Pleasant Ridge Wind Energy Project

Bird & Bat Materials

United States Department of the Interior

FISH AND WILDLIFE SERVICE
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IN REPLY REFER TO:
FWS/RIFO

November 5, 2014

Mr. Bryan Schueler
Senior Vice President
Invenergy Wind Development LLC
1 South Wacker Drive, Suite 1900
Chicago, Illinois 60606

Dear Mr. Schueler:

Thank you for your continued coordination on the Pleasant Ridge Wind Project in Livingston County, Illinois. It is our understanding that this proposed project will involve the construction of up to 136 wind turbines and associated infrastructure. The project is anticipated to be constructed in 2015 and operate for a term of 20 years, with the option of repowering at the end of this term.

The U.S. Fish and Wildlife Service (Service) has reviewed the information provided in the November, 2014 BBCS, regarding the potential presence and risk analysis for bats, migratory birds, bald eagles, and their habitats in the vicinity of the Pleasant Ridge Wind Project Site. The BBCS details preconstruction studies that have been conducted in the project area, conservation measures that will be implemented for species of concern in conjunction with the project, and post-construction monitoring plans.

Bald Eagles

The project area is over 25 miles from the nearest known bald eagle nest, which is located along the South Fork Vermilion River. Also, no bald eagles were observed in the project area during pre-project avian surveys. Invenergy has committed to implementing a wildlife carrion (i.e., road kill) removal program in the project area, as described in the BBCS. This will include coordination with local livestock operators and landowners for the prompt removal or covering of carcasses, as practical. These measures are expected to reduce the likelihood that wintering eagles or other raptors and aerial scavengers will be attracted to the area to forage.

Given this information, the Service believes that the risk of eagles colliding with turbines at the Pleasant Ridge Wind Project is low, and as such, does not recommend that you apply for an eagle take permit at this time. It is our understanding that the project will involve post-construction mortality monitoring to confirm this conclusion. Should post-construction monitoring indicate a change in the expected risk to eagles, Invenergy will reinitiate coordination with the Service.

Migratory Birds

Preconstruction avian studies have indicated that minimal habitat for migratory birds is present in the project area. With the exception of the American Golden Plover (AMGP), large flocks of migratory birds were not observed. Effects of wind energy development on the AMGP are currently unknown, and there is a significant need to better understand the influence that wind turbine development is having on this species. Invenergy has committed to studying the effects of the Pleasant Ridge Wind Project on the AMGP with the intent of augmenting knowledge of wind power -AMGP interactions in the area. Invenergy will conduct two years of post-construction AMGP monitoring to document AMGP use of the project area. Use surveys will occur in the two consecutive years following turbine construction and will consist of regular driving surveys through the project area during the expected peak AMGP migration period (April 1 – May 20). Also, general spring mortality monitoring will be conducted to document any effects of the project to migratory birds, including the AMGP. The results will be reported to the Service.

An experimental population of the federally endangered whooping crane could be led by ultra-light aircraft through Livingston County during their migration. We encourage Invenergy to coordinate with the International Crane Foundation directly regarding any potential for the passage of this migration through the project area.

Indiana bat

Invenergy has committed to siting all wind turbines at least 1,000 feet from any potential Indiana bat habitat. While a few additional areas containing trees can be found in the project boundary, these pockets or rows of trees are in isolated groups and are generally associated with the occasional farmstead and fence row, not with large blocks of forested habitat. These factors and the proposed setbacks indicate that take of Indiana bats by the project is unlikely during the summer.

Indiana bats could pass through the project area during fall migration, which is expected to occur from August 1 through October 7 in this area. (The end of fall migration for this project area was based on project-specific acoustic monitoring data, as referenced in the BBCS.) During this time period, between sunset and sunrise, Invenergy will fully feather turbine blades until a wind speed of 6.9 meters per second is reached. Specifically, curtailment will be based on the rolling wind speed average over a 10-minute period. Invenergy will confirm the effectiveness of this conservation measure by monitoring overall bat mortality during the curtailment season. Monitoring will be conducted during the first three years of operation and will occur again every three years for the life of the project. Follow-up monitoring will occur to document that no significant increase in overall bird or bat mortality has occurred relative to the baseline study.

Based on our review of the project and the above conservation measures, the Service expects that Indiana bat take will be unlikely. Therefore, no incidental take permit is recommended at this time. Should the project be modified or new information indicate that listed species may be affected, consultation with the Service should be initiated.

Northern Long-Eared Bat

The Northern long-eared bat (NLEB) was proposed for listing under the Endangered Species Act (ESA) on October 2, 2013. No critical habitat has been proposed at this time. Species proposed for listing are not afforded protection under the ESA; however, as soon as a listing becomes effective, the prohibition against jeopardizing its continued existence and "take" applies regardless of an action's stage of completion.

Based on the best available information at the time of this letter, the project area does not contain suitable or occupied summer habitat within 1000 feet of proposed turbine locations. However, NLEBs could pass through the project area during their fall migratory period (August through mid-October). According to currently available data, it is considered unlikely that NLEBs would be taken by wind turbines at a cut-in speed of 6.9 m/s. Because Invenergy proposes to curtail and feather turbines until a wind speed of 6.9 m/s has been reached (sunset to sunrise) from August 1 through October 7, the Service considers take of NLEBs to be unlikely at the facility, and no further coordination is currently warranted.

Section 9(a)(1)(B) of the ESA, 16 U.S.C.§ 1538 (a)(1)(B), makes it unlawful for any person to "take" an endangered species. Take of threatened species is prohibited pursuant to 50 C.F.R. § 17.31, which was issued by the Service under the authority of Sections 4(d) and 9(a)(1)(G) of the ESA, 16 U.S.C. §§ 1533(d) and 1538(a)(1)(G), respectively. "Take" is defined by the ESA as to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct" 16 U.S.C. § 1532(19).

This office is not authorized to provide guidance regarding our Office of Law Enforcement (OLE) investigative priorities involving federally listed species. However, we understand that OLE carries out its mission to protect ESA-listed species through investigation and enforcement, as well as by fostering relationships with individuals, companies, and industries that have taken effective steps to avoid take of listed species and by encouraging others to implement measures to avoid take of listed species. It is not possible to absolve individuals or companies from liability for unpermitted take of listed species, even if such take occurs despite the implementation of appropriate avoidance measures. However, the OLE focuses its enforcement resources on individuals and companies that take listed species without identifying and implementing all reasonable, prudent, and effective measures to avoid such take. As of this date, the Rock Island Ecological Services Field Office concludes that the project is unlikely to result in take of ESA-listed species as currently proposed.

We appreciate Invenergy's coordination with our office to establish conservation measures to avoid and minimize impacts to federal trust resources. We also appreciate Invenergy's effort to better understand AMGP use of the site through the proposed post-construction monitoring. If you have any questions regarding our comments, please contact Amber Schorg of this office at 309-757-5800, Extension 222.

Sincerely,

Kraig McPeek

Kraig McPeek
Field Supervisor

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BIRD AND BAT CONSERVATION STRATEGY FOR INVENERGY'S PLEASANT RIDGE WIND PROJECT

in Livingston County, Illinois

Prepared for

U.S. Fish and Wildlife Service
Rock Island Field Office
Moline, Illinois

By

Invenergy
Chicago, Illinois

CONFIDENTIAL BUSINESS INFORMATION

November 2014

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1.0 INTRODUCTION

Invenergy LLC (Invenergy) is developing the Pleasant Ridge Wind Project (Project or PRWP) in Livingston County, Illinois (Figure 1.1). Land use within the Project area is 98 percent tilled agriculture and developed areas. Native habitats exist but occupy a small proportion of the Project area, mainly riparian corridors along the Vermilion River, South Fork Vermilion River, and Indian Creek.

The Project will consist of several primary components, including up to 136 wind turbines, access roads, transmission and communication equipment, storage areas, and control facilities. The Project boundary includes approximately 58,287 acres (21,160 ha) of privately-owned land. Only a small portion of this Project area will host wind farm facilities. It is anticipated that the area of direct land used for 136 turbines, access roads, collection lines, overhead transmission line, substation and operations and maintenance (O&M) facility will be approximately 511 temporary acres (207 ha) and 140 permanent acres (57 ha). PRWP has acquired or is in the process of acquiring the necessary land rights to construct and operate the Project and its associated facilities.

1.1 PURPOSE OF THE BIRD AND BAT CONSERVATION STRATEGY

Wind energy is one of the fastest growing sources of renewable energy in the United States, is the most economically competitive form of renewable energy, and is generally viewed as an environmentally friendly alternative to nuclear and fossil fuel power plants (AWEA 2008, National Research Council 2007). However, construction and operation of wind energy projects has the potential to impact birds and bats through habitat fragmentation, displacement, and mortality due to collision with or proximity to rotor blades (NWCC 2010).

In March of 2012, the U.S. Fish and Wildlife Service published Land-based Wind Energy Guidelines (WEG) that identify voluntary actions wind developers can take to demonstrate compliance with the Migratory Bird Treaty Act (MBTA). One of the recommended actions identified in the WEG is development of a Bird and Bat Conservation Strategy (BBCS) documenting measures a company has taken to properly construct a wind project to avoid and minimize impacts to migratory birds and other sensitive species.

After completing a detailed analysis of the proposed Project, PRWP concludes that construction and operation of the Project is unlikely to result in the take[1] of any Endangered Species Act (ESA)-listed species. This BBCS was developed to document (1) the results of PRWP's monitoring and evaluation effort for the Project, and (2) PRWP's avoidance and conservation measures that will make take of ESA-listed species unlikely to occur, while reducing potential impacts to other bird and bat species.

[1] The term "take" is defined by the ESA to mean "*to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect*" See 16 U.S.C. § 1532 (19).

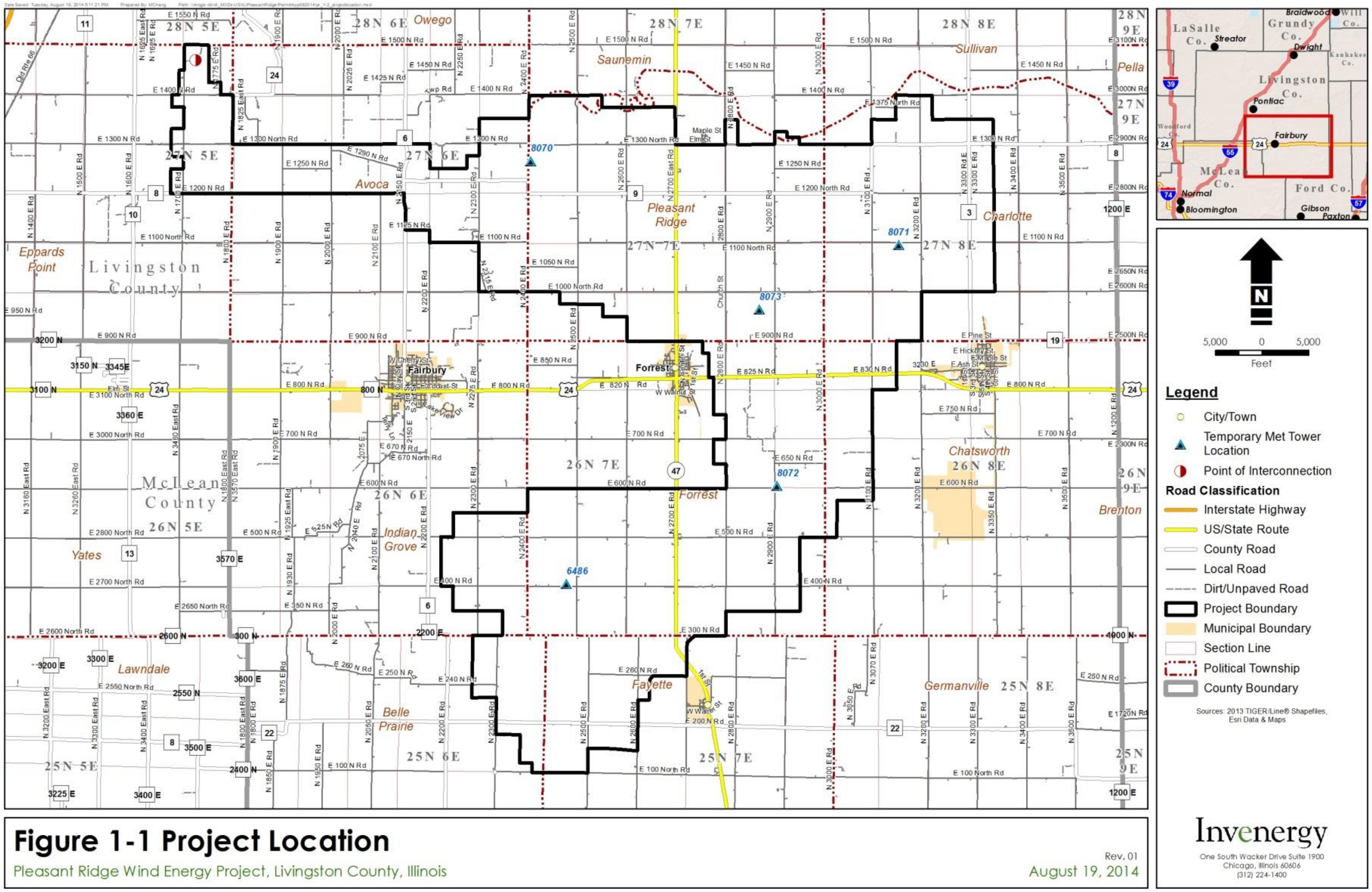

Figure 1-1 Pleasant Ridge Wind Project Location, Livingston County, Illinois

Specific goals of the Pleasant Ridge BBCS are to:

1) Demonstrate compliance with the WEG;
2) Identify measures that will avoid and minimize potential impacts to birds and bats during construction, operation, maintenance, and decommissioning of the Project;
3) Ensure the potential impacts to ESA-listed bat species are insignificant or discountable; and
4) Outline effective post-construction monitoring and adaptive management procedures to guide management actions for the life of the Project.

1.2 CONSULTATION HISTORY

The following is a summary of correspondence and meetings held with, and material submitted by Pleasant Ridge to the U.S. Fish and Wildlife Service (USFWS) and the Illinois Department of Natural Resources (IDNR) regarding the proposed Project:

September 22, 2008:	An agency coordination letter was sent to both USFWS and the IDNR for Livingston, McLean and Ford Counties, Illinois by BHE Environmental, Inc. (BHE) on behalf of Invenergy.
November 10, 2008:	An Ecological Compliance Assessment Tool (EcoCAT) was submitted by BHE for two Project areas; Pleasant Ridge "North" (IDNR Project #0903706) and Pleasant Ridge "South" (IDNR Project #0903707). For the northern portion, the bird and bat species identified were loggerhead shrike (*Lanius ludovicianus*) and upland sandpiper (*Bartramia longiauda*). For the southern portion of the project area, several natural areas, including the Mackinaw River INAI site, Sibley Grove INAI site, Weston Cemetery Prairie Illinois Natural Areas Inventory (INAI) site, Sibley Grove Nature Preserve, and Weston Cemetery Prairie Nature Preserve were identified. Additionally, the barn owl (*Tyto alba*), loggerhead shrike, and upland sandpiper were all identified for this area as well.
November 12, 2008	USFWS provided a list of species which may be present in the area including the Indiana bat (*Myotis sodalis*), the eastern prairie fringed orchid (*Platanthera leucophaea*), and the prairie bush clover (*Lespedeza leptostachya*). It was recommended that the Section 7(a)(2)Technical Assistance webpage be utilized to determine the action area, whether any of these species are present, and if the Project may affect any listed species.
January 2, 2009	IDNR provided a letter to Charles Schopp (Livingston County) in regards to the EcoCAT request that included information on documented species within the project area, potentially occurring species, natural areas within the boundary, as well as wildlife impact recommendations.
October 14, 2010	Meeting with the USFWS Rock Island Field Office to discuss the Project. Presented information on project description, habitat mapping, bird and bat survey results. The USFWS was recommended that PRWE develop measures to avoid/minimize impacts to Indiana bats and to consult with Operation Migration.
July 24, 2013	Meeting with USFWS Rock Island Field Office to provide Project update.

January/February 2014	Shared maps and received input from USFWS Rock Island Field Office during turbine micrositing to avoid bat habitat.
April 4, 2014	Submittal of an EcoCAT request by Stantec Consulting Services Inc. (Stantec) for the new Project area (IDNR Project #1410117). A request was made for more up-to-date database review given the 5-year timeframe since the last assessment had been made, as well as using the new Project boundary. No bird or bat species were identified in this preliminary review. The wetland review identified wetlands within 250 feet (76 m) of the Project location using the National Wetlands Inventory data.
April 30, 2014	Call with USFWS Rock Island Field Office to discuss micro-siting to setback from bat habitat.
June 12, 2014	Meeting with USFWS Rock Island Field Office, provided project update, summary of baseline studies completed, discussed BBCS scope and content, discussed schedule and next steps.
September 8, 2014	IDNR provided a letter to Charles Schopp (Livingston County) in regards to the EcoCAT request that included information on documented species within the project area, potentially occurring species, natural areas within the boundary, as well as wildlife impact recommendations.

Many of the 2008/2009 consultations included a study area larger than the current proposed Project boundary.

Based upon information and comments provided by USFWS and the IDNR, PRWP completed a detailed Project site characterization, including extensive biological surveys to obtain data on bird and bat use of the Pleasant Ridge Wind Farm area. The following studies were prepared by PRWP and are hereby incorporated by reference:

- Site Characterization for Wildlife Issues (January 2009; Ritzert and Good 2009)
- Chiropteran Risk Assessment (February 2009; BHE 2009)
- Bat Acoustic Surveys (July 2009-October 2009; Good et al. 2010a)
- Habitat Mapping, Land Cover Analysis (April 2009 and May 2014)
- Bird Use Counts (March 2009-February 2010; Good et al. 2010b)
- American Golden-plover Surveys (April-May 2009; Good et al. 2010b)
- Smith's Longspur Surveys (April-May 2009; Good et al. 2010b)
- Raptor Nest Surveys (May 2009 [Good et al. 2010b] and April 2014 [Stantec 2014])
- Bat Mist-netting (Summer 2011; Murray et al. 2011)
- Summary of Natural Resources at the South Fork Vermilion River Crossing (July 2014; Shoener Environmental 2014)
- Incidental Wildlife Observations (ongoing)
- Consultation with experts and USFWS (ongoing)

1.3 REGULATORY FRAMEWORK

1.3.1 Endangered Species Act

The federal ESA of 1973 [16 U.S.C. §§ 1531 *et seq*.] provides for the listing, conservation, and recovery of endangered and threatened species. The USFWS possesses responsibility for implementing the ESA to protect terrestrial species and resident fish species.

Section 9 of ESA prohibits the unauthorized "take" of listed species. Take is defined broadly by ESA to mean "*to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect*" a listed species. The term "harm" has been further defined in agency regulations to mean habitat modification that actually kills or injures a listed species.

On April 5, 2011, USFWS entered into a Memorandum of Understanding (MOU) with a number of wind energy companies to develop a programmatic, multispecies habitat conservation plan (MSHCP) for several listed species that could potentially be affected by wind energy projects. Completion of the MSHCP is several years away. As a part of the process of developing the MOU, Region 3 of the USFWS developed a process whereby interested wind energy companies may pursue technical assistance letters with USFWS to address ESA issues during the development of the MSHCP. Through the consultation process associated with developing technical assistance letters, wind energy projects may be designed and operated to avoid potential take of listed species.

As described above, PRWP intends this BBCS to serve as the basis for the development of a technical assistance letter with USFWS to document that take of listed species is unlikely to occur if the Project is designed and operated pursuant to the measures contained in the BBCS.

1.3.2 Migratory Bird Treaty Act

Among other things, the MBTA (16 U.S.C. §§ 703-712) prohibits the taking, killing, injuring or capture of listed migratory birds.

To avoid and minimize impacts to MBTA-listed species, PRWP will implement this BBCS in consultation with the USFWS that incorporates applicable measures based on WEG (USFWS 2012). These guidelines contain materials to assist in evaluating possible wind power sites, wind turbine design and location, and pre- and post-construction research to identify and/or assess potential impacts to wildlife. Measures to be taken to avoid and minimize impacts to migratory birds are described below.

1.3.3 Bald and Golden Eagle Protection Act

The BGEPA (16 U.S.C. §§ 668-668d) prohibits the take of bald and golden eagles unless pursuant to regulations. BGEPA defines the take of an eagle to include a broad range of actions, including "*…to pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, or molest or disturb.*" The term "disturb" is defined in regulations found at 50 CFR 22.3 to include agitating or bothering a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available: (1) injury to an eagle, (2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or (3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior. Measures to be taken to avoid and minimize impacts to eagles are described on the next page.

The USFWS published a final rule (Eagle Permit Rule) on September 11, 2009 under the BGEPA (50 C.F.R. 22.26) authorizing limited issuance of permits to take bald eagles and golden eagles. This permit term was extended to a maximum of 30-years in the December 9, 2013 ruling (78 FR 73704). A permit would authorize the take of bald eagles and golden eagles where the take is compatible with the preservation of the bald eagle and the golden eagle; necessary to protect an interest in a particular locality; associated with but not the purpose of the activity; and

1) for individual incidences of take: the take cannot be practicably avoided and
2) for programmatic take: the take is unavoidable even though advanced conservation practices are being implemented.

On May 2, 2013, the USFWS announced the availability of the Eagle Conservation Plan Guidance: Module 1 – Land-based Wind Energy, Version 2 (ECPG; USFWS 2013a). The ECPG provides a means of compliance with the BGEPA by providing recommendations and in-depth guidance for:

- Conducting early pre-construction assessments to identify important eagle use areas;
- Avoiding, minimizing, and/or compensating for potential adverse effects to eagles; and
- Monitoring for impacts to eagles during construction and operation.

The Guidance interprets and clarifies the permit requirements in the regulations at 50 CFR 22.26 and 22.27, and does not impose any binding requirements beyond those specified in the regulations. As for other MBTA-listed species, this BBCS incorporates site-specific, regional, and agency information and measures developed based on this information to avoid and reduce impacts to bald and golden eagles at the Project.

1.4 BBCS TERM

This BBCS will be in effect through development, construction, operation, maintenance, and decommissioning of the Project (Term). This Term will cover the 20-year minimum functional life of turbines following completion of construction, and potential extended operations and/or decommissioning of the Project. PRWP will update this BBCS, as needed, through adaptive management (Appendix A) throughout the Term. Should the Project be re-powered at the end of the Project's expected life, the BBCS will automatically renew and remain in effect until the Project is decommissioned.

1.5 BBCS PROJECT AREA

This BBCS applies to all lands leased, present and future, by PRWP for construction and operation of the Project. These lands will include the locations for all 136 turbines and associated facilities.

2.0 PROJECT DESCRIPTION

2.1 PROJECT AREA, SITING, AND FACILITIES SITING

The Project is located in Livingston County, Illinois (Figure 1.1). Land use within the Project area is 98 percent tilled agriculture and developed areas.

The Project boundary includes approximately 58,287 acres (21,160 ha) of privately-owned land. Only a small portion of this Project area will host wind farm facilities. It is anticipated that the area of direct land used for up to 136 turbines, access roads, substation and O&M facility will be approximately 511 temporary acres (207 ha) and 140 permanent acres (57 ha). PRWP has acquired or is in the process of acquiring the necessary land rights to construct and operate the Project and its associated facilities.

A 9.5 mi (15.2 km)-long overhead transmission line will be constructed to connect the Project to the existing electric power grid. It will extend from the Project substation to Point of Interconnect (POI), the ComEd Pontiac MidPoint 345-kV substation. The transmission line permanent right-of-way (ROW) occupies approximately 3 acres (1 ha) and is located on privately-owned land. Up to 29 acres (12 ha) will be temporarily disturbed during transmission line construction (Table 2.1).

Table 2.1 Estimated Surface Disturbance Acreage for the Pleasant Ridge Wind Energy Project

Disturbance Type	Temporary Disturbance (acres [hectares])	Permanent Disturbance, 136 Turbine Project (acres [hectares])
Turbine assembly areas/pads[1]	195 [79]	31 [13]
Existing roads to be upgraded	0 [0]	0 [0]
New access roads to be constructed[2]	198 [80]	99 [40]
Staging area and batch plant[3]	10 [4]	0 [0]
Collection line trenches[4]	72 [29]	0 [0]
Overhead transmission line[5]	29 [12]	3 [1]
Substation and O&M building	7 [3]	7 [3]
Total	**511 [207]**	**140 [57]**

1 Assumes a 250 x 250 ft (76 x 76 m) access pad and a permanently maintained 100 ft (30 m) diameter area.
2 Assumes 51 mi (82 km) of new access roads to be constructed, 32 ft (10 m) wide during construction, reclaimed to 16 ft (5 m) wide for the life-of-project.
3 Assumes that the staging area and batch plant location is reclaimed.
4 Assumes 148 mi (237 km) of collection line trenches, up to 4 ft (1 m) wide during construction, completely reclaimed for the life-of-project.
5 Assumes 9.5 mi (15.2 km) of overhead transmission line with construction disturbance within a 25 ft ROW.

This site was selected based on several factors, including the following:

- Geographic location in central Illinois to serve regional electric power markets
- Commercially viable wind resource
- Nearby transmission with potential to integrate a wind generation facility
- Agricultural land use
- Willing landowners
- Community and county support
- Minimal environmental impacts

The turbine siting process initially considered land under agreement, wind resource, elevation, bat habitat, and county- and landowner-required setbacks. Within these limitations, the turbine siting goal was to maximize energy production for the Project site while minimizing environmental impacts.

2.1.1 Project Components

The Project will consist of several primary components, including wind turbines, access roads, transmission and communication equipment, storage areas, and control facilities. These components are discussed in detail below.

Wind Turbines

The Project will include up to 136 GE 1.7-100 Rev 5 (GE 1.7-100) turbines or a similar model (e.g., 1.72-103). The GE 1.7-100 turbine is a three-bladed, upwind, horizontal-axis wind turbine. The turbine rotor and nacelle are mounted on top of a tubular tower. The machine employs active yaw control (designed to position the rotor to face the wind), active blade pitch control (designed to regulate turbine rotor speed), and a generator/power electronic converter system attached to a variable speed drive train designed to produce a nominal 60 hertz (Hz), 575 or 690 Volts (V) of electric power.

The GE 1.7-100 turbine has a nameplate rating of 1,790 kilowatts (kW). Each turbine is equipped with a wind speed and direction sensor that communicates to the turbine's control system when sufficient winds are present for operation. The turbine features variable-speed control and independent blade variable pitch to assure aerodynamic efficiency, and which functions as an aerodynamic control system. The GE 1.7-100 turbine begins operation in wind speeds of approximately 7 miles per hour (mph; 3.0 meters per second [m/s]) and reaches its rated capacity (1.79 MW) at a wind speed of approximately 26 mph (12 m/s). The turbine is designed to operate in wind speeds up to approximately 50 mph (22 m/s) and can withstand sustained wind speeds of more than approximately 100 mph (45 m/s). The color of all turbines, blades, and towers used for the Project will be white and the rotation direction, as an observer faces the turbines, will be clockwise.

Each turbine includes a Supervisory Control and Data Acquisitions (SCADA) communications system that permits automatic, independent operation and remote supervision, allowing continuous control of the wind farm to ensure optimal and efficient operation and early troubleshooting of problems. SCADA data provide detailed operating and performance information for each wind turbine, and PRWP maintains a database tracking each wind turbine's operational history.

Hubs, Towers, and Foundations

The rotor consists of three blades attached to a hub. The rotor blades are constructed of fiberglass and epoxy or polyester resin. The cast iron hub connects the rotor blades to the main shaft and transmits torque. The hub is attached to the nacelle, which houses the gearbox, generator, brake, cooling system, and other electrical and mechanical systems.

The GE 1.7-100 wind turbines use a 328-ft (100 m) rotor diameter with a rotor-swept area of approximately 84,496 ft^2 (7,854 m^2). The rotor speed would be 10.0 to 17.5 rpm and all rotors would rotate in the same direction.

The turbine nacelles will be mounted on freestanding monopole tubular steel towers with a hub height of 263 ft (80 m) with a total height (tip height) of 427 ft (151 m). Each tower will consist of three sections manufactured from steel plates. All welds will be made in automatically controlled power welding machines and ultrasonically inspected during manufacturing per American National Standards Institute specifications. All surfaces will be sandblasted and multiple layers of coating applied for protection against corrosion. Access to the turbine will be through a lockable steel door at the base of the tower. The steel door at the base of each tower will also include a low voltage safety light on a motion sensor for entry.

The turbine towers will be connected by anchor bolts to underground concrete and rebar foundations. Geotechnical surveys and turbine tower load specifications will dictate final design parameters of the foundations. A typical spread footer has a similar footprint to the tower diameter at grade, but may spread out below grade to as much as 48 to 62 ft (15 to 19 m) in diameter. A typical deep foundation is placed on an area approximately 31 x 31 ft (10 x 10 m) in size. Foundation type will be based on geotechnical surveys and may include spread footers or deep foundations. All foundations consist of anchor bolts, concrete, and reinforcing rebar. Specific site conditions may require subgrade modification to support the foundation.

2.1.2 Access Roads

The Project will be accessed using existing county public roadways and privately-owned roads; PRWP will upgrade existing roads and construct new roads to enable all-weather access to Project facilities. The main access route for the Project, including equipment deliveries, is via U.S. 24.

PRWP estimates that it will need to construct approximately 51 mi (61 km) of new roads for the 136 turbines. Access roads will be approximately 16 ft (5 m) wide during the operational phase. During construction, primary component haul roads and turbine/crane access roads will typically be 32 ft (10 m) wide, providing the 32 ft (10 m) needed for movement of the large crane and additional clearance area for crane operation and drainage features. Disturbance width typically increases in steeper areas due to cuts and fills necessary to construct and stabilize roads on slopes. PRWP will work with the landowners to utilize existing roads and to locate new access roads to minimize land use disturbance and avoid sensitive resources and steep roadway sections that exist near some railroad and roadway crossings to the extent possible, while maximizing transportation efficiency.

2.1.3 Communications and Collection System

A control panel inside the base of each turbine tower will house communication and electronic circuitry. A step-up transformer will be installed at the base of each turbine to raise the voltage from 690 V to collection line voltage (34.5 kV). Generated electricity will move through an underground collection system to the Project substation. Both power and communication cables will be buried in trenches a minimum of 5 ft (2 m) deep. An estimated 148 miles (237 km) of underground collection system will be installed.

2.1.4 Substation and O&M Facility

A 34.5-kV/345-kV substation will be constructed and owned by PRWP. The substation will be similar to substations used on transmission systems in the region and will be constructed and operated to industry standards.

An O&M facility that houses offices, a shop, and a work yard will also be constructed an owned by PRPA. Utilities such as electric service, water service, a septic system, and telephone service will be required at the Project O&M building. Water might be supplied locally through the use of a well(s). Permits for the installation of the septic system and the well(s) will be acquired through the local health department.

2.1.5 Transmission Line

A 345-kV overhead transmission line associated with the Project will move power from the Project substation in a northwest direction through Livingston County where it will tie into the existing ComEd Pontiac MidPoint 345-kV substation.

The transmission line will be approximately 9.5 miles (15.3 km) long. The construction ROW will be 25 ft (8 m) wide. The ROW will be routed through previously impacted (tilled) areas to minimize impacts to streams, wetlands, and other natural resources except for a 0.8-mile (0.1-km) long segment where it will cross the South Fork Vermilion River (Figure 2.1).

2.1.6 Facility Life Span

The Project's minimum life span after construction is expected to be about 20 years.

Figure 2-1 Aerial Photograph Showing Transmission Line Corridor at the South Fork Vermilion River Crossing

2.2 PROJECT CONSTRUCTION

Construction of the Project should take approximately nine to twelve months to complete once all permits have been obtained. PRWP will (1) order all necessary components, including wind turbine generators, foundation materials, electrical cable, and transformers; (2) complete micrositing of final turbine locations; (3) complete an American Land Title Association (ALTA) survey to establish locations of structures and roadways; and (4) complete soil borings, testing, and analysis for proper foundation design and materials.

The 136 turbines will be constructed using standard construction procedures and equipment used for other wind farms in the Midwestern U.S. Construction will entail the following activities, listed in typical order of occurrence:

1) Erosion control implementation;
2) Road and pad construction;
3) Substation and O&M facility construction
4) Overhead transmission line construction
5) Foundation excavation and pouring concrete foundations for turbine towers, meteorological towers, transformers pads;
6) Trenching and placement of underground collection and communications cables;
7) Tower erection, nacelle and rotor installation;
8) Testing and commissioning; and
9) Final road grading, erosion control, and site clean-up.

A construction staging and laydown area, including Project offices, equipment, and employee parking areas, will be developed on approximately 12 acres (5 ha). A temporary concrete batch plant will be used during construction and may be located adjacent to the staging area on approximately 3 acres (1 ha).

A well might be installed within the Project site to serve the necessary water requirements for the concrete batch plant. Water utilized for dust suppression may be taken from local creeks/ponds within the Project area. Portable self-contained restroom facilities will be provided and used by the contractor's personnel while on site. These facilities will be delivered, maintained, and replaced by a third party contractor.

2.2.1 Roads

Existing roads will be upgraded and new roads will be constructed in accordance with industry standards for wind farm roads and local building requirements. The roads will accommodate all-weather access by heavy equipment during construction and long-term use during operations and maintenance. New roads will be located in consultation with the landowner to minimize disturbance, maximize transportation efficiency, and avoid sensitive resources and unsuitable topography, where feasible. All new roads will be constructed for the specific purpose of Project construction, operation, and maintenance.

Roads will be designed, built, surfaced, and maintained to provide safe operating conditions at all times. The minimum travel way for access roads will be 16 ft (5 m). All roads will include road base, surface materials, appropriate drainage, and culverts. Surface disturbance will be contained within road ROWs, which will average 32 ft (10 m) along turbine/crane access roads. Disturbance width may increase in steeper areas due to cuts and fills necessary to construct and stabilize roads on slopes.

Topsoil removed during road construction will be stockpiled in elongated rows within road ROWs. Topsoil will be re-spread on cut-and-fill slopes and these areas will be revegetated as soon as possible after road construction is complete.

Construction will include temporary disturbances for crane pads at each turbine site, temporary travel roads for the cranes, temporary turning areas for oversized equipment at certain county and local road intersections, temporary laydown areas around each turbine, trenches for underground electrical collection and communication system, and for storage/stockpile areas. Construction of each turbine will include temporary impacts of approximately 8 ft (3 m) of gravel roadway on either side of the permanent roadway for 32 ft (10 m) of total width, a 250-ft x 250-ft (76-m x 76-m) gravel crane pad extending from the roadway to the turbine foundation, which will be graded to a minimum of 1 percent slope, and a 197-ft (60 m) radius rotor laydown area centered around the turbine foundation that will be graded to a maximum of 10 percent slope.

During construction, operation, and maintenance of the Project, traffic will be restricted to roads developed for the Project and designated existing roads. Use of unimproved roads will be restricted to emergency situations. Speed limits of 25 mph (11 m/s) will be set to ensure safe and efficient traffic flow. Signs will be placed along the roads as necessary to identify speed limits, travel restrictions, and other standard traffic control measures.

2.2.2 Substation and O&M Facility

The substation main transformer will be installed on an 11 x 17 ft (3 x 5 m) concrete pad and the main control building will be installed on a 15 x 33 ft (6 x 10 m) concrete pad within a 3-acre (1-ha) parcel of land centrally located within the Project. The substation will house transformers and other facilities to step-up medium voltage power from the collection system to high voltage for delivery to the 345-kV transmission line. The majority of the yard will be covered with crushed rock. The substation will be fenced with a 7 ft (2 m) high chain-link fence topped with three strands of barbed wire, for a total fence height of 8 ft (2 m). Access gates will be locked at all times and warning signs posted for public safety.

The Project O&M facility will be located separately from the Project 34.5/345-kV substation. The O&M building will be approximately 60 ft (18 m) wide and 102 ft (31 m) long and will be constructed of concrete and located on a concrete slab. The O&M building will contain all necessary plumbing and electrical collections needed for typical operation of offices and a maintenance shop. A septic system will be installed in the O&M facility.

2.2.3 Overhead Transmission Line

The transmission line will be constructed according to Avian Power Line Interaction Committee (APLIC) standards (APLIC 2006). Tree clearing for transmission line construction will occur during the period between November 1 and March 1.

An estimated 80 transmission line poles will be installed, with an average span between poles of approximately 700 ft (213 m). Transmission line poles consist of primarily single steel poles structures, secured as necessary with guy wires. Pole height will range from 90 to 115 ft (27 to 35 m). Poles will be set into a drilled hole in the soil or rock and then backfilled with select stone and granular soil fill. Setting depth will be 10 percent of the pole length plus 2 ft (<1 m) or deeper as specified by the design engineer. The poles will support both the steel-reinforced aluminum electrical conductor line and a composite fiber optic ground wire.

2.2.4 Turbine Towers, Meteorological Towers, and Transformers Foundations

Turbine towers will be anchor-bolted to concrete foundations. Foundations will be excavated using a backhoe, forms installed, and concrete poured. Anchor bolts will be embedded in the concrete, and the foundations will be allowed to cure prior to tower erection.

A 262-ft (80 m)-tall permanent meteorological tower will be installed on a 4.0 ft (1.2 m) pier foundation as part of operations. Foundation depth will depend on local soil conditions. Foundations will be drilled using a truck-mounted drilling rig and then filled with concrete. Transformer foundations will be constructed using standard cut-and-fill procedures and by pouring concrete in a shallow slab or using a precast structure set on appropriate depth of structural fill.

2.2.5 Trenching and Placement of Underground Electrical and Communications Cables

Underground electrical and communications cables will be placed in trenches below 5 ft (2 m) in depth. In some cases, trenches will run from the end of one turbine string to the end of an adjacent string to link more turbines together via the underground network. Electric collection and communications cables will be placed in the trench using trucks. Electrical cables will be installed first and the trench partially backfilled prior to placement of the communications cables. Trenches will be backfilled and the area re-vegetated concurrently with reclamation of other construction areas.

2.2.6 Tower Erection, Nacelle and Rotor Installation

Turbine tower assembly and erection will occur within the laydown area at each turbine site. Tower bottom sections will be lifted with a crane and bolted to the foundation, and then the middle and top sections will be lifted into place and bolted to the section below. Once the tower has been erected, the nacelle and then the rotor will be hoisted into place.

2.2.7 Testing and Commissioning

Testing involves mechanical, electrical, and communications inspections to ensure that all systems are working properly. Performance testing will be conducted by qualified wind power technicians and will include checks of each wind turbine and the SCADA system prior to turbine commissioning. Electrical tests of the Project (i.e., turbines, transformers, and collection system) and transmission system (i.e., transmission line and substation) will be performed by qualified electricians to ensure that all electrical equipment is operational within industry and manufacturer's tolerances and installed in accordance with design specifications. All installations and inspections will be in compliance with applicable codes and standards.

2.2.8 Final Road Grading, Erosion Control, and Site Clean-up

Once construction is complete, all disturbed areas will be graded to the approximate original contour and any remaining trash or debris will be properly disposed of off-site. Areas disturbed during construction will be stabilized and reclaimed using appropriate erosion control measures, including site-specific contouring, reseeding, or other measures agreed to by landowners and designed and implemented in compliance with the Project's Storm Water Pollution Prevention Plan (SWPPP). Areas that are disturbed around each turbine during construction will revert to the original land use after construction except for a 100-ft (30-m) diameter area around each turbine that PRWP will maintain for operation and maintenance purposes. Upon the completion of construction the existing land use will be able to continue with very little impact from the Project.

During final road grading, surface flows will be directed away from cut-and-fill slopes and into ditches that outlet to natural drainages. PRWP will prepare and implement a SWPPP, which will include standard sediment control devices (e.g., silt fences, straw bales, netting, soil stabilizers, check dams) to minimize soil erosion during and after construction. Waste materials will be disposed of at approved and appropriate landfills. Following construction, PRWP will ensure that all unused construction materials and waste are picked up and removed from the Project area.

Contractors will provide trash barrels or dumpsters to collect all construction waste for proper disposal at an approved facility. No waste disposal by incineration will occur. The O&M building will be used to store parts and equipment needed for O&M. While PRWP does not anticipate the use of any liquid chemicals within the Project area, PRWP will inspect and clean up the Project area following construction to ensure that no solid (e.g., trash) or liquid wastes (e.g., used oil, fuel, turbine lubricating fluid) were inadvertently spilled or left on-site.

Cleanup crews will patrol the construction site on a regular basis to remove litter. Final site cleanup will be performed prior to shifting responsibilities to O&M crews. O&M crews will use dumpsters on site for daily maintenance waste.

2.3 PROJECT OPERATIONS, MAINTENANCE, DECOMMISSIONING, AND RESTORATION

2.3.1 Operations and Maintenance

PRWP will operate and maintain the Project. All turbines, collection and communications lines, substations, and transmission lines will be operated in a safe manner according to standard industry operation procedures. Routine maintenance of the turbines will be necessary to maximize performance and detect potential inefficiencies. PRWP and the turbine supplier will control, monitor, operate, and maintain the Project by means of the SCADA system, and regularly scheduled on-site inspections will be conducted. Any problems will be promptly reported to on-site O&M personnel, who will perform both routine maintenance and most major repairs. Most servicing will be performed up-tower, without using a crane to remove the turbine from the tower. Additionally, all roads, pads, and trenched areas will be regularly inspected and maintained to minimize erosion. PRWP anticipates that approximately 10 to 12 O&M staff will be employed throughout the life-of-project.

All maintenance activities will occur within areas previously disturbed by construction, so no new ground disturbance will occur during O&M of the Project. Turbine maintenance is typically performed up-tower, i.e., O&M personnel climb the towers and perform maintenance within the tower or nacelle and access the towers using pick-up trucks, so no heavy equipment in needed. In the unlikely event (may never occur) that a large crane would be needed for maintenance, vegetation will be cleared within the area previously disturbed during construction to provide for safe and efficient operation of the crane, but no soil disturbance will be necessary. Ground disturbing activities may include occasional need to access underground cable or communications lines.

