sandra Simon, Kevin Murray, Benjamin Hale, Goniela Isakali

I agree to the following provisions and terms of this Scientific Permit.

Permittee's Signature: Rhett E

(Permit not valid unless signed)

Approved By: Tim Kath

Office of Resource Conservation

Date: 4-15-14

## TERMS FOR SCIENTIFIC PERMIT

1. Under no circumstances shall a scientific permit be used in lieu of sport or commercial licenses.
2. All taking shall be performed by or under the direct supervision of the permittee. Permitte must be present with persons involved in actual taking.
3. All gear left unattended must be tagged bearing name and scientific permit number of permittee.
4. Permittee must be at least eighteen (18) years of age.
5. Permits are not transferable and PERMITTE SHALL CARRY PERMIT AT ALL TIMES WHEN TAKING FAUNA.
6. Agency, company or institution listed on the application is responsible for the taking activities and reports of the individual issued this permit
7. Scientific permits will not be valid for taking any species appearing on official State List of Endangered and Threatened Vertebrate Species of Illinois (see attached Administrative Rule, Part 1010) without specific written approval from the Department of Natural Resources.
8. A federal Permit is required for the taking of species protected by the Federal Government in addition to the State Scientific Permit.
9. The Division of Wildlife Resources may require special conditions or provsions on any Scientific Permit.
10. Use of rotenone or any other toxic materials for taking must have special written approval from the Department of Natural Resources and may need a variance from the Illinois Environmental Protection Agency.
11. By january 31 of next year, an annual report of the permittee's activies must be submitted to the Division of Wildlife Resources. In addition, the permittee shall submit a copy of all written reports, etc. that result from the permitted activity. Permits will be renewed after these annual reports and appropriate publications have been received.
12. Any permit may be revoked or suspended at any time by the Department of Natural Resources.
13. Permits expire December 31 each calendar year unless otherwise specified.

The Department of Natural Resources is an equal opportunity employer.

DEPARTMENT OF THE INTERIOR
U.S. FISH AND WILDLIFE SERVICE

# FEDERAL FISH AND WILDLIFE PERMIT

2. AUTHORITY-STATUTES
16 USC 703-712

REGULATIONS
50 CFR Part 13
50 CFR 21.27

1. PERMITTEE

BISHOP HILL ENERGY LLC
ONE SOUTH WACKER DRIVE
C/O MATTHEW A. RUHTER
SUITE 1900
CHICAGO, IL 60606
U.S.A.

3. NUMBER
**MB72234A-0**

4. RENEWABLE
☒ YES
☐ NO

5. MAY COPY
☒ YES
☐ NO

6. EFFECTIVE
05/14/2012

7. EXPIRES
03/31/2015

8. NAME AND TITLE OF PRINCIPAL OFFICER *(If #1 is a business)*
KEVIN E. PARZYCK
VICE PRESIDENT DEVELOPMENT CENTRAL

9. TYPE OF PERMIT
SPECIAL PURPOSE UTILITY PERMIT FOR MIGRATORY BIRD MORTALITY MONITORING

10. LOCATION WHERE AUTHORIZED ACTIVITY MAY BE CONDUCTED
Henry County, IL: Townships of Andover, Cambridge, Burns, Kewanee, Clover, Galva, Oxford, Weller and Wethersfield. Stark Countie: Townships of Elmira, Goshen and Toulon.
133 GE 1.5-MW or 1.6 GE-MW wind turbines spanning approx. 27 miles through the above townships.

11. CONDITIONS AND AUTHORIZATIONS:

A. GENERAL CONDITIONS SET OUT IN SUBPART D OF 50 CFR 13, AND SPECIFIC CONDITIONS CONTAINED IN FEDERAL REGULATIONS CITED IN BLOCK #2 ABOVE, ARE HEREBY MADE A PART OF THIS PERMIT. ALL ACTIVITIES AUTHORIZED HEREIN MUST BE CARRIED OUT IN ACCORD WITH AND FOR THE PURPOSES DESCRIBED IN THE APPLICATION SUBMITTED. CONTINUED VALIDITY, OR RENEWAL, OF THIS PERMIT IS SUBJECT TO COMPLETE AND TIMELY COMPLIANCE WITH ALL APPLICABLE CONDITIONS, INCLUDING THE FILING OF ALL REQUIRED INFORMATION AND REPORTS.

B. THE VALIDITY OF THIS PERMIT IS ALSO CONDITIONED UPON STRICT OBSERVANCE OF ALL APPLICABLE FOREIGN, STATE, LOCAL, TRIBAL, OR OTHER FEDERAL LAW.

C. VALID FOR USE BY PERMITTEE NAMED ABOVE.

Block 10: Bishop Hill Energy LLC
Henry and Stark Counties
Illinois

D. **Possession and transport.** You are authorized to collect, transport and temporarily possess carcasses and partial remains of migratory birds found at the location/property specified in Block 10 for monitoring migratory bird mortality associated with operation of the wind facility. To accurately determine species fatality rates, which is the important research justification for authorizing this special purpose permit, the monitoring study should include standardized carcass searches, searcher efficiency trials, and carcass removal by scavenger trials.

Except for take caused by your infrastructure and operations, you may not collect or disturb and must immediately report to U.S. Fish and Wildlife Service Office of Law Enforcement (OLE) any dead migratory birds that appear to have been poisoned, shot, or otherwise killed or injured as the result of potential criminal activity. Your OLE contact phone number is 217-793-9554 Springfield IL office.

E. **Relocation.** Except for Endangered or Threatened Species and Bald Eagles or Golden Eagles, *in emergency situations* you are authorized to relocate active migratory bird nests, including eggs or nestlings, found at the location/property specified in Block 10 when (1) the safety of the migratory birds, nests or eggs is at risk, or (2) the migratory birds, nests, or eggs pose a threat of serious bodily injury or a risk to human life, including a threat of fire hazard or power outage. You may not use this authority for situations in which migratory birds are merely causing a nuisance. You must monitor relocated nests daily to assess success of the relocation.

*If you seek to harass or live-trap and relocate an Endangered or Threatened Species, Bald Eagles, or Golden Eagles you must get an*

☒ ADDITIONAL CONDITIONS AND AUTHORIZATIONS ALSO APPLY

12. REPORTING REQUIREMENTS
**ANNUAL REPORT DUE: 01/31**

| ISSUED BY | TITLE | DATE |
|---|---|---|
| | CHIEF, MIGRATORY BIRD PERMIT OFFICE - REGION 3 | 05/11/2012 |

*additional permit to do so.*

F. **Data Collection.**

(1) The following data must be recorded for each search:
(a) date,
(b) start time,
(c) end time,
(d) interval since last search,
(e) observer,
(f) search method used,
(g) identifying information for the turbine or turbines searched, and,
(h) weather data for each search, including the weather for the interval since the last search.

(2) All relevant data associated with each carcass or parts collection must be recorded, including:
(a) date,
(b) species,
(c) sex and age (if known),
(d) observer name and contact information,
(e) turbine or pole number,
(f) distance of carcass from turbine or pole,
(g) azimuth from turbine (including GPS coordinates in decimal degrees),
(h) habitat surrounding carcass (*e.g.*, bare ground, tall grass, shrubby)
(i) condition and description of carcass with suspected cause of death if apparent (entire, partial, scavenged, wing severed from body, blood oozing from mouth from apparent blunt force trauma),
(j) estimated time of death ( $\leq$ 1 day, 2 days, etc.),
(k) information on carcass disposition, and
(l) any relevant notes or additional information.