Access roads will be maintained as needed during O&M to prevent off-road detours due to ruts, mud holes, etc. It is anticipated that maintenance will occur twice per year but more frequent maintenance will be performed, if needed, to maintain roads in a condition acceptable to the county (for county roads) and to the landowner (for private roads). All fuels and/or hazardous materials will be properly stored during transportation and at the job site. Workers will be instructed to keep all job sites in a sanitary and safe condition. Workers will be expected to respect the property rights of private landowners.

Vegetation mowing will occur along Project roads and around turbines for vegetation control purposes.

The transmission line route and other Project areas will be inspected for hazard trees that may pose safety threats or potential damage to Project facilities. Hazard trees will be trimmed or cut as needed. Tree cutting will occur from November 1 through March 1 to avoid impacting any roosting bats, unless PRWP deems there is imminent threat of property damage and/or safety hazard were the tree to fall on Project facilities.

2.3.2 Decommissioning and Restoration

At the end of the Project's useful life, PRWP expects to explore alternatives for either repowering or decommissioning the Project. One option may be to continue operation of the Project, providing energy under a new long-term contract with a power purchaser or on a merchant basis. If it is determined that the wind turbines will not continue operation, be replaced or repowered after 20 years, the following sequence for removal of components will be implemented:

1) Turbines, transmission line, and substation will be dismantled and removed;
2) Pad-mounted transformers will be removed;

3) All turbine and substation foundations will be removed to a depth of 4 ft (1 m); and
4) All disturbed areas and access roads will be graded to as near as practicable the original contour, if the landowner requests that PRWP decommission these areas.

A decommissioning fund will be established based on the requirements of Livingston County and will cover dismantling of the turbines and towers, as well as land reclamation, monitoring of revegetation success, and reseeding if needed to ensure revegetation success. An independent expert, or Professional Engineer, will be engaged to assess the size of fund needed based on resale or salvage value of the Project components. This estimate, if required, will be re-assessed periodically and reported to Livingston County.

2.4 WILDLIFE PROTECTION MEASURES

PRWP proposes to implement a host of measures designed to avoid and minimize impacts to birds, bats, and the environment. These conservation and mitigation practices, which are a part of the proposed Project, are summarized below:

2.4.1 General

- All federal, state, and local environmental laws, orders, and regulations will be complied with.
- Prior to construction, all supervisory construction personnel will be instructed on the protection of wildlife resources including: (1) federal and state laws regarding plants and wildlife, including collection and removal and (2) the importance of these resources and the purpose and necessity of protecting them. This information will be disseminated through the contractor hierarchy to ensure that all appropriate staff members are aware of the correct procedures and responsibility to report wildlife incidences.
- PRWP will monitor bird and bat carcasses at the site in accordance with the monitoring plan presented in the Monitoring and Adaptive Management Plan (MAMP; Appendix A), to verify the effectiveness of the avoidance, minimization, and mitigation strategies incorporated in the Pleasant Ridge Wind Farm.
- PRWP has consulted and coordinated with USFWS and IDNR for mitigation activities related to bats, eagles, other raptors, and other migratory birds. As discussed under Section 2.1 and below, the Project has been sited such that potential impacts to these taxa are reduced. Additional measures to avoid/minimize impacts to birds and bats are presented in Sections 2.4.2 – 2.4.5, below.

2.4.2 Surveys and Siting

The effects of pre-construction, construction, and operational activities were taken into account during the pre-development stage of this Project and were assessed by conducting wildlife surveys. While many of these surveys were conducted prior to publication of the WEG, PRWP has determined that the surveys, as updated in 2014, meet WEG recommendations (USFWS 2012). Pre-construction wildlife and habitat surveys within the Project area include:

- Site Characterization for Wildlife Issues (January 2009)
- Chiropteran Risk Assessment (February 2009)
- Habitat Mapping, Land Cover Analysis (April 2009 and May 2014)
- Bird Use Counts (March 2009-February 2010)

- American Golden-plover Surveys (April-May 2009)
- Smith's Longspur Surveys (April-May 2009)
- Raptor Nest Surveys (May 2009 and April 2014)
- Bat Acoustic Surveys (July 2009-October 2009)
- Bat Mist-netting (Summer 2011)
- Summary of Natural Resources at the South Fork Vermilion River Crossing (July 2014)

PRWP has sited infrastructure to minimize and avoid adverse effects on federally listed plants and summering Indiana bats and northern long-eared bats and to minimize impacts to migratory birds. Mitigation measures incorporated into Project siting include the following:

- Potentially-suitable foraging habitats for Indiana bat and northern long-eared bat were evaluated for connectivity to one another and to the Vermilion and South Fork Vermilion rivers. If habitats were determined to be connected, a 1,000 ft (305 m) setback from those habitats was established to prevent the turbine sites from being connected to the Vermilion River system.
- The Project has been sited in a previously disturbed landscape and to avoid critical habitats for sensitive species.
- Turbines will be located to avoid: (1) known bat hibernation, swarming, and maternity/nursery colonies, (2) areas or features of the landscape known to attract raptors, and (3) potential bird mortality, as practicable.
- Fragmentation of wildlife habitat will be avoided through the use, where practical, of lands already disturbed, including using existing roadways.

2.4.3 Surface Water, Soils, and Vegetation

Appropriate storm water management practices that do not create attractions for birds will be implemented. A SWPPP will be prepared to ensure that erosion is minimized during storm events and will be kept on-site at all construction sites, as well as in the construction contractors' offices. PRWP and its contractors will implement the SWPPP. To minimize damage to the land surface and property, contractors will limit the movement of crews and equipment to the Project site, including access routes, to that which is necessary for safe and efficient construction. When weather and ground conditions permit, construction-caused deep ruts will be leveled, filled and graded, or otherwise eliminated. Ruts, scars, and compacted soils will be loosened and leveled using a ripper or disc or other landowner-approved method. Damage to ditches, roads, and other features of the land will be repaired. Water bars or small terraces will be constructed along access road ditches on hillsides to minimize water erosion and to facilitate natural revegetation.

- All federal regulations concerning the crossing of waters of the U.S., as listed in Title 33 Code of Federal Regulations [C.F.R.] Part 323, will be complied with.
- Wind turbines and most ancillary facilities will be built on uplands, which avoid surface water features and designated floodplains.
- Wind turbines will not be placed in areas containing waters of the U.S.
- Refueling and staging will occur at least 300 ft (91 m) from the edge of a channel bank at all stream channels. Sediment control measures will be utilized.

- Prior to construction, field surveys will be conducted to determine the presence of jurisdictional wetlands and streams within the footprint of each turbine location and ancillary facilities. Once the layout for the Project has been finalized, results of the field surveys and a summary of impacts will be submitted to the USACE, and the required authorizations/permits will be obtained.
- Roads, portions of roads, crane paths, and staging areas not required for operation and maintenance will be restored to the original contour and made impassable to vehicular traffic. Areas to be reclaimed will be contoured, graded, and seeded as needed to promote successful revegetation, provide for proper drainage, and prevent erosion. Seed mixtures will be developed based on best management practices for the region, requirements or recommendations by the county, or specific requests by the landowner or easement requirements
- Contractors will be required to cover riparian areas with mats made of timber or similar material located along the transmission line ROW and minimize physical disturbance to riparian vegetation during construction.
- During Project construction, riparian areas will be avoided, where feasible. If avoidance is not feasible, such as at the Vermilion River crossing, activities within riparian areas will be conducted in conformance with SWPPP requirements.
- During construction and operation of the Project, industry-standard best management practices (BMP) will be implemented to protect topsoil and adjacent resources and to minimize soil erosion. Practices may include containing excavated material, protecting exposed soil, stabilizing restored material and revegetating areas as necessary.
- Existing roads and previously disturbed lands will be used where feasible, to reduce vegetation impacts within the Project area. Surface disturbance will be limited to that which is necessary for safe and efficient construction.
- All surface-disturbed areas will be restored to the approximate original contour and reclaimed in accordance with easement agreements.
- Removal or disturbance of vegetation will be 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.
- Soil erosion control measures will be monitored, especially after storms, and will be repaired or replaced if needed.
- Construction activities in areas of moderate to steep slopes (≥15-20%) will be avoided, where possible.

2.4.4 Site Management

- All carrion discovered on-site during regular maintenance and monitoring activities will be removed to avoid attracting bald eagles and other raptors.
- Hunting, fishing, dogs, or possession of firearms by its employees and its designated contractor(s) in the Project area will be prohibited during construction, operation, and maintenance.
- Project personnel will be advised regarding speed limits on roads (25 mph [11 m/s]) to minimize wildlife mortality due to vehicle collisions.

- Potential increases in poaching will be minimized through employee and contractor education regarding wildlife laws. If violations are discovered, the offense will be reported to the IDNR and offending employee or contractor will be disciplined and may be dismissed by PRWP and/or prosecuted by the IDNR.
- Travel will be restricted to designated roads; no off-road travel will be allowed except in emergencies.

2.4.5 Collision Risk

Lighting will be minimized to that which is required by the Federal Aviation Administration (FAA). The FAA typically requires every structure taller than 200 ft (61 m) above ground level to be lighted, but in the case of wind power developments, FAA allows a strategic lighting plan that provides complete conspicuity to aviators but does not require lighting every turbine. PRWP will develop a lighting plan for the Project to be submitted for FAA approval. An estimated 60-65 percent of the Project's turbines will be designated for lighting with medium intensity dual red synchronously flashing lights for night-time use and daytime use, if needed. The turbines will be lighted only as required by FAA regulations, plus a low voltage, shielded light on a motion sensor at the entrance door to each turbine. To avoid disorienting or attracting birds or bats, FAA lighting on turbines will employ strobed, minimum-intensity lights as recommended by the Service (USFWS 2012).

During the late summer and fall swarming and migration seasons (August 1 – October 7), Pleasant Ridge turbines will be curtailed at 15.2 mph (6.9 m/s) from sunset to sunrise. This curtailment schedule targets the seasons during which the majority of all bat mortalities have occurred at wind energy facilities (Arnett et al. 2008) and the period during which bat activity was found to be the highest at the Pleasant Ridge Project area (Good et al. 2010a).

Turbine blades will remain fully feathered (i.e., blades will be oriented parallel to the wind) so rotors will move very slowly prior to reaching the turbine cut-in speed. At cut-in wind speeds, the blades will pitch into the wind, rotor speeds will increase, and the generators will 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.

PRWP will test the effectiveness of this operational protocol through monitoring during the first three years of operation and once every three years thereafter (Appendix A).

The following collision-avoidance/minimization measures will also be implemented:

- Unguyed, tubular towers and slow-rotating, upwind rotors will be used.
- Avian Power Line Interaction Committee suggested practices (2006) will be used to ensure that the transmission line is designed and constructed in a manner to minimize bird collision and electrocution risk.
- Collection and communication lines will be buried.

2.4.6 Fencing

The substation and O&M building will be fenced as required for public safety, but no other fencing is proposed at this time. The public will continue to have access to portions of the Project area via public roads and private roads that are regularly open to the public.

2.4.7 Hazardous and Solid Wastes

All applicable hazardous material laws and regulations existing or hereafter enacted or promulgated regarding these chemicals will be complied with and a Spill Prevention, Control, and Countermeasure Plan (SPCCP) will be 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 will not be stored in or near any stream, nor will any vehicle refueling or routine maintenance occur in or near streams. When work is conducted in and adjacent to streams, fuels and coolants will be contained in the fuel tanks and radiators of vehicles or other equipment.

Construction activities will be performed using standard construction best management practices so as to minimize the potential for accidental spills of solid material, contaminants, debris, and other pollutants. Excavated material or other construction materials will not be stockpiled or deposited near or on stream banks.

No burning or burying of waste materials will occur at the Project site. The contractor will be responsible for the removal of all waste materials from the construction area. All contaminated soil and construction debris will be disposed of in approved landfills in accordance with appropriate environmental regulations.

2.4.8 Fire Protection

Fires will be handled in accordance with Invenergy Services LLC's Fire Protection and Prevention Plan (Invenergy Services LLC 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 Invenergy management, and limited fire suppression using fire extinguishers by trained Invenergy personnel.

At all times during construction and operation, satisfactory spark arresters will be maintained on internal combustion engines.

2.4.9 Weeds

Mechanical measures will be used to control noxious weeds in all surface-disturbed areas.

2.4.10 Noise

Effective exhaust mufflers will be installed and properly maintained on all construction equipment. PRWP will require construction contractors to comply with federal limits on truck noise. Construction activities will take place mostly during daylights hours. Construction contractors will be required to ensure their employee and delivery vehicles are driven responsibly. PRWP and its contractors will adhere to a Project-wide speed limit of 25 mph (11 m/s) or lower depending on the requirements of the specific equipment utilizing the roads. Nighttime construction work will be minimized, and when it does occur, it generally will be limited to relatively quiet activities.

3.0 AVIAN AND BAT RESOURCES

3.1 HABITAT DESCRIPTION

The Project area is located within the Central Corn Belt Plains Ecoregion, which encompasses a large portion of central Illinois (Woods et al. 2007). The Central Corn Belt Plains Ecoregion is composed of vast glaciated plains; much of this region was historically dominated by tallgrass prairie, with groves of trees and marshes scattered across the level uplands. Topography within the Project area is flat to rolling, with elevations ranging from 200 to 250 ft (61 to 76 m) above sea level (approximately). The South Fork of the Vermilion River and a small portion of the Vermilion River are located within the Project area (Figure 1.1). There are no protected areas within the Project area (Illinois Natural Preserves Commission [INPC] 2013).

Land use within the Project area is dominated (92.6%) by tilled and un-tilled agriculture, primarily corn (*Zea* spp.) and soybean (*Glycine max*) crops (Table 3.1). Due to high levels of disturbance and lack of native vegetation, agricultural habitats are of limited quality for birds and bats. Cultivated agriculture is rarely used as nesting habitat by birds, although certain, disturbance-tolerant species may forage in crops. Agricultural fields may attract large flocks of birds, such as blackbirds and Canada geese (*Branta canadensis*), during the fall migration and winter seasons (Erickson et al. 2002). Agricultural habitat does not provide roosting habitat for bats, but certain bat species, primarily big brown bat (*Eptesicus fuscus*) and evening bat (*Nycticeius humeralis*), may forage over agricultural fields within the Project area. Other bat species in the region may occasionally forage over crops within the Project area but are more likely to use forested and open water habitats (Bat Conservation International, Inc. [BCI] 2014).

Table 3.1 Land Cover Types, Coverage, and Composition within the Pleasant Ridge Project Area, Based on National Land Cover Database in May of 2014

Habitat	Acres [Hectares]	% Composition
Cultivated Crops (e.g., corn, soybeans)	55,946[22,641]	92.6
Developed	3,432[1,389]	5.7
Deciduous Forest	451[183]	0.7
Hay/Pasture	347[140]	0.6
Open Water	122[49]	0.2
Woody Wetlands	111[45]	0.2
Barren Land	19[8]	0.0
Herbaceous	3[1]	0.0
Total	**60,431[24,456]**	**100**

The remaining land cover within the Project area is comprised of developed areas (5.7%), and deciduous forest, hayfields, pasture, open water, woody wetlands, barren land and herbaceous areas (1.7% combined). Pasture, hayfields, and herbaceous areas may provide nesting habitat for grassland and passerine birds. However, these habitats exist only as small, isolated patches within the Project area. Similarly, the Project area contains only limited amounts of forested habitat (woodlot, shelterbelts). Forest fragments such as those found within the Project area are typically not considered high-quality nesting habitat for birds due to their limited size and abundance of edge habitat, which is associated with higher incidence of nest predation and parasitism (U.S. Geological Survey [USGS] 2011). These small patches of forest habitat may receive higher levels of bird use during migration, as forest fragments often provide stopover habitat for migrating passerines and other birds (Packett and Dunning 2009). Forest fragments within the Project area may also provide limited amounts of foraging or roosting habitat for the nine bat species whose geographic distributions include Livingston County. Many of these species also forage along stream corridors or over water and may use the small areas of open water within the Project area (BCI 2014).

The transmission line crossing of the South Fork Vermilion River was inspected on August 21, 2014, to document environmental conditions along this 400-ft long x 150-ft wide segment of the route. The survey area was comprised of bottomland forested floodplain bordering the South Fork Vermilion River. Canopy tree species included red, white and black oaks (*Quercusrubra*, *Q. alba*, and *Q. velutina*, respectively), black walnut (*Juglans nigra*) and hackberry (*Celtis occidentalis*). The understory was dominated by stinging nettle (*Urtica dioica*), black raspberry (*Rubus occidentalis*), gooseberry (*Ribes* sp.) and honeysuckle (*Lonicera* sp.*).* Coarse woody debris was present in low to moderate amounts. Two trees were identified as potential bat roosts, one located on the western bank of the river (a standing snag with multiple open limb scar holes and a hollow cavity) and one located on the eastern bank of the river (a standing snag with open limb scar holes and dead split limbs.

Site Characterization for Wildlife Issues

A Biological Site Characterization Study was prepared for PRWP in January 2009 (Ritzert and Good 2009). Published literature, field guides, public data sets, the November 12, 2008 USFWS correspondence and the January 2, 2009 IDNR correspondence were all used to identify biological resources within the Project area. This information has also been updated with the September 8, 2014 IDNR correspondence.

Much of the site is located on flat cropland which is generally recommended by the USFWS as the ideal location for wind projects. The flat agricultural fields within the Project area lack defined topographic edges and the Project is not located near any major ridgelines or other features that might funnel raptors or migrating songbirds through the Project. The amount of suitable stopover habitat (e.g., wetlands, grasslands, forest/woodland habitat) for migrating songbirds is limited within the Project. Waterfowl and shorebirds may utilize croplands in the Project area during migration. While site characteristics suggest that the area will not concentrate most migrating birds, information compiled by Region 3 of the USFWS indicates raptors and other bird species will likely migrate over the Project area as they travel across central Illinois to and from migration routes that follow the shoreline of the Great Lakes (Ritzert and Good 2009). Additionally, bird use of the area is expected to be higher near restored grasslands, Indian Creek and the South Fork of the Vermilion River in the Project area. The proposed Project is located within the migratory route for the Smith's longspur (*Calcarius pictus)* and the American golden-plover (*Pluvialis dominica;* Ritzert and Good 2009).

There is limited potential for species protected under the ESA to occur in the Project area due to the preponderance of tilled agriculture. The whooping crane (*Grus americana*) has some potential to occur during migration, and a new ultra-light led migration route occurs within Livingston County. This population is listed as "experimental and non-essential" under the ESA, but is still protected under the MBTA. The federally endangered Indiana bat and proposed-for-listing northern long-eared bat also have some potential to breed within forested areas and migrate through the site, although this potential is considered low due to the preponderance of tilled agriculture.

In their September 2014 letter, the IDNR identified five state-listed bird species which may occur within the current Project boundary (Figure 1.1) including the loggerhead shrike (*Lanius ludovicianus*), upland sandpiper (*Bartramia longicauda*), osprey (*Pandion haliaetus*), black-billed cuckoo (*Coccyzus erthropthalmus*), and northern harrier (*Circus cyaneus*). Although the Project area contains mostly cropland, there are localized shelterbelts, grassland, hayfields and wetland habitat, and there is potential for state listed species to occur in these areas.

A limited amount of potential raptor nesting habitat is available within the Project area, mainly within small riparian corridors and shelterbelts.

3.2 PRE-CONSTRUCTION AVIAN SURVEYS

3.2.1 Fixed-Point Bird Use Surveys

Fixed-point bird use surveys were conducted within the Project area from March 5, 2009, through March 2, 2010 (Good et al. 2010b). Surveys were conducted at 35 points established throughout the then-proposed Project area which was larger than and completely encompassed the current Project area. Surveys were conducted weekly during the spring and fall migration seasons and monthly during the winter to estimate the seasonal, spatial, and temporal use of the Project area by birds, particularly raptors. No surveys were conducted during the summer. A total of 509 20-minute fixed-point surveys were completed. Results of these surveys are summarized below (from Good et al. 2010b).

Sixty-seven species were observed during all fixed-point surveys (Table 3.2), with an average species richness of 0.66 large bird species/2,625-ft [800-m] plot/20-min survey and 1.47 small bird species/328-ft [100-m] plot/20-min survey. The total number of species was greater in the spring (59 species) then in the fall (38) or winter (25). The most abundant bird species observed, regardless of size, were European starling (*Sturnus vulagris;* 1,320 observations), red-winged blackbird (*Agelaius phoeniceus*; 656 observations) and brown-headed cowbird (*Molothrus ater;* 581 observations). The most abundant large bird species observed were killdeer (*Charadrius vociferous*; 169 individuals) and American crow (*Corvus brachyrhynchos*; 169 observations).

A total of 5,325 bird observations comprised of 1,469 separate groups were recorded during the surveys. Overall, use by large bird species was higher during the spring and fall (3.40 and 2.43 birds/2,625-ft [800-m] plot /20-min survey, respectively) than during the winter (1.05 birds/2,625-ft [800-m] plot /20-min survey; Table 3.3). Small bird use followed a similar pattern, with higher use in the spring and fall (9.10 and 10.53 birds/328-ft [100-m] plot /20-min survey, respectively) than in the winter (4.58 birds/328-ft [100-m] plot /20-min survey).

Waterbirds

Waterbirds had the highest use in the spring (0.06 bird/800-m plot/20-min survey), followed by the fall (0.02) and winter (<0.01). Great blue heron (*Ardea herodias*) had the highest use of all waterbirds during all three seasons. Waterbirds comprised 3.3 percent of the overall large bird use in the spring, 1.3 percent in the fall, and 0.6 percent in the winter. Waterbirds were observed during 6 percent of the spring surveys, 2.3 percent of the fall surveys, and 0.7 percent of the winter surveys.

Waterfowl

Waterfowl had similar use during the fall (0.55 bird/800-m plot/20-min survey) and spring (0.51), and lower use in the winter (0.07). Snow goose (*Chen caerulescens*) and Canada goose (*Branta canadensis*) were the only waterfowl observed during the fall season, and use by snow goose was higher than use by Canada goose (0.34 and 0.21 bird/800-m plot/20-min survey, respectively). Six waterfowl species were observed during the spring season, with Canada goose comprising the majority of use (0.30 bird/800-m plot/20-min survey). Only one species, Canada goose, was observed in the winter (0.07 bird/800-m plot/20-min survey). Waterfowl comprised 31.8 percent of the overall large bird use during the fall, 26.6 percent during the spring, and 6 percent in the winter. Waterfowl were observed more frequently in the spring (7.7%) and the fall (2.9%).

Shorebirds

Shorebirds had similar use in the spring (0.48 bird/800-m plot/20-min survey) and fall (0.35), and no shorebirds were observed in the winter. Killdeer comprised the majority of use during both seasons

(25.3% of the overall large bird use in the spring and 20.3% in the fall). Shorebirds were observed during 34.3 percent of the surveys in the spring and 13.1 percent of surveys in the fall.

Raptors

A total of 100 raptor observations were recorded within the PRWP, representing seven species. The most common raptor species observed during the surveys within the study area were red-tailed hawk (*Buteo jamaicensis;* 50 individuals), American kestrel (*Falco sparverius;* 22 individuals) and northern harrier (19 individuals).

Raptor use was highest in the winter (0.28 bird/800-m plot/20-min survey), followed by the fall (0.21) and spring (0.15). Winter use was primarily comprised of red-tailed hawk (0.11), American kestrel (0.08), and northern harrier (0.06). Red-tailed hawks had the highest use of any raptor in the fall (0.10) and spring (0.09). Raptors comprised 23 percent of the overall large bird use in the winter, 12.1 percent in the fall, and 7.9 percent in the spring. Raptors were observed during 21.2 percent of surveys in the winter and 17.7 percent in the fall, and 12.3 percent of the surveys in the spring.

Data collected during fixed-point count surveys did not indicate the presence of important eagle use areas (i.e. nests and breeding territories, communal roosts and foraging concentrations, migration corridors and stopovers) within the Project area (Good et al. 2010b). An additional survey was conducted in May 2014 to evaluate habitat within the current Project area and a 10-mile buffer for potential eagle nests (see Section 3.2.2).

Passerines

A 100-m radius plot was used for small birds, thus making them not directly comparable to the large bird types. Passerine use was higher in the fall (8.69 birds/100-m plot/20-min survey) and the spring (7.36) compared to the winter (3.50). European starling had the highest use by any one species during the fall (3.97 birds/100-m plot/20-min survey), while red-winged blackbird had the highest use in the spring (1.78) and dark-eyed junco (*Junco hyemalis*) had the highest use in the winter (1.38). Passerines were observed during 87.6 percent of the spring surveys, 66.9 percent of the fall surveys, and 48.5 percent of the winter surveys. Only 1 percent of all passerine observations were within the presumed rotor-swept zone.

Sensitive Species

The only sensitive species recorded during the fixed-point bird use surveys was the northern harrier. A total of 19 northern harrier observations, a state-listed endangered species, were recorded during point counts, as well as an additional 10 incidental observations. The number of observations may represent repeated observations of the same individual in some cases. Specific American golden-plover and Smith’s longspur surveys were also conducted (see Sections 3.2.3 and 3.2.4).

Table 3.2 Number of Observations and Groups, by Season and Overall, for each Bird Type, Raptor Subtype, and Species Observed during Fixed-Point Bird Use Surveys at the Pleasant Ridge Project Area, March 5, 2009-March 2, 2010 (Good et al. 2010b)

Species/ Type	Scientific Name	Spring		Fall		Winter		Total	
		# grps	# obs	# grps	# obs	# grps	# obs	# grps	# obs
Waterbirds		**13**	**14**	**4**	**4**	**1**	**1**	**18**	**19**
great blue heron	*Ardea herodias*	12	13	4	4	1	1	17	18
ring-billed gull	*Larus delawarensis*	1	1	0	0	0	0	1	1
Waterfowl		**23**	**123**	**5**	**97**	**1**	**10**	**29**	**230**
Canada goose	*Branta canadensis*	14	68	4	37	1	10	19	115

Species/ Type	Scientific Name	Spring # grps	Spring # obs	Fall # grps	Fall # obs	Winter # grps	Winter # obs	Total # grps	Total # obs
green-winged teal	*Anas crecca*	1	5	0	0	0	0	1	5
mallard	*Anas platyrhynchos*	5	14	0	0	0	0	5	14
northern shoveler	*Anas clypeata*	1	10	0	0	0	0	1	10
ring-necked duck	*Aythya collaris*	1	20	0	0	0	0	1	20
snow goose	*Chen caerulescens*	1	6	1	60	0	0	2	66
Shorebirds		**83**	**109**	**23**	**62**	**0**	**0**	**106**	**171**
killdeer	*Charadrius vociferus*	81	107	23	62	0	0	104	169
Wilson's snipe	*Gallinago delicata*	2	2	0	0	0	0	2	2
Rails/Coots		**1**	**6**	**0**	**0**	**0**	**0**	**1**	**6**
American coot	*Fulica americana*	1	6	0	0	0	0	1	6
Raptors		**29**	**33**	**34**	**37**	**28**	**30**	**91**	**100**
Accipiters		*2*	*2*	*3*	*4*	*0*	*0*	*5*	*6*
Cooper's hawk	*Accipiter cooperii*	1	1	0	0	0	0	1	1
sharp-shinned hawk	*Accipter striatus*	1	1	3	4	0	0	4	5
Buteos		*18*	*21*	*16*	*17*	*12*	*13*	*46*	*51*
red-tailed hawk	*Buteo jamaicensis*	18	21	16	17	11	12	45	50
rough-legged hawk	*Buteo lagopus*	0	0	0	0	1	1	1	1
Northern Harrier		*4*	*4*	*7*	*8*	*7*	*7*	*18*	*19*
northern harrier	*Circus cyaneus*	4	4	7	8	7	7	18	19
Falcons		*5*	*6*	*8*	*8*	*8*	*8*	*21*	*22*
American kestrel	*Falco sparverius*	5	6	8	8	8	8	21	22
Owls		**0**	**0**	**0**	**0**	**1**	**2**	**1**	**2**
great horned owl	*Bubo virginianus*	0	0	0	0	1	2	1	2
Vultures		**18**	**31**	**7**	**13**	**0**	**0**	**25**	**44**
turkey vulture	*Cathartes aura*	18	31	7	13	0	0	25	44
Upland Game Birds		**16**	**17**	**5**	**5**	**1**	**1**	**22**	**23**
ring-necked pheasant	*Phasianus colchicus*	16	17	5	5	1	1	22	23
Doves/Pigeons		**43**	**82**	**21**	**66**	**2**	**9**	**66**	**157**
Eurasian collared-dove	*Streptopelia decaocto*	1	1	0	0	0	0	1	1

Species/ Type	Scientific Name	Spring # grps	Spring # obs	Fall # grps	Fall # obs	Winter # grps	Winter # obs	Total # grps	Total # obs
mourning dove	*Zenaida macroura*	28	44	19	58	2	9	49	111
rock pigeon	*Columba livia*	14	37	2	8	0	0	16	45
Large Corvids		**15**	**31**	**10**	**21**	**14**	**86**	**39**	**138**
American crow	*Corvus brachyrhynchos*	15	31	10	21	14	86	39	138
Passerines		**992**	**2,161**	**196**	**1,744**	**73**	**417**	**1,261**	**4,322**
American goldfinch	*Carduelis tristis*	15	19	34	67	1	1	50	87
American robin	*Turdus migratorius*	120	271	39	183	1	5	160	459
American tree sparrow	*Spizella arborea*	1	5	0	0	3	14	4	19
Baltimore oriole	*Icterus galbula*	1	1	0	0	0	0	1	1
barn swallow	*Hirundo rustica*	54	83	5	25	0	0	59	108
black-capped chickadee	*Poecile atricapillus*	1	2	0	0	0	0	1	2
blue jay	*Cyanocitta cristata*	4	4	6	8	3	4	13	16
brown-headed cowbird	*Molothrus ater*	131	323	5	256	1	2	137	581
brown thrasher	*Toxostoma rufum*	3	3	1	1	0	0	4	4
Carolina chickadee	*Poecile carolinensis*	1	2	0	0	0	0	1	2
chipping sparrow	*Spizella passerina*	8	9	0	0	0	0	8	9
cliff swallow	*Petrochelidon pyrrhonota*	0	0	2	20	0	0	2	20
common grackle	*Quiscalus quiscula*	122	300	7	16	0	0	129	316
dark-eyed junco	*Junco hyemalis*	1	1	0	0	4	101	5	102
dickcissel	*Spiza americana*	9	12	2	2	0	0	11	14
eastern bluebird	*Sialia sialis*	1	6	4	7	0	0	5	13
eastern kingbird	*Tyrannus tyrannus*	2	2	0	0	0	0	2	2
eastern meadowlark	*Sturnella magna*	80	94	3	3	0	0	83	97
eastern phoebe	*Sayornis phoebe*	1	1	0	0	0	0	1	1
eastern towhee	*Pipilo erythrophthalmus*	1	1	0	0	0	0	1	1
European starling	*Sturnus vulgaris*	56	254	33	903	12	163	101	1,320

Species/ Type	Scientific Name	Spring		Fall		Winter		Total	
		# grps	# obs	# grps	# obs	# grps	# obs	# grps	# obs
field sparrow	*Spizella pusilla*	3	3	0	0	0	0	3	3
gray catbird	*Dumetella carolinensis*	0	0	1	1	0	0	1	1
horned lark	*Eremophila alpestris*	91	143	21	55	35	70	147	268
house finch	*Carpodacus mexicanus*	1	2	0	0	0	0	1	2
house sparrow	*Passer domesticus*	12	20	1	1	4	15	17	36
house wren	*Troglodytes aedon*	2	2	0	0	0	0	2	2
indigo bunting	*Passerina cyanea*	5	5	1	1	0	0	6	6
Lapland longspur	*Calcarius lapponicus*	6	37	1	10	5	31	12	78
northern cardinal	*Cardinalis cardinalis*	7	7	0	0	1	1	8	8
red-winged blackbird	*Agelaius phoeniceus*	202	485	18	163	1	8	221	656
savannah sparrow	*Passerculus sandwichensis*	1	1	0	0	0	0	1	1
song sparrow	*Melospiza melodia*	18	24	1	1	1	1	20	26
tree swallow	*Tachycineta bicolor*	8	11	2	6	0	0	10	17
tufted titmouse	*Baeolophus bicolor*	0	0	0	0	1	1	1	1
vesper sparrow	*Pooecetes gramineus*	24	28	8	14	0	0	32	42
yellow-rumped warbler	*Dendroica coronata*	0	0	1	1	0	0	1	1
Other Birds		**16**	**19**	**7**	**8**	**1**	**1**	**24**	**28**
belted kingfisher	*Ceryle alcyon*	0	0	1	1	0	0	1	1
chimney swift	*Chaetura pelagica*	7	10	0	0	0	0	7	10
downy woodpecker	*Picoides pubescens*	4	4	1	1	0	0	5	5
northern flicker	*Colaptes auratus*	3	3	5	6	0	0	8	9
red-bellied woodpecker	*Melanerpes carolinus*	0	0	0	0	1	1	1	1
red-headed woodpecker	*Melanerpes erythrocephalus*	2	2	0	0	0	0	2	2
Overall		**1,249**	**2,626**	**312**	**2,057**	**121**	**555**	**1,682**	**5,238**

Table 3.3 Mean Bird Use[1], Percent of Total Composition (%), and Frequency of Occurrence (%), by Season and Overall, for each Bird Type, Raptor Subtype, and Species Observed during Fixed-Point Surveys at the Pleasant Ridge Project Area, March 5, 2009-March 2, 2010 (Good et al. 2010b)

	Use			% Composition			% Frequency		
Species/Type	**Spring**	**Fall**	**Winter**	**Spring**	**Fall**	**Winter**	**Spring**	**Fall**	**Winter**
Waterbirds	**0.06**	**0.02**	**<0.01**	**3.3**	**1.3**	**0.6**	**6**	**2.3**	**0.7**
great blue heron	0.06	0.02	<0.01	3.1	1.3	0.6	5.6	2.3	0.7
ring-billed gull	<0.01	0	0	0.2	0	0	0.4	0	0
Waterfowl	**0.51**	**0.55**	**0.07**	**26.6**	**32**	**6**	**7.9**	**2.9**	**0.7**
Canada goose	0.3	0.21	0.07	15.7	12	6	5.4	2.3	0.7
green-winged teal	0.02	0	0	0.9	0	0	0.4	0	0
mallard	0.06	0	0	3.3	0	0	2.2	0	0
northern shoveler	0.04	0	0	1.9	0	0	0.4	0	0
ring-necked duck	0.07	0	0	3.7	0	0	0.4	0	0
snow goose	0.02	0.34	0	1.1	20	0	0.4	0.6	0
Shorebirds	**0.48**	**0.35**	**0**	**25.3**	**20**	**0**	**34.3**	**13**	**0**
killdeer	0.47	0.35	0	24.7	20	0	33.3	13	0
Wilson's snipe	0.01	0	0	0.6	0	0	1.1	0	0
Rails/Coots	**0.02**	**0**	**0**	**1.1**	**0**	**0**	**0.4**	**0**	**0**
American coot	0.02	0	0	1.1	0	0	0.4	0	0
Raptors	**0.15**	**0.21**	**0.28**	**7.9**	**12**	**23**	**12.3**	**18**	**21.2**
Accipiters	*<0.01*	*0.02*	*0*	*0.4*	*1.3*	*0*	*0.7*	*1.7*	*0*
Cooper's hawk	<0.01	0	0	0.2	0	0	0.4	0	0
sharp-shinned hawk	<0.01	0.02	0	0.2	1.3	0	0.4	1.7	0
Buteos	*0.09*	*0.1*	*0.11*	*4.9*	*5.6*	*9.5*	*7.7*	*9.1*	*10.6*
red-tailed hawk	0.09	0.1	0.11	4.9	5.6	8.9	7.7	9.1	9.9
rough-legged hawk	0	0	<0.01	0	0	0.6	0	0	0.7
Northern Harrier	*0.01*	*0.05*	*0.06*	*0.7*	*2.6*	*4.8*	*1.4*	*4*	*5*
northern harrier	0.01	0.05	0.06	0.7	2.6	4.8	1.4	4	5
Falcons	*0.03*	*0.05*	*0.08*	*1.8*	*2.6*	*6.5*	*2.8*	*4.6*	*7*
American kestrel	0.03	0.05	0.08	1.8	2.6	6.5	2.8	4.6	7
Owls	**0**	**0**	**0.03**	**0**	**0**	**2.3**	**0**	**0**	**1.4**
great horned owl	0	0	0.03	0	0	2.3	0	0	1.4
Vultures	**0.15**	**0.07**	**0**	**8.1**	**4.3**	**0**	**8.9**	**4**	**0**
turkey vulture	0.15	0.07	0	8.1	4.3	0	8.9	4	0
Upland Game Birds	**0.07**	**0.03**	**<0.01**	**3.8**	**1.6**	**0.6**	**7**	**2.9**	**0.7**
ring-necked pheasant	0.07	0.03	<0.01	3.8	1.6	0.6	7	2.9	0.7
Doves/Pigeons	**0.34**	**0.38**	**0.08**	**17.6**	**22**	**7.1**	**17.6**	**12**	**2.1**
Eurasian collared-dove	<0.01	0	0	0.2	0	0	0.4	0	0
mourning dove	0.19	0.33	0.08	9.8	19	7.1	11.8	11	2.1
rock pigeon	0.14	0.05	0	7.5	2.6	0	5.8	1.1	0
Large Corvids	**0.12**	**0.12**	**0.75**	**6.3**	**6.9**	**62.7**	**5.6**	**5.7**	**11.3**
American crow	0.12	0.12	0.75	6.3	6.9	62.7	5.6	5.7	11.3
Overall	**1.91**	**1.74**	**1.19**	**100**	**100**	**100**	**100**	**100**	**100**

[1] Number of large birds/2,625-ft [800-m] plot /20-min survey, Number of small birds/328-ft [100-m] plot/20-min survey

3.2.2 Raptor Nest Surveys

The first round of raptor nest surveys was conducted in March 2009 using a ground-based approach (Good et al. 2010b). This survey included the entire then-proposed Project area and was completed by driving along public roads and accessible private roads looking for raptor nest structures within areas of suitable habitat. Two active red-tailed hawk nests and one inactive raptor nest were discovered within the Project area.

Another raptor nest survey was completed on April 16, 2014, using a fixed-wing aerial straight-line transect eagle and raptor nest survey methods, following the guidelines established in the ECPG (USFWS 2013a, Stantec 2014). This survey included the current Project area as well as a 10-mile (16-km) buffer. No bald eagle nests were observed, and two active red-tailed hawk nests were identified. In addition, seven great blue heron rookeries were observed within the 10-mile (16-km) Project buffer. One inactive likely buteo nest occurs in the forested corridor where the transmission line will cross the South Fork Vermilion River, and was discovered in the 2014 survey of that crossing.

3.2.3 American Golden-plover Surveys

Fourteen American golden-plover surveys were conducted between March 31 and May 14, 2009. Surveys were conducted by driving all public roads at approximately 20 mph in the then-proposed Project area and recording the number, location, and habitat of all American golden-plovers observed. Twice each survey day, observers spent a minimum of 30 minutes observing areas being used by American golden-plovers to record behavior, with a specific emphasis on obtaining flight height data. Eight groups of 113 American golden-plovers were observed during these surveys

3.2.4 Smith's Longspur Surveys

Smith's longspur surveys were conducted between March 31 and May 14, 2009 (Good et al. 2010b). The Project area was accessed by vehicle to determine where potential suitable habitat was located. Observers conducted point count surveys in suitable habitat two days per week for 30 min. Any Smith's longspurs observed were recorded, along with information on their behavior and flight heights. In addition to point count surveys, all Smith's longspurs observed while conducting American golden-plover surveys were recorded and their location plotted on a map. No Smith's longspurs were observed.

3.3 PRE-CONSTRUCTION BAT SURVEYS

3.3.1 Chiropteran Risk Assessment

A preliminary risk assessment for bat species at PRWP was conducted in February 2009 (BHE 2009), including a desktop review as well as a site visit on November 17, 2008. Tree cover in all of Livingston County totals only 1.3 percent, leaving little habitat for most migratory, tree-roosting bat species. Nine species have distributions that include Livingston County (Table 3.4). Wooded habitat is uncommon and occurs primarily along watercourses, particularly Indian Creek and the Vermilion River in the northwest portion of the Project area. Other than these areas, located in the northwest portion of the Project area, the Project area lacks significant land features such as ridgelines, river corridors, or forested expanses that may be used by migrating bats.

Good bat foraging and roosting habitat occurs at the transmission line crossing of the South Fork Vermilion River, and two trees were identified as potential bat roosts, one located on the western bank of the river (a standing snag with multiple open limb scar holes and a hollow cavity) and one located on the eastern bank of the river (a standing snag with open limb scar holes and dead split limbs (Shoener Environmental 2014).

Nine bat species, all members of the family Vespertilionidae, have geographic distributions that include Livingston County (Table 3.4): big brown bat (*Eptesicus fuscus*), silver-haired bat (*Lasioncysteris* *noctivagans*), eastern red bat (*Lasiurus borealis*), hoary bat (*Lasiurus cinereus*), little brown bat (*Myotis lucifugus*), northern long-eared bat, Indiana bat, tri-colored bat (*Perimyotis subflavus*), and evening bat (*Nycticereius humeralis*) (BCI 2014; Table 3.4). Of these species, only the Indiana bat is listed under the ESA as endangered. The northern long-eared bat is currently proposed by the USFWS for listing under the ESA as endangered, and a separate request has been submitted for a status review of the little brown bat.

Table 3.4 Bat Species Potentially Present within the Pleasant Ridge Project Area during Summer, Winter, and Migration (Summer/Fall)(BHE 2009).

		Potential Seasonal Presence within 5 mi (8 km) of the Pleasant Ridge Project Area		
Species	**Federal status**	**Summer**	**Winter**	**Migration**
Big brown bat	None	X	X	X
Silver-haired bat	None	X		X
Eastern red bat	None	X		X
Hoary bat	None	X		X
Little brown bat	Status review	X		X
Northern long-eared bat	Proposed Endangered	X		X
Indiana bat	Endangered	X		X
Evening bat	None	X		X
Tri-colored bat	None	X		X

3.3.2 Acoustic Surveys

Acoustic surveys of bat activity within the Project area were conducted from July 15 to October 21, 2009 (Good et al. 2010a). Surveys designed to detect ultrasonic bat calls within the Project area were implemented using 6 Anabat™ SD1 detectors places at five meteorological (MET) towers as well as one non-met tower site expected to receive high levels of bat activity.

Across all stations, the majority (60.1%) of the calls were less than 30 kilohertz in frequency (e.g., big brown bat, hoary bat, silver-haired bat), while 25.7 percent were 30 to 40 kilohertz in frequency (e.g. eastern red bat, evening bat). The remaining 14.2 percent of calls were by high-frequency bat species (e.g., little brown bat, northern long-eared bat, Indiana bat, tri-colored bat). At the MET towers, a slightly higher percentage of passes were by low-frequency species (68.8%), while high-frequency species comprised 16.4 percent of all passes, and passes by mid-frequency bats accounted for 14.8 percent of passes. Species identification was possible for the hoary and eastern red bat, which made up less than 1.0 percent and 2.5 percent of passes at all stations, respectively. When the non-MET station is excluded from analysis, hoary bats composed less than 1 percent of all bat passes, and eastern red bats made up 2.6 percent of bat passes. Activity levels for bat passes peaked in late July at the non-MET station. For MET stations, activity levels peaked in late August. Activity levels for hoary and eastern red bats were highest in late July/early August, suggesting these species may migrate through the study area during this time period.

The mean number of bat passes per detector-night was compared to existing data from nine studies of seven wind-energy facilities where both bat activity and mortality levels have been measured. The level of bat activity documented at the PRWP was higher than that at wind-energy facilities in Minnesota and Wyoming, where reported bat mortalities are low, but was much lower than at facilities in the eastern U.S., where reported bat mortality is highest.

Table 3.5 Summary of Bat Passes Recorded at Pleasant Ridge Wind Farm between 15 July and 21 October 2009.

Anabat Station	Location	High-frequency passes	Mid-frequency Passes	Low-frequency passes	Total Bat Passes	Detector-Nights
Non-MET Site						
PR5	ground	232	557	984	1,773	90
MET Sites						
PR1g	ground	23	12	58	93	19
PR1h	raised	1	21	68	90	54
PR2g	ground	20	9	56	85	28
PR2h	raised	2	18	79	99	63
PR3	ground	46	28	145	219	89
PR4	ground	44	38	186	268	75
PR6g	ground	13	10	39	62	42
PR6h	raised	2	1	4	7	41
	Total ground	**146**	**97**	**484**	**727**	**253**
	Total raised	**5**	**40**	**151**	**196**	**158**
	Total	**151**	**137**	**635**	**923**	**411**
All Bat Data						
	Total ground	**378**	**654**	**1,468**	**2,500**	**343**
	Total raised	**5**	**40**	**151**	**196**	**158**
	Total	**383**	**694**	**1,619**	**2,696**	**501**

Arnett et al. (2006) and Redell et al. (2006) reported greater high frequency group activity at low elevations and greater low frequency group activity at high elevations. Based upon the relative number of ultrasound calls recorded, results from these studies suggest that during the fall migration bats with high frequency calls (smaller bats) are less active at rotor-swept height than bats with low frequency calls (larger bats). This is consistent with results of studies that suggest different species of bats partition their use of habitats vertically (Kalcounis et al. 1999; Hayes and Gruver 2000). Results from Pleasant Ridge indicate patterns similar to these studies, as ground-based units averaged more bat calls per night (3.09) than the raised stations (1.14).

Acoustic data, such as these described for the Pleasant Ridge Wind Farm, are useful in characterizing bat communities and populations at a study site. However, these data are not reliable for definitively determining species presence at a site because of the similarity in echolocation frequencies between species, and patterns shared among species. As such, these data are most often used to determine bat activity at the genus level or, indirectly, by call frequency groupings, as discussed above. Furthermore, acoustic data cannot be used to estimate local population sizes of bat species in a specific geographic area because there is no way to determine how many bats made the calls that were recorded (e.g., a single bat can fly by a detector multiple times), nor can the sex or age of a bat be determined from acoustic data (Kunz et al 2007).

3.3.3 Indiana Bat Mist-net Study

A summer Indiana bat mist-net survey was conducted within the Project area in 2011 (Murray et al. 2011). The main objectives were to: 1) determine the presence/probable absence of the Indiana bat during the summer and 2) document the occurrence of other bat species.

Mist-nest surveys were conducted at six sites between June 30 and July 20, 2011, for a total of 26 net nights. Bats were captured at five of six sites, ranging from zero to 29 bats per site. A total of 83 bats of 5 species were captured. Big brown bats were the most common species (56 bats; 67.5% of total captures) followed by eastern red bats (20.5%), northern long-eared bats (6.0%), evening bats (2.4%), and hoary bats (2.4%). One unidentified *Myotis* bat was also captured, but it escaped from the mist-net before it could be identified.

The mist-net survey at PRWP was consistent with and exceeded the standard recommendation by the USFWS (2007). No Indiana bats were captured, and it was thus determined that there is a probable absence of the Indiana bat from the Project area during the summer (Murray et al. 2011). Though not listed at the time of the surveys, the northern long-eared bat has been proposed for listing as endangered by the USFWS since the mist-netting survey was completed. Five northern long-eared bats were captured at three of the mist-netting sites, all located in the northwest portion of the Project area, north of Fairbury, Illinois (Murray et al. 2011).

4.0 POTENTIAL IMPACTS TO BIRDS AND BATS

4.1 BIRDS

4.1.1 Habitat Fragmentation and Displacement during Construction and Decommissioning

The Project is sited within previously altered habitat that is dominated by tilled and un-tilled agriculture, and developed areas, which comprise over 98 percent of the area. The area also receives regular vehicular traffic and human activity, especially during the growing season. PRWP has committed to placing turbines within tilled and untilled agricultural areas and avoiding placing turbines within pasture and grassland habitats.

Construction of the Project will temporarily disturb approximately 511 acres (207 ha); 140 acres (57 ha) will remain disturbed throughout the life of the Project. Because the Project is sited in a largely agricultural setting and facilities have been micro-sited to avoid native habitats, fragmentation of native habitats from Project construction will be low. Incidental injury/ mortality and disturbance of birds due to elevated levels of human activity during construction and decommissioning are also expected to be low.

The large majority of birds detected during surveys within and near the Project area were common species adapted to human disturbance (Good et al. 2010b); these species are less likely to be displaced due to Project activities (Shaffer and Johnson 2008, Kerlinger 2002). Avian habitat within the Project area is predominately disturbed or fragmented, with a high ratio of edge habitat to interior habitat. Additionally, pre-construction surveys indicate that bird use and diversity in the Project area is relatively low (Good et al. 2010b). Displacement effects from Project construction and decommissioning are therefore expected to be low.

Incidental injury or mortality of juvenile birds may occur if construction occurs in non-tilled areas during the breeding season. However, nesting habitat for ground- and shrub-nesting birds is limited within the Project area, due to the predominance of active agriculture, and PRWP has incorporated several strategies in the Project siting process and construction plans, discussed in Section 2.4, which are designed to minimize these potential impacts. Direct injury or mortality during construction and decommissioning is expected to be low.

The nest tree containing a likely buteo nest located in the transmission line corridor at the crossing of the South Fork Vermilion River will be removed during tree clearing, which will be conducted during the period from November 1 to March 1 to avoid disturbing nesting birds. Loss of habitat associated with removal of the nest tree and other trees in this small area constitutes a minor impact to birds, as adjacent habitat and possible nest trees are available along the South Fork Vermilion River corridor.

4.1.2 Displacement and Collision-related Mortality during Operations

Although Project operations have the potential to cause displacement of birds from the Project area, bird species sensitive to disturbance currently exhibit low use of the Project area and minimal suitable habitat for these species is present, as discussed above. The majority of birds occurring within the Project area are members of common, disturbance-tolerant species (Good et al. 2010b). Therefore, it is unlikely that displacement impacts from the turbines would greatly alter the composition of the area's avian community. For species that are displaced, it is unclear if displacement impacts would persist for the life of the Project; certain species may adapt to the presence of the turbines (Ornithological Council 2007). Studies of displacement impacts to birds from operating turbines are limited; clear and consistent patterns of impacts have yet to be established (Poulton 2010).

Northern harrier, a state-endangered grassland species, was observed using the Project area during the spring, fall and winter seasons. Displacement of migrating northern harriers from wind turbines has not been documented. Breeding northern harriers showed lower than expected use of the Buffalo Ridge, MN Phase 2 wind project at small (within 328 ft [100 m]) and large (344-17,598 ft [105-5,364 m]) scales in a 1998 Before/After-Control/Impact (BACI) study of grassland bird use (Johnson et al. 2000). However, use of the Phase 2 area at a small scale by northern harriers was not significantly different than expected in 1999, nor was use of Phase 2 or 3 areas at a large scale different than expected in 1999.

American golden-plover is a federal species of conservation concern (USFWS 2008) and an Illinois species of greatest need of concern (IDNR 2005), and 113 observations were recorded during species-specific surveys (Good et al. 2010b). American golden-plovers have not been shown to be especially susceptible to collisions with turbines. A fatality study was conducted at a wind-energy facility in Benton County, Indiana, which is adjacent to a known American golden-plover Important Bird Area (Audubon 2014) that receives use from an estimated 42,000 – 84,000 American golden-plovers during spring migration, yet no American golden-plover fatalities were found (Johnson et al. 2009). No American golden-plover carcasses have been recorded at wind energy projects in Henry or Vermilion Counties, Illinois (Good et al. 2013, Gruver et al. 2013, Ritzert et al. 2013, Simon et al. 2013, Good et al. 2014, Gruver et al. 2014, Ritzert et al. 2014a,b,c, Simon et al. 2014).

The operating turbines will also pose a risk of bird mortalities from collisions. Based on the results of post-construction mortality studies at similar facilities, the Project should have fatality rates similar to those observed at other western and Midwestern facilities, within the range of 0.44 to 11.83 birds/turbines/year. A comparison of the Pleasant Ridge pre-construction avian survey results to other available pre-construction survey reports indicates that surveys within the Project area detected many fewer birds and fewer species than have generally been detected at other Midwest wind energy sites. Publically available pre-construction surveys for wind projects in Illinois are extremely limited; however, surveys at several other agricultural wind energy project areas in Wisconsin reported much higher numbers of birds detected for given levels of survey effort. Survey results are not directly comparable across these sites due to variations in sample plot size, timing of surveys, and other differences in study design. Instead, these data provide a high-level reference of bird detections over given periods of survey effort for Midwest wind projects. Survey hours represent the additive total effort; effort of independent search parties, even those searching simultaneously, contributes as separate time periods.

Over approximately 170 survey hours at the Project area, 5,325 birds comprised of 67 species were observed. At the Glacier Hills wind energy site, located in an agricultural landscape in Wisconsin, a total of 59,643 birds of 151 species were observed over 123.5 survey hours (Cutright 2009). Over a total of 188.3 survey hours at the Forward Energy Center, WI, 6,522 birds of 134 species were observed in forested plots, 3,950 birds of 98 species were observed in grassland plots, and 2,808 birds of 105 species were observed in wetland plots (Kerlinger et al. 2007a). Pre-construction surveys at the Cedar Ridge Wind Farm, WI, detected 52,956 birds of 120 species over a total of 275.3 survey hours (Guarnaccia and Kerlinger 2008). At the Blue Sky and Green Field Wind Energy Projects, WI, a total of 79.5 survey hours were conducted at each project area. Surveys detected 31,136 birds of 125 species at Blue Sky and 16,211 birds of 116 species at Green Field (Gruver et al. 2009).

Raptor passage rates at the Project area were similar to those recorded at other Midwest sites. Plot sizes varied slightly across studies, but the results of other pre-construction surveys provide a relative comparison of raptor use per 20 minutes of survey effort. During the Pleasant Ridge avian surveys, 100 raptors comprised of seven species were observed; raptor use averaged 0.15, 0.28, and 0.15 raptor/plot/20 min survey in the fall, winter, and spring, respectively (Good et al. 2010b). At Buffalo Ridge, MN, raptor use averaged 0.78, 0.22, 0.64, and 0.60 raptor/plot/20 min survey in the fall, winter, spring, and summer, respectively (Johnson et al. 2000). At Black Fork, OH, raptor use averaged 0.13 and 0.26 raptor/plot/20 min survey in the fall and spring, respectively (Ecology and Environment 2009 as cited in Good et al. 2010b). At Grand Ridge, IL, raptor use averaged 0.20, 0.10, and 0.32 raptor/plot/20 min survey in the fall, winter, and spring, respectively (Derby et al. 2009 as cited in Good et al. 2010b). At Buckeye Wind, Ohio, raptor use averaged 0.11 and 0.20 raptor/plot/20 min survey in the fall and spring, respectively (Stantec 2009). The number of raptor species detected has been similar across Midwest sites, ranging from 4 to 13 species (Kerlinger et al. 2007a, Guarnaccia and Kerlinger 2008, Cutright 2006, 2009).

Given the low numbers of birds and bird species detected, the moderate raptor use rate, and the placement of turbines away from the Vermilion River and the South Fork of the Vermilion River and associated native habitats, estimated mortality rates are likely to be at the low end of the known range (0.44 to 11.83 b/t/y). Studies at the Crescent Ridge site, located in an agricultural landscape in Illinois, reported mortality rates of 0.49 b/t in fall 2005 and 0.47 b/t in spring 2006 (Kerlinger et al. 2007b). However, post-construction studies at the Blue Sky Green Field (Gruver et al. 2009) and Cedar Ridge (BHE 2011) facilities in Wisconsin have demonstrated that avian mortality rates at the high end of this range may occur at facilities sited in agricultural habitats.

Bird risk at the Project area is likely highest during the spring and fall migration seasons, as has been observed at most wind energy facilities (reviewed in NWCC 2010). Passerines, both resident and migrant, are likely at highest risk in the Project area, as this avian group represents the majority (75%) of mortalities at wind turbines nationwide and was by far the group most frequently observed during surveys within and near the Project area (Good et al. 2010b). Night-migrating passerines may be at a higher risk, as this group has accounted for over 50 percent of avian fatalities at certain sites, but no particular species or group of species has been identified as incurring greater numbers of fatalities (Erickson et al. 2002). Birds taking off at dusk or landing at dawn, or birds traveling in low cloud or fog conditions (which lower the flight altitude of most migrants) are likely at the greatest risk of collision (Kerlinger 1995). Nationally, these mortalities have not been known to result in a significant population level impact to any one species, mainly because the migratory species with relatively high collision mortality are regionally abundant.

Collision risk is likely to be much lower for other bird groups in the Project area. Very few waterbirds or waterfowl were observed during the pre-construction avian surveys; higher numbers of shorebirds were observed, primarily killdeer and American golden-plover (Good et al. 2010b). However, national research has demonstrated that waterbirds rarely collide with inland turbines (Everaert 2003, Kingsley and Whittam 2007 as cited in NWCC 2010), perhaps because of the consistently high (150-1500 m) altitudes at which waterbirds migrate over land (Kerlinger 1995). No American golden-plover fatalities were documented at the Bishop Hill, California Ridge or Fowler Ridge wind farms (Good et al. 2011, 2012; Ritzert et al. 2014a, 2014b), although they are known to occur on those sites, so risk to this species is low. Risk to waterfowl may be increased at the Project area during the winter months if the croplands within the Project area attract large flocks of Canada geese (Erickson et al. 2002). Raptor use of the Project area was observed to be relatively low during the pre-construction surveys. No strong association with topographic features within the Project area was noted for raptors. The most frequently-observed raptor species were red-tailed hawk and American kestrel, both common species in the Midwest. Given the lack of major raptor migration routes through the Project area raptor fatality rates at the Pleasant Ridge site are expected to be lower than or similar to those at other Midwest sites, not likely to exceed one or two carcasses a year (Poulton 2010).

Results of the avian studies in the Project area show only six species regularly flew within the rotor-swept area; however, overall use by these species was low (Table 4.1). Therefore, no particular species is expected to be at high risk from the Project.

Concerns expressed by the USFWS and IDNR regarding avian resources within the Project area focused primarily on collision risks during the migration season to listed species and certain other migratory birds. The USFWS and IDNR both expressed concern for migrating American golden-plovers and Smith's longspur, migratory birds and species of concern. The IDNR additionally expressed concern over the migratory whooping crane; an ESA listed endangered species with an experimental, non-essential population of around 100 individuals that migrate across Illinois, including Livingston County. The IDNR expressed concern for several state-listed species which are known or have the potential to occur near or

Table 4.1 Species Observed Flying within Rotor-Swept Area during Fixed-Point Bird Use Surveys, March 5, 2009-March 2, 2010

Species	No. of Groups Flying	Overall Mean Use	% Flying	% Flying within Rotor-Swept Area at Initial Obs.	% Flying within Rotor-Swept Area at Any Time
Red-tailed hawk	44	0.10	98.0	18.4	30.6
Turkey vulture	24	0.06	97.7	27.9	55.8
American crow	27	0.47	87.0	2.5	59.2
Ring-billed gull	1	<0.01	100.0	100.0	100.0
American kestrel	17	0.06	81.8	5.6	11.1
Great blue heron	17	0.03	100.0	27.8	27.8

within the Project area: northern harrier, upland sandpiper, loggerhead shrike, osprey, and black-billed cuckoo.

Two of the above-listed species (American golden-plover and northern harrier) were observed within the Project area during pre-construction surveys. Neither of these species were observed flying in the rotor-swept area. Although northern harriers typically fly at heights below the rotor-swept area of turbines, as demonstrated during pre-construction surveys within the Project area, they have occasionally been documented as fatalities at other wind energy facilities (Erickson et al. 2001). The potential therefore exists for northern harrier mortalities to occur at the Project, particularly during migration, but mortalities are expected to be few considering the low use of the Project area by the species. Both of the state-listed species observed within the Project area are considered to be at low collision risk due the results of other post-construction mortality studies and the species' lack of observed use of the rotor-swept area.

No bald eagles nest were discovered during either of the raptor nest surveys completed within the Project area and corresponding buffers. Additionally, no bald eagles were observed during pre-construction avian surveys. Neither bald eagles nor important eagle-use areas were detected during pre-construction avian surveys within the Project area. Because additional surveys in 2014 did not indicate the presence of eagle-use areas within a 10-mile buffer of the Project, as well as none along the segment of the Vermilion River adjacent to the Project area, the Project likely poses low risk to bald eagles at this time.

4.2 BATS

4.2.1 All Bats

Pre-construction acoustic bat surveys indicated a low level of bat activity within the Project area. Compared to the 3.09 average bat passes per detector night recorded during the fall at the Pleasant Ridge site (excluding the reference site), 6.78 bat passes per detector night were recorded at the Cedar Ridge site in Wisconsin (BHE 2007 as cited in BHE 2010), 1.99 bat passes were recorded per detector night at the Blue Creek site in Ohio (BHE 2009 as cited in BHE 2010), and 12.4 bat passes per detector night were recorded at the Buckeye Wind site in Ohio (Stantec 2009).

Activity at the Project area was highly variable, as has often been the case at other studies (Erickson et al. 2002), but followed temporal and seasonal patterns similar to the results of several other studies.

Seasonally, bat activity in the Project area peaked during August and September, and for most bat species summering in central Illinois, autumn migration typically occurs between August and September (Cryan 2003); the higher level of bat activity observed at the Project area in August and September may therefore be associated with dispersal from summer habitat, juvenile bats becoming volant, the onset of breeding, and migration to winter habitats.

Impacts to bats within the Project area are expected to primarily occur during the operational phase of the Project. Except for the crossing of the Vermilion River, for which trees will be cut during the period from November 1 through March 1, construction and decommissioning activities are not expected to require the removal of trees or old buildings, making it unlikely that roosting or nesting bats would be disturbed or incur mortalities during these phases of the Project. Once the Project is operational, however, turbines will present a risk of bat mortality due to collisions or possibly barotrauma. Due to the lack of habitat features that may attract bats, Project siting and micro-siting, and the wildlife protection measures that are built into the Project design, mortality rates should be lower than have been documented at other Midwestern sites. Bat mortalities in the Midwest have mostly occurred in the swarming and migration seasons, typically between mid-July and mid-September (e.g., Kerlinger et al. 2007b, Johnson et al. 2003, Howe et al. 2002). Migratory tree bat species have comprised the majority of fatalities in the Midwest and nationally (e.g., Erickson et al. 2002, Kunz et al. 2007). Bat activity was measured from July 15 – October 21, 2009, encompassing much of the fall migration season, and the correlation between bat activity and carcasses is not yet well linked, so the pattern of bat mortality at this site is unknown but will be monitored in spring and fall (see Appendix A). Mortality risk at the Project may primarily affect bats that are migrating through the Project area during the late summer or early fall, similar to other sites. Additionally, certain weather conditions, including low wind speeds, warmer temperatures, and high cloud ceilings, are likely to increase the risk of bat mortality at the Project area, as these conditions have been demonstrated to coincide with nights of high bat mortality at wind energy facilities (Kunz et al. 2007, Gruver et al. 2009).

The lack of forested habitat and open water within the Project area may reduce risk to bats, as most bat species in Illinois prefer forests and bodies of open water for foraging and migration stopover roosting habitat (BCI 2014). Bats migrating through the vicinity of the Project area may prefer the North and South Fork Vermilion Rivers and associated forests compared to the open landscape within the Project area. Turbines have been sited to avoid high-quality bat habitat, but their presence, even in open, non-forested areas, poses a risk of bat mortality. Bat mortality has been documented at Midwest wind energy facilities in agricultural areas during the migration season, demonstrating that some migrating bats will fly over open land (Good et al 2011, Kerlinger et al. 2007b, Johnson et al. 2003, Howe et al. 2002, BHE 2011). Bat migration patterns and behaviors, and subsequently, indicators of bat fatality risk at wind energy sites, are not well understood (Poulton 2010). However, the avoidance and minimization measures to be implemented at this project (see Section 2.4) have been documented at other sites to reduce all bat mortality (Good et al. 2014; Gruver et al. 2014 and to avoid take (see Section 4.4.2).

4.2.2 Indiana and Northern Long-eared Bats

The potential for take of Indiana and northern long-eared bats at the site is primarily limited to the migration season and is unlikely to occur, as discussed below.

The Project is unlikely to cause the take of Indiana or northern long-eared bats during the summer maternity season due to lack of suitable forested or open water habitat in the Project area and the manner in which PRWP has developed the Project. Based on the known patterns of bat fatalities at wind farms described above, an assessment of potential risk to bats at the Project involves evaluation of the site-specific data in terms of species presence/probable absence, seasonal distribution, and activity levels (Kunz et al. 2007), as well as a comparison to regional patterns.

Direct Effects

The potential direct effects of the Project could include direct mortality of bats due to collisions with turbines or possibly barotrauma, or latent mortality if a bat is injured but does not immediately die. For wind projects in the Midwestern United States, overall bat mortality estimates have ranged from approximately 1.88 to 27.23 bats per MW per year (Table 4.2).

Based on the analysis of seasonal distribution of Indiana and northern long-eared bats in the region, no direct effects are expected to occur during the winter months because these species are not active during the winter months and there are no known Indiana or northern long-eared bat hibernacula located near the Project area. Take is unlikely to occur during the summer breeding season, because all foraging habitat connected to the river has been avoided by 1000 ft (305 m) or more. Murray and Kurta (2004) radio-tracked Indiana bats foraging 0.3 to 2.6 miles (0.5 to 4.2 km) from nursery colonies, and the bats were never observed to cross open areas while foraging or traveling to a foraging site. Northern long-eared bats generally travel shorter distances than Indiana bats (USFWS 2014). The USFWS has recommended that a 1000 ft (305 m) setback from connected habitats adequately protects Indiana and northern long-eared bats foraging during the summer months (USFWS 2014).

Available information indicates that take of Indiana and northern long-eared bats is also unlikely to occur during the spring migration periods. Mortality data from other post-construction studies in Illinois during spring documented no Indiana or northern long-eared bat carcasses (Ritzert et al. 2013, 2014a, 2014b, 2014c). Eleven of the 14 northern long-eared bats with timing information occurred in the fall, and four of the six documented Indiana bat fatalities occurred during fall (Table 4.3). The majority (80%) of the *Myotis* detections at the Project area occurred in August.

Based on previous studies and site-specific data it is unlikely that Indiana or northern long-eared bat mortality will occur during the spring migration season; a low level of mortality risk may exist during the fall migration season.

During preconstruction acoustic surveys at the Project area, only 16.4 percent of all bat passes detected were attributed to high-frequency species, which would include the *Myotis* species. Of these passes, only 5 passes were at the raised detectors, while the remaining 146 passes were from ground detectors. Data from the Pleasant Ridge acoustic study inconclusively supported the patterns documented at other wind sites, where high-frequency bats, including *Myotis*, typically fly below the rotor-swept area.

In addition to Project siting and turbine setbacks to avoid potential bat habitat, PRWP will raise cut-in speeds to 15.2 mph (6.9 m/s) from August 1 through October 7 from sunset until. Raising cut-in speeds has been shown to significantly reduce bat fatalities at wind energy facilities (e.g., Arnett et al. 2009, 2010; Baerwald et al. 2009; Good et al. 2011, 2012; Young et al. 2011) and is expected to further reduce risk to any Indiana or northern long-eared bats migrating through the Project area during fall.

Additionally, PRWP will monitor the effectiveness of this avoidance measure at reducing bat fatalities and will use adaptive management (see Appendix A) so that risks to all bats in general and Indiana and northern long-eared bats in particular are avoided/minimized.

Table 4.2 Summary of Bat Mortality Reported from Wind Project Monitoring Studies in the Midwest.

Project	State	Total MW	Bat fatalities per MW per study period	Study Period(s)	Reference
Buffalo Ridge, Phases I-III	MN	235.6	2.30	15 Mar-15 Nov 1996 15 Mar-15 Nov 1997 15 Mar-15 Nov 1998 15 Mar-15 Nov 1999	Johnson et al. 2003
Buffalo Ridge, Lake Benton I & II	MN	210.8	2.88	15 June-15 Sep 2001 15 June-15 Sep 2002	Johnson et al. 2004
Blue Sky Green Field	WI	145	24.6	21 Jul-31 Oct 2008 15 Mar-31 May 2009	Gruver et al. 2009
Kewaunee County	WI	20.5	6.45	Jul 1999-Jul 2001	Howe et al. 2002
Cedar Ridge	WI	68	27.23	Mar-May 2009 Jul-Nov 2009 Mar-May 2010 Jul-Nov 2010	BHE 2011
Crescent Ridge	IL	49.5	1.88	Sep-Nov 2005 Mar-May 2006 Aug 2006	Kerlinger et al. 2007b
Top of Iowa	IA	80.1	8.58	15 Apr-15 Dec 2003 15 Apr – 15 Dec 2004	Jain 2005
Forward Energy Center	WI	129	15.63	15 Jul–15 Nov 2008 15 Apr–31 May 2009 15 Jul-15 Oct 2009 15 Apr-31 May 2010	Grodsky and Drake 2011
Fowler Ridge	IN	600	18.91	13 Apr-15 May 2010 1 Aug-15 Oct 2010 1 April – 15 May 2011 15 July – 29 Oct 2011	Good et al. 2012
Arithmetic mean of bat fatalities/MW/yr:			12.05		

The analysis of possible direct effects indicates that Indiana or northern long-eared bat take at the Project is unlikely due to the incorporation of avoidance and minimization measures into the proposed action. In particular, project siting and the incorporation of cut-in speed adjustments will reduce the risk of potential interactions with the species. Monitoring and adaptive management measures presented in the MAMP (Appendix A) will evaluate the effectiveness of these measures over the life of the Project.

Table 4.3 Summary of publically available Indiana and northern long-eared bat fatalities at wind energy facilities in the United States.

Species	Wind Farm	State	Number Taken	Year(s)	Season	Source
Indiana bat	Fowler Ridge	Indiana	2	2009, 2010	Fall	Fowler Ridge 2013
	North Allegheny	Pennsylvania	1	2011	Fall	USFWS 2011a
	Laurel Mountain	West Virginia	1	2012	Summer	USFWS 2012d
	Blue Creek	Ohio	1	2012	Fall	USFWS 2012e
	(not released)	Ohio	1	2014	Spring	USFWS, personal communication
Northern long-eared Bat	Mountaineer	West Virginia	6	2003	Fall	Kerns and Kerlinger 2004
	Meyersdale	Pennsylvania	2	2004	Fall	Kerns et al. 2005
	Mt. Storm	West Virginia	1	2008	Fall	Young et al. 2009
	Ellenburg	New York	1	2008	Unknown[1]	Jain et al. 2009
	Fowler	Indiana	1	2009	Fall	Fowler Ridge 2013
	Cohocton and Dutch Hill	New York	1	2010	Summer	Stantec 2011
	Wethersfield	New York	1	2010	Summer	Jain et al. 2011
	California Ridge	Illinois	1	2013	Fall	Gruver et al. 2014

[1]This carcass was an incidental find, and no information on the timing was available in the report.

Indirect Effects

Indirect effects of the proposed Project could include loss of foraging, roosting, maternity, or wintering habitat due to cutting trees during Project construction. The proposed Project is unlikely to have any measurable indirect effects due to habitat loss on the Indiana or northern long-eared bat, because all turbines will be located in agricultural fields (previously disturbed, non-forested habitats) and with sufficient buffer (1,000 ft [305 m] from connected foraging habitats) to reduce the potential to impact foraging individuals. Access road, collection line, and other facilities (except the transmission line) construction would not require tree cutting. Tree cutting will be required for the transmission line; however, it will be completed during the period between November 1 and March 1 and thus will not impact roosting bats and will result in minimal habitat loss.

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Appendix A

Monitoring and Adaptive Management Plan

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Tables

1.0 BACKGROUND AND GOALS

Pleasant Ridge Wind Farm (PRWP) has voluntarily prepared a Bird and Bat Conservation Strategy (BBCS) for the Pleasant Ridge Wind Energy Project to avoid and minimize impacts on bird and bat species from the Project. Specific goals of the BBCS are to: (1) demonstrate compliance with the WEG; (2) identify measures that will avoid and reduce potential impacts to birds and bats during construction, operation, maintenance, and decommissioning of the Project; (3) ensure the potential impacts to ESA-listed bat species are reduced to the point where take is unlikely; and (4) outline effective post-construction monitoring and adaptive management procedures to guide management actions for the life of the Project.

This Monitoring and Adaptive Management Plan (MAMP) has been developed in conjunction with the Pleasant Ridge BBCS to provide a means of assessing the effectiveness of the BBCS in meeting the above-stated goals. Included in the MAMP for this Project are: a post-construction carcass monitoring plan (monitoring), an American golden-plover monitoring plan (monitoring), and an adaptive management plan (adaptive management).

2.0 CARCASS MONITORING PLAN

2.1 MONITORING GOALS

The goals of post-construction monitoring are to determine overall bird and bat estimated fatality rates at the Pleasant Ridge Wind Farm and evaluate the circumstances under which carcasses occur. Post-construction monitoring results also provide the triggers for adaptive management, described in Section 3 in this MAMP.

2.2 SPECIES TO BE MONITORED

The post-construction monitoring plan will address all bird and bat species carcasses observed within the Pleasant Ridge Project Area. Based on the analysis provided in Section 4.2.1 of the Pleasant Ridge BBCS, Indiana bat (*Myotis sodalis*) and northern long-eared bat (*Myotis septentrionalis*) mortalities are unlikely to occur at the Project, and thus 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 Pleasant Ridge wind facility and compared to 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.

Monitoring designed to detect Indiana and northern long-eared bat carcasses is not proposed because 1) Indiana and northern long-eared bat fatalities are unlikely, 2) such a study would require extensive ground surveys and considerable expense for the purposes of detecting an unlikely event, 3) the proposed study could detect Indiana or northern long-eared bat fatalities, and 4) more extensive monitoring could be implemented, as described in the adaptive management plan (Section 3 of this MAMP), should one of the adaptive management triggers be met.

2.3 PERMITS AND WILDLIFE HANDLING PROCEDURES

2.3.1 Permits

State and federal collecting/salvaging permits will be acquired from the Illinois Department of Natural Resources (IDNR) and the U.S. Fish and Wildlife Service (USFWS) by PRWP's consultants and PRWP 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.

2.3.2 Wildlife Handling Procedures

All carcasses found will be labeled with a unique number, individually bagged, and retained in a freezer at the Pleasant Ridge 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, PRWP 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.

2.4 MONITORING

2.4.1 Study Design

The results of post-construction monitoring at wind facilities 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 mortality 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). PRWP'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 mortality monitoring at the Pleasant Ridge facility will involve baseline standardized carcass searches, follow-up standardized carcass searches, 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., season, location). Intensive carcass searches will be conducted during the first three years of Project operation by a consultant and by specifically trained PRWP personnel to establish baseline fatality estimates. After the first three years of monitoring, PRWP will have baseline data from which to measure changes in overall bird and bat fatalities. Follow-up carcass searches will be conducted by trained PRWP personnel during the fall season (August 1 – October 7) once every three years to confirm that no significant increase in overall bird or bat estimated mortality has occurred relative to the baseline mortality estimates. Searcher efficiency and carcass removal trials are critical for developing appropriately corrected and unbiased fatality estimates. Searcher 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 Land-based Wind Energy Guidelines (USFWS 2012) 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.

Focus Species

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

Sample Size

Standardized carcass searches will be conducted at 30 of the 136 turbines. This sample size optimizes field survey effort while maximizing expected confidence in the data and associated results. Table A-1, below, was developed using a mean bat fatality rate and corresponding standard deviation calculated from results of studies at other wind energy facilities within the Midwest. 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 (136 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).

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

No. of Turbines Searched	Mean Fatality (bats/turbine/year)	95% Confidence Limits		95% Confidence Interval
		Low	High	
10	21.6	15.8	27.3	5.7
20	21.6	17.5	25.6	4.1
30	21.6	18.3	24.9	3.3
40	21.6	18.7	24.4	2.9
50	21.6	19.0	24.1	2.6
60	21.6	19.2	23.9	2.3
80	21.6	19.5	23.6	2.0
100	21.6	19.8	23.4	1.8
136	21.6	20.0	23.1	1.6

[1] For this analysis, mean fatality estimate (12.05 bats/MW/turbine and an assumed 1.79 MW turbine) from the data presented in Table 4.2 of the Pleasant Ridge BBCS, and the standard deviation of those values (9.27).

During follow-up studies (discussed below under Timing and Duration) conducted every three years by trained PRWP personnel, 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 which can be compared against the baseline estimate established during the first year of monitoring to confirm that no significant increase in overall bird or bat mortality has occurred. 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 to be sampled will be determined using a stratified random sampling approach. These 30 sample turbines will include turbines located in the western part of the Project area, closer to the few areas of suitable bat habitat. 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 baseline sample turbines will reduce the introduced variables (i.e., location) and provide a more accurate comparison of fatality rates between study years.

Search Intervals

Search intervals will be once weekly for each of the 30 sample turbines during the spring and fall periods of intensive monitoring. Search intervals 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 WEG (USFWS 2012) recommend that carcass search intervals should be adequate for the species the study is attempting to find. 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 mortality 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.

2.4.2 Field Methods

Plot Size, Vegetation Mowing, Visibility Classes

Search plots measuring 256 x 256 ft (78 x 78 m) will be established at the base of each sampled turbine. The majority of bird and bat carcasses typically fall within 100 ft (30 m) 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, and USFWS 2012). This plot size will exceed one-half the maximum turbine rotor height of the Pleasant Ridge turbines (214 ft [65 m]). This should minimize the number of fatalities or injured birds or bats which 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.

Timing and Duration

Baseline standardized carcass searches will be conducted at the Pleasant Ridge site for a total of four weeks in the spring (April 15 – May 15) during the first year of Project operation and eight weeks during the fall (August 1 – October 7) during the first three years of Project operation. Baseline carcass searches will be conducted by both a consultant and specifically-trained PRWP personnel. Trained PRWP personnel will then conduct follow-up carcass searches for eight weeks during the fall (August 1 – October 7) every three years to confirm that no significant increase in overall bird or bat mortality has occurred relative to the baseline study.

Standardized Carcass Searches

All carcass searches will be conducted by a biologist or appropriately-trained PRWP 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 Pleasant Ridge Project area. Any unknown birds and bats or suspected Indiana or northern long-eared 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 (45 to 60 m per minute) while searching 10 ft (3 m) 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, bird and bat carcasses will be labeled with a unique number, bagged, and stored frozen (with a copy of the original data sheet) at the Pleasant Ridge Operations and Maintenance building.

Bird and bat carcasses found in non-search areas (e.g. near a Pleasant Ridge 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.

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 which 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 which 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 USFWS guidelines (USFWS 2012), this is a sufficient number of carcasses that can be distributed across a sample size of 30 turbines without exceeding the limit of one to 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 saturating the site with carcasses and potentially artificially inflating the carcass removal rate by attracting scavengers.

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 to large-sized 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 located 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 PRWP 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 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.

PRWP Personnel Training

PRWP searchers will be full-time PRWP 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.

<u>Standardized Carcass Searches</u>: PRWP searchers will be trained by a qualified biologist of PRWP's choice, most likely the consulting biologist conducting the baseline mortality 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 to (1) compare baseline fatality estimates determined using data collected by trained PRWP personnel to estimates determined using data collected by the consultant and (2) compare searcher efficiency rates of the trained PRWP personnel to searcher efficiency rates of the consultant. These tests will confirm that PRWP personnel are adequately trained and qualified to accurately conduct follow-up carcass searches.

<u>Bird and Bat Identification:</u> PRWP searchers will be permitted to handle bird and bat carcasses as described in Section 2.3.1 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 or any

suspected Indiana 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, PRWP will conduct training sessions for Project personnel to ensure that wildlife handling procedures described in Section 2.3.2 in this monitoring plan are properly implemented.

2.4.3 Statistical Methods for Estimating Fatality Rates

The methodology for 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) and Huso (2010). 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 or Shoenfeld (2004) estimator, which tend towards negative biases, problematic. The bird and bat fatality rates presented in the Pleasant Ridge BBCS were mostly calculated from studies which 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 Pleasant Ridge 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. However, calculation of estimated fatality rates using the Huso estimator will enable cross-checking results from the Erickson or Shoenfeld estimator.

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 turbine. Variance and 90 percent 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.

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.

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 which 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.

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 Pleasant Ridge 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.

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 which 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} 10m distance band from the turbine, p_k is the estimated searcher efficiency rate in the k^{th} 10m distance band from the turbine, and s_k is the proportion of the k^{th} 10m distance bands that were sampled across all turbines.

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 follow-up fall carcass searches.

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:

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

2.5 DATA ANALYSIS AND REPORTING

2.5.1 Data Analysis

Analysis of data collected during the post-construction mortality study will include spring and fall season 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 very small numbers of carcasses so species- and genus-level fatality calculations may not be possible for some species/genera). *Myotis* fatality estimates will be calculated when supported by sufficient observed mortality. Data analysis will be performed to assess fatality estimates by turbine location. Data may also be analyzed to determine the influence of factors such as date and location on bird and bat fatality rates. These relationships may influence turbine operation, as described in Section 3.2 of this MAMP.

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, PRWP will qualitatively evaluate fatality events with regards to notable weather events.

2.5.2 Reporting

PRWP will provide an annual mortality monitoring report to the USFWS following the completion of each year of post-construction monitoring. The report will include fatality estimates and data summaries. Fatalities will be expressed both in terms of fatalities/turbine/season and in terms of fatalities/MW/season, as recommended by the WEG (USFWS 2012) to facilitate comparison with other studies. The reports will include all data analyses, including correlation analyses and overall fatality estimates, and a discussion of monitoring results and their implications. In addition to the mortality monitoring reports, PRWP will promptly report any fatalities of ESA-listed species to the USFWS.

3.0 AMERICAN GOLDEN-PLOVER MONITORING PLAN

3.1 MIGRATION MONITORING

3.1.1 Monitoring Goals

The goals of American golden-plover migration monitoring are to determine the timing of the species' use of the Project area during the spring migration and to assess the general behavior and movement patterns of the species within the Project area.

3.1.2 Study Design

American golden-plover migration monitoring will be conducted between April 1 and May 20 of the first two years of Project operation. This survey period coincides with the peak spring migration stopover period for American golden-plovers in the upper Midwest. Four survey transects will be established bisecting the Project area; two transects will follow north-south roads and the other two will follow east-west roads. Transect locations will be determined using aerial photography and knowledge of the Project area. Surveys will be conducted four days per week; two transects will be surveyed each day so that each transect is surveyed two times per week.

Observers will drive transects at approximately 15-20 mph (6.7-8.9 m/s) while looking for birds on both sides of the road. Observation points will be established approximately each mile along the transects. Observers will stop at each observation point and scan the surrounding area with binoculars to determine if American golden-plovers are present. Stops will last for no more than three minutes unless plovers are observed. No unplanned stops will be made unless plovers are spotted. Data collected for all individuals and flocks detected during surveys will include: date, time, location, habitat, weather conditions, number of individuals observed, behavior (e.g. resting, feeding, etc.), flight height, and direction of flight. If American golden-plovers are observed during a transect survey, observers will spend approximately 30 minutes collecting additional data on plover behavior and flight height/direction at up to two observation locations per day. Surveys will begin at 0800 am and end when the transects have been completed.

Weather conditions (e.g. temperature, wind speed, cloud cover) will be recorded at the beginning and end of each transect survey.