(3) All carcasses and partial remains collected must be digitally photographed, bagged, and labeled with:
(a) the date,
(b) a unique specimen number,
(c) the transect or subplot number, and
(d) the turbine or pole number.

G. **Injured birds.** To provide treatment to injured birds, you must capture, stabilize and immediately transfer injured or sick migratory birds found at the location specified in Block 10, including eagles and Threatened or Endangered species, to a federally permitted migratory bird rehabilitator for care. The rehabilitator (or if not available, a licensed, practicing veterinarian) can decide to euthanize a migratory bird or eagle. Rehabilitation costs are your responsibility. See condition I for reporting instructions.

H. **Collection of live, non-injured migratory birds, eggs, or nests is not authorized by this permit.** You are not authorized to take, capture, harass or disturb Bald Eagles or Golden Eagles, or species listed as Threatened or Endangered under the U.S. Endangered Species Act (see 50 CFR 17.11).

I. **Reporting.**
(1) You must report bird injuries and deaths in accordance with the timeframes specified below. We request that you also report voluntarily comparable bat injury and mortality information. If you have an account with the U.S. Fish and Wildlife Service (Service) Bird Injury and Mortality Reporting System (BIMRS) for reporting wind industry incidents, you must report the incidents in BIMRS at: *https://birdreport.fws.gov/*. If you do not have a BIMRS account, you must report the incident to USFWS 5600 American Blvd. W, Bloomington, MN 55437 (612-713-5436).

(a) You must report any **Bald Eagle or Golden Eagle** found dead or injured to OLE by the **next available business day** (see Condition D for contact information) and your migratory bird permit office at USFWS 5600 American Blvd. W, Bloomington, MN 55437 (612-713-5436). Your report must include as much of the data as possible in F(2) above. You can provide information not available at the time of your initial report to OLE within 48 hours or as directed by the OLE officer.

(b) You must report any **Threatened or Endangered Species** found dead or injured within **48 hours**. The report must include as much of the data as possible in F(2) above. A list of Threatened and Endangered species by State may be found in the U.S. Fish and Wildlife Service's Threatened and Endangered Species System (TESS) database at: *http://www.fws.gov/endangered.*

(c) You must report bird mortalities or injuries to the Service in accordance with paragraph I(1) within **30 days** of the discovery for migratory birds other than Eagles and Threatened or Endangered species. Your report must include the information from condition F (2) above.

(d) You must report any emergency active nest relocation activity (per condition E) within **3 business days**. Your report must include the species and number of active nests, including eggs and nestlings, relevant site locations, method of relocation, and a complete description of the emergency circumstances warranting the relocation.

(2) You must submit an **Annual Report** of dead and injured birds collected (which you may generate from the BIMRS database if your

company holds an account) to your migratory bird permit issuing office by January 31 following each calendar year in which the permit is in effect. Your report must include at a minimum the following for each carcass or partial carcass collected and each live, injured migratory bird captured: species, date collected or captured, location, condition (live or dead), pole/turbine number, apparent cause of mortality, weather conditions when mortality/injury occurred, name and contact information of person collecting, and disposition of those carcasses or parts. The report form 3-202-17 is available at *http://www.fws.gov/forms/3-202-17.pdf.*

(3) **Banded Birds** (carcasses collected and injured birds) must be reported to the U.S. Geological Survey Bird Banding Laboratory at 1-800-327-2263 or *http://www.reportband.gov.* Information provided must include, as accurately as possible, species of bird, band number, date recovered, recovery location that can be narrowed down to a specific 10-minute block, and name and contact information of the person who recovered the carcass or bird.

J. **Disposition of Carcasses and Parts.**
(1) You must deliver **Bald Eagle** and **Golden Eagle** carcasses to the Service Office of Law Enforcement (OLE), to be forwarded to the National Eagle Repository (NER) in Colorado. However, with prior authorization from an OLE Special Agent you may ship carcasses directly to the NER (contact the NER at 303-287-2110 for shipping instructions). Disposition must be reported in your annual report to the issuing permit office and in BIMRS if you have a BIMRS account.

(2) You must transfer dead or injured **Threatened and Endangered Species** in accordance with instructions from your migratory bird permit issuing office. The disposition of these animals must be reported in your annual report to the issuing permit office and in BIMRS if you have a BIMRS account.

(3) **Migratory Bird** carcasses and parts (other than those of Eagles and Threatened and Endangered species) must be stored at the facilities at the location specified in Block 10 until the end of the calendar year in which they were collected. Unless otherwise specified by the permit issuing office or OLE, carcasses and parts may be:
(a) used for searcher efficiency and scavenger removal trials;
(b) turned over to the State wildlife agency regulating migratory bird mortality monitoring activities associated with wind energy; or,
(c) with additional authorization from the permit issuing office, donated to a public scientific or educational institution or to an individual or entity authorized by federal permit to acquire and possess migratory bird specimens.

All dead specimens and parts (except Eagles and Threatened and Endangered species) that you do not transfer to another authorized party must be disposed of by such means as are necessary to ensure that they are not exposed to animals in the wild, such as by burning or burying them.

K. **Renewal.** In addition to an updated monitoring protocol, any renewal request for this permit must include information on the fatality rates of affected species or fatality patterns, analysis of those rates/patterns, whether any adjustments or measures were taken to avoid or minimize mortalities, if so, and preliminary results of those modifications.

L. **Subpermittees.**
(1) Any person who is employed by or under contract to the permittee for the activities specified in this permit or is otherwise designated by the permittee as a subpermittee in writing may exercise the authority of this permit.

(2) Subpermittees must be at least 18 years of age. As the permittee, you are legally responsible for ensuring that your subpermittees are adequately trained and adhere to the terms of your permit. You are responsible for maintaining current records of who you have designated as a subpermittee, including copies of letters you have provided.

M. **Carrying your permit.** You and any subpermittees must carry a legible copy of this permit and display it upon request whenever you are exercising its authority. Subpermittees must also carry your written subpermittee designation letter.

N. **Records.** You must maintain records in accordance with 50 CFR 13.46 and 50 CFR 21.27 and this permit. You must keep all required records and collected wildlife parts relating to permitted activities at the location you identified in writing to the migratory bird permit issuing office.

O. **Personal use.** This permit does not authorize personal use of any migratory birds, parts, nests or eggs salvaged, transported, or temporarily possessed under the authority of this permit.

P. **Other permissions.** This permit does not authorize you to conduct activities on Federal, State, tribal, or other public or private property without additional prior written permits or permission from the agency/landowner.

Q. **Applicable laws.** You may not conduct the activities authorized by this permit if doing so would violate the laws of the applicable State, county, municipal or tribal government or any other applicable law.

R. **Site inspections.** Acceptance of this permit authorizes the Director's agent to enter the wind development property at any reasonable hour as necessary to inspect the wildlife, records, turbines, property, and associated infrastructure for wildlife impacted by the wind development, and for compliance with the terms of this permit and governing regulations.