3.1.3 Data Analysis and Reporting

American golden-plover observations will be used to determine the dates during which plovers are present in the Project area. The locations and number of birds for each observation will be mapped to determine areas of plover use within the Project area. Habitat characteristics recorded at each observation and at the observation points will be analyzed to assess plover selection of different habitats within the Project area. Behavioral observation data will be analyzed to determine flight paths between areas of use, average flight heights within the Project area, and time spent flying in the rotor-swept area by plovers. Monitoring data and results will be included in the annual monitoring report provided to the USFWS, as described in Section 2.5.2, above.

3.2 CARCASS MONITORING

3.2.1 Monitoring Goals

The goals of American golden-plover monitoring are to detect carcasses of spring-migrating American golden-plovers from the Project and, if applicable, develop an estimate of plover mortality from the Project.

3.2.2 Study Design

American golden-plover carcass monitoring will be conducted during the four-week spring monitoring period (April 15 – May 15, a portion of the American golden-plover stopover period when plovers are likely to be moving through) during the first two years of Project operation if plovers are observed within the Project area during the transect surveys. If initiated, plover carcass monitoring will be conducted largely according to the study design described in Section 2.4, above. The same 30 study turbines will be searched during plover mortality monitoring, although the search interval at each turbine will be increased from once a week to twice a week.

Any other carcasses found incidentally during plover monitoring will be recorded as well.

3.2.3 Data Analysis and Reporting

Analysis of the plover monitoring data will be conducted as described for the carcass monitoring in Section 2.5.1, above. The results of the searcher efficiency and carcass removal trials conducted during spring carcass monitoring will be applied to the results of the plover monitoring to develop a plover fatality estimate, if necessary. Should plover carcass monitoring be conducted during the second year of project operation (when spring mortality monitoring is not scheduled), searcher efficiency and carcass removal trials will be conducted during the plover monitoring. Fatality estimates will not be developed for other species found as incidental fatalities. Results of the plover carcass monitoring will be included in the annual monitoring report provided to the USFWS, as described in Section 2.5.2, above.

4.0 ADAPTIVE MANAGEMENT

4.1 ADAPTIVE MANAGEMENT GOALS

The goals of the adaptive management plan are to enable the incorporation of results from the post-construction monitoring into the Project's avoidance, minimization, and mitigation plan. 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. Adaptive management will provide effective measures to meet the Project's BBCS goals of avoiding and reducing impacts to birds and bats.

4.2 ADAPTIVE MANAGEMENT PLAN

To enable the results of post-construction monitoring to influence and improve the avoidance, minimization, and mitigation measures of the Project, certain trigger events and the subsequent changes or actions have been established. Changes to the Project's minimization and mitigation plan may be triggered by certain events, but no changes to the agreed upon turbine operational protocols will occur without USFWS concurrence (except temporary cessation of turbine operations for maintenance).

The events that would trigger changes to the avoidance, minimization, and mitigation plan presented herein would be:

- Take of any Indiana bats or other ESA-listed species;
- Take of any bald or golden eagles; or
- Identification of one or more variable(s) with a consistent and strong negative relationship to bat mortality.

If take of any Indiana bats or other ESA-listed species occurs at the Project, the following actions will be taken:

1) PRWP will, working with a trained wildlife biologist, promptly identify and store the carcass after its discovery.
2) USFWS will be notified within one business day and positive identification of the discovery.
3) PRWP and the USFWS will meet and confer to determine, based on the available data, the circumstances under which the carcass occurred.
4) If a particular cause for the carcass can be identified, PRWP will develop specific mitigation measures in consultation with USFWS to address the occurrence, including, but not limited to, raising cut-in speeds on a specific turbine or group of turbines during specified wind conditions or periods of the year.
5) PRWP will conduct follow-up post-construction monitoring as described in Section 2 of this MAMP during fall in the subsequent year to assess whether cut-in speed adjustments or other mitigation measures are sufficient to reduce impacts to ESA-listed species.
6) PRWP and USFWS will determine the need to pursue additional ESA permits or authorizations in view of new information.

If a bald or golden eagle take occurs at the Project, the following actions will be taken:

1) PRWP will, working with a trained wildlife biologist, promptly identify and store the carcass after its discovery.

2) USFWS will be notified within one business day and positive identification of the discovery.
3) PRWP and the UWFWS will meet and confer to determine, based on the available data, the circumstances under which the carcass occurred.
4) If a particular cause can be identified, PRWP will develop specific mitigation measures in consultation with USFWS.
5) PRWP will conduct follow-up post-construction monitoring as described in Section 2 of this MAMP in the fall of the subsequent year to assess whether mitigation measures are sufficient to reduce impacts to bald and golden eagles.
6) PRWP and USFWS will determine the need to obtain additional BGEPA permits or authorizations in view of new information.

If, through post-construction monitoring, one or more variable(s), including but not limited to a specific period of the night, seasonal period, temperature, wind speed[s], pressure, etc, that has a consistent and strong negative relationship to estimated bat mortality is identified, the following actions will be taken:

1) Curtailment protocol will be lifted and turbines will be fully operational when the identified variable(s) is present in site conditions.

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 birds and bats.

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Fixed-wing Aerial Straight-Line Transect Bald Eagle and Raptor Nest Survey

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Livingston County, Illinois

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Project #193702854

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1.0 INTRODUCTION

In support of the Pleasant Ridge Wind Farm (Project) proposed by Invenergy, LLC (Invenergy), Stantec Consulting Services Inc. (Stantec) completed a fixed-wing aerial straight-line transect bald eagle (*Haliaeetus leucocephalus*) and raptor nest survey in Livingston County, Illinois. This report outlines presents the project description, objectives, methods, and results of the aerial survey and nest inventory survey effort. The survey was conducted as part of the pre-construction and planning phase of the Project.

1.1 PROJECT DESCRIPTION

The proposed Project is located in southeast Livingston County in Illinois (Figure 1). Land use within the Project area is dominated by agriculture (i.e., row crops and hay/pastureland) with woodlands found primarily associated with riparian corridors along the Vermillion River, South Fork Vermillion River and Indian Creek (Figure 1).

1.2 OBJECTIVES

On July 9, 2007, the U.S. Fish and Wildlife Service (USFWS) announced that the bald eagle would be removed in the lower 48 states from the Federal List of Endangered and Threatened Wildlife (72 Fed.Reg. 37346-37372). The rule became effective on August 8, 2007. The bald eagle remains protected under the federal Bald and Golden Eagle Protection Act (BGEPA) and the Illinois Wildlife Code (520 ILCS 5/).

In 2013, the USFWS published the Eagle Conservation Plan Guidance (ECPG) Module 1 – Land-based Wind Energy (Version 2; USFWS 2013), which provides in-depth guidance of conserving bald eagles in the course of siting, constructing, and operating wind energy facilities. While compliance with the ECPG is voluntary, the guidance provides a means of complying with regulatory requirements. The ECPG recommends that surveys for active eagle nests be conducted within the project footprint, as well as a 10-mile buffer. The objectives of the fixed-wing straight-line aerial transect survey included:

- Document active and inactive bald eagle and other raptor species nests within the Project area.
- Document active and inactive raptor species nests within a 2-mile buffer of the Project area.
- Document active and inactive bald eagle nests within a 10-mile buffer of the Project area.

2.0 METHODS

2.1 FIXED-WING RAPTOR NEST SURVEY

Stantec completed a fixed-wing aerial straight-line survey for the proposed Project on April 16, 2014. The survey was conducted between 0600hours and 1500hours and followed the mapped transect lines shown on Figure 1. The temperature during the survey event reached 62ºF, with clear skies and winds at 12 to 20 mph.

The fixed-wing aerial straight-line transect survey was completed using a 1972 Cessna Model 172 airplane. In areas where raptor nests are widely scattered and conspicuous, fixed-wing aerial surveys are considered acceptable (USFWS 2013).

Prior to flight, parallel transects were established on aerial photographs for the pilot to track while in flight. Transects were spaced 0.5 mile apart, though transects were widened to 1 mile apart over the portions of the Project area with a clear absence of woodland habitat. Additionally, transects were plotted along waterways in the northwest corner of the survey area to more accurately assess wooded sections of the Vermillion River and its tributaries. If forested areas were located between transects and were not visible from a transect, the plane deviated from the established transect route to survey these forested areas.

The fixed-wing aerial straight-line surveys were conducted by two Stantec wildlife biologists with experience detecting and identifying raptor species and nests. Each biologist was assigned to one side of the plane, surveying for nests and individual birds as each transect was flown. Observed nests were identified to species, if possible, and documented as active or inactive based on visual activity observations. An in-flight GPS was used to mark the general location of each identified nest.

3.0 RESULTS

3.1 BALD EAGLES

No bald eagle nests were found within the project area or the 10-mile buffer.

3.2 OTHER RAPTOR SPECIES

Two non-eagle raptor nests were identified during the aerial survey (Figure 1). Both nests were active red-tailed hawk (*Buteo jamaicensis)* nests, identified as RTHA 1 and 2 and were documented in Transect 14 and 19, respectively. Both nests are located outside of the project area but within the 2-mile buffer. No additional raptor nests were identified during the survey.

3.3 OTHER OBSERVATIONS

In addition to raptor nests, seven great blue heron (*Ardea erodias)* rookeries were observed within the 10-mile Project buffer. There rookeries are identified as GBHE-1 through GBHE-7 on Figure 1.

4.0 SUMMARY

No bald eagle nests were found within the project area or the 10-mile buffer. Two active red-tailed hawk nests and seven great blue heron rookeries were found during the survey

5.0 LITERATURE CITED

USFWS. 2013. Eagle conservation plan guidance, Module 1 – land-based wind energy, Version 2. U.S. Fish and Wildlife Service, Migratory Birds Division. <http://www.fws.gov/migratorybirds/PDFs/Eagle%20Conservation%20Plan%20Guidance-Module%201.pdf.> Accessed 1 May 2013.

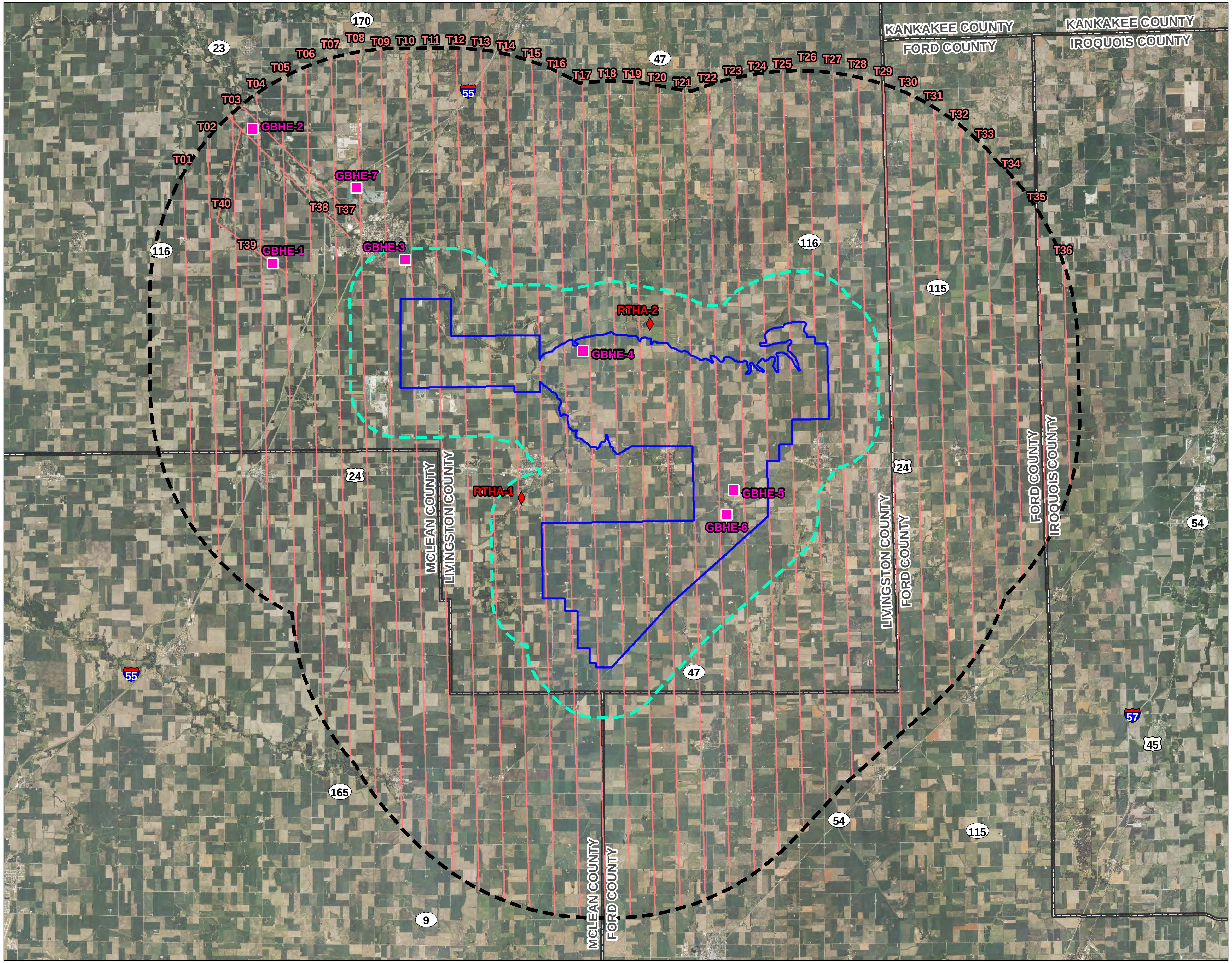


Figure No.
1

Title
Raptor Data and Orthophotography

Client/Project
Invenergy
Pleasant Ridge Wind Farm

Project Location
Livingston Co., IL

193702854
Prepared by AB on 2014-05-08
Technical Review by MP on 2014-05-08
Independent Review by SP on 2014-05-08

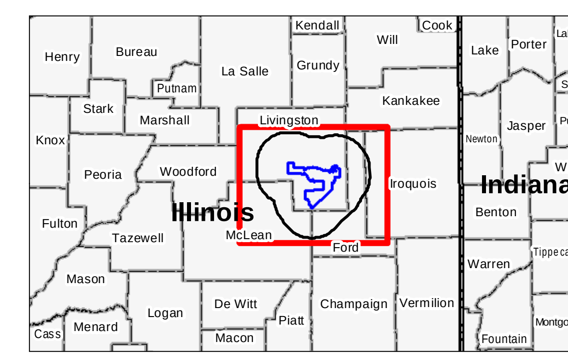
N

0 2 4 Miles
1:253,440 (At original document size of 11x17)

Legend
- Project Boundary
- 2mi Buffer
- 10mi Buffer
- Raptor Survey Transect

Field Located Nest / Rookery Locations
- Eagle Nest*
- Great Blue Heron Rookery
- Red-tailed Hawk Nest

*No Eagle nests found during survey



Notes
1. Coordinate System: NAD 1983 StatePlane Illinois East FIPS 1201 Feet
2. Data Sources Include: Invenergy, Stantec, and Esri
3. Orthophotography: 2012 NAIP

Stantec

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Wildlife Baseline Studies for the Pleasant Ridge Wind Farm Livingston County, Illinois

Final Report
March 5, 2009 – March 2, 2010

Prepared for:

Invenergy
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Prepared by:

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August 13, 2014

NATURAL RESOURCES ◆ SCIENTIFIC SOLUTIONS

EXECUTIVE SUMMARY

Invenergy, LLC. (Invenergy) has proposed a wind-energy facility in Livingston County, Illinois, between the towns of Fairbury and Chatsworth, known as the Pleasant Ridge Wind Farm (PRWF). Invenergy contracted Western Ecosystems Technology, Inc. (WEST) to conduct wildlife and habitat surveys in the PRWF to estimate the impacts of project construction and operations on wildlife. The following document contains results for fixed-point bird use surveys, ground-based raptor nest surveys, habitat mapping, American golden-plover and Smith's longspur surveys, and incidental wildlife observations.

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

The PRWF falls within the Central Corn Belt Plains Ecoregion, which encompasses a large portion of central Illinois. Much of the region was originally dominated by tall-grass prairie and had scattered groves of trees and marshes occurring on level uplands. Today, most of the area has been cleared to make way for highly productive farms producing corn, soybeans, and livestock. Most of the PRWF contains cropland habitats, while the remaining areas are comprised of developed lands, pasture and hayfields, grasslands, and deciduous forests.

The objective of the fixed-point bird use surveys was to estimate the seasonal, spatial, and temporal use of the PRWF by birds, particularly raptors. Fixed-point surveys were conducted from March 5, 2009, through March 2, 2010, at 35 points established throughout the PRWF. No surveys were conducted during the summer from June 1 – August 31, 2009 as overall bird use was expected to be low. A total of 509 20-minute fixed-point surveys were completed. Sixty-seven unique species were observed over the course of all fixed-point bird use surveys, with a mean of 0.66 large bird species/800-meter plot/20-minute survey and a mean of 1.47 small bird species/100-meter plot/20-minute survey. More unique species were observed during the spring (59 species) compared to the fall (38) and winter (25). The most abundant bird species observed, regardless of bird size, were European starling (1,320 individuals), red-winged blackbird (656), and brown-headed cowbird (581). The most abundant large bird species observed were killdeer (169 individuals) and American crow (138). A total of 100 individual raptors were recorded within the PRWF, representing seven species. The most common raptor species observed in the study area were red-tailed hawk (50 individuals), American kestrel (22), and northern harrier (19).

Waterbird use was highest in the spring (0.06 birds/800-meter plot/20-minute survey) and great blue heron had the highest use of all waterbirds during all three seasons. Waterfowl use was similar during the spring and fall (0.51 and 0.55 birds/800-meter plot/20-minute survey, respectively), and comprised primarily of Canada goose and snow goose. Shorebird use was

higher in the spring (0.48 birds/800-meter plot/20-minute survey) than the fall (0.35), and no shorebirds were observed in the winter. The only rail or coot species observed during fixed-point bird use surveys was American coot, which was only observed in the spring. Raptor use was highest during the winter (0.28 birds/800-meter plot/20-minute survey) and lowest during the spring (0.15). Owls were only observed in the winter (0.03 birds/800-meter plot/20-minute survey) Vulture use was higher in spring (0.14 birds/800-meter plot/20-minute survey) than the fall (0.07), and no vultures were observed in the winter. The only vulture species observed was the turkey vulture. Ring-necked pheasant was the only upland game bird observed during surveys and had the highest use in spring (0.07 birds/800-meter plot/20-minute survey), followed by fall (0.03), and winter (<0.01). The only large corvid observed during surveys was American crow, which had higher use in the winter (0.75 birds/800-meter plot/20-minute survey) than spring and fall (0.12, each). Passerines had use values ranging from 3.50 birds/100-meter plot/20-minute survey in winter to 8.69 in fall; however, the focus for small birds was within a 100-meter viewshed and use by small bird types is not directly comparable to use by the large bird types.

Levels of bird use varied within the study area by point. For all large bird species combined, use was highest at point nine, with 6.38 birds/20-minute survey. The mean use at point nine was largely comprised of large corvids and waterfowl (3.69 and 2.06 birds/20-minute survey, respectively). Use at the other points ranged from 0.08 to 5.75 birds/20-minute survey for all large bird species combined. Waterbird use was relatively low, ranging from zero to 0.19 birds/20-minute survey, while waterfowl use ranged from zero to 3.75 birds/20-minute survey. Shorebird use was highest at point four (1.38 birds/20-minute survey) and use at the other points ranged from zero to 1.00 birds/survey. Rails and coots were only observed at point 19 (0.38 birds/20-minute survey). Raptor use was highest at points 15 (0.69 birds/20-minute survey) and 19 (0.62), and use ranged from zero to 0.46 birds/20-minute survey at the remaining points. Vultures were observed at 11 points with use ranging from at 0.06 to 0.62 birds/20-minute survey at these points, while upland game birds were observed at 13 points with use ranging from 0.31 to 0.06 birds/20-minute survey at the points. Use for large corvids ranged from 0.06 to 3.69 birds/20-minute survey at the points at which they were observed. Passerine use, limited to within 100-meters of the point, was highest at point four, with 27.0 birds/20-minute survey, and passerine use ranged from 2.38 to 15.4 birds/20-minute survey at the other points. The majority of small bird use at point four was comprised of brown-headed cowbird and European starling.

During the study, 291 single birds or groups of large birds totaling 653 individuals were observed flying during fixed-point bird use surveys. For all large bird species combined, 95.0% of birds were observed flying below the rotor swept height, 4.7% were within the rotor swept height, and 0.3% were observed flying above the rotor swept height for typical turbines that could be used in the PRWF. Bird types most often observed flying within the turbine rotor swept height were waterbirds (31.6%), vultures (27.9%), and raptors (10.9%). A total of 3,170 passerines and other small birds in 810 groups were recorded flying within 100-meters of the survey plots in the proposed wind resource area, with 99.1% below the rotor swept height, 0.9% within the rotor swept height, and none observed flying above the rotor swept height.

For large bird species with at least 20 separate groups of flying birds, turkey vulture (27.9%) was observed most often within 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, red-tailed hawk and turkey vulture had the highest probability of turbine exposure. For passerines and other small birds within 100-meters of the point, the bird species with the highest exposure index were Lapland longspur and cliff swallow.

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 raptor nest surveys were conducted in March 2009. The surveys were conducted prior to leaf-out to improve the chances of finding nests. Two active red-tailed hawk nests and one inactive nest of an unknown raptor were located in the PRWF, resulting in an active nest density of 0.02/mi^2.

The purpose of the habitat mapping survey was to identify potential habitat for federally- or state-listed species. The dominant habitat type observed was tilled agriculture, which comprised 90.6% of the PRWF. Unmowed grasslands were the next most common habitat type observed and comprised 2.4%, while developed areas comprised 1.6%, woodlots 1.5%, and savannah 1.3%. The remaining area was comprised of small amounts of mowed grasslands, un-tilled agriculture (hayfields), shelterbelts with trees and shrubs, pasture, open water, and railroad verge.

The objective of American golden-plover surveys was to measure overall use and distribution of migrating American golden-plovers in the PWRF, considered a species of Greatest Need of Conservation by the Illinois Department of Natural Resources (IDNR) and a species of conservation concern by the United States Fish and Wildlife Service (USFWS). Surveys were conducted twice per week during the spring migration period by driving all public roads in the PRWF and recording the number, location and habitat of all American golden-plovers observed. Twice each survey day, observers spent a minimum of 30 minutes observing areas being used by golden plover in order to record behaviors of American golden-plovers, with a specific emphasis on obtaining data on flight heights when American golden-plover were observed. A total of fourteen American golden-plover surveys were conducted between March 31 and May 14, 2009. Eight groups of 113 American plovers were observed during these surveys. Use of the PRWF by American golden-plovers was low compared to known stopover locations in Illinois and Indiana.

The objective of Smith's longspur surveys was similar to that of the American golden-plover surveys. The PRWF was assessed by vehicle to determine locations of the types of fields where Smith's longspur may occur. Where suitable habitat was found, observers conducted point count surveys at each location two days a week and each point count lasted for 30 minutes. Surveys for Smith's longspurs were conducted in conjunction with American golden-plover surveys from March 31 through May 14, 2009. No Smith's longspur were observed during surveys.

The objective of incidental wildlife observations was to provide record of wildlife seen outside of the standardized surveys. The most abundant large bird species recorded incidentally was red-tailed hawk (36 observations in 33 groups). Eight bird species were recorded incidentally that were not observed during fixed-point bird use surveys: blue-winged teal, bufflehead, dunlin, greater yellowlegs, hooded merganser, northern mockingbird, wild turkey, and wood duck. A total of four mammal species and one amphibian species were also recorded incidentally, with white-tailed deer being the most commonly observed non-avian species (24 observations).

Based on fixed-point bird use data collected for the PRWF, mean annual raptor use was 0.23 raptors/800-meter plot/20-minute survey. The annual rate was low relative to raptor use at 39 other wind-energy facilities in the United States and was approximately the same as raptor use recorded at the nearby Grand Ridge Wind Energy Facility (GRWEF). Raptor use at the PRWF was lower than at other wind-energy facilities where raptor fatality rates have been highest.

Surveys within the proposed PRWF were conducted during the spring, fall and winter seasons, which included seasons of highest expected bird use. One Illinois state-listed endangered species, northern harrier, and one IDNR species of Greatest Need of Conservation and USFWS species of conservation concern, American golden-plover, were observed during all surveys. No surveys were conducted at the PRWF during the summer due to the preponderance of tilled agriculture. However; some non-tilled habitat types are present that could potentially support breeding state-listed species during the summer.

The USFWS interim guidelines for wind-energy development suggest that wind-energy facilities be sited within previously altered habitats. The PRWF is dominated by tilled and un-tilled agriculture, and developed areas, which comprise 90.6 % of the area. Most turbines will be located within tilled agriculture, which will reduce potential impacts to birds. The results of bird studies at PRWF show raptor use rates during the spring, fall and winter were lower than observed at other wind-energy facilities, and similar to other projects in the Midwest, likely due to the dominance of tilled agriculture. A study of bird fatalities at the GRWEF found bird fatality rates to be 0.72/megawatt/year, which was low compared to other wind-energy facilities in the Midwest and the United States. The placement of turbines within tilled agriculture should further reduce potential bird fatality rates for most bird species. Fatality rates of birds at the PRWF are expected to be similar to those observed at other wind-energy facilities in the Midwest, based on data collected during this study, dominance of relatively flat tilled agriculture in the PRWF, and results of fatality monitoring studies conducted at other wind-energy facilities in Illinois.

Fixed-point bird use surveys were not conducted during the summer due to the preponderance of tilled agriculture, which limits the amount of suitable nesting habitat for most bird species. However, other habitat types such as mowed grasslands, unmowed grasslands, un-tilled agriculture, pasture, savannah, shelterbelts, and railroad verge, are present and may provide habitat for state-listed species such as upland sandpiper, loggerhead shrike, northern harrier, and Franklin's ground squirrel. Woodlots are also present that may provide potential habitat for the federally endangered Indiana bat within portions of the PRWF. Invenergy has committed to placing turbines within tilled agriculture, which greatly reduces the potential for potential habitat for most state-listed species to be impacted. Some streams are also present that have the potential to support state-listed aquatic species. The potential exists for infrastructure to be located within non-agricultural habitat types or at stream crossings, and construction activities have the potential to impact individual state-listed species should occupied habitats be impacted.

Habitat data collected during this study can be utilized to identify locations where turbines or infrastructure may be located within or near potential habitat for state-listed species, and to determine if further surveys or mitigation measures are warranted to protect individual state or federally listed species.

STUDY PARTICIPANTS

Western EcoSystems Technology

Rhett Good	Project Manager,
Michelle L. Ritzert	Research Biologist/Wildlife Biologist
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Saif Nomani	Statistician
JR Boehrs	GIS Technician
Melissa Wolfe	Report Compiler
Andrea Palochak	Technical Editor
Christopher Rea	Field Technician
Kariane Heidebrecht	Field Technician

REPORT REFERENCE

Good, R.E., M. L. Ritzert, J.P. Ritzert, and K. Bay. 2010. Wildlife Baseline Studies for the Pleasant Ridge Wind Resource Area, Livingston County, Illinois. Final Report: March 5, 2009 – March 2, 2010. Prepared for Invenergy, Chicago, Illinois. Technical report prepared by Western EcoSystems Technology, Inc. (WEST), Bloomington, Indiana.

ACKNOWLEDGEMENTS

A number of individuals from different organizations were instrumental in the completion of the project. Protocols were presented to Heidi Woebber of the USFWS and Keith Shank of the IDNR. Gina Wolf and John Martin served as project managers for Invenergy. All the landowners in the project deserve recognition for their support and cooperation in allowing safe, secure, and trouble-free property access.

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INTRODUCTION

Invenergy, LLC (Invenergy) has proposed a wind-energy facility in southern Livingston County, Illinois (Figures 1 and 2), known as the Pleasant Ridge Wind Farm (PRWF). Invenergy contracted Western Ecosystems Technology, Inc. (WEST) to conduct pre-construction wildlife surveys in the PRWF to estimate the impacts of wind-energy facility construction and operations on wildlife.

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

Baseline surveys were conducted from March 5, 2009, through March 2, 2010, at the PRWF and included fixed-point bird use surveys, ground-based raptor nest surveys, habitat mapping, American golden-plover (*Pluvialis dominica*) and Smith's longspur (*Calcarius pictus*) surveys, acoustic bat surveys and incidental wildlife observations. 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 PRWF is greatly enhanced by operational monitoring data collected at 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. The results of the acoustic bat surveys and potential impacts are presented in a separate final report (Good et al. 2010).

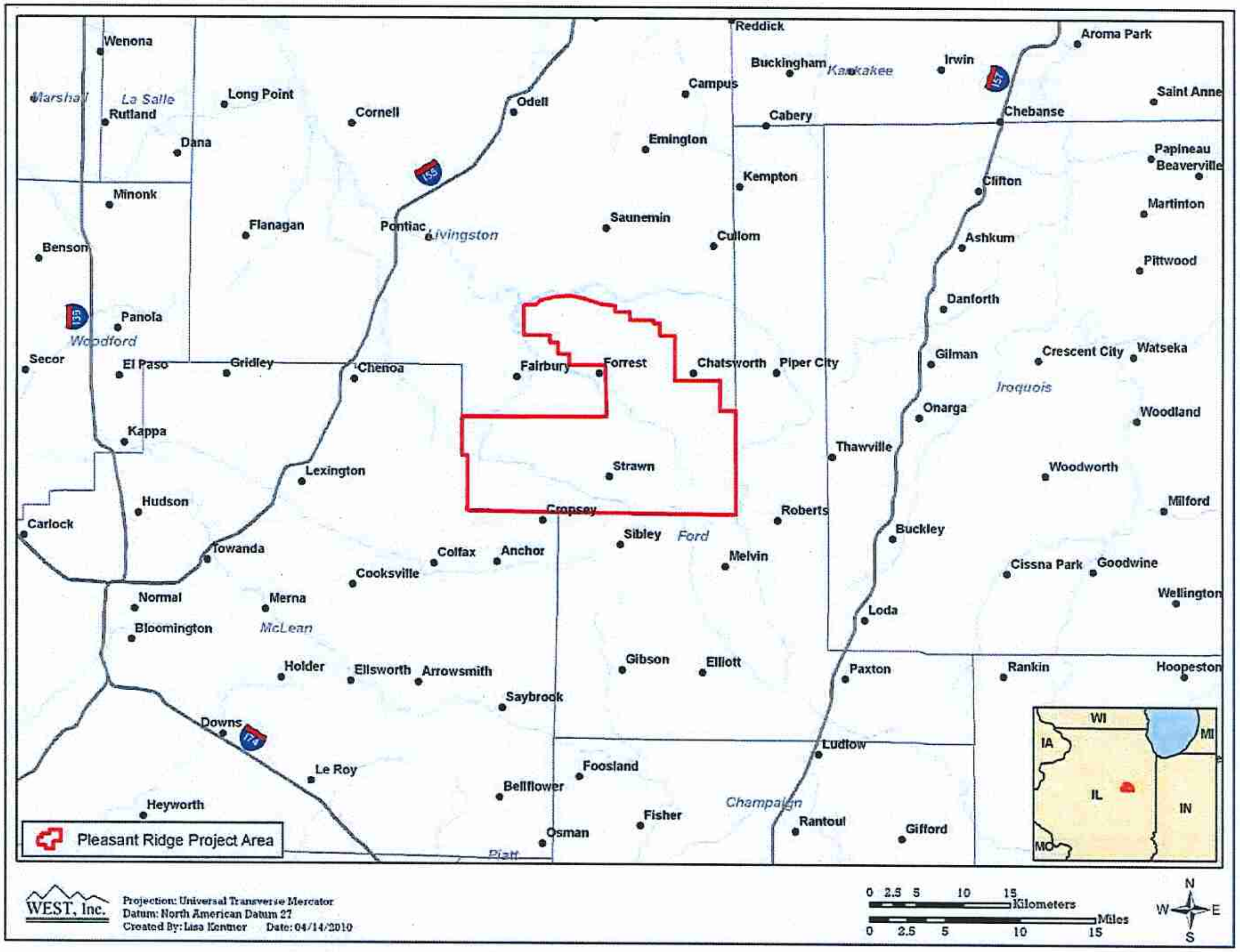

Figure 1. Location of the Pleasant Ridge Wind Farm.

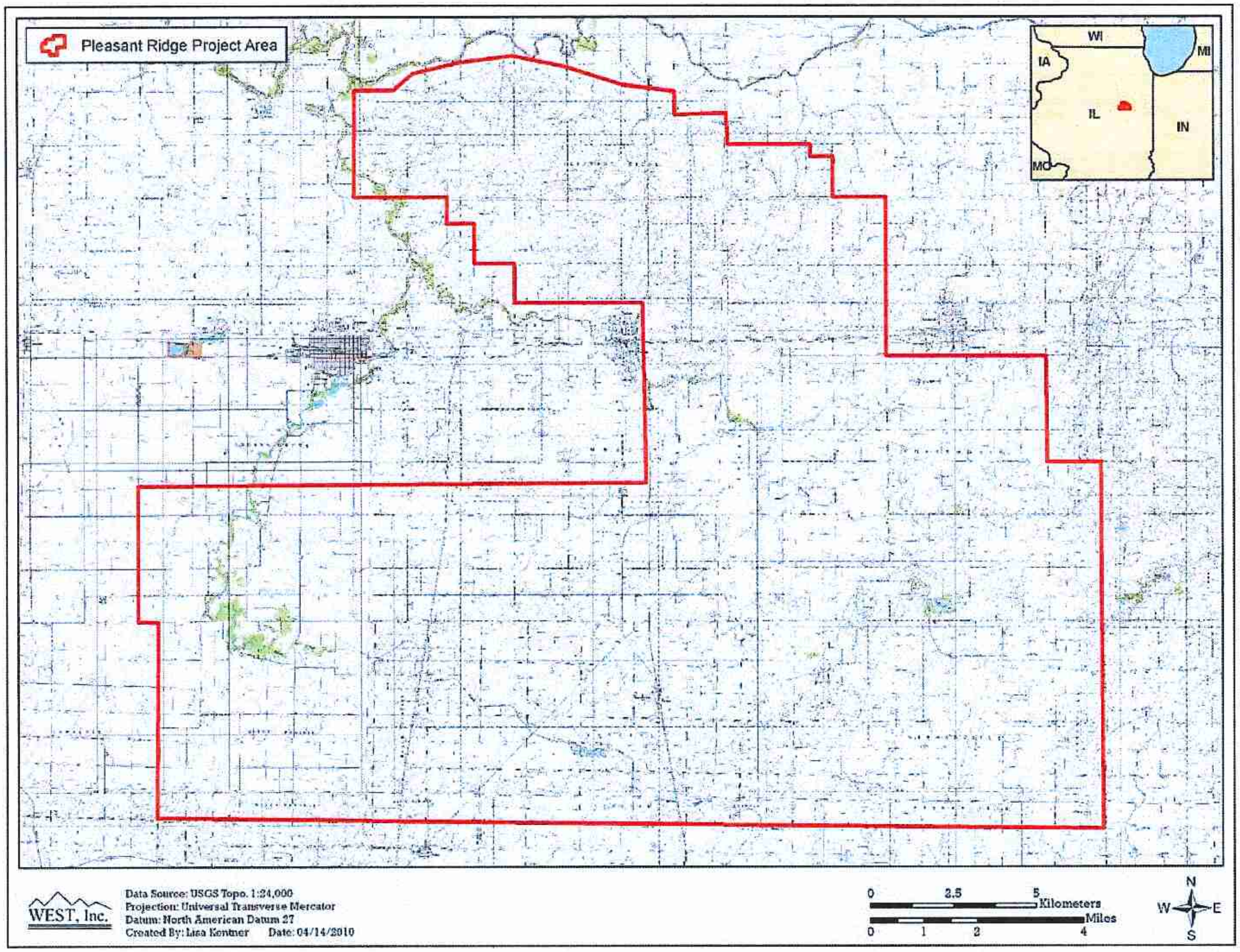

Figure 2. Overview of the Pleasant Ridge Wind Farm.

STUDY AREA

The PRWF is 109,278 acres (170.75 square miles [mi^2]) in size and is located in southern Livingston County, Illinois, near the towns of Fairbury and Chatsworth (Figures 1 and 2). The PRWF falls within the Central Corn Belt Plains Ecoregion, which encompasses a large portion of central Illinois (Woods et al. 2007). The Central Corn Belt Plains Ecoregion is comprised of vast glaciated plains and much of the region was originally dominated by tall-grass prairie and had scattered groves of trees and marshes occurring on level uplands. Today, most of the area has been cleared to make way for highly productive farms producing corn (*Zea mays*), soybeans (*Glycine max*), and livestock. Many streams within this ecoregion have been tilled, ditched, and tied into existing drainage systems, which has altered the ecology of many streams in the area. Most streams running through the PRWF are channelized. However, there are natural streams in the PRWF that include Indian Creek (a tributary to the Vermilion River) and the North and South Forks of the Vermilion River.

The PRWF is located within a landscape dominated by tilled agriculture, which comprises approximately 90.6% of the area (Tables 1a and 1b; Figure 3). The remaining areas are comprised of smaller amounts of unmowed grasslands, developed areas, woodlots and savannahs (Tables 1a and 1b; Figure 3). Developed areas are generally confined to the town of Strawn, as well as homesteads, farms, and roads scattered throughout the PRWF.

Table 1a. Habitat types present at the Pleasant Ridge Wind Farm.

Habitat	Acres	% Composition
Tilled Agriculture (corn/soybean)	98,964.30	90.6
Unmowed Grassland	2,592.20	2.4
Developed	1,793.33	1.4
Woodlot	1,675.20	1.5
Savannah	1,381.80	1.3
Mowed Grassland	825.80	0.8
Untilled Agriculture (hayfields)	760.60	0.7
Shelterbelt (trees)	587.40	0.5
Railroad Verge	295.70	0.3
Pasture	180.50	0.2
Shelterbelt (shrubs)	151.50	0.1
Open Water	79.80	0.1
Total	**109,288.13**	**100**

Table 1b. Descriptions of habitats mapped at the Pleasant Ridge Wind Farm by Western EcoSystems Technology, Inc.

Habitat	Habitat Description
Agriculture (corn & soybean)	Areas with planted crops (typically soybean [*Glycine max*], corn [*Zea mays*]).
Agriculture (hayfield)	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.).
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-meters [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.

The number and size of wind turbines to be installed in the PRWF is currently unknown. A likely rotor swept height (RSH) for potential collision with a turbine blade of 35- to 130-meters (m; 115- to 427-feet [ft]) above ground level (AGL) was used for the purposes of the analyses.

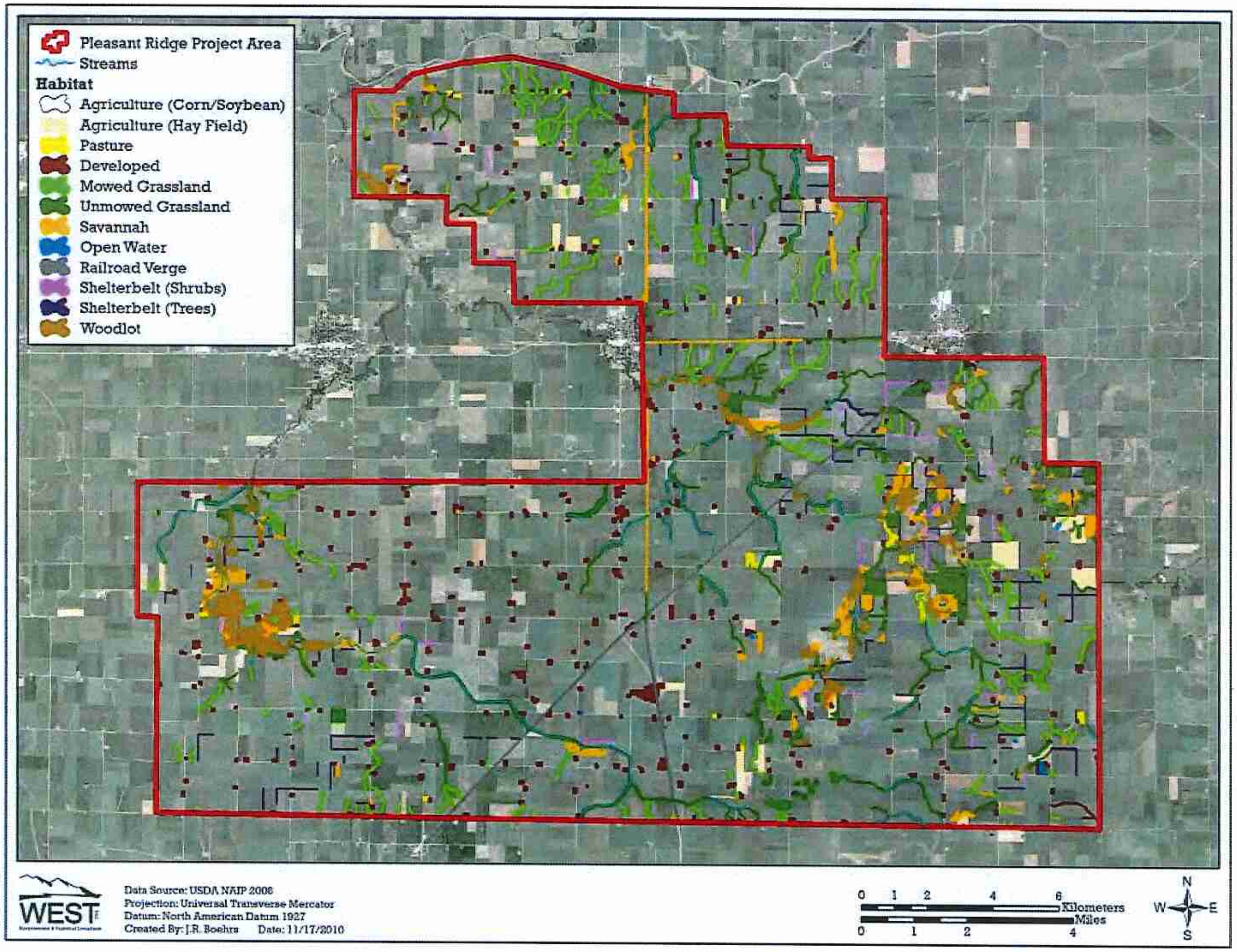

Figure 3. Habitat types mapped within the Pleasant Ridge Wind Farm.