*This permit does not, nor shall it be construed to, authorize lethal take or injury of migratory birds or limit or preclude the U.S. Fish and Wildlife Service from exercising its authority under any law, statute, or regulation, or from taking enforcement action against any individual, company, or agency. This permit is not intended to relieve any individual, company, or agency of its obligations to comply with*

*any applicable Federal, State, Tribal, or local law, statute, or regulation.*

Illinois
Department of
Natural Resources
One Natural Resources Way · Springfield, Illinois 62702-1271
www.dnr.illinois.gov

All 3 sites

# PERMIT FOR POSSESSION OF ENDANGERED OR THREATENED SPECIES

Permit type: _S_ Permit No. 15-031 is issued to: Brad Romano and the associates listed in Attachment A (Shoener Environmental, Inc.) 239 Main Street, Suite 301, Dickson City, PA 18519 to allow **surveys, collection, salvage, possession, and storage** of the following animals or animal products of endangered or threatened species or federal endangered plants:

| SPECIES | ITEM | QUANTITY |
|---|---|---|
| 1. All State Listed Bat Species | Carcass | As Encountered |
| 2. All State Listed Bird Species | Carcass | As Encountered |

Permit version: Original _X_ Renewal __ Amended __

Special conditions: This permit is valid for the following locations: Bishop Hill Wind Energy Facility (Henry County), Grand Ridge Wind Facility (LaSalle County), and California Ridge Wind Energy Facility (Champaign and Vermillion Counties). Carcasses found outside of the search area will be treated similar to those found within the search area. Vegetation within the search area will be maintained at a suitable low height (less than 6 inches) for the duration of the study with mowing to occur (if necessary) within 24 hours after carcass collections. The applicant will notify the IDNR of the results of the carcass removal trials and efficiency trials and any subsequent changes to the monitoring schedule on a **quarterly basis.** If listed species are encountered, the IDNR will be notified within 72 hours of positive ID (preferably with photographs of diagnostic characteristics and geographic location) at mike.moomey@illinois.gov Annual reporting criteria for the permit will consist of a spreadsheet of all collected specimens that includes all the information contained within the data sheets. All carcasses will be maintained frozen individually in sealed bags containing the completed data sheets and after identification.. Upon completion of the study or at any time during, all specimens will be turned over to the IDNR upon request. IDNR contacts are; mike.moomey@illinois.gov and john.wilker@illinois.gov. Applicants must utilize appropriate decontamination procedures to

prevent the spread of disease between individuals and sites and every effort should be made to prevent the spread of exotic or invasive plants/plant propagules.

**Standard conditions:**

- **Reporting-** Annual reports must be submitted by January 31 of each year. Changes in inventory of specimens must be reported within 5 days. Changes in personal information or affiliation must be reported within 10 days.
- **Propagation-** Propagation requires a permit for such a purpose, only available under Scientific and Zoological/Botanical permits.
- **Disposal or Transfer-** Applicants must obtain a permit prior to transfer or disposal of specimens.
- **Facilities**: Holding facilities must meet the standards set forth by the Federal Animal Welfare Act.
- **Temporary holding**: Specimens allowed under limited permits may be held temporarily (up to 90 days) by other persons only after written consent of the director.
- **Revocation**: Permits may be revoked if false information was used to obtained permit, reports were not submitted, facility standards were not met, or applicant violates state or federal laws.

**THIS PERMIT IF VOID IF IT CONTAINS ANY STRIKE-OUTS, OVERWRITES OR OTHER ALTERATIONS AND IS NON-TRANSFERABLE**

ITEMS LISTED ON THIS PERMIT MAY BE SOLD, GIVEN AWAY OR OTHERWISE DISPOSED OF ONLY WITH PERMISSION OF THE ILLINOIS DEPARTMENT OF NATURAL RESOURCES

Signed: _____
Dr. Jim Herkert
Office Director
IDNR Office of Resource Conservation

Date issued: 5/18/15 Expiration Date: December 31, 2015

*This permit is issued pursuant to the Illinois Endangered Species Protection Act and authorizes only those activities listed above. This permit does NOT exempt the permittee from compliance with any other federal, state, or local law, statute, ordinance, or regulation. As a permit holder, the individual/agency acknowledges that all collections of Federal and State listed species be reported to the Endangered Species Program Manager (IL. DNR-Division of Natural Heritage) within 10 days of collection.

ATTACHMENT A
Brad Romano (Shoener Environmental)
Permit #15-031

The following associates are authorized to work under the direction of the applicant:

Michael David
Jessica Noe,
Carlyle Meekins
Heath Smith
Suzie Marlow
Tom Wallenfeldt
Brian Good
William Chrisman
Gordon Lee
Zackary Sisk

# ILLINOIS DEPARTMENT OF NATURAL RESOURCES

**Authorization is hereby granted, under Section 5/3.22, Chapter 520 and Section 5/20-100, Chapter 515 of the Illinois compliled Statues to:**

Bishop Hill

Last Name: **Romano** First Name: **W. Brad** Permit Number: **NH15.5850**

Issued: **8/24/2015** **Expires: 12/31/2015**

Business Name: Shoener Environmental, Inc.

Street Address: 239 Main Street, Suite 301

City: Dickson City State: PA Zip Code: 18519

for strictly scientific, educational or zoological purposes, to take the Illinois fauna identified below subject to the following provisions:

Applicant and all individuals listed may legally capture, handle, collect data and/or obtain biological samples, by scientifically accepted and approved methods, for projects and species listed below [as listed on the accompanying Illinois Department of Natural Resources (IDNR) scientific permit application/project proposal (on file in Springfield, IL) strictly for scientific, educational and/or zoological purposes]. Permitted activities include; salvage of avian and chiropteran carcasses (quantities as encountered) utilizing visual observation teams daily, identification to species and general data collection. Salvage carcasses in excellent condition of Hoary (Lasiurus cinereus), and Silver-haired (Lasionycteris noctovagans) bats may be utilized for searcher efficiency and/or carcass removal trials after proper documentation to include photographs. If listed species are encountered, the IDNR will be notified within 72 hours of positive ID (preferably with photographs of diagnostic characteristics and geographic location) at mike.mooney@illinois.gov . Carcasses found outside of the search area will be treated similar to those found within the search area. Bird carcasses encountered will be treated and reported similar to bats. The applicant will notify the IDNR of the results of the carcass removal trials and efficiency trials and any subsequent changes to the monitoring schedule on a quarterly basis. All carcasses will be maintained frozen individually in sealed bags containing the completed data sheets (or copies). All carcasses will be maintained at the same facility and housed together and not separated. The IDNR reserves the right to inspect the specimens upon request for identification purposes. Upon completion of the study or at any time during, all specimens will be turned over to the IDNR upon request. Upon completion of the study, the specimens not turned over to the IDNR will be donated to the collection facility at an approved Zoological or Scientific institution, incinerated, or buried. The applicant will notify the IDNR within 72 hours if greater than 10 birds or bats are found during any single search. Annual reporting criteria for the permit will be submitted on a quarterly basis with a final report within 30 days of the completion of the study and consist of a spreadsheet of all collected specimens containing all information collected for each specimen including species identification and disposition of sample. Possession of a valid scientific collection permit does not grant access for permitted activities as other permits may be required. A federal permit is required for all projects involving federally regulated species, including migratory birds. Any permitted activities conducted on State-owned properties require prior approval and possession of an IDNR Research / Site Permit. Any permitted activities conducted on sites Dedicated or Registered through the Illinois Nature Preserves Commission require prior approval and possession of an INPC Research Permit. Applicants must utilize appropriate decontamination procedures to prevent the spread of disease between individuals and sites and every effort should be made to prevent the spread of exotic or invasive plants/plant propagules.
Authorization: Henry county
Individuals working under direction of applicant include: Michael David, Jessica Noe, Carlyle Meekins, Heath Smith, Suzie Marlow, Tom Wallenfeldt, Brian Good, William Chrisman, Gordon Lee, Zackary Sisk and temporary employees (names on file in Springfield).

I agree to the following provisions and terms of this Scientific Permit.

Permittee's Signature: _____ Approved By: _____ Date: 8-27-15

(Permit not valid unless signed) Office of Resource Conservation

## TERMS FOR SCIENTIFIC PERMIT

1. Under no circumstances shall a scientific permit be used in lieu of sport or commercial licenses.
2. All taking shall be performed by or under the direct supervision of the permittee. Permitte must be present with persons involved in actual taking.
3. All gear left unattended must be tagged bearing name and scientific permit number of permittee.
4. Permittee must be at least eighteen (18) years of age.
5. Permits are not transferable and PERMITTE SHALL CARRY PERMIT AT ALL TIMES WHEN TAKING FAUNA.
6. Agency, company or institution listed on the application is responsible for the taking activities and reports of the individual issued this permit
7. Scientific permits will not be valid for taking any species appearing on official State List of Endangered and Threatened Vertebrate Species of Illinois (see attached Administrative Rule, Part 1010) without specific written approval from the Department of Natural Resources.
8. A federal Permit is required for the taking of species protected by the Federal Government in addition to the State Scientific Permit.
9. The Division of Wildlife Resources may require special conditions or provsions on any Scientific Permit.
10. Use of rotenone or any other toxic materials for taking must have special written approval from the Department of Natural Resources and may need a variance from the Illinois Environmental Protection Agency.
11. By january 31 of next year, an annual report of the permittee's activies must be submitted to the Division of Wildlife Resources. In addition, the permittee shall submit a copy of all written reports, etc. that result from the permitted activity. Permits will be renewed after these annual reports and appropriate publications have been received.
12. Any permit may be revoked or suspended at any time by the Department of Natural Resources.
13. Permits expire December 31 each calendar year unless otherwise specified.

The Department of Natural Resources is an equal opportunity employer.

# ILLINOIS DEPARTMENT OF NATURAL RESOURCES

**Authorization is hereby granted, under Section 5/3.22, Chapter 520 and Section 5/20-100, Chapter 515 of the Illinois compliled Statues to:**

Last Name: **Romano** First Name: **W. Brad** Permit Number: **NH15.5850**

Issued: **5/7/2015** **Expires: 12/31/2015**

Business Name: Shoener Environmental, Inc.

Bishop

Street Address: 239 Main Street, Suite 301

City: Dickson City State: PA Zip Code: 18519

for strictly scientific, educational or zoological purposes, to take the Illinois fauna identified below subject to the following provisions:

Applicant and all individuals listed may legally capture, handle, collect data and/or obtain biological samples, by scientifically accepted and approved methods, for projects and species listed below [as listed on the accompanying Illinois Department of Natural Resources (IDNR) scientific permit application/project proposal (on file in Springfield, IL) strictly for scientific, educational and/or zoological purposes]. Permitted activities include; salvage of avian and chiropteran carcasses (quantities as encountered) utilizing visual observation teams daily, identification to species and general data collection. Salvaged carcasses must be maintained and not utilized for searcher efficiency and or carcass removal trials. If listed species are encountered, the IDNR will be notified within 72 hours of positive ID (preferably with photographs of diagnostic characteristics and geographic location) at mike.moomey@illinois.gov . Carcasses found outside of the search area will be treated similar to those found within the search area. Bird carcasses encountered will be treated and reported similar to bats. The applicant will notify the IDNR of the results of the carcass removal trials and efficiency trials and any subsequent changes to the monitoring schedule on a quarterly basis. All carcasses will be maintained frozen individually in sealed bags containing the completed data sheets (or copies). All carcasses will be maintained at the same facility and housed together and not separated. The IDNR reserves the right to inspect the specimens upon request for identification purposes. Upon completion of the study or at any time during, all specimens will be turned over to the IDNR upon request. Upon completion of the study, the specimens not turned over to the IDNR will be donated to the collection facility at an approved Zoological or Scientific institution, incinerated, or buried. The applicant will notify the IDNR within 72 hours if greater than 10 birds or bats are found during any single search. Annual reporting criteria for the permit will be submitted on a quarterly basis with a final report within 30 days of the completion of the study and consist of a spreadsheet of all collected specimens containing all information collected for each specimen including species identification and disposition of sample. Possession of a valid scientific collection permit does not grant access for permitted activities as other permits may be required. A federal permit is required for all projects involving federally regulated species, including migratory birds. Any permitted activities conducted on State-owned properties require prior approval and possession of an IDNR Research / Site Permit. Any permitted activities conducted on sites Dedicated or Registered through the Illinois Nature Preserves Commission require prior approval and possession of an INPC Research Permit. Applicants must utilize appropriate decontamination procedures to prevent the spread of disease between individuals and sites and every effort should be made to prevent the spread of exotic or invasive plants/plant propagules.

Authorization: Henry county

Individuals working under direction of applicant include: Michael David, Jessica Noe, Carlyle Meekins, Heath Smith, Suzie Marlow, Tom Wallenfeldt, Brian Good, William Chrisman, Gordon Lee, Zackary Sisk and temporary employees (names on file in Springfield).

I agree to the following provisions and terms of this Scientific Permit.

Permittee's Signature: _____ Approved By: _____ Date: 5-11-15

(Permit not valid unless signed) Office of Resource Conservation

## TERMS FOR SCIENTIFIC PERMIT

1. Under no circumstances shall a scientific permit be used in lieu of sport or commercial licenses.
2. All taking shall be performed by or under the direct supervision of the permittee. Permitte must be present with persons involved in actual taking.
3. All gear left unattended must be tagged bearing name and scientific permit number of permittee.
4. Permittee must be at least eighteen (18) years of age.
5. Permits are not transferable and PERMITTE SHALL CARRY PERMIT AT ALL TIMES WHEN TAKING FAUNA.
6. Agency, company or institution listed on the application is responsible for the taking activities and reports of the individual issued this permit
7. Scientific permits will not be valid for taking any species appearing on official State List of Endangered and Threatened Vertebrate Species of Illinois (see attached Administrative Rule, Part 1010) without specific written approval from the Department of Natural Resources.
8. A federal Permit is required for the taking of species protected by the Federal Government in addition to the State Scientific Permit.
9. The Division of Wildlife Resources may require special conditions or provsions on any Scientific Permit.
10. Use of rotenone or any other toxic materials for taking must have special written approval from the Department of Natural Resources and may need a variance from the Illinois Environmental Protection Agency.
11. By january 31 of next year, an annual report of the permittee's activies must be submitted to the Division of Wildlife Resources. In addition, the permittee shall submit a copy of all written reports, etc. that result from the permitted activity. Permits will be renewed after these annual reports and appropriate publications have been received.
12. Any permit may be revoked or suspended at any time by the Department of Natural Resources.
13. Permits expire December 31 each calendar year unless otherwise specified.