METHODS

The study at the PRWF consisted of the following surveys: 1) fixed-point bird use surveys; 2) ground-based raptor nest surveys; 3) habitat mapping; 4) American golden-plover surveys; 5) Smith's longspur surveys; and 6) 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 PRWF by birds, particularly raptors, defined here as kites, accipiters, buteos, harriers, eagles, falcons, and owls. Fixed-point surveys (variable circular plots) were conducted using methods described by Reynolds et al. (1980). The points were selected systematically using a random starting point to survey the PRWF, while providing relatively even coverage. All birds seen during each 20-minute (min) fixed-point survey were recorded.

Bird Use Survey Plots

Thirty-five points were selected to achieve relatively even coverage of the PRWF and survey representative habitats and topography within the PRWF (Figure 4). Each survey plot was an 800-m (2,625-ft) radius circle centered on the point.

Bird Survey Methods

All species of birds observed during fixed-point surveys were recorded. A unique observation number was assigned to each observation.

The date, start, and end time of the survey period, and weather information such as temperature (degrees Fahrenheit), wind speed (miles per hour), wind direction, and percent 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 flight direction at first observation were recorded to the nearest 5-m (16-ft) interval. Other information recorded about the observation included whether or not the observation was auditory only and the 10-minute (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 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.

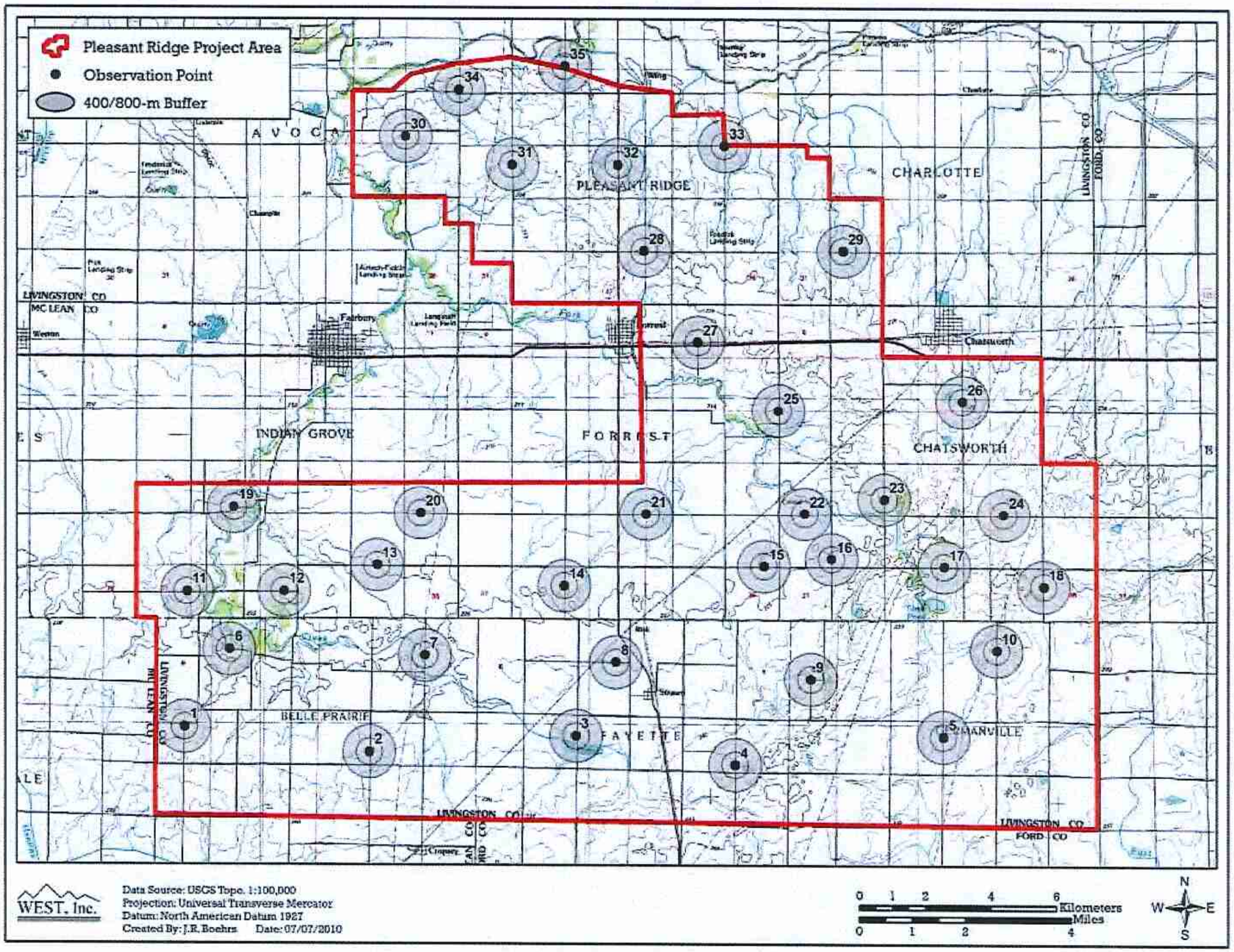

Figure 4. Fixed-point bird use survey points at the Pleasant Ridge Wind Farm.

Observation Schedule

Sampling intensity was designed to document bird use and behavior by habitat and season within the PRWF. Fixed-point bird use surveys were conducted from March 5, 2009, through March 2, 2010. Surveys were conducted approximately weekly during spring (March 1 to May 31) and fall (September 1 to October 31) migration seasons, with half of the plots surveyed each week. During the winter (November 1 to February 28), half of the plots were surveyed every other week with each plot being surveyed on a monthly basis. No surveys were conducted during the summer (June 1 to August 31) as bird use was expected to be relatively low. Surveys were conducted during daylight hours and survey periods varied to approximately cover all daylight hours during a season. To the extent practical, each point was surveyed about the same number of times.

Ground-Based Raptor Nest Surveys

The objective of the ground-based raptor nest surveys was to locate raptor nests in the PRWF. A ground-based search for nesting raptors was conducted in March 2009 that included the entire boundary of the PRWF. 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 nest structures. Potential nest locations were recorded on recent aerial photographs, and digitized in ArcGIS 9.3. Current status (inactive [no raptor species on or near nest], active [raptor present on nest or nearby exhibiting nesting behavior such as carrying nest material, defending nest, etc.], incubating, young in nest), and species present were recorded for each nest.

Habitat Mapping

Habitat types within the PRWF were mapped on recent aerial photographs and verified in the field during the spring of 2009. The purpose of the habitat mapping survey was to identify potential habitat for federally- or state-listed species.

American Golden-Plover Surveys

The purpose of the American golden-plover surveys was to measure overall use and distribution of migrating American golden-plovers, considered a species of Greatest Need of Conservation by the Illinois Department of Natural Resources (IDNR; IDNR 2005) and species of conservation concern by the United States Fish and Wildlife Service (USFWS; USFWS 2008). Surveys were conducted by driving all public roads at approximately 20 mph in the PRWF and recording the number, location, and habitat of all American golden-plovers observed. Twice each survey day, observers spent a minimum of 30 min observing areas being used by American golden-plovers in order to record the behaviors of the species, with a specific emphasis on obtaining data on flight heights. Surveys were conducted twice per week, and during one day each week, all the north-south roads were surveyed. During the second survey day each week, all east-west roads were surveyed. A total of fourteen surveys were conducted between March 31 and May 14, 2009.

Smith's Longspur Surveys

The Smith's longspur is also considered a species of Greatest Need of Conservation by the IDNR (IDNR 2005) and species of conservation concern by the USFWS (USFWS 2008). Migrating Smith's longspurs have very specific habitat affinities in Illinois, specifically, corn stubble fields that have foxtail grass (*Alopecurus* spp., Briskie 2009). The PRWF was assessed by vehicle to determine where potential suitable habitat was located. Observers conducted point count surveys at each location two days per week for 30 min. Any Smith's longspurs observed were recorded, along with information on their behavior and flight heights. In addition to point count surveys, all Smith's longspurs observed while conducting surveys of the entire project area for American golden-plovers were recorded and their location plotted on a map. Because Smith's longspur is hard to distinguish from Lapland longspur (*Calcarius lapponicus*), which also may occur in the PRWF, observers were trained in the proper identification of Smith's longspurs based on visual and auditory cues. Surveys for Smith's longspurs were conducted twice per week from March 31 to May 14, 2009 in conjunction with American golden-plover surveys.

Incidental Wildlife Observations

The objective of incidental wildlife observations was to provide record 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 by Universal Transverse Mercator (UTM) coordinates.

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 in all steps were made.

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

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 (i.e., number of species/plot/20-min survey) compared among seasons for fixed-point bird use surveys.

Bird Use, Composition, and Frequency of Occurrence
For the standardized fixed-point bird use estimates, only observations of large birds detected within the 800-m (2,625-ft) radius plot were used in the analysis. For small birds only observations within a 100- m (328-ft) 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 PRWF. 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 PRWF.

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.

RESULTS

All surveys were completed at the PRWF from March 5, 2009 through March 2, 2010; however, no surveys were conducted during the summer (June 1 – August 31). Seventy-five unique bird species, four mammal species, and one amphibian species were identified during all surveys completed at the PRWF. Results of the fixed-point bird use surveys, ground-based raptor nest surveys, habitat mapping, American golden-plover surveys, Smith's longspur surveys, and incidental wildlife observations, as well as the specific numbers of unique species observed for each survey type, are discussed in the sections below.

Fixed-Point Bird Use Surveys

A total of 509 20-min fixed-point bird use surveys were conducted at the PRWF (Table 2). Two different viewsheds (800-m for large birds and 100-m for small birds) were utilized when calculating the different statistics: species richness, use, percent composition, percent frequency, and exposure index. No fixed-point bird use surveys were conducted during the summer as bird use was expected to be relatively low.

Table 2. Summary of species richness (species/plot[a]/20-min survey), and sample size by season and overall during the fixed-point bird use surveys at the Pleasant Ridge Wind Farm, March 5, 2009 – March 2, 2010.

Season	Number of Visits	# Surveys Conducted	# Unique Species	Species Richness	
				Large Birds	Small Birds
Spring	8	228	59	1.02	2.80
Fall	5	175	38	0.62	1.05
Winter	3	105	25	0.39	0.66
Overall	**16**	**509**	**67**	**0.66**	**1.47**

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

Bird Diversity and Species Richness

Sixty-seven unique species were observed over the course of all fixed-point bird use surveys, with a mean number of large bird species of 0.66 species/800-m plot/20-min survey and 1.47 small bird species/100-m plot/20-min survey (Table 2). More unique species were observed during the spring (59 species) compared to the fall (38) and winter (25; Table 2). No fixed-point bird use surveys were conducted in the summer as overall bird use was expected to be low. The mean number of species per survey for large birds was higher in the spring (1.02 species/survey), followed by the fall (0.62) and winter (0.39; Table 2). For small birds, the mean number of species per survey was also higher in the spring (2.80 species/survey), followed by the fall (1.05) and winter (0.66; Table 2). A total of 5,238 individual bird observations within 1,682 separate groups were recorded during the fixed-point surveys (Appendix A). Cumulatively, regardless of bird size, three species (4.4% of all species) comprised 48.8% of the observations: European starling (*Sturnus vulgaris*; 1,320 individuals), red-winged blackbird (*Agelaius phoeniceus*; 656), and brown-headed cowbird (*Molothrus ater*; 581). All other species comprised less than 10% of the observations individually. The most abundant large bird species observed were killdeer (*Charadrius vociferous*; 169 individuals in 104 groups) and American crow (*Corvus brachyrhynchos*; 138 individuals in 39 groups). A total of 100 individual raptors were recorded within the PRWF, representing seven species (Appendix A). The most abundant raptor species observed were red-tailed hawk (*Buteo jamaicensis*; 50 observations), American kestrel (*Falco sparverius*; 22), and northern harrier (*Circus cyaneus*; 19).

Bird Use, Composition, and Frequency of Occurrence by Season

Mean bird use, percent composition, and frequency of occurrence by season were calculated (Appendix B). The highest overall large bird use occurred in the spring (1.82 birds/plot/20-min survey), followed by the fall (1.74) and winter (1.32; Appendix B-1). For small birds, use was highest in the fall (8.73), followed by the spring (6.79) and winter (3.26; Appendix B-2).

Waterbirds

Waterbirds had the highest use in the spring (0.06 birds/800-m plot/20-min survey), followed by the fall (0.02) and winter (<0.01; Appendix B-1). Great blue heron (*Ardea herodias*) had the highest use of all waterbirds during all three seasons. Waterbirds comprised 3.3% of the overall large bird use in the spring, 1.3% in the fall, and 0.6% in the winter. Waterbirds were observed during 6% of the spring surveys, 2.3% of the fall surveys, and 0.7% of the winter surveys (Appendix B-1).

Waterfowl

Waterfowl had similar use during the fall (0.55 birds/800-m plot/20-min survey) and spring (0.51), and lower use in the winter (0.07; Appendix B-1). Snow goose (*Chen caerulescens*) and Canada goose (*Branta canadensis*) were the only waterfowl observed during the fall season (Appendix A), and use by snow goose was higher than use by Canada goose (0.34 and 0.21 birds/800-m plot/20-min survey, respectively). Six waterfowl species were observed during the spring season, with Canada goose comprising the majority of use (0.30 birds/800-m plot/20-min survey; Appendix B-1). Only one species, Canada goose, was observed in the winter (0.07 birds/800-m plot/20-min survey). Waterfowl comprised 31.8% of the overall large bird use during the fall, 26.6% during the spring, and 6% in the winter. Waterfowl were observed more frequently in the spring (7.7%) and the fall (2.9%; Appendix B-1).

Shorebirds

Shorebirds had similar use in the spring (0.48 birds/800-m plot/20-min survey) and fall (0.35), and no shorebirds were observed in the winter (Appendix B-1). Killdeer comprised the majority of use during both seasons (25.3% of the overall large bird use in the spring and 20.3% in the fall). Shorebirds were observed during 34.3% of the surveys in the spring and 13.1% of surveys in the fall (Appendix B-1).

Rails and Coots

Rail and coot use was represented entirely by one group of six American coots (*Fulica americana*) in the spring (0.02 birds/800-m plot/20-min survey), comprising 1.1% of the spring large bird use (Appendix B-1). Rails and coots were observed during 0.4% of the spring surveys.

Raptors

Raptor use was highest in the winter (0.28 birds/800-m plot/20-min survey), followed by the fall (0.21) and spring (0.15; Appendix B-1). Winter use was primarily comprised of red-tailed hawk (0.11), American kestrel (0.08), and northern harrier (0.06). Red-tailed hawks had the highest use of any raptor in the fall (0.10) and spring (0.09). Raptors comprised 23% of the overall large bird use in the winter, 12.1% in the fall, and 7.9% in the spring. Raptors were observed during 21.2% of surveys in the winter and 17.7% in the fall, and 12.3% of the surveys in the spring (Appendix B-1).

Owls

The only owl species observed in the PRWF was great horned owl (*Bubo virginianus*). Owls were only observed in the winter and were rarely recorded (0.03 birds/800-m plot/20-min survey; Appendix B-1). Owls comprised 2.3% of large bird use in the winter and were observed during 1.4% of surveys (Appendix B-1).

Vultures

Vultures had the highest use in the spring (0.15 birds/800-m plot/20-min survey), followed by the fall (0.07), and there were no vultures observed during the winter (Appendix B-1). The only vulture species observed was turkey vulture (*Cathartes aura*; Appendix A). Vultures comprised 8.1% of the overall large bird use in the spring and 4.3% in the fall. Vultures were observed during 8.9% of the spring surveys and 4% of the fall surveys (Appendix B-1).

Upland Game Birds

Upland game birds, consisting exclusively of ring-necked pheasants (*Phasianus colchicus*: Appendix A), were more commonly recorded in the spring (0.07 birds/800-m plot/20-min survey), followed by the fall (0.03) and winter (<0.01; Appendix B-1). Upland game birds comprised 3.8% of the overall large bird use in the spring, 1.6% in the fall, and 0.6% in the winter. Upland game birds were observed during 7% of surveys in the spring compared to 2.9% in the fall and 0.7% in the winter (Appendix B-1).

Doves/Pigeons

Doves and pigeons had higher use in fall (0.38 birds/800-m plot/20-min survey), followed by spring (0.34), and winter (0.08; Appendix B-1). Doves and pigeons comprised 21.6% of large birds observed during the fall, 17.6% in the spring, and 7.1% in the winter. Doves and pigeons were observed during 17.6% of spring surveys, 12% of fall surveys, and 2.1% of winter surveys (Appendix B-1).

Large Corvids

Large corvids had relatively higher use in the winter (0.75 birds/800-m plot/20-min survey), compared to the spring (0.12) and fall (0.12; Appendix B-1). The only large corvid species observed was American crow (Appendix A). Large corvids made up approximately two-thirds of the overall large bird use in the winter (62.7%) compared to less than 7% of the overall large bird use in the spring and fall. Large corvids were observed during 11.3% of the winter surveys, followed by 5.7%of the fall, and 5.6% of the spring surveys (Appendix B-1).

Small Birds

A 100-m viewshed was used for small birds, thus making them not directly comparable to the large bird types. Passerine use was higher in the fall (8.69 birds/100-m plot/20-min survey) and the spring (7.36) compared to the winter (3.50; Appendix B-2). European starling had the highest use by any one species during the fall (3.97 birds/100-m plot/20-min survey), while red-winged blackbird had the highest use in the spring (1.78) and dark-eyed junco (*Junco hyemalis*) had the highest use in the winter (1.38). Passerines were observed during 87.6% of the spring surveys, 66.9% of the fall surveys, and 48.5% of the winter surveys (Appendix B-2).

Bird Flight Height and Behavior

Flight height characteristics were estimated for both bird types (Table 3) and bird species (Table 4 and Appendix C). During all surveys, 291 single large birds or groups totaling 653 individuals were observed flying within the 800-m plot (Table 3). Overall, 4.7% of large birds observed flying were recorded within the likely RSH, 95.0% were below the likely RSH, and 0.3% were flying above the likely RSH (Table 3). The majority of flying raptors (87%) were observed below the likely RSH, 10.9% were within the likely RSH, and only 2.2% were above the likely RSH. Waterbirds had the highest percentage of flying birds within the likely RSH (31.6%) followed by vultures with 27.9% within the likely RSH. Raptors had the third highest percentage of birds within the likely RSH, primarily due to 18.0% of buteo observations recorded at this height. All waterfowl, shorebirds, upland game birds, and doves/pigeons were observed flying below the likely RSH (Table 3). Passerines and other small birds within a 100-m of the point were most often observed below the likely RSH (99.1%). Only 1.0% of passerines were recorded within the likely RSH and no passerines or other small birds were recorded above the likely RSH (Table 3).

Table 3. Flight height characteristics by bird type during fixed-point bird use surveys at the Pleasant Ridge Wind Farm, March 5, 2009 - March 2, 2010. Large bird observations were limited to within 800-meters (m) and small birds were limited to within 100-meters.

Bird Type	# Groups Flying	# Obs Flying	Mean Flight Height (m)	% Obs Flying	% within Flight Height Categories 0-35 m	35- 130 m	> 130 m
Waterbirds	18	19	27.94	100	68.4	31.6	0
Waterfowl	15	126	11.60	54.8	100	0	0
Shorebirds	67	113	6.58	66.1	100	0	0
Rails/Coots	0	0	0	0	0	0	0
Raptors	84	92	17.17	92.0	87.0	10.9	2.2
Accipiters	*5*	*6*	*11.00*	*100*	*100*	*0*	*0*
Buteos	*45*	*50*	*24.31*	*98.0*	*78.0*	*18.0*	*4.0*
Northern Harrier	*17*	*18*	*5.76*	*94.7*	*100*	*0*	*0*
Falcons	*17*	*18*	*11.47*	*81.8*	*94.4*	*5.6*	*0*
Owls	0	0	0	0	0	0	0
Vultures	24	43	27.62	97.7	72.1	27.9	0
Upland Game Birds	1	1	1.00	4.3	100	0	0
Doves/Pigeons	55	139	7.02	88.5	100	0	0
Large Corvids	27	120	12.81	87.0	97.5	2.5	0
Large Birds Overall	**291**	**653**	**13.59**	**73.5**	**94.9**	**4.7**	**0.3**
Passerines	796	3,154	4.95	89.3	99.0	1.0	0
Other Birds	14	16	10.36	66.7	100	0	0
Small Birds Overall	**810**	**3,170**	**5.05**	**89.1**	**99.1**	**0.9**	**0**

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

Of all large bird species, five species had at least 20 groups observed flying. The only species observed flying within the likely RSH during at least 20% of the observations was turkey vulture (27.9%; Table 4). Ring-billed gull (*Larus delawarensis*) was always (100%) seen flying within the likely RSH; however, this was only based on one observation. Of all passerine and small bird species, there were no species that had more than 20 groups observed flying within the likely RSH (Table 4). Only two small bird species were observed flying within the likely RSH. Two groups of cliff swallow (*Petrochelidon pyrrhonota*) were observed flying during fixed-point surveys and 50.0% of observations were within the likely RSH. Ten groups of Lapland longspur were also recorded flying and of those 26.7% were observed flying with the likely RSH.

Table 4. Relative exposure index and flight characteristics by bird species[a] during the fixed-point bird use surveys at the Pleasant Ridge Wind Farm, March 5, 2009 - March 2, 2010.

Species	# Groups Flying	Overall Mean Use	% Flying	% Flying within RSH[b] based on initial obs	Exposure Index	% Within RSH at anytime
		Large Bird Species[c]				
red-tailed hawk	44	0.10	98.0	18.4	0.02	30.6
turkey vulture	24	0.06	97.7	27.9	0.02	55.8
American crow	27	0.47	87.0	2.5	0.01	59.2
ring-billed gull	1	<0.01	100	100	<0.01	100
American kestrel	17	0.06	81.8	5.6	<0.01	11.1
great blue heron	17	0.03	100	27.8	<0.01	27.8

Table 4. Relative exposure index and flight characteristics by bird species[a] during the fixed-point bird use surveys at the Pleasant Ridge Wind Farm, March 5, 2009 - March 2, 2010.

Species	# Groups Flying	Overall Mean Use	% Flying	% Flying within RSH[b] based on initial obs	Exposure Index	% Within RSH at anytime
			Small Bird Species[c]			
Lapland longspur	10	0.20	96.2	26.7	0.05	26.7
cliff swallow	2	0.03	100	50.0	0.01	50.0
European starling	73	1.44	97.3	0	0	0.3

[a] Only includes species with actual exposure index values. See Appendix C for all species.
[b] RSH: The likely "rotor swept height" for potential collision with a turbine blade, or 115-427-ft (35-130-m) above ground level (AGL).
[c] 800-meter (m) radius plot for large birds and 100-m for small birds.

Bird Exposure Index

A relative exposure index was calculated for each bird species (Table 4 and Appendix C). This index is only based on initial flight height observations and relative abundance (defined as the use estimate) and does not account for other possible collision risk factors, such as foraging or courtship behavior. Those species that had higher potential exposure to the likely RSH are listed in Table 4, and a complete list of all species is presented in Appendix C. Red-tailed hawk and turkey vulture both had the highest exposure index value (0.02), followed by American crow (0.01) (Table 4). Lapland longspur had the highest exposure index value for all small bird species (0.05), followed by cliff swallow (0.01; Table 4).

Spatial Use

For all large bird species combined, use was highest at points nine (6.38 birds/20-min survey), 19 (5.75), and 31 (4.88). Bird use at other points ranged from 0.08 to 3.12 birds/20-min survey (Appendix D). The use estimate for point nine was largely comprised of large corvid and waterfowl use (3.69 and 2.06 birds/20-min survey, respectively). Waterbird use was relatively low across all points, ranging from zero to 0.19 birds/20-min survey. Waterfowl use was highest at point 31, with 3.75 birds/20-min survey, while waterfowl use at other points ranged from zero to 2.44 birds/20-min survey. Mean shorebird use was highest at point four (1.38 birds/20-min survey) and use ranged from zero to 1.00 birds/20-min survey at other points. Rails and coots were only observed at point 19 (0.38 birds/20-min survey). Raptor use was highest at points 15 and 19 (0.69 and 0.62 birds/20-min survey, respectively), and use by raptors ranged from zero to 0.46 birds/20-min survey at other points. Vulture use was highest at point six with 0.62 birds/20-min survey, while vulture use at other points ranged from zero to 0.44. Upland game bird use was relatively low across all points, ranging from zero to 0.31 birds/20-min survey. Dove and pigeon use was highest at points 15 and 11, with 1.44 and 1.38 birds/20-min survey, respectively, while dove and pigeon use ranged from zero to 0.75 birds/20-min survey at other points. Large corvid use was highest at point nine (3.69 birds/20-min survey) and use ranged from zero to 0.81 birds/20-min survey at other points. Passerine use, focused within 100 m of the point, was highest at point four (27.0 birds/20-min survey), and use ranged from 2.38 to 15.4 birds/20-min survey at other points. Use at point four was primarily comprised of brown-headed cowbird and European starling.

Flight paths for waterbirds, waterfowl, shorebirds, raptors, and vultures were digitized and mapped (Appendix E). No obvious flyways or concentration areas were observed for any large bird type.

Sensitive Species Observations

Nineteen northern harriers, a state-listed endangered species (IDNR 2009), were recorded within the PRWF during all fixed-point bird use surveys (Table 5 and Figure 5).

Table 5. Summary of sensitive species observed at the Pleasant Ridge Wind Farm during fixed-point bird use surveys (FP), American golden-plover surveys (AMGP), and as incidental wildlife observations (Inc.), March 5, 2009 – March 2, 2010.

			FP		AMGP		Inc.		Total	
Species	**Scientific Name**	**Status**	**# of grps**	**# of obs**	**# of grps**	**# of obs**	**# of grps**	**# of obs**	**# of grps**	**# of obs**
American golden-plover	*Pluvialis dominica*	FSOC, SGNC	0	0	8	113	0	0	8	113
northern harrier	*Circus cyaneus*	SE	18	19	0	0	9	10	27	29
Total	**2 species**		**18**	**19**	**8**	**113**	**9**	**10**	**35**	**142**

FSOC = Federal species of conservation concern (USFWS 2008); SE state endangered (IDNR 2009); SGNC – Species of Greatest Need of Concern (IDNR 2005).

Ground-Based Raptor Nest Surveys

Two active red-tailed hawk nests and one inactive raptor nest were conducted the PRWF, resulting in a nest density of 0.02 nests/mi^2 (0.02 nests/km^2). All three nests were within the PRWF (Table 6 and Figure 6). The inactive nest was likely that of a red-tailed hawk based on the abundance of red-tailed hawks in the PRWF, but may potentially be used by other raptor species.

Table 6. Nesting raptor species and nest density for the Pleasant Ridge Wind Farm (PRWF).

Species	# of active nests within the PRWF	# of inactive nests within the PRWF	Density with PRWF (#/square mile)
red-tailed hawk	2	0	0.01
unknown raptor	0	1	<0.01
Total	**2**	**1**	**0.02**

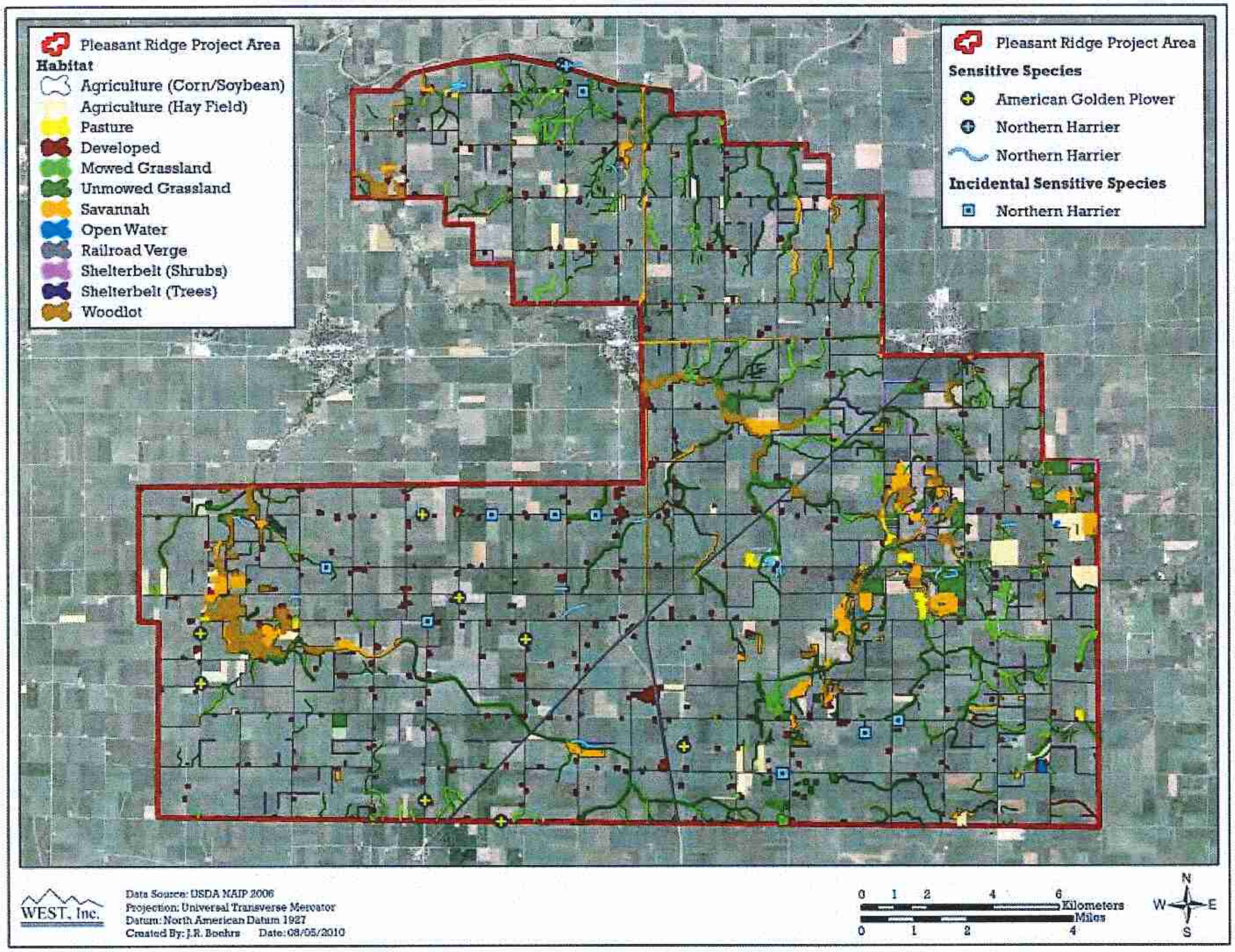

Figure 5. Sensitive species locations observed in the Pleasant Ridge Wind Farm.

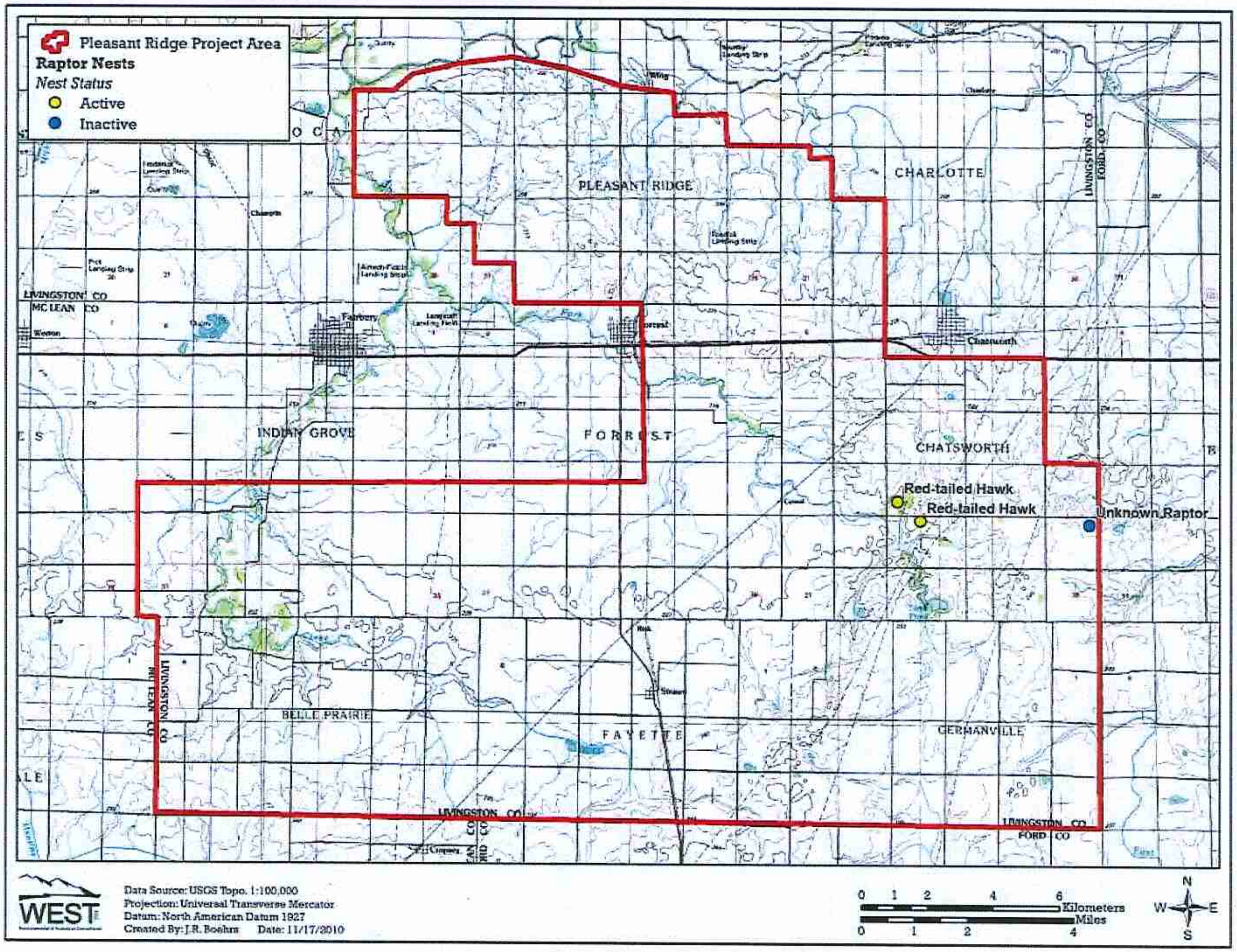

Figure 6. Location of raptor nests at the Pleasant Ridge Wind Farm.

Habitat Mapping

The results of the habitat mapping effort can be found in Figure 3 and Table 1a, while a description of each habitat type can be found in Table 1b. The habitat mapping effort was broad in scale. The dominant habitat type observed was tilled agriculture (corn and soybean), which comprised 90.6% (98,964.30 acres [154.63 mi^2]) of the PRWF. Unmowed grasslands were the next most common habitat type observed and comprised 2.4% (2,592.20acres [4.05 mi^2]) of the PRWF. Developed areas comprised 1.6% (1,793.33 acres [2.80 mi^2]), woodlots 1.5% (1,675.20 acres [0.26 mi^2]) and savannah 1.3% (1,381.80 acres [2.16 mi^2]) of the PRWF. The remaining area was comprised of small amounts of mowed grasslands, un-tilled agriculture (hayfields), shelterbelts with trees and shrubs, pasture, open water, and railroad verge.

American Golden-Plover Surveys

A total of 14 American golden-plover surveys were conducted between March 31 and May 14, 2009. Eight groups of 113 American golden-plovers were observed during these surveys (Table 5 and Figure 5). All (100%) of the American golden-plover observations were made below the likely ZOR.

Smith's Longspur Surveys

Surveys for Smith's longspurs were conducted in areas with potential suitable habitat in conjunction with American golden-plover surveys from March 31 to May 14, 2009. No Smith's longspurs were observed.

Incidental Wildlife Observations

There were 20 bird species recorded incidentally at the PRWF, totaling 162 birds within 92 separate groups during all surveys (Table 7). Four mammal species and one amphibian species were also observed incidentally at the PRWF.

Bird Observations

The most abundant bird species recorded as an incidental wildlife observation was red-tailed hawk (36 individuals; Table 7). Eight bird species were only seen incidentally at the PRWF: blue-winged teal (*Anas discors*), bufflehead (*Bucephala albeola*), dunlin (*Calidris alpina*), greater yellowlegs (*Tringa melanoleuca*), hooded merganser (*Lophodytes cucullatus*), northern mockingbird (*Mimus polyglottos*), wild turkey (*Meleagris gallopavo*), and wood duck (*Aix sponsa*).

Mammal Observations

Twenty-four white-tailed deer (*Odocoileus virginianus*) were observed incidentally during the surveys at the PRWF (Table 7). Eight thirteen-lined ground squirrels (*Spermophilus tridecemlineatus*), one raccoon (*Procyon lotor*), and one striped skunk (*Mephitis mephitis*) were also observed.

Amphibian Observations

One green frog (*Rana clamitans*) was observed incidentally during surveys at the PRWF (Table 7).

Sensitive Species Observations

Ten northern harriers, a state-endangered species (IDNR 2009), were recorded incidentally within the PRWF (Tables 5 and 7; Figure 5).

Table 7. Incidental wildlife observed while conducting all surveys at the Pleasant Ridge Wind Farm, March 5, 2009 - March 2, 2010.

Species	Scientific Name	#grps	# obs
red-tailed hawk	*Buteo jamaicensis*	33	36
dunlin	*Calidris alpina*	1	30
American kestrel	*Falco sparverius*	23	26
turkey vulture	*Cathartes aura*	7	13
northern harrier	*Circus cyaneus*	9	10
blue-winged teal	*Anas discors*	1	9
ring-necked pheasant	*Phasianus colchicus*	2	8
greater yellowlegs	*Tringa melanoleuca*	1	6
American crow	*Corvus brachyrhynchos*	2	4
rough-legged hawk	*Buteo lagopus*	3	3
ring-necked duck	*Aythya collaris*	1	3
wild turkey	*Meleagris gallopavo*	1	3
mallard	*Anas platyrhynchos*	1	2
northern shoveler	*Anas clypeata*	1	2
wood duck	*Aix sponsa*	1	2
bufflehead	*Bucephala albeola*	1	1
Cooper's hawk	*Accipiter cooperii*	1	1
hooded merganser	*Lophodytes cucullatus*	1	1
northern mockingbird	*Mimus polyglottos*	1	1
sharp-shinned hawk	*Accipiter striatus*	1	1
Bird Subtotal	**20 species**	**92**	**162**
white-tailed deer	*Odocoileus virginianus*	4	24
thirteen-lined ground squirrel	*Spermophilus tridecemlineatus*	8	8
raccoon	*Procyon lotor*	1	1
striped skunk	*Mephitis mephitis*	1	1
Mammal Subtotal	**4 species**	**14**	**34**
green frog	*Rana clamitans*	1	1

DISCUSSION AND IMPACT ASSESSMENT

Potential Impacts

Impacts to wildlife resources from wind-energy facilities can be direct or indirect. Direct impacts are considered to be 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 PRWF to wildlife are not expected to negatively impact bird populations based on the preponderance of tilled agriculture within the study area, but could impact individual nesting birds or burrowing wildlife within non-tilled areas.

The USFWS and the IDNR have expressed concern over the potential operation of wind-energy facilities to cause fatalities or displacement impacts to birds and bats over the life of the proposed wind-energy facility (IDNR 2007, USFWS 2003). The study described in this report was designed to help address these concerns. Discussion of potential bat fatalities can be found in Good et al. (2010).

Direct Impacts

Raptors

Typically, wind-energy facilities that have shown the highest raptor fatality rates have also shown the highest raptor use rates. Overall raptor use at the PRWF was relatively low compared to wind-energy facilities where raptor use is considered high (Figure 7).

The exposure index analysis may provide insight into what species might be the most likely turbine casualties. 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 likely 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 PRWF. 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 have been observed demonstrating behaviors at other wind-energy facilities that may increase their risk of collision with turbines (flights 50-m [164-ft] from turbines and many flights through the likely 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.