The Department of Natural Resources is an equal opportunity employer.

# ILLINOIS DEPARTMENT OF NATURAL RESOURCES

**Authorization is hereby granted, under Section 5/3.22, Chapter 520 and Section 5/20-100, Chapter 515 of the Illinois compliled Statues to:**

Last Name: **Romano** First Name: **W. Brad** Permit Number: **NH15.5898**

Issued: **4/27/2015** **Expires: 12/31/2015**

Business Name: Shoener Environmental, Inc.

Street Address: 239 Main Street, Suite 301

City: Dickson City State: PA Zip Code: 18519

for strictly scientific, educational or zoological purposes, to take the Illinois fauna identified below subject to the following provisions:

Applicant and all individuals listed may legally capture, handle, collect data and/or obtain biological samples, by scientifically accepted and approved methods, for projects and species listed below [as listed on the accompanying Illinois Department of Natural Resources (IDNR) scientific permit application/project proposal (on file in Springfield, IL) strictly for scientific, educational and/or zoological purposes]. Permitted activities include; possession of up to 950 previously salvaged non-listed bat carcasses and up to 170 bird (chicken and pigeon) carcasses for use in searcher efficiency trials. Carcasses for the trial will be clearly marked and maintained separate from all other carcasses. Proof of specimen origin (invoices, transfer slips, etc.) should be maintained with carcasses. Any carcass remaining after the study should be donated to a zoological or scientific institution or buried. Annual reporting criteria for this permit will constitute a quarterly report (June, Sept. and Dec.) detailing results of efficiency trials and any changes made to the monitoring schedule as a result of trials. Possession of a valid scientific collection permit does not grant access for permitted activities as other permits may be required. A federal permit is required for all projects involving federally regulated species, including migratory birds. If endangered and threatened species are incidentally captured, handled or identified during the permitted activity, the occurrence needs to be documented (preferably with photographs of diagnostic characteristics and geographic location) and reported via email to Tara Kieninger at: tara.kieninger@illinois.gov and DNR.ETPermit@illinois.gov within (72) hours. The specimen cannot be removed and should be released on site immediately. Intentional capture, handling and/or collection of endangered or threatened species require prior approval and possession of an Endangered or Threatened Species Permit. Any permitted activities conducted on State-owned properties require prior approval and possession of an IDNR Research / Site Permit. Any permitted activities conducted on sites Dedicated or Registered through the Illinois Nature Preserves Commission require prior approval and possession of an INPC Research Permit. Applicants must utilize appropriate decontamination procedures to prevent the spread of disease between individuals and sites and every effort should be made to prevent the spread of exotic or invasive plants/plant propagules.
Authorization: Henry, Vermilion and Champaign counties
Individuals working under direction of applicant include: Michael David, Jessica Noe, Carlyle Meekins, Heath Smith, Suzie Marlow

I agree to the following provisions and terms of this Scientific Permit.

Permittee's Signature: _____ Approved By: _____ Date: 4-27-15

(Permit not valid unless signed) Office of Resource Conservation

## TERMS FOR SCIENTIFIC PERMIT

1. Under no circumstances shall a scientific permit be used in lieu of sport or commercial licenses.
2. All taking shall be performed by or under the direct supervision of the permittee. Permitte must be present with persons involved in actual taking.
3. All gear left unattended must be tagged bearing name and scientific permit number of permittee.
4. Permittee must be at least eighteen (18) years of age.
5. Permits are not transferable and PERMITTE SHALL CARRY PERMIT AT ALL TIMES WHEN TAKING FAUNA.
6. Agency, company or institution listed on the application is responsible for the taking activities and reports of the individual issued this permit
7. Scientific permits will not be valid for taking any species appearing on official State List of Endangered and Threatened Vertebrate Species of Illinois (see attached Administrative Rule, Part 1010) without specific written approval from the Department of Natural Resources.
8. A federal Permit is required for the taking of species protected by the Federal Government in addition to the State Scientific Permit.
9. The Division of Wildlife Resources may require special conditions or provsions on any Scientific Permit.
10. Use of rotenone or any other toxic materials for taking must have special written approval from the Department of Natural Resources and may need a variance from the Illinois Environmental Protection Agency.
11. By january 31 of next year, an annual report of the permittee's activies must be submitted to the Division of Wildlife Resources. In addition, the permittee shall submit a copy of all written reports, etc. that result from the permitted activity. Permits will be renewed after these annual reports and appropriate publications have been received.
12. Any permit may be revoked or suspended at any time by the Department of Natural Resources.
13. Permits expire December 31 each calendar year unless otherwise specified.

The Department of Natural Resources is an equal opportunity employer.

# ILLINOIS DEPARTMENT OF NATURAL RESOURCES

**Authorization is hereby granted, under Section 5/3.22, Chapter 520 and Section 5/20-100, Chapter 515 of the Illinois compliled Statues to:**

Last Name: **Romano** First Name: **W. Brad** Permit Number: **NH15.5898**

Issued: **5/28/2015** **Expires: 12/31/2015**

Business Name: Shoener Environmental, Inc.

Street Address: 239 Main Street, Suite 301

City: Dickson City State: PA Zip Code: 18519

for strictly scientific, educational or zoological purposes, to take the Illinois fauna identified below subject to the following provisions:

Applicant and all individuals listed may legally capture, handle, collect data and/or obtain biological samples, by scientifically accepted and approved methods, for projects and species listed below [as listed on the accompanying Illinois Department of Natural Resources (IDNR) scientific permit application/project proposal (on file in Springfield, IL) strictly for scientific, educational and/or zoological purposes]. Permitted activities include; possession of up to 950 previously salvaged non-listed bat carcasses and up to 170 bird (chicken and pigeon) carcasses for use in searcher efficiency trials. Carcasses for the trial will be clearly marked and maintained separate from all other carcasses. Proof of specimen origin (invoices, transfer slips, etc.) should be maintained with carcasses. Any carcass remaining after the study should be donated to a zoological or scientific institution or buried. Annual reporting criteria for this permit will constitute a quarterly report (June, Sept. and Dec.) detailing results of efficiency trials and any changes made to the monitoring schedule as a result of trials. Possession of a valid scientific collection permit does not grant access for permitted activities as other permits may be required. A federal permit is required for all projects involving federally regulated species, including migratory birds. If endangered and threatened species are incidentally captured, handled or identified during the permitted activity, the occurrence needs to be documented (preferably with photographs of diagnostic characteristics and geographic location) and reported via email to Tara Kieninger at: tara.kieninger@illinois.gov and DNR.ETPermit@illinois.gov within (72) hours. The specimen cannot be removed and should be released on site immediately. Intentional capture, handling and/or collection of endangered or threatened species require prior approval and possession of an Endangered or Threatened Species Permit. Any permitted activities conducted on State-owned properties require prior approval and possession of an IDNR Research / Site Permit. Any permitted activities conducted on sites Dedicated or Registered through the Illinois Nature Preserves Commission require prior approval and possession of an INPC Research Permit. Applicants must utilize appropriate decontamination procedures to prevent the spread of disease between individuals and sites and every effort should be made to prevent the spread of exotic or invasive plants/plant propagules.
Authorization: Henry, LaSalle, Vermilion and Champaign counties
Individuals working under direction of applicant include: Michael David, Jessica Noe, Carlyle Meekins, Heath Smith, Suzie Marlow

I agree to the following provisions and terms of this Scientific Permit.