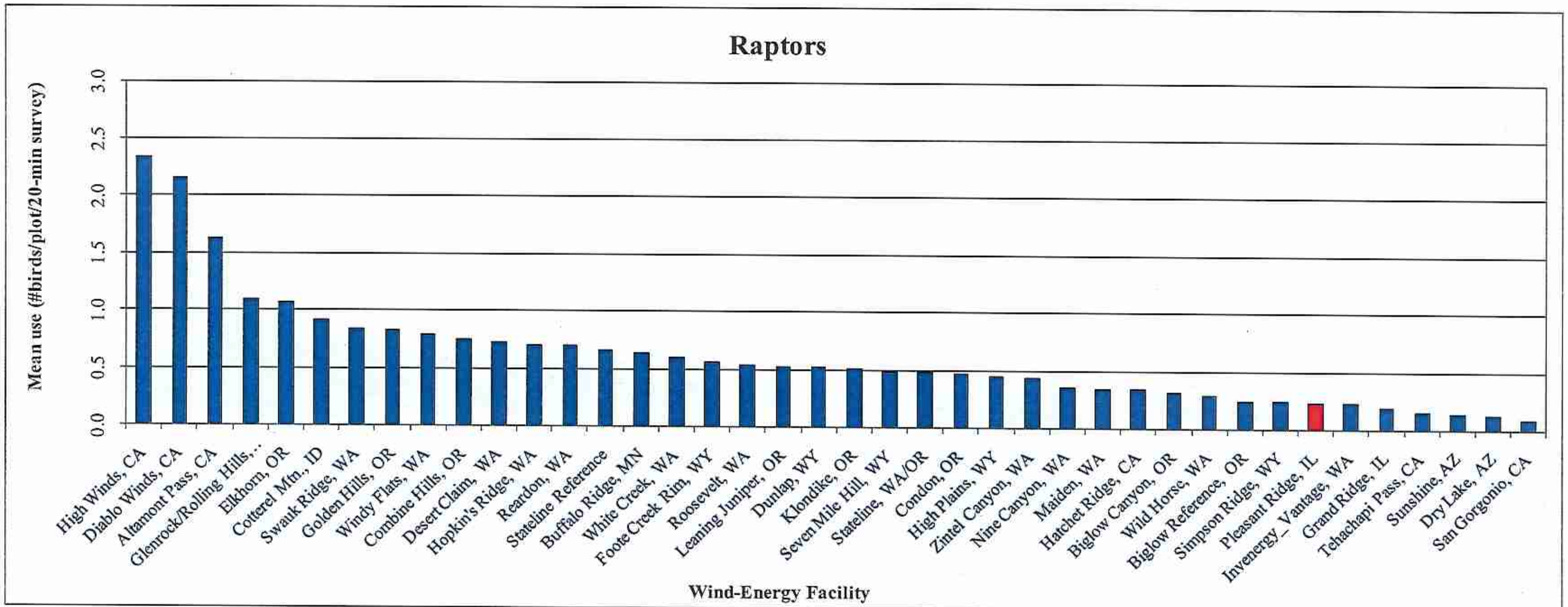

Figure 7. Comparison of annual raptor use between the Pleasant Ridge Wind Farm and other US wind-energy facilities.
Data from the following sources:

Pleasant Ridge, 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

The data collected at the PRWF showed that a low number of raptors utilized the PRWF during the study period. Overall mean raptor use at the PRWF is similar to raptor use reported from four other wind-energy facilities in the Midwest and Illinois (Table 8). 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 nine raptors (including four incidental finds) were recorded as fatalities at studies of seven wind-energy facilities located in tilled agriculture landscapes in Wisconsin (three facilities), Minnesota, Iowa, and Illinois (two facilities; Howe et al. 2002, Johnson et al. 2002b, Jain 2005, Kerlinger et al. 2007, BHE Environmental 2009, Gruver et al. 2009, Derby et al. 2010). A single red-tailed hawk was found as a casualty at a sub-station at the nearby Grand Ridge Wind Energy Facility (GRWEF), but no raptors were found as fatalities as the result of turbine collisions during a one year study (Derby et al. 2010). Raptor fatality rates at the PRWF are expected to be similar to those observed at other Midwest wind-energy facilities.

Table 8. Comparison of seasonal raptor use at other wind-energy facilities in the Midwestern region compared to the Pleasant Ridge Wind Farm.

	Raptor Use (# raptors/20-min survey)				
Site	**Fall**	**Winter**	**Spring**	**Summer**	**Reference**
Pleasant Ridge, IL	0.21	0.31	0.15	-	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

Waterfowl/Waterbirds/Shorebirds

A total of 18 groups of waterbirds (ring-billed gull and great blue heron) were recorded flying in the PRWF during fixed-point bird use surveys, and of those, approximately 32% of observations were recorded within the likely RSH, which may indicate that these species may be vulnerable to turbine collisions. Observations of great blue herons were distributed throughout the PRWF and no strong associations with habitat features were observed. A total of 17 groups of great blue herons were recorded flying during fixed-point bird surveys and approximately 28% of the observations were recorded within the likely RSH. Even though great blue heron is a relatively common species, this species is rarely reported as a fatality from wind-energy facilities in the U.S. (Erickson et al. 2001, Karas et al. 2007). While no great blue herons have been reported as fatalities at the wind-energy facilities in the Midwest listed above, nine great blue herons were recorded as fatalities at the Altamont Pass Wind Resource Area over an 18 year period (Smallwood and Karas 2009). A single ring-billed gull was observed flying within the likely RSH. None of the waterfowl or shorebird species observed during surveys within the PRWF were recorded flying within the likely RSH. At Midwestern wind-energy facilities, only eight waterfowl (4.1% of all Midwest bird fatalities), five waterbirds (2.6%), and two shorebirds (1%) have been reported as fatalities (Howe et al. 2002, Johnson et al. 2002b, Jain 2005, Kerlinger et al. 2007, BHE Environmental 2009, Gruver et al. 2009, Derby et al. 2010). The Midwestern proportions of bird fatalities are similar to those reported nationwide for waterfowl (5.3%), waterbirds (3.3%), and shorebirds (0.7%; NRC 2007).

Vultures

Despite the fact that turkey vultures are commonly observed near wind-energy facilities, turkey vultures are rarely observed as fatalities (Erickson et al. 2001a). One notable exception is the Buffalo Gap Wind-Energy Facility (BGWEF) in Texas (Tierney 2007), where higher rates of turkey vulture fatalities were observed compared to other wind-energy facilities. The landscape of the BGWEF differs greatly from the PRWF 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 vultures were observed flying during surveys in the PRWF. Based on flight height data, turkey vultures were recorded within the likely RSH for approximately 56% of observations, and some potential exists for turkey vulture fatalities to occur at the PRWF. Only one turkey vulture has been documented incidentally as a fatality at all wind-energy facilities in the Midwest (Howe et al. 2002, Johnson et al. 2002b, Jain 2005, Kerlinger et al. 2007, BHE Environmental 2009, Gruver et al. 2009, Derby et al. 2010) and therefore turkey vulture may not be at a relatively high risk of turbine collision in the Midwest.

Passerines

The majority of passerine species observed during the study were recorded as flying below the likely RSH of turbines, indicating that most passerine species have a relatively low risk of collision during daylight hours. Only two small bird species were observed flying within the likely RSH during surveys. Lapland longspur and cliff swallow.

Lapland longspurs may have a potentially higher risk of collision with wind turbines at the PRWF than other small birds, based on the heights at which they were observed. Lapland longspurs fatalities have been documented as fatalities in high numbers (5,000-10,000) at communications towers (Shire et al. 2000). Communication towers, specifically those that have Federal Communications Commission lights, have higher rates of small bird fatalities because the light attracts nocturnal migrants, the lattice structures are enticing perches to small birds, and the guy wires are difficult for birds to see, especially on foggy nights or low cloud nights (Shire et al. 2000). However, new generation turbines with a tubular design reduce the appeal to small birds for use as perches and the lack of guy wires reduces the potential for collisions to occur. Relatively few Lapland longspur and other passerines have been documented as fatalities at Midwest wind-energy facilities (Howe et al. 2002, Johnson et al. 2002b, Jain 2005, Koford et al. 2005, Kerlinger et al. 2007, Gruver 2009, BHE 2009, Derby et al. 2010).

Cliff swallow had the second highest relative exposure risk of all small birds observed in the PRWF. While cliff swallow have been found as fatalities at other wind-energy facilities (Erickson et al. 2001), there have not been large mortality events documented. Some potential exists for cliff swallows to collide with turbines. The proposed project is not expected to have large impacts on cliff swallow populations based on the fatality rates of swallow species observed at other wind-energy facilities.

To date passerine fatality rates at Midwestern wind-energy facilities have been relatively low. The range of overall bird fatality estimates at seven 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, Derby et al. 2010; Table 9). Bird fatality rates have been shown to be higher in the eastern U.S., especially within largely forested landscapes (NRC 2007).

Table 9. Avian mortality associated with other wind-energy facilities in the Midwest.

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**
Grand Ridge, IL	0.72	Derby et al. 2010
Mean	**3.02**	

* No winter (December, January, and February) surveys conducted
**No winter (November, December, January, and February) surveys conducted

Indirect Impacts

Displacement Impacts

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). Wind-energy facility operation also may reduce breeding songbird densities in close proximity to turbine locations. Leddy et al. (1999) surveyed bird densities in Conservation Reserve Program (CRP) grasslands at the Buffalo Ridge Wind-Energy Facility (BRWEF) in Minnesota, and found mean densities of ten grassland bird species were four times higher at areas located 180-m (591-ft) 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 BRWEF. 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, woodlots, savannah, pasture and hayfields) encompass approximately 6,590 acres (10.30 mi^2; 6.0%) of the PRWF. Invenergy has committed to placing turbines within tilled agriculture, thus greatly reducing the potential for grassland songbirds to be displaced from suitable nesting areas.

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 BRWEF, the abundance of 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 100-m of the turbines. However, studies conducted at wind-energy facilities in Iowa and Illinois have not shown avoidance by Canada geese (Jain 2005, Derby et al. 2009).

Threatened, Endangered, and Sensitive Species

No federally-listed threatened or endangered species were observed during all surveys in the PRWF. One Illinois state-listed endangered species (IDNR 2009), northern harrier, and one IDNR species of Greatest Need of Conservation and USFWS species of conservation concern (IDNR 2005, USFWS 2008), American golden-plover, were observed during all surveys (Table 5). Fixed-point bird surveys were conducted in the spring and fall migrations, and during the winter, which were the seasons expected to receive the greatest amount of use by birds.

Tilled agriculture is the dominant habitat type in the proposed PRWF and comprises approximately 90.6% of the total area. The USFWS (2003) recommends that wind-energy facilities be placed within areas devoid of natural features attractive to birds or in previously altered habitats. Corn and soybean fields typically do not provide suitable breeding or nesting habitat for species protected under the federal or Illinois endangered species acts, with the potential exception of the upland sandpiper. Fixed-point bird use surveys were not conducted during the summer due to the preponderance of tilled agriculture, which limits the amount of suitable nesting habitat for most bird species. However, other habitat types such as mowed grasslands, unmowed grasslands, un-tilled agriculture, pasture, savannah, shelterbelts, and railroad verge, are present and may provide habitat for breeding sensitive species such as upland sandpiper (state-endangered; *Bartramia longicauda*), loggerhead shrike (state-endangered; *Lanius ludovicianus*), northern harrier (state-endangered), and Franklin's ground squirrel (state-threatened; *Spermophilus franklinii*). Invenergy has committed to placing turbines within tilled agriculture, which greatly reduces the potential for potential habitat for most state-listed species to be impacted. Some streams are also present that have the potential to support state-listed aquatic species. Some potential exists for infrastructure to be located within non-agricultural landcover types or at stream crossings, and construction activities have some limited potential to impact individual state-listed species should occupied habitats be impacted.

Northern Harrier

A total of 29 northern harriers, an Illinois state-endangered species (IDNR 2009), were observed during fixed-point bird use surveys at the PRWF. Northern harriers were observed during the spring, fall and winter seasons. Most observations of northern harriers likely represent individuals migrating through or wintering in the PRWF; however, no summer surveys were complete and northern harrier may nest in suitable habitat within the PRWF.

The number of northern harriers reported during the surveys may not represent 29 separate individuals. Rather, a portion of this total likely represents repeated observations of the same individuals. Of the 17 observations of flying northern harriers, 100% were observed flying below the likely RSH. The hunting habits of northern harrier 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 likely RSH when conducting aerial courtship displays, and this species may occasionally fly within the likely RSH during migration. However, the data collected at the PRWF and other wind-energy facilities (Smallwood et al. 2009, Johnson et al. 2000b, Kerlinger 2002, Derby et al. 2009) indicates that northern harrier spend the majority of their time flying below the likely RSH. Northern harrier have been documented as fatalities at wind-energy facilities (Erickson et al. 2001a), and the potential exists for northern harrier to be found as fatalities at the PRWF, particularly during migration. However, the flight characteristics of the northern harrier may reduce the potential for fatalities to occur at the PRWF.

Some potential exists for northern harriers to nest within the PRWF. Northern harriers require large undisturbed wetlands, pastures, old fields, marshes, and upland habitats for breeding (Kleen et al. 2004). Suitable breeding habitat is limited in Illinois and no northern harrier has been documented breeding in Livingston County (Kleen et al. 2004). Research regarding northern harrier response to wind turbines is limited, and has showed mixed results. In Europe, hen harriers (a.k.a. northern harriers) 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 200 – 300-m (656 – 984-ft) from an operational wind turbine, and Pearce-Higgins et al. (2009) found foraging northern harriers to be less abundant within 250-m (820-ft) of operating turbines compared to control areas. The PRWF is comprised of 4.2% of habitats that northern harrier may find suitable for nesting (i.e., unmowed grassland, railroad verge, pasture and savannah).

American Golden-Plover

A total of 113 American golden-plovers were observed within the PRWF during American golden-plover surveys. American golden-plover were observed in the south western portion of the PRWF near Indian Creek (Figure 5). The American golden-plover is considered a species of conservation concern by the USFWS (2008) and a species of Greatest Need of Concern by the IDNR (2005). American golden plover has not been shown to be especially susceptible to collisions with turbines. A fatality study was conducted at a wind-energy facility in Benton County, Indiana, which is adjacent to a known American golden-plover Important Bird Area (IBA; Audubon 2010) that receives use from an estimated 42,000 – 84,000 American golden-plovers during spring migration, yet no American golden-plover fatalities were found (Johnson et al. 2009). Other fatality studies in the Midwest have been conducted and to date only two shorebirds, both killdeer, have been documented as fatalities (Howe et al. 2002, Johnson et al. 2002b, Jain 2005, Kerlinger et al. 2007, BHE Environmental 2009, Gruver et al. 2009, Derby et al. 2010).

The USFWS and the IDNR have expressed concern over the potential of wind-energy facilities in Illinois to displace American golden-plovers from areas used during spring migration. Central and eastern Illinois is used by staging American golden-plovers during spring migration as they migrate to more northerly nesting areas. However, observations of American golden-plovers during the spring of 2009 in the PRWF were low compared to other documented stopover areas in Illinois (O'Neal and Alessi 2008) and Indiana (IBA; Audubon 2010). The behavioral responses of American golden-plovers to wind turbines have not been well studied. Johnson et al. (2009) recorded no observations of plovers within 400-m of turbines at a wind-energy facility in Indiana; however, lower amounts of soybean fields were present near turbines, which is the preferred foraging habitat for American golden-plovers. Johnson et al. (2009) suggested that farmers rotate crop types between corn and soybean on a regular basis, and that additional years of study were needed before strong conclusions regarding American golden-plover responses to wind turbines could be made. If American golden-plovers avoid areas near turbines during spring migration, potential fatality rates for the species may be reduced. American golden-plovers utilize soybean fields for foraging in Indiana and Illinois during migration. While American golden-plovers have some potential to be displaced by wind turbines, the potential for displacement from wind turbines to impact any species is of greater concern when preferred habitats are limited or rare. The data collected during this study do not indicate that the PRWF is utilized as heavily as other well known American golden-plover stopover areas, such as the American golden-plover Important Bird Areas near Newman, Dalton City, and Arcola, Illinois (CWHP 2010) and Union Township in Benton County, Indiana (IBA; Audubon 2010). It is unlikely that potential displacement from soybean fields in the PRWF would have any impact on American golden-plover populations considering the abundance of soybean fields in Illinois, and low numbers observed within the PRWF.

CONCLUSIONS

The USFWS interim guidelines for wind-energy development suggest that wind-energy projects should be sited within previously altered habitats (USFWS 2003). The proposed project is dominated by tilled and un-tilled agriculture, and developed areas, which comprise 90.6 % of the area. Most turbines will be located within tilled agriculture, which will reduce potential impacts to birds. The results of bird studies at PRWF area show raptor use rates during the spring, fall and winter were lower than observed at other wind-energy facilities, and similar to other projects in the Midwest, likely due to the dominance of tilled agriculture. A study of bird fatalities at the GRWEF found bird fatality rates to be 0.72/MW/year, which was low compared to other wind-energy facilities in the Midwest and the U.S. The placement of turbines within tilled agriculture should further reduce potential bird fatality rates for most bird species. Fatality rates of birds at the PRWRA are expected to be similar to or lower than those observed at other wind-energy facilities in the Midwest, based on data collected during this study, dominance of relatively flat tilled agriculture in the PRWRA, and results of fatality monitoring studies conducted at other wind-energy facilities in Illinois.

Fixed-point bird use surveys were not conducted during the summer due to the preponderance of tilled agriculture, which limits the amount of suitable nesting habitat for most bird species. However, other habitat types such as mowed grasslands, unmowed grasslands, un-tilled agriculture, pasture, savannah, shelterbelts, and railroad verge, are present and may provide habitat for breeding state-listed species such as upland sandpiper (*Bartramia longicauda*), loggerhead shrike, northern harrier, and Franklin's ground squirrel. Woodlots are also present that may provide potential habitat for the federally listed Indiana bat within portions of the PRWF. Invenergy has committed to placing turbines within tilled agriculture, which reduces the potential for potential habitat for most state-listed species to be impacted. Some streams are also present that have the potential to support state-listed mussel or fish species. Some potential exists for infrastructure to be located within non-agricultural landcover types or at stream crossings, and construction activities have some limited potential to impact individual state-listed species should occupied habitats be impacted.

Habitat data collected during this study can be utilized to identify locations where turbines or infrastructure may be located within or near potential habitat for state-listed species, and to determine if further surveys or mitigation measures are warranted to protect individual state-listed species.

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Appendix A. Summary and Total Number of Individuals and Groups for Each Bird Type and Species, by Season and Overall, During the Fixed-Point Bird Use Surveys at the Pleasant Ridge Wind Farm, March 5, 2009 - March 2, 2010.

Appendix A. Total number of individuals and groups for each bird type and species[a], by season and overall, during the fixed-point bird use surveys at the Pleasant Ridge Wind Farm[a], March 5, 2009 - March 2, 2010.

		Spring		Fall		Winter		Total	
Species/Type	Scientific Name	# grps	# obs	# grps	# obs	# grps	# obs	# grps	# obs
Waterbirds		**13**	**14**	**4**	**4**	**1**	**1**	**18**	**19**
great blue heron	*Ardea herodias*	12	13	4	4	1	1	17	18
ring-billed gull	*Larus delawarensis*	1	1	0	0	0	0	1	1
Waterfowl		**23**	**123**	**5**	**97**	**1**	**10**	**29**	**230**
Canada goose	*Branta canadensis*	14	68	4	37	1	10	19	115
green-winged teal	*Anas crecca*	1	5	0	0	0	0	1	5
mallard	*Anas platyrhynchos*	5	14	0	0	0	0	5	14
northern shoveler	*Anas clypeata*	1	10	0	0	0	0	1	10
ring-necked duck	*Aythya collaris*	1	20	0	0	0	0	1	20
snow goose	*Chen caerulescens*	1	6	1	60	0	0	2	66
Shorebirds		**83**	**109**	**23**	**62**	**0**	**0**	**106**	**171**
killdeer	*Charadrius vociferus*	81	107	23	62	0	0	104	169
Wilson's snipe	*Gallinago delicata*	2	2	0	0	0	0	2	2
Rails/Coots		**1**	**6**	**0**	**0**	**0**	**0**	**1**	**6**
American coot	*Fulica americana*	1	6	0	0	0	0	1	6
Raptors		**29**	**33**	**34**	**37**	**28**	**30**	**91**	**100**
Accipiters		*2*	*2*	*3*	*4*	*0*	*0*	*5*	*6*
Cooper's hawk	*Accipiter cooperii*	1	1	0	0	0	0	1	1
sharp-shinned hawk	*Accipter striatus*	1	1	3	4	0	0	4	5
Buteos		*18*	*21*	*16*	*17*	*12*	*13*	*46*	*51*
red-tailed hawk	*Buteo jamaicensis*	18	21	16	17	11	12	45	50
rough-legged hawk	*Buteo lagopus*	0	0	0	0	1	1	1	1
Northern Harrier		*4*	*4*	*7*	*8*	*7*	*7*	*18*	*19*
northern harrier	*Circus cyaneus*	4	4	7	8	7	7	18	19
Falcons		*5*	*6*	*8*	*8*	*8*	*8*	*21*	*22*
American kestrel	*Falco sparverius*	5	6	8	8	8	8	21	22
Owls		**0**	**0**	**0**	**0**	**1**	**2**	**1**	**2**
great horned owl	*Bubo virginianus*	0	0	0	0	1	2	1	2
Vultures		**18**	**31**	**7**	**13**	**0**	**0**	**25**	**44**
turkey vulture	*Cathartes aura*	18	31	7	13	0	0	25	44
Upland Game Birds		**16**	**17**	**5**	**5**	**1**	**1**	**22**	**23**
ring-necked pheasant	*Phasianus colchicus*	16	17	5	5	1	1	22	23

Appendix A. Total number of individuals and groups for each bird type and species[a], by season and overall, during the fixed-point bird use surveys at the Pleasant Ridge Wind Farm[a], March 5, 2009 - March 2, 2010.

		Spring		Fall		Winter		Total	
Species/Type	Scientific Name	# grps	# obs	# grps	# obs	# grps	# obs	# grps	# obs
Doves/Pigeons		**43**	**82**	**21**	**66**	**2**	**9**	**66**	**157**
Eurasian collared-dove	*Streptopelia decaocto*	1	1	0	0	0	0	1	1
mourning dove	*Zenaida macroura*	28	44	19	58	2	9	49	111
rock pigeon	*Columba livia*	14	37	2	8	0	0	16	45
Large Corvids		**15**	**31**	**10**	**21**	**14**	**86**	**39**	**138**
American crow	*Corvus brachyrhynchos*	15	31	10	21	14	86	39	138
Passerines		**992**	**2,161**	**196**	**1,744**	**73**	**417**	**1,261**	**4,322**
American goldfinch	*Carduelis tristis*	15	19	34	67	1	1	50	87
American robin	*Turdus migratorius*	120	271	39	183	1	5	160	459
American tree sparrow	*Spizella arborea*	1	5	0	0	3	14	4	19
Baltimore oriole	*Icterus galbula*	1	1	0	0	0	0	1	1
barn swallow	*Hirundo rustica*	54	83	5	25	0	0	59	108
black-capped chickadee	*Poecile atricapillus*	1	2	0	0	0	0	1	2
blue jay	*Cyanocitta cristata*	4	4	6	8	3	4	13	16
brown-headed cowbird	*Molothrus ater*	131	323	5	256	1	2	137	581
brown thrasher	*Toxostoma rufum*	3	3	1	1	0	0	4	4
Carolina chickadee	*Poecile carolinensis*	1	2	0	0	0	0	1	2
chipping sparrow	*Spizella passerina*	8	9	0	0	0	0	8	9
cliff swallow	*Petrochelidon pyrrhonota*	0	0	2	20	0	0	2	20
common grackle	*Quiscalus quiscula*	122	300	7	16	0	0	129	316
dark-eyed junco	*Junco hyemalis*	1	1	0	0	4	101	5	102
dickcissel	*Spiza americana*	9	12	2	2	0	0	11	14
eastern bluebird	*Sialia sialis*	1	6	4	7	0	0	5	13
eastern kingbird	*Tyrannus tyrannus*	2	2	0	0	0	0	2	2
eastern meadowlark	*Sturnella magna*	80	94	3	3	0	0	83	97
eastern phoebe	*Sayornis phoebe*	1	1	0	0	0	0	1	1
eastern towhee	*Pipilo erythrophthalmus*	1	1	0	0	0	0	1	1
European starling	*Sturnus vulgaris*	56	254	33	903	12	163	101	1,320
field sparrow	*Spizella pusilla*	3	3	0	0	0	0	3	3
gray catbird	*Dumetella carolinensis*	0	0	1	1	0	0	1	1
horned lark	*Eremophila alpestris*	91	143	21	55	35	70	147	268
house finch	*Carpodacus mexicanus*	1	2	0	0	0	0	1	2
house sparrow	*Passer domesticus*	12	20	1	1	4	15	17	36
house wren	*Troglodytes aedon*	2	2	0	0	0	0	2	2
indigo bunting	*Passerina cyanea*	5	5	1	1	0	0	6	6

Appendix A. Total number of individuals and groups for each bird type and species[a], by season and overall, during the fixed-point bird use surveys at the Pleasant Ridge Wind Farm[a], March 5, 2009 - March 2, 2010.

		Spring		Fall		Winter		Total	
Species/Type	**Scientific Name**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**
Lapland longspur	*Calcarius lapponicus*	6	37	1	10	5	31	12	78
northern cardinal	*Cardinalis cardinalis*	7	7	0	0	1	1	8	8
red-winged blackbird	*Agelaius phoeniceus*	202	485	18	163	1	8	221	656
savannah sparrow	*Passerculus sandwichensis*	1	1	0	0	0	0	1	1
song sparrow	*Melospiza melodia*	18	24	1	1	1	1	20	26
tree swallow	*Tachycineta bicolor*	8	11	2	6	0	0	10	17
tufted titmouse	*Baeolophus bicolor*	0	0	0	0	1	1	1	1
vesper sparrow	*Pooecetes gramineus*	24	28	8	14	0	0	32	42
yellow-rumped warbler	*Dendroica coronata*	0	0	1	1	0	0	1	1
Other Birds		**16**	**19**	**7**	**8**	**1**	**1**	**24**	**28**
belted kingfisher	*Ceryle alcyon*	0	0	1	1	0	0	1	1
chimney swift	*Chaetura pelagica*	7	10	0	0	0	0	7	10
downy woodpecker	*Picoides pubescens*	4	4	1	1	0	0	5	5
northern flicker	*Colaptes auratus*	3	3	5	6	0	0	8	9
red-bellied woodpecker	*Melanerpes carolinus*	0	0	0	0	1	1	1	1
red-headed woodpecker	*Melanerpes erythrocephalus*	2	2	0	0	0	0	2	2
Overall		**1,249**	**2,626**	**312**	**2,057**	**121**	**555**	**1,682**	**5,238**

Appendix B. Mean Use, Percent of Total Composition, and Frequency of Occurrence for Large Birds and Small Birds Observed During the Fixed-Point Bird Use Surveys at the Pleasant Ridge Wind Farm, March 5, 2009 – March 2, 2010.

Appendix B-1. Mean bird use (number of birds/plot/20-min 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 Pleasant Ridge Wind Farm, March 5, 2009 - March 2, 2010.

	Use			% Composition			% Frequency		
Species/Type	**Spring**	**Fall**	**Winter**	**Spring**	**Fall**	**Winter**	**Spring**	**Fall**	**Winter**
Waterbirds	**0.06**	**0.02**	**<0.01**	**3.3**	**1.3**	**0.6**	**6.0**	**2.3**	**0.7**
great blue heron	0.06	0.02	<0.01	3.1	1.3	0.6	5.6	2.3	0.7
ring-billed gull	<0.01	0	0	0.2	0	0	0.4	0	0
Waterfowl	**0.51**	**0.55**	**0.07**	**26.6**	**31.8**	**6.0**	**7.9**	**2.9**	**0.7**
Canada goose	0.30	0.21	0.07	15.7	12.1	6.0	5.4	2.3	0.7
green-winged teal	0.02	0	0	0.9	0	0	0.4	0	0
mallard	0.06	0	0	3.3	0	0	2.2	0	0
northern shoveler	0.04	0	0	1.9	0	0	0.4	0	0
ring-necked duck	0.07	0	0	3.7	0	0	0.4	0	0
snow goose	0.02	0.34	0	1.1	19.7	0	0.4	0.6	0
Shorebirds	**0.48**	**0.35**	**0**	**25.3**	**20.3**	**0**	**34.3**	**13.1**	**0**
killdeer	0.47	0.35	0	24.7	20.3	0	33.3	13.1	0
Wilson's snipe	0.01	0	0	0.6	0	0	1.1	0	0
Rails/Coots	**0.02**	**0**	**0**	**1.1**	**0**	**0**	**0.4**	**0**	**0**
American coot	0.02	0	0	1.1	0	0	0.4	0	0
Raptors	**0.15**	**0.21**	**0.28**	**7.9**	**12.1**	**23.0**	**12.3**	**17.7**	**21.2**
Accipiters	*<0.01*	*0.02*	*0*	*0.4*	*1.3*	*0*	*0.7*	*1.7*	*0*
Cooper's hawk	<0.01	0	0	0.2	0	0	0.4	0	0
sharp-shinned hawk	<0.01	0.02	0	0.2	1.3	0	0.4	1.7	0
Buteos	*0.09*	*0.10*	*0.11*	*4.9*	*5.6*	*9.5*	*7.7*	*9.1*	*10.6*
red-tailed hawk	0.09	0.10	0.11	4.9	5.6	8.9	7.7	9.1	9.9
rough-legged hawk	0	0	<0.01	0	0	0.6	0	0	0.7
Northern Harrier	*0.01*	*0.05*	*0.06*	*0.7*	*2.6*	*4.8*	*1.4*	*4.0*	*5.0*
northern harrier	0.01	0.05	0.06	0.7	2.6	4.8	1.4	4.0	5.0
Falcons	*0.03*	*0.05*	*0.08*	*1.8*	*2.6*	*6.5*	*2.8*	*4.6*	*7.0*
American kestrel	0.03	0.05	0.08	1.8	2.6	6.5	2.8	4.6	7.0
Owls	**0**	**0**	**0.03**	**0**	**0**	**2.3**	**0**	**0**	**1.4**
great horned owl	0	0	0.03	0	0	2.3	0	0	1.4
Vultures	**0.15**	**0.07**	**0**	**8.1**	**4.3**	**0**	**8.9**	**4.0**	**0**
turkey vulture	0.15	0.07	0	8.1	4.3	0	8.9	4.0	0
Upland Game Birds	**0.07**	**0.03**	**<0.01**	**3.8**	**1.6**	**0.6**	**7.0**	**2.9**	**0.7**
ring-necked pheasant	0.07	0.03	<0.01	3.8	1.6	0.6	7.0	2.9	0.7
Doves/Pigeons	**0.34**	**0.38**	**0.08**	**17.6**	**21.6**	**7.1**	**17.6**	**12.0**	**2.1**
Eurasian collared-dove	<0.01	0	0	0.2	0	0	0.4	0	0
mourning dove	0.19	0.33	0.08	9.8	19.0	7.1	11.8	10.9	2.1
rock pigeon	0.14	0.05	0	7.5	2.6	0	5.8	1.1	0
Large Corvids	**0.12**	**0.12**	**0.75**	**6.3**	**6.9**	**62.7**	**5.6**	**5.7**	**11.3**
American crow	0.12	0.12	0.75	6.3	6.9	62.7	5.6	5.7	11.3
Overall	**1.91**	**1.74**	**1.19**	**100**	**100**	**100**			

Appendix B-2. Mean use (number of birds/100-m plot/20-min 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 Pleasant Ridge Wind Farm, March 5, 2009 - March 2, 2010.

	Use			% Composition			% Frequency		
Species/Type	**Spring**	**Fall**	**Winter**	**Spring**	**Fall**	**Winter**	**Spring**	**Fall**	**Winter**
Passerines	**7.36**	**8.69**	**3.50**	**99.0**	**99.5**	**99.6**	**87.6**	**66.9**	**48.5**
American goldfinch	0.07	0.38	0.01	0.9	4.3	0.4	5.0	18.9	1.4
American robin	0.84	1.02	0.07	11.3	11.6	2.0	33.8	20.0	1.4
American tree sparrow	0.02	0	0.19	0.2	0	5.5	0.4	0	2.8
barn swallow	0.39	0.14	0	5.3	1.6	0	22.1	2.9	0
black-capped chickadee	<0.01	0	0	<0.1	0	0	0.4	0	0
blue jay	<0.01	0.04	0.04	<0.1	0.5	1.2	0.4	2.9	2.8
brown-headed cowbird	1.11	1.46	0.01	14.9	16.8	0.4	39.3	2.9	0.7
brown thrasher	0.01	<0.01	0	0.1	<0.1	0	1.0	0.6	0
chipping sparrow	<0.01	0	0	<0.1	0	0	0.7	0	0
cliff swallow	0	0.11	0	0	1.3	0	0	1.1	0
common grackle	1.20	0.09	0	16.2	1.0	0	35.8	4.0	0
dark-eyed junco	<0.01	0	1.38	<0.1	0	39.4	0.4	0	3.5
dickcissel	0.04	0.01	0	0.5	0.1	0	1.9	1.1	0
eastern bluebird	0.02	0.04	0	0.3	0.5	0	0.4	2.3	0
eastern kingbird	0.01	0	0	0.2	0	0	1.1	0	0
eastern meadowlark	0.15	0.02	0	2.1	0.2	0	10.7	1.7	0
eastern phoebe	<0.01	0	0	<0.1	0	0	0.4	0	0
European starling	0.77	3.97	0.52	10.4	45.4	14.7	16.1	14.9	9.2
field sparrow	<0.01	0	0	<0.1	0	0	0.7	0	0
horned lark	0.44	0.31	0.64	5.9	3.5	18.3	24.9	11.4	31.0
house finch	<0.01	0	0	<0.1	0	0	0.4	0	0
house sparrow	0.08	<0.01	0.18	1.0	<0.1	5.2	4.5	0.6	4.2
indigo bunting	<0.01	<0.01	0	<0.1	<0.1	0	0.4	0.6	0
Lapland longspur	0.17	0.06	0.36	2.2	0.7	10.1	2.5	0.6	4.2
northern cardinal	0.02	0	<0.01	0.3	0	0.2	2.2	0	0.7
red-winged blackbird	1.78	0.90	0.06	23.9	10.3	1.6	53.0	8.6	0.7
savannah sparrow	<0.01	0	0	<0.1	0	0	0.4	0	0
song sparrow	0.08	<0.01	<0.01	1.1	<0.1	0.2	5.0	0.6	0.7
tree swallow	0.05	0.03	0	0.6	0.4	0	3.5	1.1	0
tufted titmouse	0	0	0.01	0	0	0.4	0	0	1.4
vesper sparrow	0.08	0.08	0	1.0	0.9	0	7.0	4.6	0
yellow-rumped warbler	0	<0.01	0	0	<0.1	0	0	0.6	0
Other Birds	**0.08**	**0.04**	**0.01**	**1.0**	**0.5**	**0.4**	**5.5**	**3.4**	**1.4**
belted kingfisher	0	<0.01	0	0	<0.1	0	0	0.6	0
chimney swift	0.05	0	0	0.7	0	0	3.7	0	0
downy woodpecker	<0.01	<0.01	0	<0.1	<0.1	0	0.7	0.6	0
northern flicker	<0.01	0.03	0	<0.1	0.3	0	0.7	2.3	0
red-bellied woodpecker	0	0	0.01	0	0	0.4	0	0	1.4
red-headed woodpecker	<0.01	0	0	<0.1	0	0	0.7	0	0
Overall	**7.44**	**8.73**	**3.51**	**100**	**100**	**100**			

Appendix C. Relative Exposure Index and Flight Characteristics for Large and Small Bird Species During the Fixed-Point Bird Use Surveys at the Pleasant Ridge Wind Farm, March 5, 2009 - March 2, 2010.

Appendix C-1. Relative exposure index and flight characteristics for large bird species during the fixed-point bird use surveys at the Pleasant Ridge Wind Farm, March 5, 2009 - March 2, 2010.

Species	# Groups Flying	Overall Mean Use	% Flying	% Flying within RSH based on initial obs	Exposure Index	% Within RSH at anytime
red-tailed hawk	44	0.10	98.0	18.4	0.02	30.6
turkey vulture	24	0.06	97.7	27.9	0.02	55.8
American crow	27	0.47	87.0	2.5	0.01	59.2
ring-billed gull	1	<0.01	100	100	<0.01	100
American kestrel	17	0.06	81.8	5.6	<0.01	11.1
great blue heron	17	0.03	100	27.8	<0.01	27.8
killdeer	65	0.22	65.7	0	0	0
mourning dove	39	0.17	84.7	0	0	0
Canada goose	9	0.16	40.9	0	0	0
snow goose	2	0.08	100	0	0	0
rock pigeon	16	0.05	100	0	0	0
northern harrier	17	0.05	94.7	0	0	0
ring-necked pheasant	1	0.03	4.3	0	0	0
ring-necked duck	0	0.02	0	0	0	0
mallard	4	0.02	92.9	0	0	0
northern shoveler	0	0.01	0	0	0	0
American coot	0	<0.01	0	0	0	0
Cooper's hawk	1	<0.01	100	0	0	0
Eurasian collared-dove	0	<0.01	0	0	0	0
great horned owl	0	<0.01	0	0	0	0
green-winged teal	0	<0.01	0	0	0	0
rough-legged hawk	1	<0.01	100	0	0	0
sharp-shinned hawk	4	<0.01	100	0	0	60.0
Wilson's snipe	2	<0.01	100	0	0	0

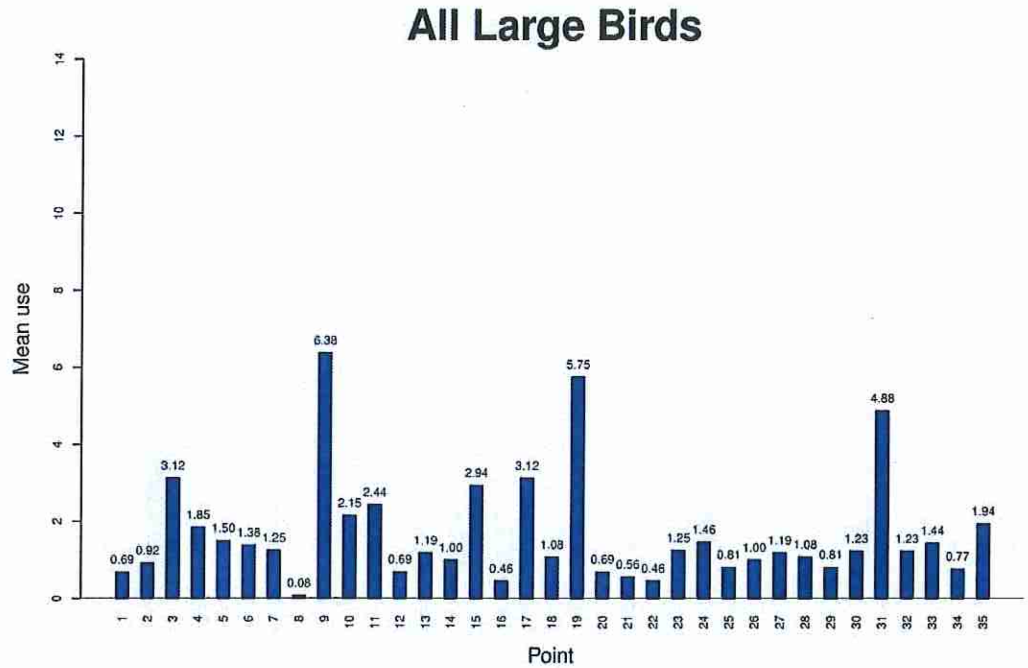
RSH: The likely "rotor swept height" for potential collision with a turbine blade, or 115-427-ft (35-130-m) above grounc level (AGL).

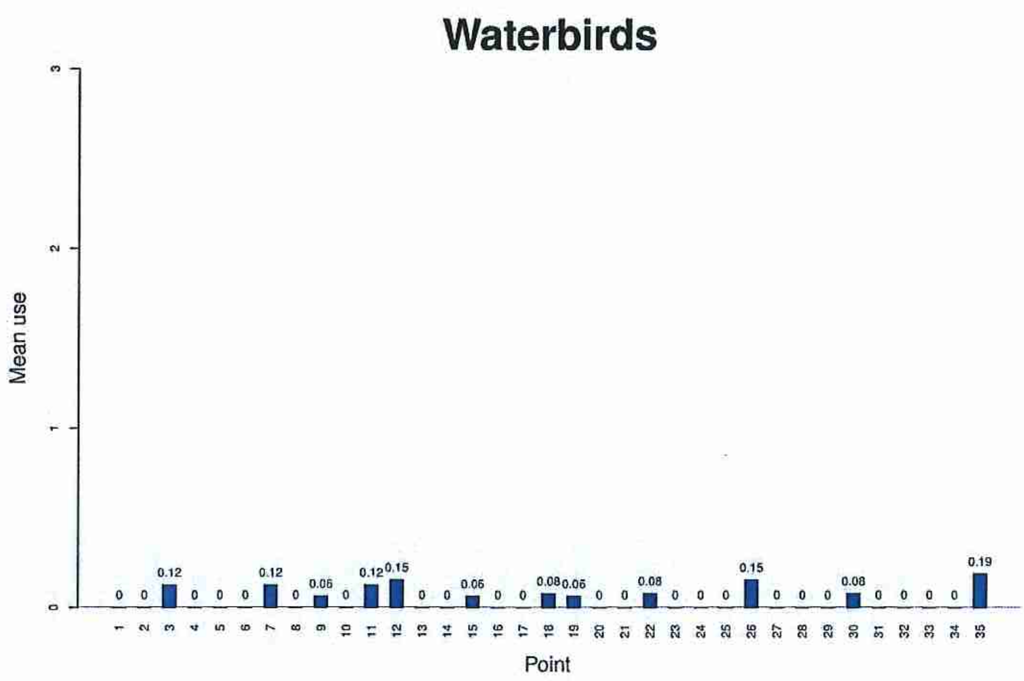
Appendix C-2. Relative exposure index and flight characteristics for small bird species during the fixed-point bird use surveys at the Pleasant Ridge Wind Farm, March 5, 2009 - March 2, 2010.