Permittee's Signature: (Permit not valid unless signed)

Approved By: Office of Resource Conservation

Date: 6/1/15

## TERMS FOR SCIENTIFIC PERMIT

1. Under no circumstances shall a scientific permit be used in lieu of sport or commercial licenses.
2. All taking shall be performed by or under the direct supervision of the permittee. Permitte must be present with persons involved in actual taking.
3. All gear left unattended must be tagged bearing name and scientific permit number of permittee.
4. Permittee must be at least eighteen (18) years of age.
5. Permits are not transferable and PERMITTE SHALL CARRY PERMIT AT ALL TIMES WHEN TAKING FAUNA.
6. Agency, company or institution listed on the application is responsible for the taking activities and reports of the individual issued this permit
7. Scientific permits will not be valid for taking any species appearing on official State List of Endangered and Threatened Vertebrate Species of Illinois (see attached Administrative Rule, Part 1010) without specific written approval from the Department of Natural Resources.
8. A federal Permit is required for the taking of species protected by the Federal Government in addition to the State Scientific Permit.
9. The Division of Wildlife Resources may require special conditions or provsions on any Scientific Permit.
10. Use of rotenone or any other toxic materials for taking must have special written approval from the Department of Natural Resources and may need a variance from the Illinois Environmental Protection Agency.
11. By january 31 of next year, an annual report of the permittee's activies must be submitted to the Division of Wildlife Resources. In addition, the permittee shall submit a copy of all written reports, etc. that result from the permitted activity. Permits will be renewed after these annual reports and appropriate publications have been received.
12. Any permit may be revoked or suspended at any time by the Department of Natural Resources.
13. Permits expire December 31 each calendar year unless otherwise specified.

The Department of Natural Resources is an equal opportunity employer.

# Appendix F. Black-billed Cuckoo Breeding Survey and Habitat Assessment – Proposed Study Plan

# Black-billed Cuckoo Breeding Survey and Habitat Assessment Proposed Study Plan

## 1 Introduction

The objective of the black-billed cuckoo (BBCU) study is to conduct presence/absence surveys and assess habitat conditions on Illinois state-owned lands so that the results can be used by the Illinois Department of Natural Resources (DNR) in management decisions.

The most robust bird dataset in Illinois is the breeding bird survey (BBS), and 45 routes are located within the state. BBCU are recorded on BBS routes occasionally, and the BBS results suggest the species is uncommon in Illinois. However, BBS routes typically travel public roads, and based on the location of most BBS routes in Illinois, potential BBCU habitat is unlikely surveyed by the BBS. Thus, surveys designed to target potential BBCU habitat will provide important information to the DNR about the habitat and presence or absence of BBCU on state-owned and managed lands.

### 1.1 Life History

Generally, BBCUs initiate nesting in the Midwestern U.S. from late May to late June, but active nests have been recorded as late as mid-September (Eastman 1991). Clutch size for BBCU is most often 2 to 3 eggs; rarely 4 or 5. Eggs are usually laid every second day, but intervals of 1 to 4 days have been reported. Because incubation begins after the first egg is laid, estimates of length of incubation are variable, and range from 10 to 14 days (Hughes 2001).

### 1.2 Habitat Use

Habitat preferences of the BBCU are not well studied likely as a result of the species' reclusive habits. Spencer (1943) studied six nests and found nesting habitat ranged from an 'open wooded area' (two nests) to second growth forest and thickets (four nests). BBCUs use a wide range of habitats but are most commonly associated with forest edges, fencerows, riparian areas and shrublands (Spencer 1943, Hughes 2001). Kleen et al. (2004) describes the species as more likely to utilize "older, more wooded side of woodland edges" and is "less likely to be found near suburbia than the yellow-billed cuckoo." Trends in habitat use across breeding bird atlas records suggest that BBCUs will nest in habitat associated with water or marshy areas and use trees that typically form thickets such as willow, alder, birch and beech (Hughes 2001). Little is known about the about the territorial behavior of the BBCU (Hughes 2001), but Freeman and Merriam (1986) hypothesized that home range size is 2 to 5 hectares (ha; 5 to 12.4 acres).

BBCU nests are typically placed 3 to 6 feet above the ground, but nest height varies. In Ontario, nests were observed as high as 40 feet above ground, but 50% of nests (117 out of 233) were placed between 3 to 5 feet above ground (Peck and James 1983). Studies in Michigan and North Dakota report nests averaged 5 feet above ground (Spencer 1943, Stewart 1975).

# 2 Methods

As a BBCU-specific survey protocol is not available, the survey methods in the study plan have been adapted from the western yellow-billed cuckoo survey protocol (Halterman et al. 2015) and revised to be consistent with BBCU life history and habitat requirements. The timing of this protocol is intended to assess BBCU presence and document habitat conditions in survey locations. Accurate population determination is beyond the scope of this protocol, but conducting surveys during the peak of breeding activity will increase the probability of detecting any BBCUs that are present. A call playback is used during each survey to detect BBCU that might have been otherwise overlooked.

## 2.1 Survey Area

The survey area was selected based on two primary factors: 1) the land is Illinois state-owned, and 2) the land contains deciduous forest habitat in 5+ ha blocks. Based on conversations with the DNR, survey areas within the Vermilion River and Little Vermilion River Conservation Opportunity Area in eastern Illinois were considered because of the available Illinois state-owned and/or managed land and deciduous forest associated with the Middle Fork Vermilion River.

The Middle Fork State Fish and Wildlife Area was selected for BBCU surveys and habitat assessment based on the presence and distribution of deciduous forest habitat (Figures 1 and 2). To survey the habitat most likely used by BBCU, transects will be established within the Fish and Wildlife Area resulting in approximately 2,200 meters. Consistent with BBCU habitat preferences, forest interior will not be surveyed (see Section 2.3). The biologists will use the transects shown on Figure 2 to guide the survey, but may deviate from the transect to cover the perimeter habitat patches.

## 2.2 BBCU Survey Periods

BBCU are a reclusive species and are more often heard than observed visually. Thus, in order to determine if BBCU occupy a habitat patch, multiple visits are required with a call playback on the last visit. There are three survey periods, and four total surveys are conducted for the purpose of assessing whether BBCUs are present at a site; additionally a pre-survey site reconnaissance visit is also proposed. The number of surveys is similar to that used for yellow-billed cuckoo, where it has been found that four surveys will have a 95% probability of detecting yellow-billed cuckoos, when they are present at a site during the breeding season (McNeil et al. 2013, Carstensen et al. 2015).

**Pre-survey Reconnaissance Period: May 21 - June 15.** No surveys required. This spans the earliest time that BBCUs may arrive on breeding grounds, but most BBCUs present during this period are likely migrants. The pre-season reconnaissance site visit should be used for biologists to visit the site, examine the habitat and transect locations, and walk transects to determine if any issues with access exist.