Species	# Groups Flying	Overall Mean Use	% Flying	% Flying within RSH based on initial obs	Exposure Index	% Within RSH at anytime
Lapland longspur	10	0.20	96.2	26.7	0.05	26.7
cliff swallow	2	0.03	100	50.0	0.01	50.0
European starling	73	1.44	97.3	0	0	0.3
red-winged blackbird	148	0.77	92.2	0	0	0
brown-headed cowbird	105	0.67	78.3	0	0	0
American robin	100	0.50	91.0	0	0	0
horned lark	64	0.50	70.9	0	0	0
dark-eyed junco	5	0.49	100	0	0	0
common grackle	108	0.38	97.1	0	0	0
barn swallow	56	0.15	98.1	0	0	0
American goldfinch	31	0.11	82.5	0	0	0
house sparrow	13	0.09	77.4	0	0	0
American tree sparrow	4	0.07	100	0	0	0
eastern meadowlark	19	0.05	66.7	0	0	0
vesper sparrow	17	0.04	69.7	0	0	0
blue jay	3	0.03	33.3	0	0	0
song sparrow	9	0.03	59.1	0	0	0
chimney swift	6	0.02	80.0	0	0	0
eastern bluebird	1	0.02	46.2	0	0	0
tree swallow	10	0.02	100	0	0	0
dickcissel	5	0.01	63.6	0	0	0
belted kingfisher	1	<0.01	100	0	0	0
black-capped chickadee	1	<0.01	100	0	0	0
brown thrasher	3	<0.01	100	0	0	0
chipping sparrow	0	<0.01	0	0	0	0
downy woodpecker	2	<0.01	66.7	0	0	0
eastern kingbird	2	<0.01	100	0	0	0
eastern phoebe	1	<0.01	100	0	0	0
field sparrow	1	<0.01	50.0	0	0	0
house finch	1	<0.01	100	0	0	0
indigo bunting	0	<0.01	0	0	0	0
northern cardinal	2	<0.01	40.0	0	0	0
northern flicker	3	<0.01	42.9	0	0	0
red-bellied woodpecker	0	<0.01	0	0	0	0
red-headed woodpecker	2	<0.01	100	0	0	0
savannah sparrow	0	<0.01	0	0	0	0
tufted titmouse	1	<0.01	100	0	0	0
yellow-rumped warbler	1	<0.01	100	0	0	0

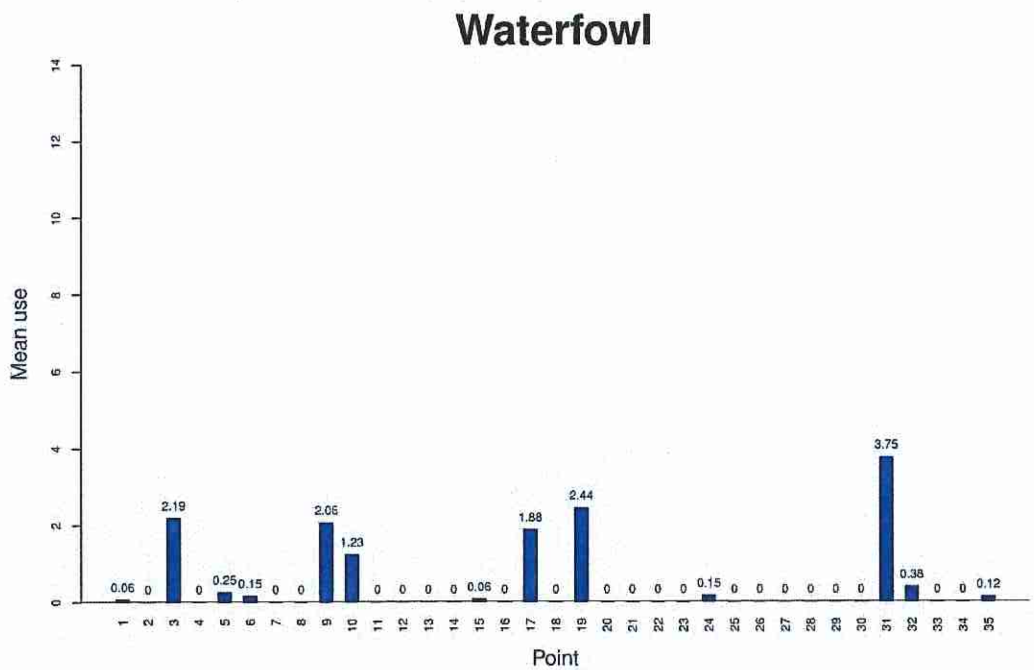
RSH: The likely "rotor swept height" for potential collision with a turbine blade, or 35-130-m (115-427-ft) above ground level (AGL).

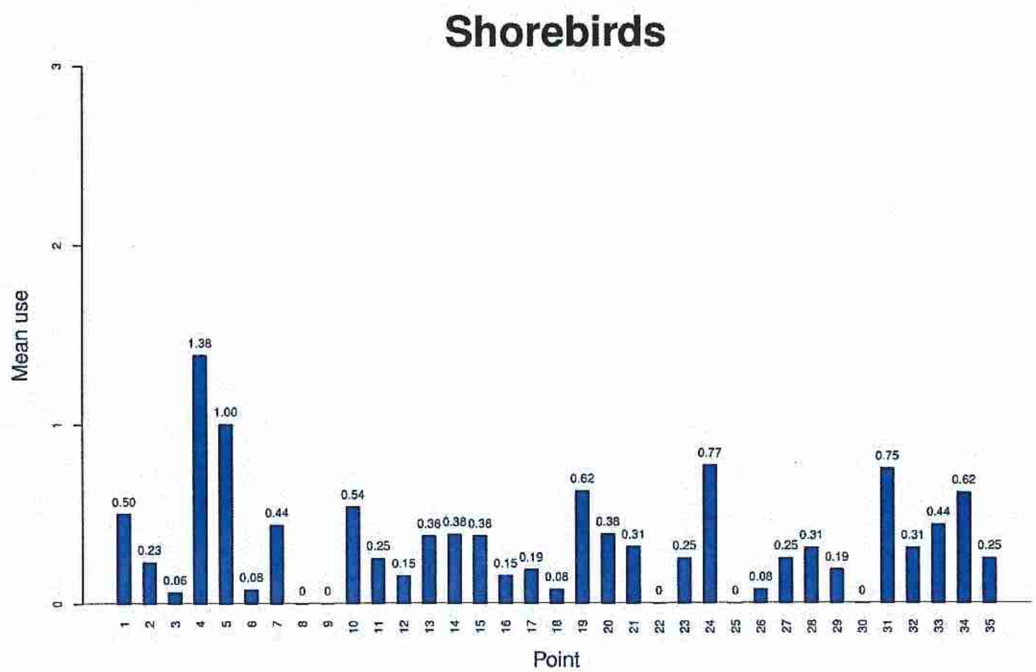
Appendix D. Mean Use by Point for Large and Small Birds, Major Bird Types, and Raptor Subtypes at the Pleasant Ridge Wind Farm.



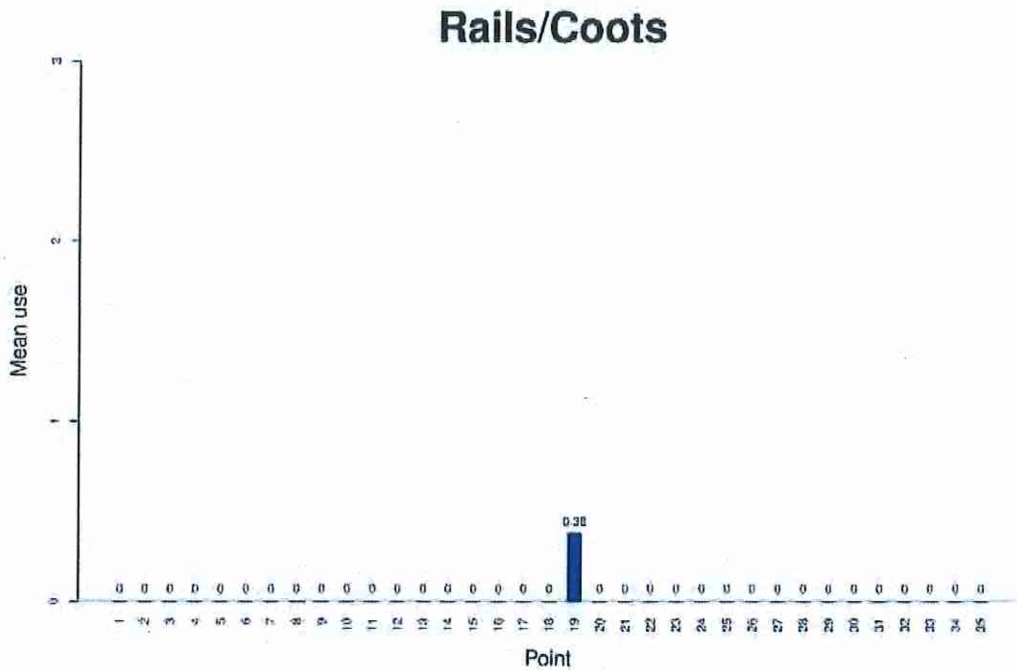


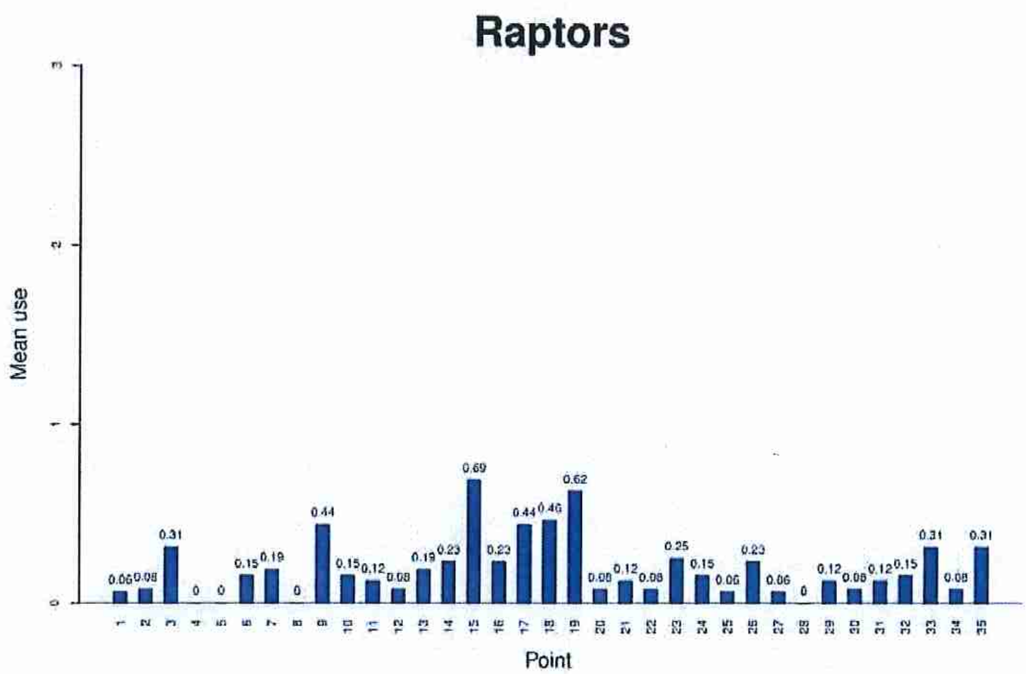
Appendix D. Mean use (number of birds/20-min survey) at each fixed-point bird use survey point for all birds and major bird types at the Pleasant Ridge Wind Farm.





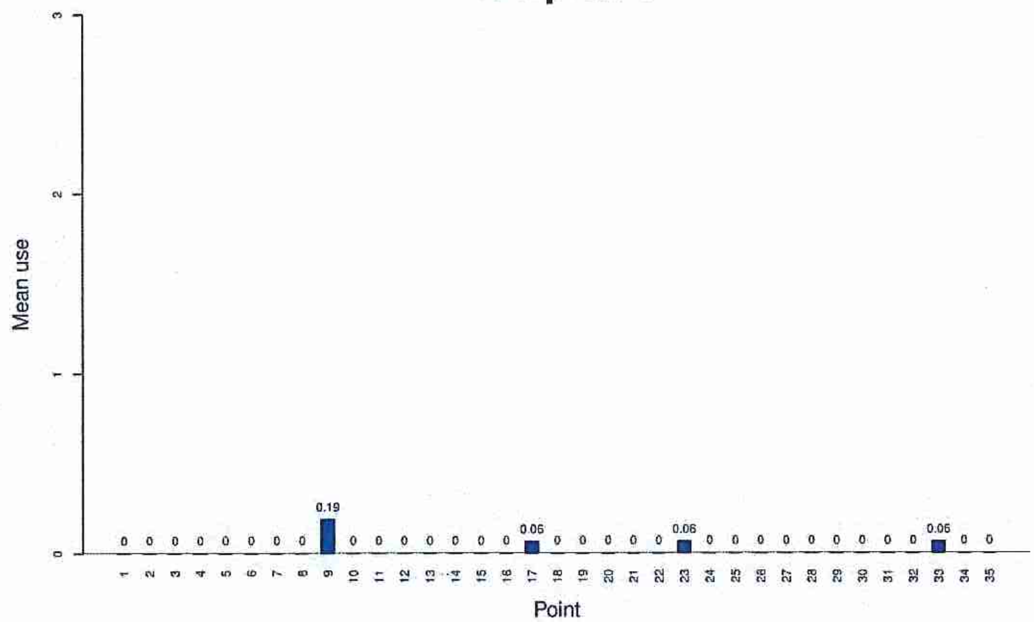
Appendix D (*continued*). Mean use (number of birds/20-min survey) at each fixed-point bird use survey point for all birds and major bird types at the Pleasant Ridge Wind Farm.



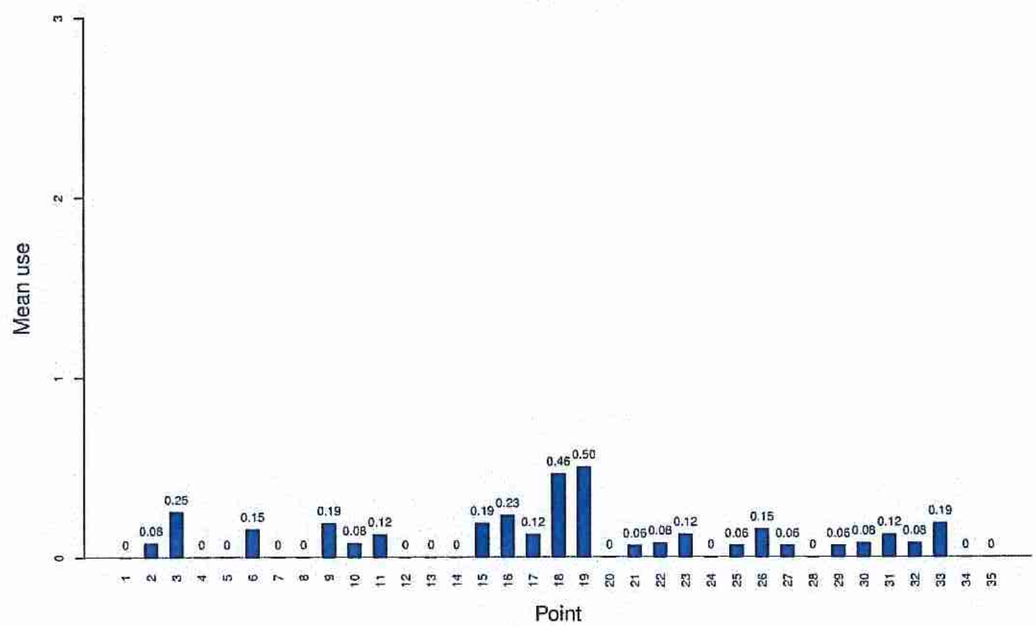


Appendix D (continued). Mean use (number of birds/20-min survey) at each fixed-point bird use survey point for all birds and major bird types at the Pleasant Ridge Wind Farm.

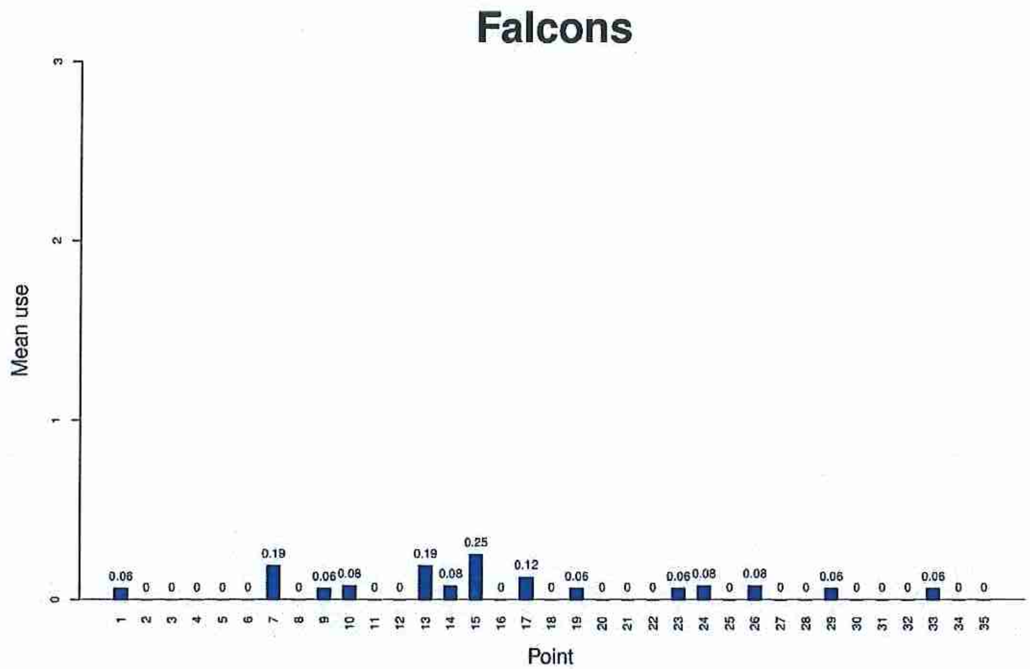
Accipiters

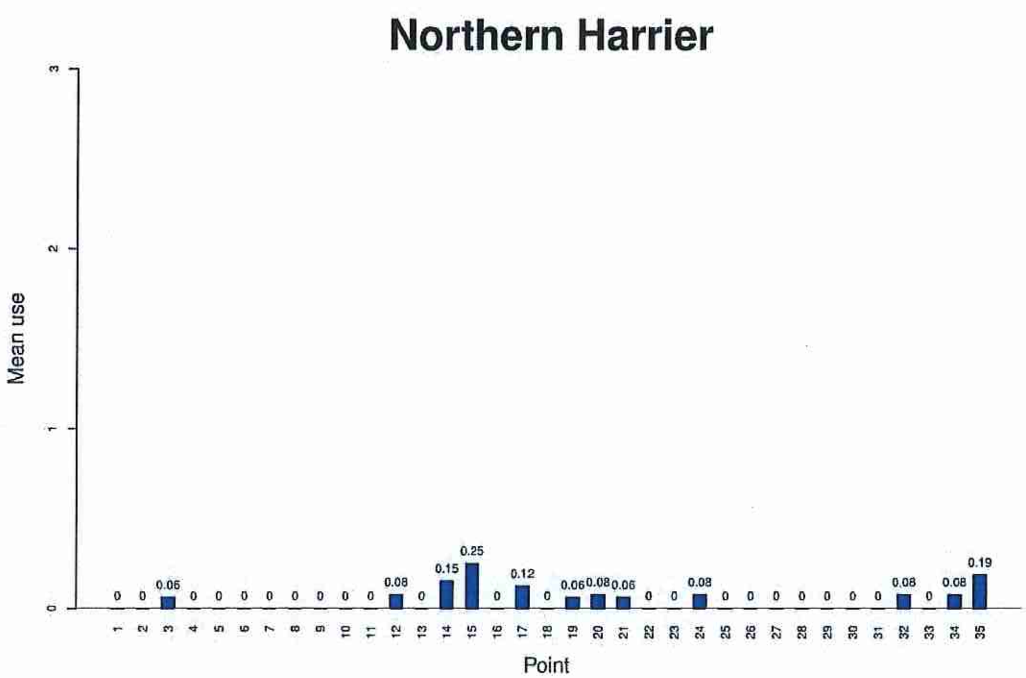


Buteos

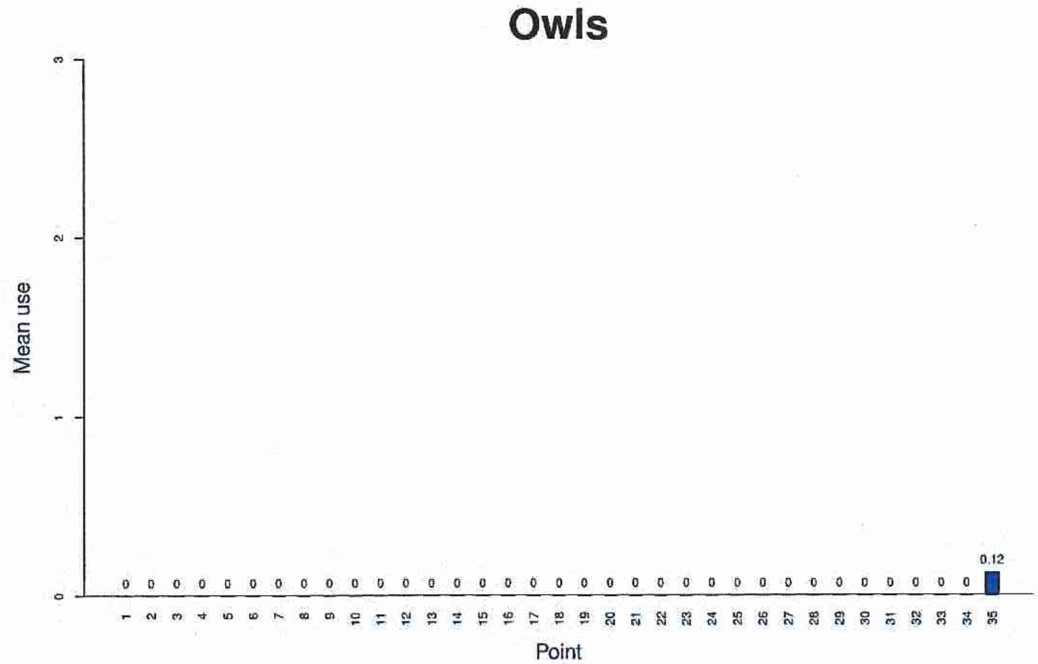


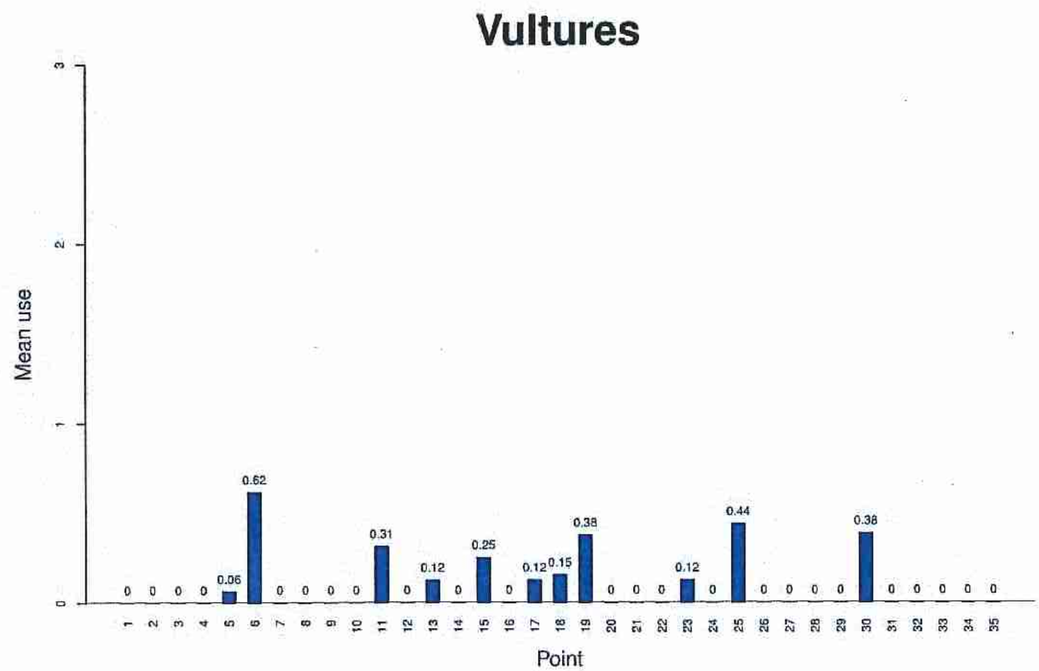
Appendix D (*continued*). Mean use (number of birds/20-min survey) at each fixed-point bird use survey point for all birds and major bird types at the Pleasant Ridge Wind Farm.



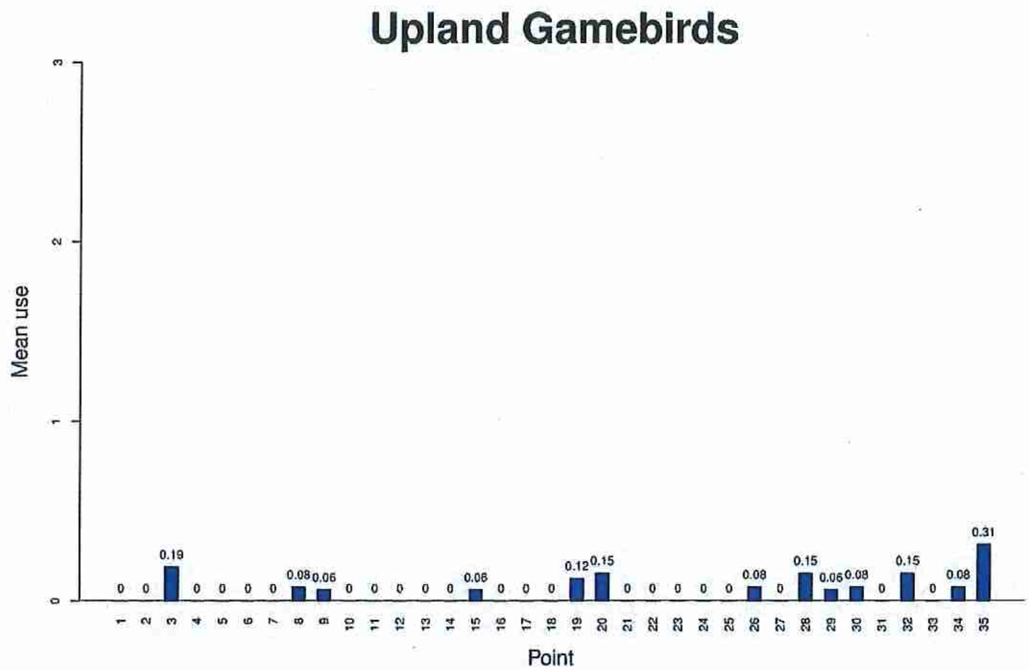


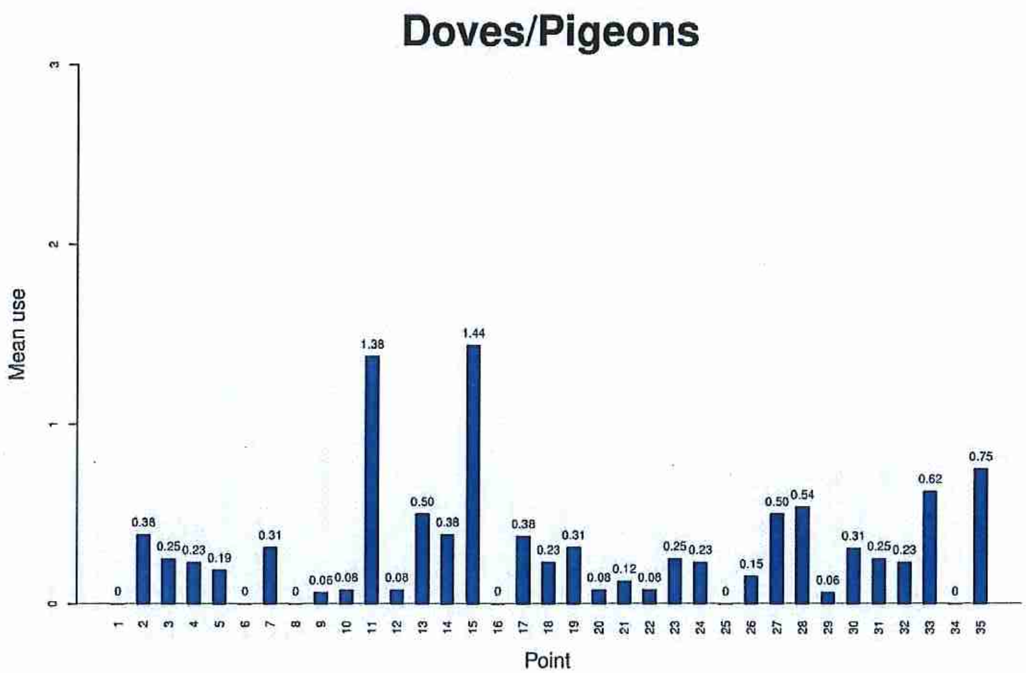
Appendix D (*continued*). Mean use (number of birds/20-min survey) at each fixed-point bird use survey point for all birds and major bird types at the Pleasant Ridge Wind Farm.



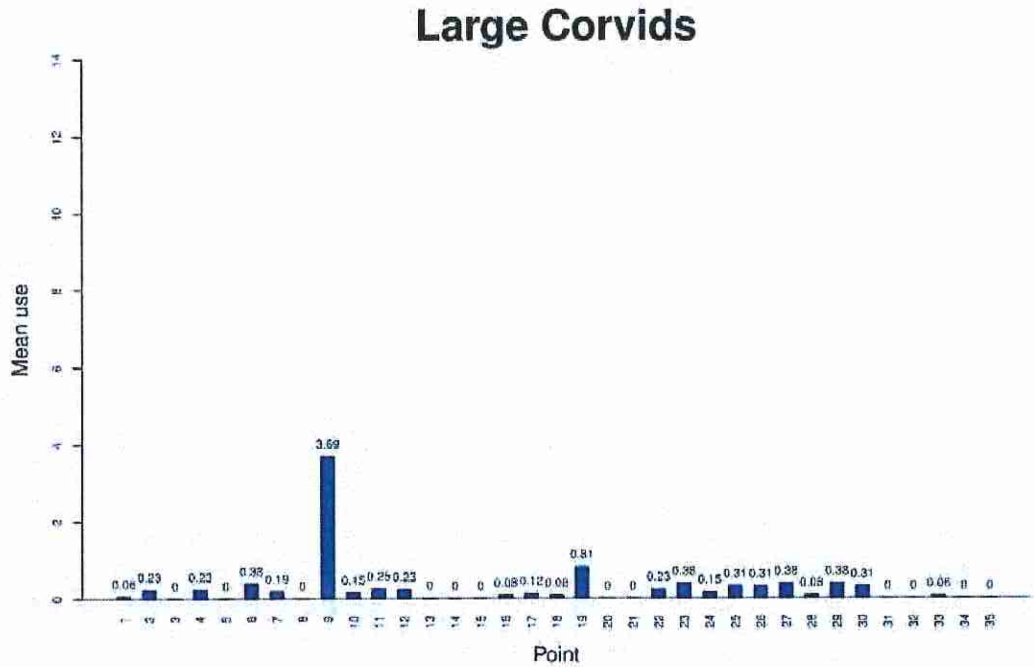


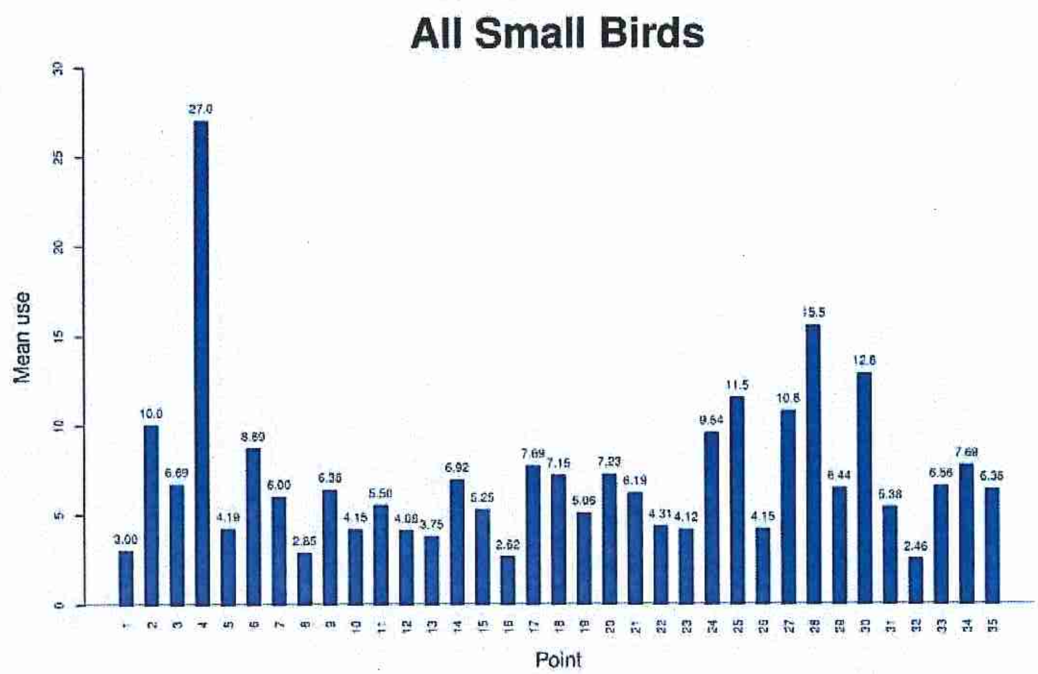
Appendix D (*continued*). Mean use (number of birds/20-min survey) at each fixed-point bird use survey point for all birds and major bird types at the Pleasant Ridge Wind Farm.



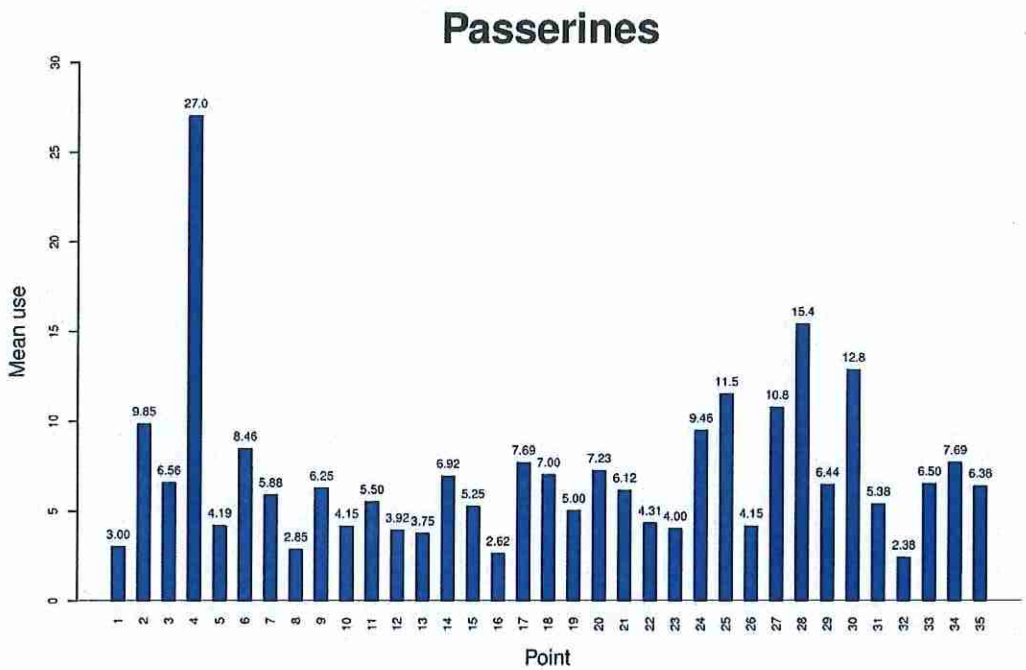


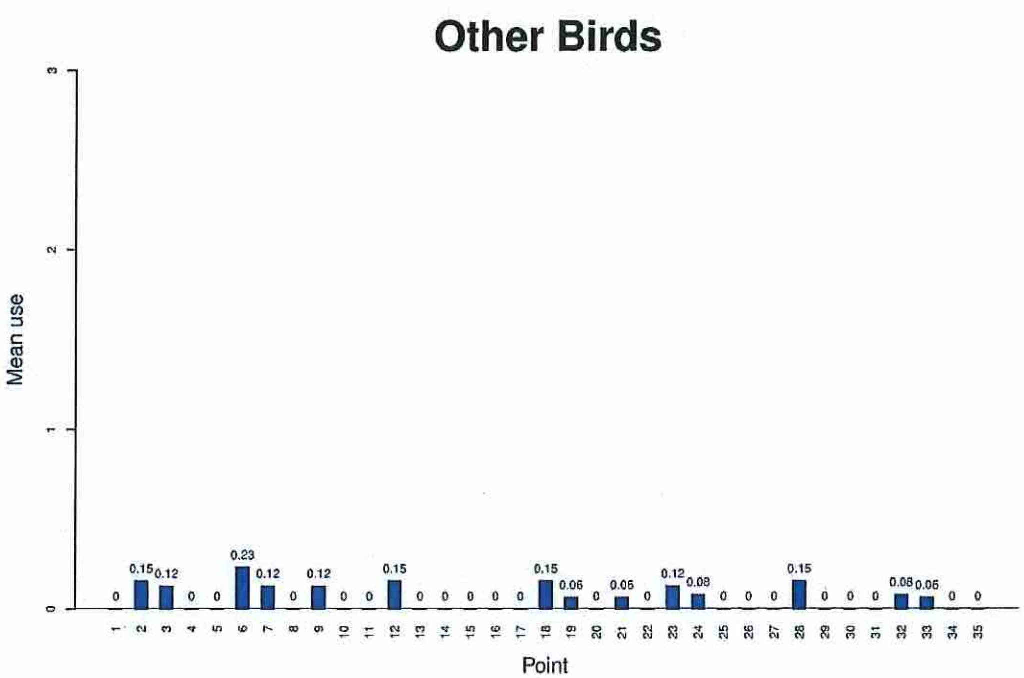
Appendix D (*continued*). Mean use (number of birds/20-min survey) at each fixed-point bird use survey point for all birds and major bird types at the Pleasant Ridge Wind Farm.





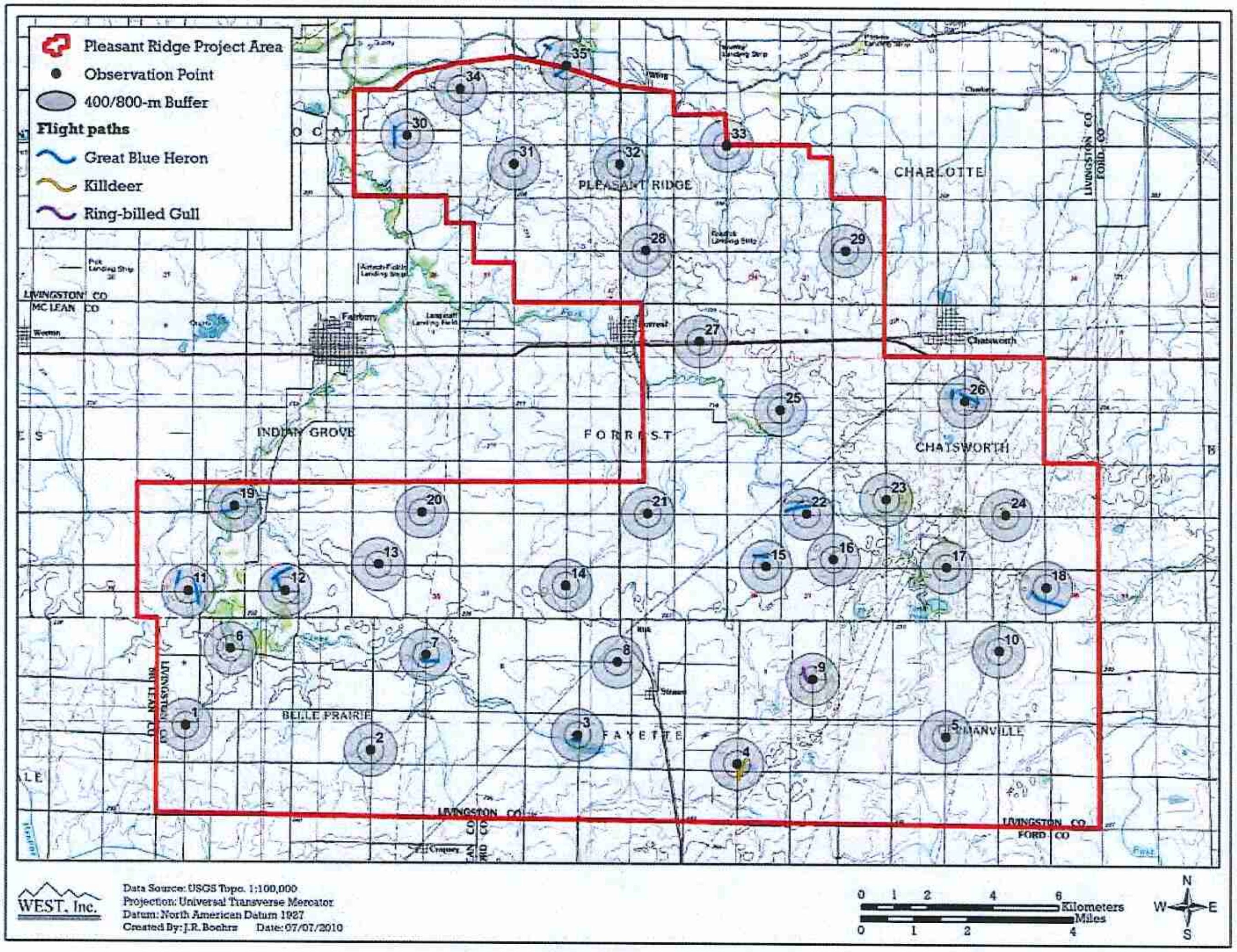
Appendix D (*continued*). Mean use (number of birds/20-min survey) at each fixed-point bird use survey point for all birds and major bird types at the Pleasant Ridge Wind Farm. Observations of passerines and other small birds were focused within 100-m viewsheds.