**Survey Period 1: June 16 - June 30.** One survey is required. This survey occurs as migrating birds are passing through, and breeding birds arrive. Although many birds detected during this

time may be migrants, surveys during this time will help with seasonal survey detection interpretation, and will also allow surveyors to familiarize themselves with all survey areas.

**Survey Period 2: July 1 - July 31.** Two surveys are required during this period, and should be spaced between 12 and 15 days apart. BBCUs encountered during this time are mostly breeders, though migrants, wandering individuals, and young of the year may be encountered. This is the period when breeding activity is most likely to be observed (e.g. copulation, food carries, alarm calls). Extra time should be taken to cautiously observe all BBCUs encountered during this time, while avoiding disrupting potentially breeding birds.

**Survey Period 3: August 1 - August 15.** One survey is required, and most breeding birds are finishing breeding activities and departing. BBCUs are typically much less vocal and responsive during this time than during Survey Period 2.

## 2.3 BBCU Survey Methods

Biologists will begin surveys as soon as there is enough light to safely walk (just before sunrise) and continue, depending on the temperature, wind, rain, background noise, and other environmental factors, until 1100. Surveys should not be conducted after temperatures reach 40 degrees C (104 F). If the detectability of BBCUs is being reduced by environmental factors (e.g. excessive heat, cold, wind, or noise), surveys planned for that day should be postponed until conditions improve.

BBCU use a wide range of habitats but are most commonly associated with forest edges, fencerows, riparian areas and shrublands (Spencer 1943, Hughes 2001). Thus, BBCU surveys will focus on areas of habitat exhibiting a complex understory structure and will not focus on forest interior. Within a study area all potentially suitable habitat patches should be surveyed. A patch is defined as an area of habitat 5 ha or greater in extent that is separated by at least 300 m from an adjacent patch of apparently suitable BBCU habitat. Little is known about BBCU territory size, but 5 ha is considered a typical size for BBCU patch occupancy (Freeman and Merriman (1986). Thus, an individual shrub may be less than 5 ha, but if a 5 ha area consists of a series of shrub patches, it should be considered a habitat patch. The surveyor can skip over areas of unsuitable habitat (e.g. agriculture) between patches

Surveys will focus on the edge of habitat patches, or if the habitat patch is comprised of shrubs, surveys should be conducted throughout the habitat patch. Biologists will arrive at the starting point of the transect and wait at least one minute to listen for unsolicited BBCU calls (i.e. BBCUs that may be calling before broadcast of the calls). If no BBCUs are heard during the initial listening period, surveyors will begin the first broadcast. The broadcast consists of five contact/cu-cu-cu-cu calls, each spaced one minute apart. For consistency and comparability of the data, only the call provided will be used. The recording should be played at approximately 70 decibels db.Biologists will listen and watch intently for responding BBCUs during and after each of the five broadcast calls. This includes watching for movement as silent birds may move closer to investigate. If no BBCU is detected at the broadcast-point after five broadcast calls, the biologists will continue 100 m along the transect and start a new broadcast as described above. In between broadcast calls, surveyors should be listening for BBCUs, and not be filling out the datasheet. BBCUs may respond by calling from a distance, so the surveyors will listen for these

responses. BBCUs typically respond with the contact/cu-cu-cu-cu call. When a BBCU is detected, the biologist will terminate the broadcast, as it may divert the bird from normal breeding activity or attract the attention of predators. The surveyors will concentrate on observing the bird rather than immediately recording data. When recording data, all data for the detection(s) will be documented, including the compass bearing and estimated distance from the observer to the detected BBCU(s).

After a BBCU has been detected and appropriate data collected, the surveyors will move 300 m further along the transect before resuming the survey. This will minimize the likelihood of detecting the same BBCU.

When a BBCU is encountered between broadcast points (i.e. an unsolicited detection is made while traveling to, from, or between broadcast points), the biologists will stop and record all information in the same manner as if the detection was made during a broadcast. No calls will be broadcast in this situation. After making observations and recording information regarding the detection(s), the surveyor will move 300 m from the point where the detection was made, along the transect and continue with the procedures for conducting a survey broadcast.

Data collected will include information descriptive of the survey (date, time, location, transect, broadcast point etc.), and information on any BBCU detections (time, type of vocalization, behavior and age). For a full description of data that should be recorded see Halterman et al. (2015).

## 2.4 Habitat Survey Methods

The objective of the habitat survey is to conduct a rapid assessment of habitat structure to determine if habitat is suitable for breeding BBCU. After the BBCU surveys are completed, biologists familiar with Illinois vegetation will walk the transect and record habitat data every 300 meters along the transect and at every point where a BBCU detection occurred. At each vegetation point, the observer will stand at the edge of the habitat and record three habitat metrics. The first habitat metric is to provide information on the *general forest structure* and the biologist will determine if there is a mature canopy with deciduous understory vegetation, mature canopy with no understory vegetation, or if the habitat is secondary deciduous growth or shrubland. The second habitat metric is the *understory canopy height* from the lowest growth to the top of the understory canopy. The third habitat metric is the *understory density* measured by the biologist estimating the percent cover of the understory from the survey point looking into the understory.

# 3 Data Analysis and Reporting

The data will be analyzed consistent with the objectives to determine presence/absence of BBCU at surveyed areas and to assess habitat suitability for BBCU. Three primary results are of interest from the survey: level of survey effort, number of BBCU detections, and habitat characteristics. As BBCU surveys are not conducted in Illinois, reporting the level of survey effort in terms of kilometers of transect and hours of survey will provide information so that the number of BBCU detections (if any) can be standardized to detections/kilometer. If BBCU are

detected, data will be analyzed to determine the average time of detection, common behaviors, and location of detections. Habitat data will be analyzed to determine the proportion of survey points that contained understory vegetation suitable for BBCU nesting. A deciduous understory or shrubland between 0 – 2 meters above ground and percent cover of 60% or higher is considered to be suitable for breeding BBCU for this analysis.

After all surveys are completed, one report will be completed in standard scientific format with an introduction, methods, results, and discussion. Maps will be produced that show the location of the transects, broadcast stations and BBCU detections, if any. Further, a map showing suitable breeding BBCU along the transect will be included in the report.

# 4 Survey Benefits

The BBCU presence/absence surveys and habitat assessment will target Illinois state-owned and/or managed land and use methods specific to detecting the BBCU. The surveys have value to the DNR even if BBCU are not detected for several reasons. First, the survey is designed specifically to determine presence/absence of BBCU and negative results provide more information regarding the species distribution in the study area than other types of broad-scale data (e.g., BBS). Second, vegetation data will help evaluate suitable BBCU habitat in Illinois state-owned and/or managed land, which can be used to inform habitat management decisions.

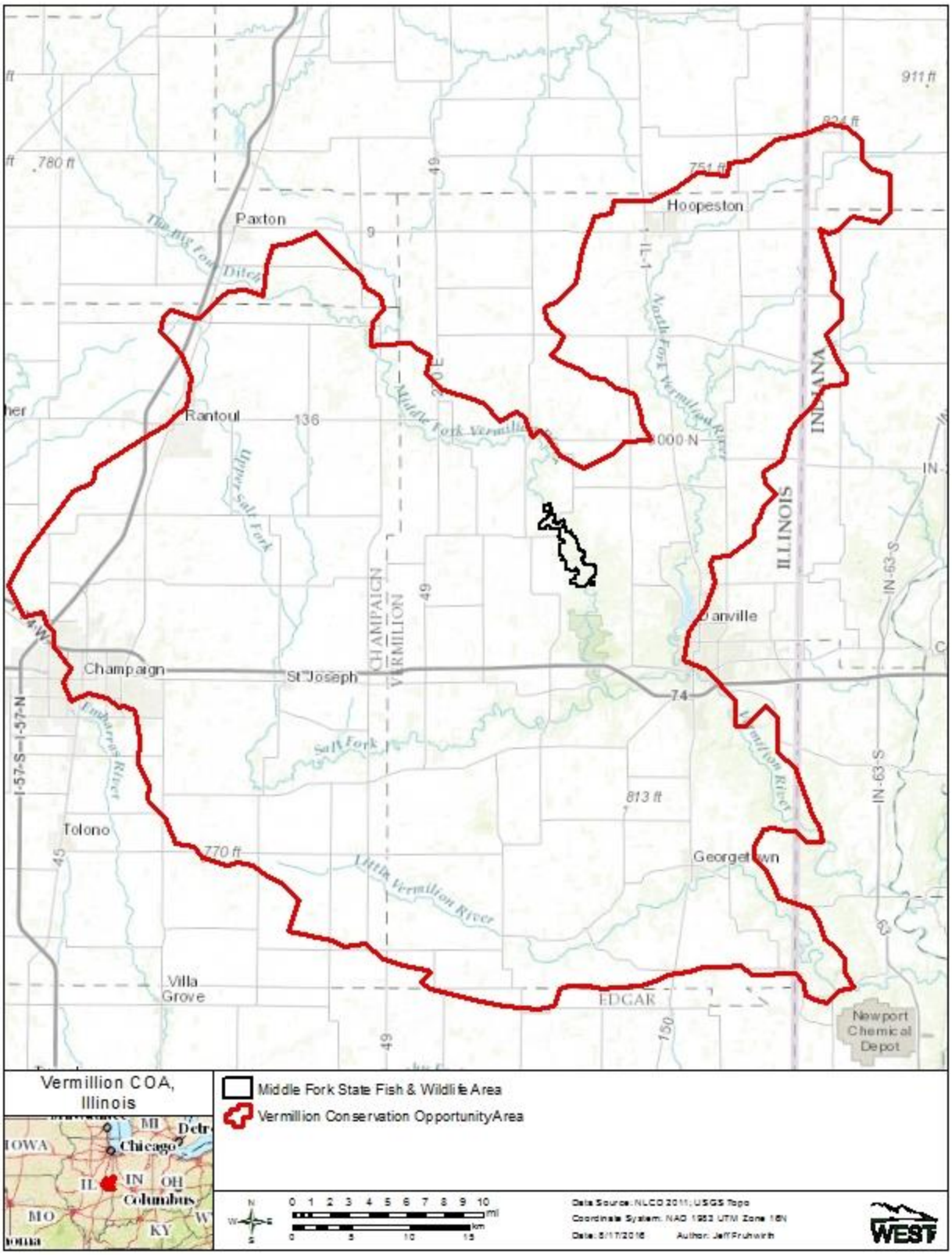


**Figure 1. Location of Middle Fork State Fish and Wildlife Area, for BBCU Presence/Absence Surveys**

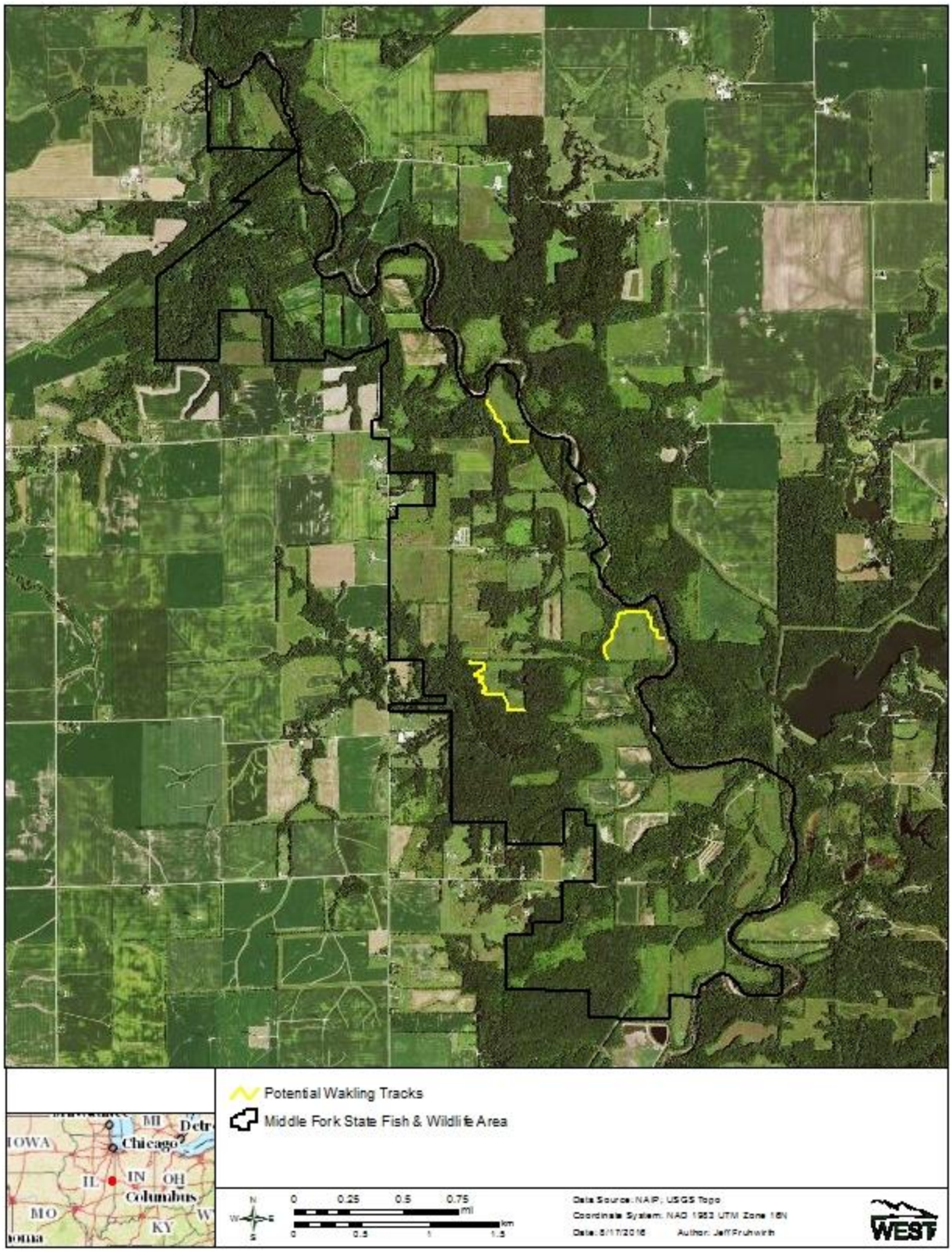


**Figure 2. Proposed Survey Transects within Middle Fork State Fish and Wildlife Area, for BBCU Presence/Absence Surveys**

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