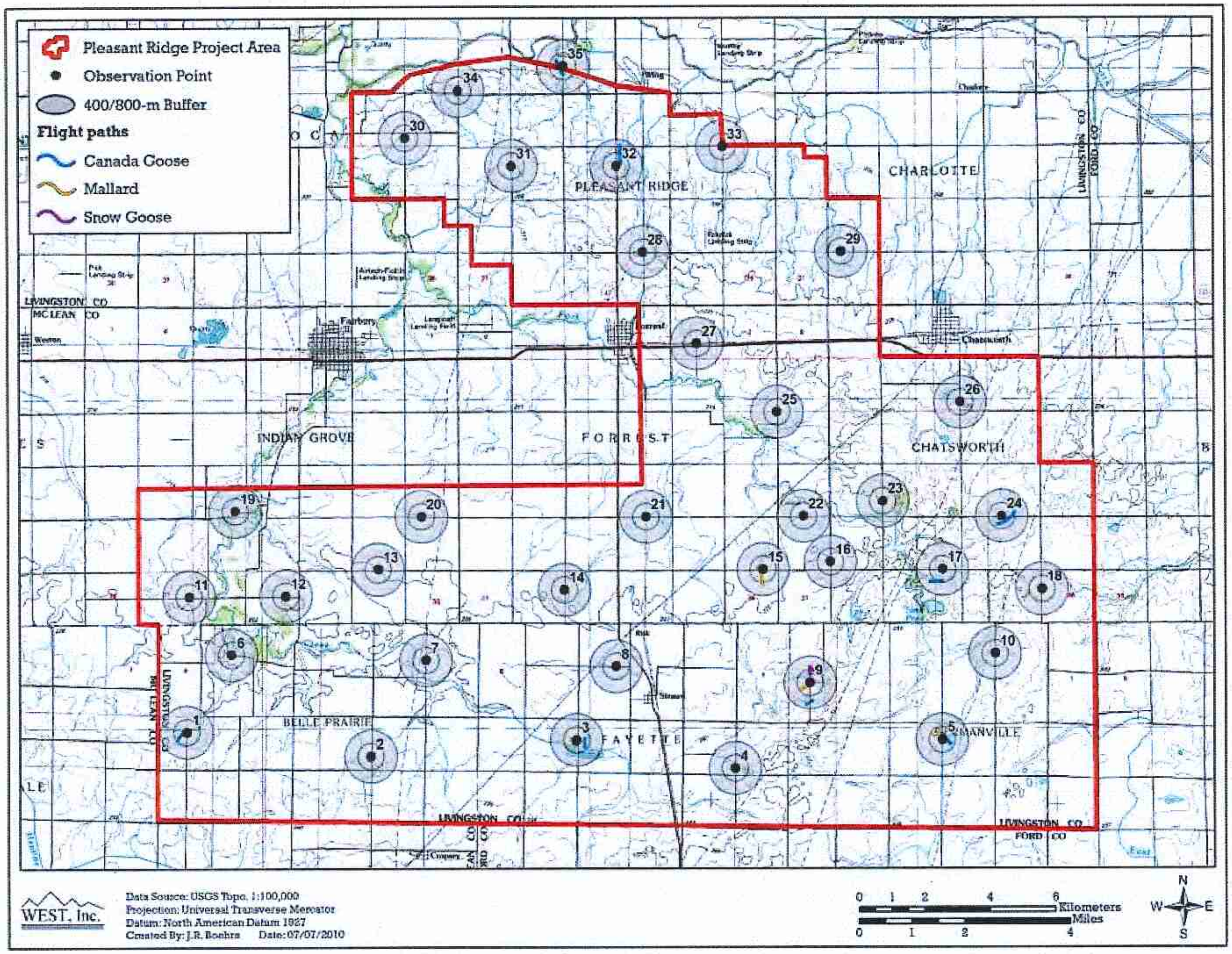


Appendix D (continued). Mean use (number of birds/20-min survey) at each fixed-point bird use survey point for all birds and major bird types at the Pleasant Ridge Wind Farm. Observations of passerines and other small birds were focused within 100-m viewsheds.

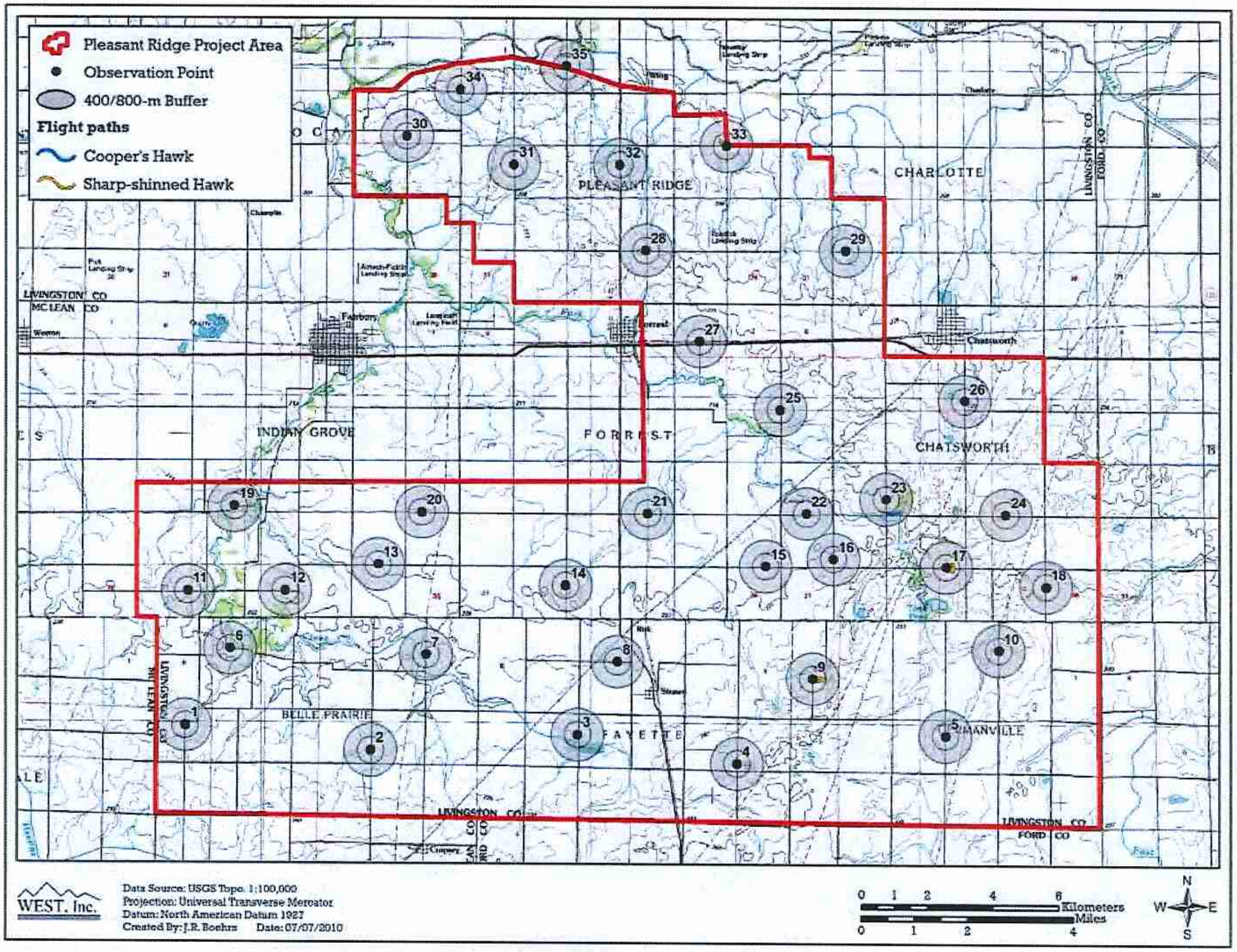
Appendix E. Large Bird Flight Paths Observed during Fixed-Point Bird Use Surveys at the Pleasant Ridge Wind Farm.



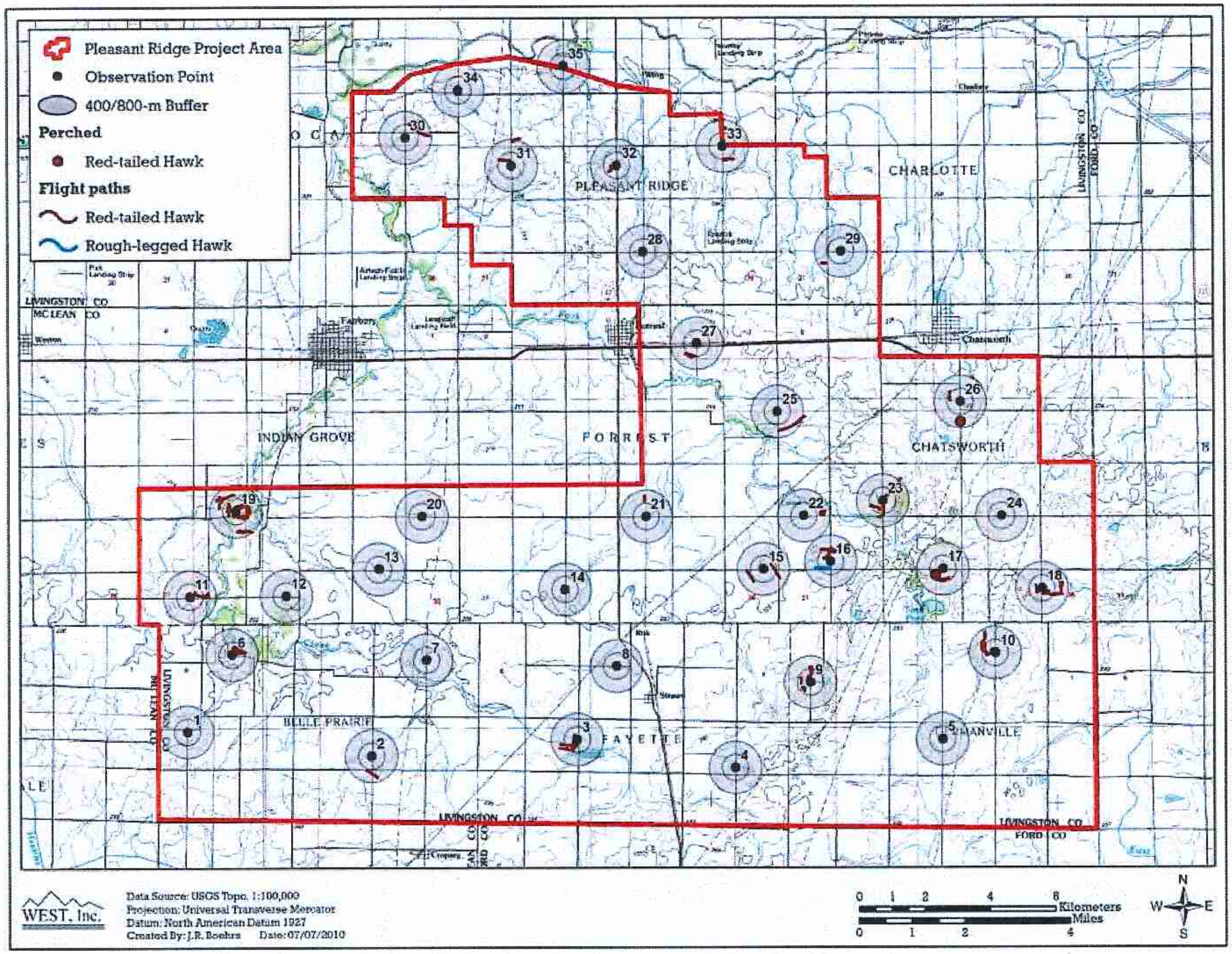
Appendix E-1. Spatial use by flight paths of waterbirds and shorebirds at the Pleasant Ridge Wind Farm.



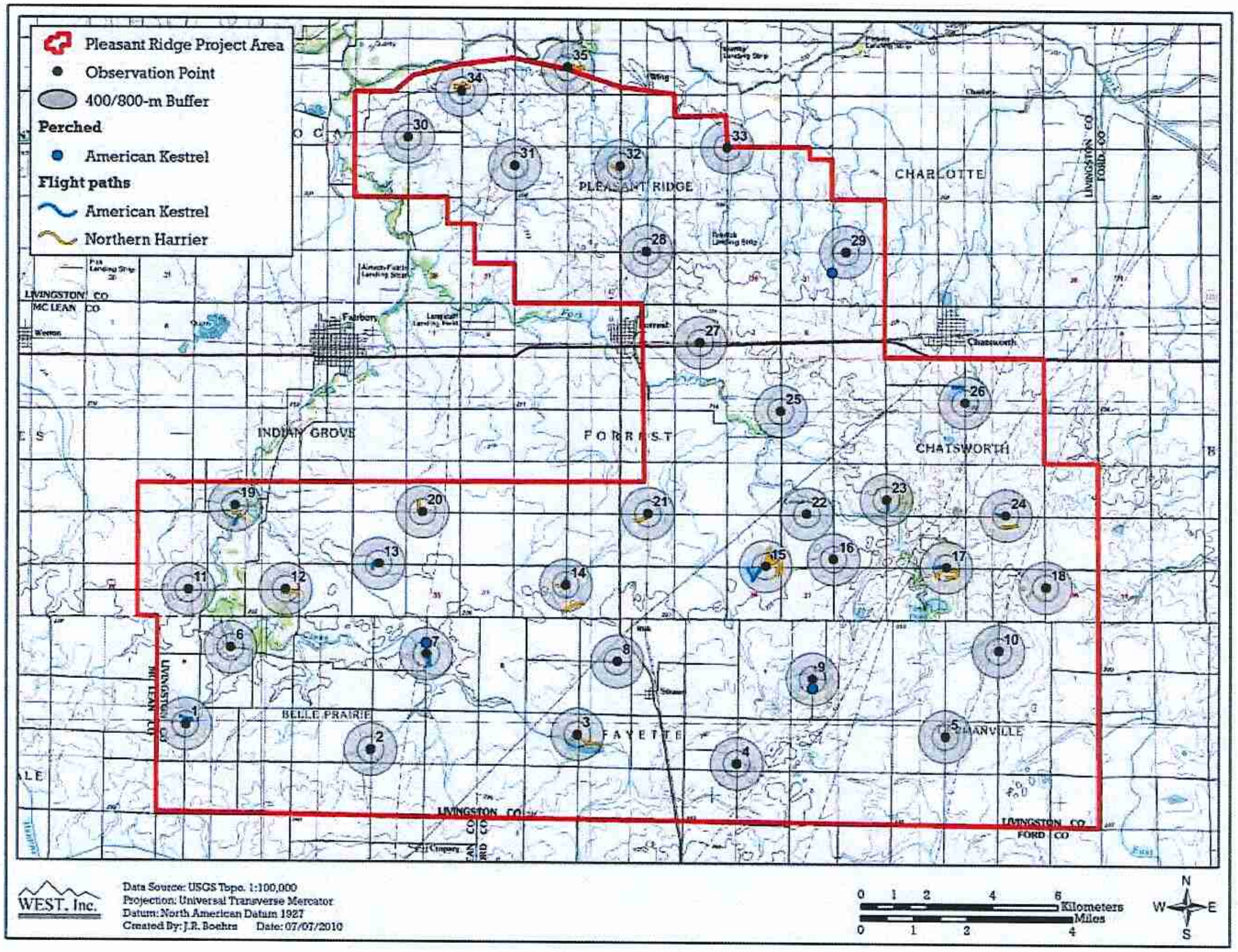
Appendix E-2. Spatial use by flight paths of waterfowl at the Pleasant Ridge Wind Farm.



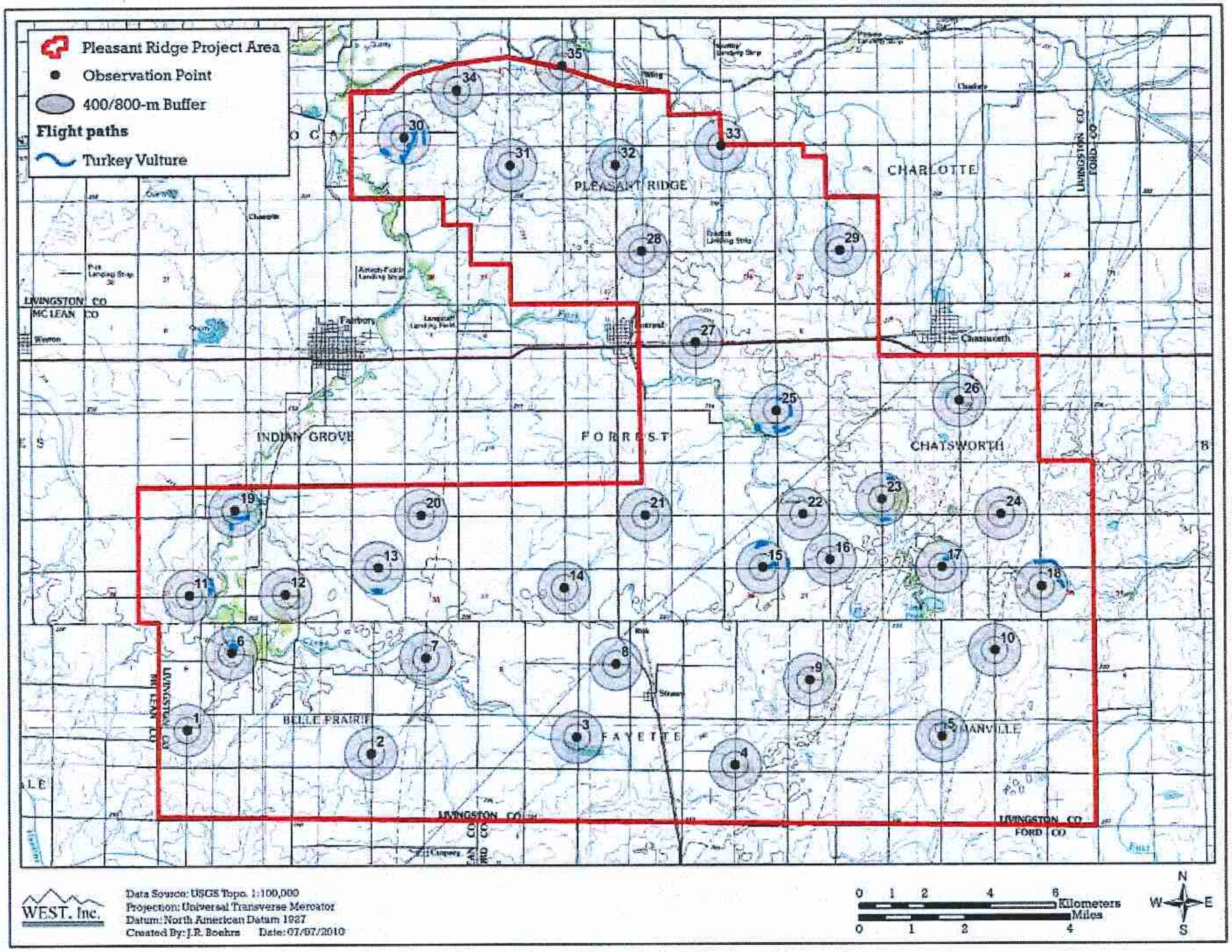
Appendix E-3. Spatial use by flight paths of accipiters at the Pleasant Ridge Wind Farm.



Appendix E-4. Spatial use by flight paths of buteos at the Pleasant Ridge Wind Farm.



Appendix E-5. Spatial use by flight paths of northern harriers and falcons at the Pleasant Ridge Wind Farm.



Appendix E-6. Spatial use by flight paths of vultures at the Pleasant Ridge Wind Farm.

Bat Acoustic Studies for the Pleasant Ridge Wind Resource Area
Livingston County, Illinois

Final Report
July 15 – October 21, 2009

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February 16, 2010

EXECUTIVE SUMMARY

Western EcoSystems Technology, Inc. initiated surveys in July 2009 designed to assess bat use within the proposed Pleasant Ridge Wind Resource Area in Livingston County, Illinois. Acoustic surveys for bats using Anabat™ SD1 ultrasonic detectors were conducted at five stations using six Anabats from July 15 to October 21, 2009. One station was placed in an area expected to receive high bat activity to be used as reference site. The remaining five stations were located at met towers, or non-reference areas. Detectors were placed below two met towers for the entire study. One paired set of detectors (raised and ground) and one raised unit was rotated between the remaining three met towers each week, so that monitoring occurred at five of the six stations each survey week.

The objective of the acoustic bat surveys was to estimate the seasonal and spatial use of the Pleasant Ridge Wind Resource Area by bats. Overall, a total of six Anabat units recorded 2,696 bat passes during 501 detector-nights. Averaging bat passes per detector-night across all locations, a mean of 4.28 bat passes per detector-night was recorded. Excluding the reference station, the remaining five Anabat units recorded 923 bat passes during 411 detector-nights, yielding a mean of 2.36 bat passes per detector-night. Bat activity was approximately twice as high at non-reference ground units (3.09±0.24 bat passes per night) than what was recorded at the raised units (1.14±0.15 bat passes per night).

Across all stations, the majority (60.1%) of the calls were less than 30 kilohertz in frequency (e.g., big brown bat, hoary bat, silver-haired bat), while 25.7% were 30 to 40 kilohertz in frequency (e.g. eastern red bat). The remaining calls were by high-frequency bat species (e.g. *Myotis* species). For non-reference stations, a slightly higher percentage of passes were by low-frequency species (68.8%), while high-frequency species comprised 16.4% of all passes and passes by mid-frequency bats accounted for 14.8% of passes recorded at non-reference stations. Species identification was possible for the hoary and eastern red bat, which made up less than 1% and 2.5% of passes at all stations, respectively. When the reference station is excluded from analysis, hoary bats composed less than 1% of all bat passes, and eastern red bats made up 2.6% of bat passes. Activity levels for bat passes peaked in late July at the reference station. For non-reference stations, activity levels peaked in late August. Activity levels for hoary and eastern red bats were highest in late July/early August, suggesting these species may migrate through the study area during this time period.

The mean number of bat passes per detector-night was compared to existing data from nine studies of seven wind-energy facilities where both bat activity and mortality levels have been measured. The level of bat activity documented at the Pleasant Ridge Wind Resource Area was higher than that at wind-energy facilities in Minnesota and Wyoming, where reported bat mortalities are low, but was much lower than at facilities in the eastern US, where reported bat mortality is highest. Assuming that a relationship between bat activity and bat mortality exists, bat fatality levels at the PRWRA may be expected to be more similar to fatality rates observed at wind-energy facilities in the Midwest than those reported in the eastern US.

STUDY PARTICIPANTS

Western EcoSystems Technology

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REPORT REFERENCE

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A number of individuals from different organizations were instrumental in the completion of the monitoring at the Bishop Hill Wind Project. Gina Wolf served as project manager for Invenergy and provided funding for the project. All the landowners in the Bishop Hill project deserve recognition for their support and cooperation in allowing safe, secure, and trouble-free property access.

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INTRODUCTION

Invenergy LLC (Invenergy) is proposing to develop a wind-energy facility in Livingston County, Illinois. Invenergy requested Western EcoSystems Technology, Inc. (WEST) develop and implement a standardized protocol for baseline studies of bat use in the Pleasant Ridge Wind Resource Area (PRWRA) for the purpose of estimating the impacts of the wind-energy facility on bats. The protocol for this baseline study is similar to protocols used at other wind-energy facilities in the US and involves passive acoustic sampling using Anabat ™ ultrasonic SD1 bat detectors.

The following is a final report describing the results of Anabat surveys during the 2009 study season within the proposed PRWRA. In addition to site-specific data, this report presents existing information and results of bat monitoring studies conducted at other wind-energy facilities. Where possible, comparisons with regional and local studies were made.

STUDY AREA

The PRWRA is approximately 109,278 acres (170.75 square miles [mi^2]) in size and is located in southern Livingston County, Illinois. Ford County borders the south and eastern edges and McLean County borders the west edge of the PRWRA near the town of Fairbury (Figure 1). According to the National Landcover Dataset (USGS NLCD 2001), the dominant landcover type within the PRWRA is cultivated cropland (corn [*Zea mays*] and soybean [*Glycine max*]), comprising 92.3% (100,866 acres; 157.60 mi^2) of the total land area. Developed areas are the second most common cover type, comprising 5.1% (5,573 acres; 8.71 mi^2) of the PRWRA and are generally confined to the town of Strawn, farms, and homesteads. Pasture/hayfields and deciduous forests occupy 1.2% of the study area each (1,327 and 1,320 acres [2.07 and 2.06 mi^2], respectively), and the remaining area is comprised of small amounts of woody wetlands, barren land, open water, and grassland. The PRWRA falls within the Central Corn Belt Plains Ecoregion, which encompasses a large portion of central Illinois (Woods et al.2007). The Central Corn Belt Plains Ecoregion is composed of vast glaciated plains and is scattered with sand sheets and dunes. Much of the Central Corn Belt Plains Ecoregion was originally dominated by tall-grass prairie and had scattered groves of trees and marshes occurring on level uplands. Today, most of the Ecoregion has been cleared to make way for highly productive farms producing corn, soybeans, and livestock. Streams within the Central Corn Belt Ecoregion have been tilled, ditched, and tied into existing drainage systems, which has caused a reduction in the amount of aquatic habitat. Streams running through the PRWRA are channelized; however, there are natural streams that include Indian Creek, a tributary to the Vermilion River, and the South Fork of the Vermilion River.

METHODS

Bat Acoustic Surveys

The objective of the bat use surveys was to estimate the spatial and temporal use of the PRWRA by bats. Bats were surveyed using Anabat™ SD1 bat detectors (Titley Scientific™, Australia).

Bat detectors are a recommended method to index and compare habitat use by bats. The use of bat detectors for calculating an index to bat impacts is a primary bat risk assessment tool for baseline wind-energy development surveys (Arnett 2007, Kunz et al. 2007a). Bat activity was surveyed using six Anabat detectors from July 15 to October 21, 2009, a period corresponding to likely fall bat migration in central Illinois.

Bat use was monitored at five stations with six total Anabats within the PRWRA (Figure 1). Three detectors were placed at fixed ground-based locations: two were placed at the base of meteorological (met) towers (PR3 and PR4) and one unit was placed at a reference area (PR5) in the northern portion of the PRWRA in habitat thought to be attractive to bats for foraging and drinking opportunities. Data collected from the reference station were analyzed separately from the other stations. Three detectors (one paired set of Anabat detectors and one lone Anabat detector) 'roamed' between three met tower locations (PR1g and PR1h, PR2g and PR2h, and PR6g and PR6h) in the southern portion of the PRWRA. Each week one of the three met towers with 'roaming' Anabat detectors would have a pair of Anabat detectors (one at the base of the tower and one raised unit), and a second met tower would have a raised unit, and the remaining met tower would have no Anabat detector. These three Anabat detectors were rotated between the met towers to increase spatial coverage.

Anabat detectors record bat echolocation calls with a broadband microphone. The echolocation sounds are then translated into frequencies audible to humans by dividing the frequencies by a predetermined ratio. A division ratio of 16 was used for the study. Bat echolocation detectors also detect other ultrasonic sounds, such as those sounds made by insects, raindrops hitting vegetation, and other sources. A sensitivity level of six was used to reduce interference from these other sources of ultrasonic noise. Calls were recorded to a compact flash memory card with large storage capacity. The detection range of Anabat detectors depends on a number of factors (e.g., echolocation call characteristics, microphone sensitivity, habitat, the orientation of the bat, atmospheric conditions; Limpens and McCracken 2004), but is generally less than 98 feet (ft; 30 meters [m]) due to atmospheric absorption on echolocation pulses (Fenton 1991). To ensure similar detection ranges among detectors, microphone sensitivities were calibrated using a BatChirp (Tony Messina, Las Vegas, Nevada) ultrasonic emitter as described in Larson and Hayes (2000). All units were programmed to turn on each night approximately one half-hour before sunset and turn off approximately one half-hour after sunrise.

Anabat detectors were placed inside plastic weather-tight containers with a hole cut in the side of the container for the microphone to extend through. Microphones for Anabat detectors on the ground were encased in polyvinyl chloride (PVC) tubing with two drain holes that curved skyward at 45 degrees outside of the container to minimize the potential for water damage due to rain. Silica gel packets were placed in each container to minimize the amount of moisture due to condensation and were replaced on a weekly basis Containers were raised approximately 3.3 ft (1.0 m) off the ground to minimize echo interference and lift the unit above vegetation (Appendix A). The Anabat units with raised microphones were protected from weather identically; however, the microphone itself was fixed on the met tower at a height of 147.6 ft (45 m) above the ground. Microphones were encased in a Bat-Hat weather-resistant housing (EME Systems, Berkeley, California) with a Plexiglas reflector plate underneath the microphone, and the microphone was attached to a coaxial cable that transmitted ultrasonic sounds to an Anabat unit at the base of the tower (Appendix A).

Statistical Analysis

Bat Acoustic Surveys

The unit of activity was the number of bat passes (Hayes 1997). A bat pass was defined as a continuous series of two or more call notes produced by an individual bat with no pauses between call notes of more than one second (White and Gehrt 2001, Gannon et al. 2003). In this report, the terms bat pass and bat call are used interchangeably. The number of bat passes was determined by downloading the data files to a computer and tallying the number of echolocation passes recorded. Total number of passes was corrected for effort by dividing by the number of detector-nights.

For each station, bat calls were sorted into three groups based on their minimum frequency that roughly corresponds to species groups of interest. For example, most species of *Myotis* bats echolocate at frequencies above 40 kilohertz (kHz), while species such as the eastern red bat (*Lasiurus borealis*) typically have echolocation calls between 30 and 40 kHz, and species such as big brown (*Eptesicus fuscus*), silver-haired (*Lasionycteris noctivagans*), and hoary bat (*Lasiurus cinereus*), have echolocation frequencies at or below 25 kHz. Therefore, calls were classified as high-frequency (HF; more than 40 kHz), mid-frequency (MF; 30 to 40 kHz), or low-frequency (LF; less than 30 kHz). To establish which species may have produced calls in each category, a list of species with the potential to occur in the PRWRA was compiled from range maps (Table 1; Harvey et al. 1999, BCI website). Data determined to be noise produced by a source other than a bat or calls that did not meet the pre-specified criteria to be termed a pass were removed from the analysis.

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

The total number of bat passes per detector-night was used as an index for bat use in the PRWRA. Bat pass data represented levels of bat activity rather than the numbers of individuals present because individuals could not be differentiated by their calls. To assess potential for bat mortality, the mean number of bat passes per detector-night (averaged across ground-based monitoring stations) was compared to existing data from wind-energy facilities where both bat activity and mortality levels have been measured.

RESULTS

Bat Acoustic Surveys

Overall Activity

Five sampling locations (PR1, PR2, PR3, PR4, and PR6) were considered non-reference stations, and were monitored on a total of 99 nights during the period July 15 to October 21, 2009. Non-reference Anabat units recorded 923 bat passes on 411 detector-nights (Table 2). Averaging bat passes at non-reference locations per detector-night across locations, 2.36 ± 0.20 (mean ± standard error [SE]) bat passes per detector-night were recorded. Data from the one reference location (PR5) was analyzed separately as a reference station and this station was monitored for 99 nights during the period July 15 to October 21, 2009. The reference unit recorded 1,773 bat passes on the 90 detector-nights and the average was 19.7 ± 2.94 bat passes per detector-night (Table 2). The number of noise files varied throughout the study period (Figure 3a and 3b). All Anabats recorded for 84.77% of the study period and coverage varied by date due to equipment malfunctions (Figure 2).

Spatial Variation

Across the PRWRA and excluding the reference station, ground-based units averaged more bat calls per night (3.09 ± 0.24) than the raised stations (1.14 ±0.14 bat calls per night; Table 2). Bat activity was relatively higher at the reference station (PR5; 19.7 ± 2.94 bat passes per night; Table 2; Figure 4a) than at the ground-based and raised non-reference stations. Comparing data across the roaming stations (PR1, PR2 and PR6) when both raised and ground-based units were being monitored simultaneously, the ground-based units recorded more bat calls than the raised units (Figure 5). Both ground-based and raised units primarily recorded LF and MF bat calls; however, the ground-based units recorded much higher levels of HF bat calls relative to the raised units (Figure 5).

Temporal Variation

For the non-reference stations, bat activity was higher during the last week in July throughout August and peaked during the week of August 26 to September 1 (Table 3b, Figure 6b). Activity dropped slightly during the week of September 2 – 8; however, levels of activity peaked again during the week of September 9 – 15 and then activity decreased to levels approximately equal to or lower than the mean at the non-reference stations for the entire study (Table 3b, Figure 6b). Peak activity at the reference station occurred during the first two weeks of monitoring, July 15 – 28. No bat activity was recorded the week of July 29 – August 4 due to equipment malfunctions, and bat activity remained approximately equal to or lower than the mean bat use at the reference station for the remainder of the study (Table 3a, Figure 6a).

Bat activity at the non-reference ground-based stations increased more rapidly than what was recorded at the non-reference raised stations (Figure 7a). The reference station recorded 50% of all bat calls (Table 3a and Figure 7b) approximately three weeks before the non-reference stations recorded 50% of all bat call recorded at all non-reference stations (Table 3b and Figure 7a).

Species Composition

Non-reference Stations

Patterns of activity between the frequency groups recorded at non-reference ground-based stations were similar across the PRWRA (Table 2); passes by LF bats (66.6%) outnumbered passes by HF bats (20.08%) and MF bats (13.3%; Table 2; Figure 4b). Additionally, patterns of activity recorded at non-reference raised stations were similar across the PRWRA (Table 2); passes by LF bats (77 %), outnumbered passes by MF bats (20.4%) and HF bats (2.6%; Table 2; Figure 4b). At the non-reference stations, peak HF and MF bat passes occurred from July 22-28, and peak MF bat passes occurred from July 15-21 (Table 3b; Figure 6b). Activity by LF species appeared to peak slightly later, with most LF passes recorded from August 26 to September 15 (Table 3b; Figure 6b).

Passes attributable to hoary bats comprised 0.9% of the total bat passes and 1.4% of all LF passes detected at the non-reference stations (Table 2). The highest hoary bat activity was recorded by Anabat units PR1h, PR3, and PR4 (Table 2; Figure 8b). At the paired units (PR1, PR2, and PR3), there were more hoary bat calls recorded at the raised units than at the ground-based units (Table 2). The majority of hoary bat activity at non-reference stations was recorded July 22 – 28 (41.2%; Table 4b; Figure 9c). No hoary bats were recorded early or late in the study period (Table 4b; Figure 9b).

Passes attributable to eastern red bats comprised 2.6% of all the bat passes and 17.56% of all MF passes detected at non-reference stations (Table 2). Approximately 58% of all red bat calls were recorded by Anabat units PR1h and PR3 collectively (Table 2; Figure 8b). Approximately 64% of eastern red bat passes were detected between August 5 to September 1 (Table 4b; Figure 9b). No eastern red bat calls were recorded after September 29 (Figure 9b).

Reference Station

At the reference station, the majority (55.5%) of bat passes were by LF species, then MF species (31.4%), and HF species (13.1%; Table 2; Figure 4a). Peak activity for LF, MF, and HF bats occurred much earlier than non-reference stations, with activity peaking between July 15 – 28 (42.1%, 56.0%, and 37.7%, respectively; Table 3a; Figure 6a).

Passes attributable to hoary bats comprised 0.5% of the total bat passes and 0.9% of all LF passes detected at the reference station in the PRWRA (Table 2). Peak hoary bat activity was recorded between July 15 – 28 (53.2%; Table 4a; Figure 9a). No hoary bats were recorded from August 12 – 25 or after September 16 (Table 4a; Figure 9a).

Passes attributable to eastern red bats comprised 2.4% of all bat passes and 4.4% of all MF passes recorded at the reference station (Table 2). More eastern red bats were recorded from July 22 – 28 (48.4%) than during any other week of the survey period (Table 4a; Figure 9b). A smaller peak occurred from August 12 – 25. Eastern red bats were not detected during the weeks of September 16 – 22, September 30 to October 6, or after October 20 (Table 4a; Figure 9b).

DISCUSSION

Potential Impacts

Assessing the potential impacts of wind-energy development to bats at the PRWRA is complicated by the current lack of understanding of why bats die at wind turbines (Kunz et al. 2007b, Baerwald et al. 2008), combined with the inherent difficulties of monitoring elusive, nocturnal-flying mammals (O'Shea et al. 2003). Additionally, because installed capacity for wind-energy has increased rapidly in recent years, the availability of well-designed studies from existing wind-energy facilities lags development of proposed facilities (Kunz et al. 2007b). To date, monitoring studies of wind-energy facilities suggest that:

a) bat mortality shows a rough correlation with bat activity (Table 5);

b) the majority of fatalities occur during the post-breeding or fall migration season (roughly August and September);

c) migratory tree-roosting species (eastern red, hoary, and silver-haired bats) comprise almost 75% of reported bat fatalities, and;

d) the highest reported fatalities have occurred at wind-energy facilities located along forested ridge tops in the eastern and northeastern US. However, recent studies in agricultural regions of Iowa, Wisconsin and Alberta, Canada, report relatively high fatalities as well (Table 5).

Based on these patterns, current guidance to assess potential risk to bats at a proposed wind-energy facility involves evaluation of on-site bat acoustic data in terms of activity levels, seasonal variation, and species composition (Kunz et al. 2007b), as well as comparison to regional patterns.

Overall Activity

To date, nine studies of seven wind-energy facilities have recorded both Anabat detections per night and bat mortality (Table 5), and eight of these studies measured bat activity concurrently with fatality studies. While these studies show correlation between activity and fatalities, the expectation among the scientific and resource-management communities is that a similar relationship holds for pre-construction activity and post-construction fatalities. The addition of pre-construction data sets, like the one collected from the PRWRA, will contribute to the understanding of the relationship between bat activity near wind turbines and bat fatalities. To our knowledge, data for the studies in Table 5 were collected using Anabat detectors placed near the ground (i.e., none raised on met towers) and none of the detectors were located near features attractive to bats.

Bat activity recorded by non-reference ground-based detectors within the PRWRA (3.09±0.24 bat passes per detector-night; Table 2) was higher than that observed at wind-energy facilities in Minnesota and Wyoming, where bat mortality was relatively low, but bat activity at the PRWRA was much lower than activity recorded at facilities in West Virginia, Iowa, and Tennessee, where bat mortality rates were relatively high (Table 5).

Spatial Variation

Recorded bat activity was highest at the reference station, PR5 (19.7±2.94 bat passes per night). This station was located in a grassy verge along the north fork of the Vermilion River that likely attracted bats for foraging and drinking opportunities. Non-reference ground-based detectors had relatively lower bat activity (3.09±0.24 bat passes per night) and non-reference raised detectors had the lowest bat activity (1.14±0.15 bat passes per night). However, data regarding differences in bat passes between the ground-based and raised detectors at the paired stations should be interpreted with caution since the raised detector was outfitted with a Plexiglas reflector and the ground unit was outfitted with a PVC tube at a 45 degree angle. Slack et al. (2008) found the Plexiglas reflector plate recorded approximately ½ the number of bat calls as the PVC tube during simultaneous monitoring, and some calls at the raised units may have not have been recorded. If the assumption is made that only ½ of the number of bat calls at raised units were recorded, the raised units would have recorded 2.28 bat passes per night which is approximately 1/3 less than the bat passes at ground units.

Comparing the paired stations, PR1, PR2, and PR6, provided relatively even coverage of the southern portion of the PRWRA use by bats at ground level and within the ZOR. The ground units consistently recorded twice as many bat calls as the raised units (Table 2; Figure 5). The species composition of the ground and raised stations differed slightly. LF bats were the most recorded bat at raised and ground stations; however, HF bats were recorded more often at ground stations than raised stations and more MF bats were recorded at raised stations than ground stations (Table 2; Figure 5). This suggests that HF species, such as myotis, do not fly and echolocate as often as other species near blade height as other bat species.

Detectors placed near met towers or at potential turbine locations may be used to contextualize activity relative to previous studies that have measured both activity and fatality levels (e.g., Table 5), but such sampling locations are not generally in areas likely to attract or retain bats. Thus, in all likelihood, the data collected at these sampling locations provide a lower bound on the estimate of potential facility-wide bat activity. The increased levels of bat activity recorded at the reference station, relative to the non-reference stations, provides an upper bound for the estimated activity levels by bats within the PRWRA. Increased activity recorded at the reference station is likely attributable to the presence of habitat attractive to bats as roosting, foraging, or drinking sites. Individual bats are likely to spend longer periods of time at this type of location as they forage, drink, or interact socially, and thus may be recorded multiple times. The increased level of activity at the reference station should not, however, be correlated with increased numbers of bats, as bat passes do not translate directly to the number of bats present.

Temporal Variation

For resident bats that undertake relatively local or regional movements to hibernacula, both adults and young-of-the-year must accumulate the fat reserves that will see them through the winter; the number of foraging areas and the intensity of use in foraging areas can increase to meet those needs. For tree-roosting species of bats that do not hibernate, movements toward southern wintering grounds appear to begin in late July and echolocation passes by these species tend to increase as they migrate. Both migratory and hibernating species begin to engage in reproductive behaviors in late summer and fall, which for hibernating species is associated with increased grouping and increased travel between groups (Brack 2006), and this may also be the case for migratory tree-roosting species (Cryan 2008). The end result is increased flights for foraging and mating opportunities during the summer and fall, which is detected during acoustic surveys and which appears to correlate to the time period of increased fatalities recorded at wind turbines.

Bat activity peaked earlier at the reference stations compared to the non-reference stations. The earlier peak in activity in the reference area likely represents use by volant juveniles and foraging of individuals to build up fat reserves before fall migration or fall migration out of the area (Brack 2006). Peak activity occurred later at non-reference stations, and may represent a larger percentage of migrating bats. Increased levels of bat activity observed at met towers followed the general pattern seen in other studies both in the Midwest and elsewhere (Kunz et al. 2007a), and likely reflects the general phenology of temperate zone bats. The increased levels of activity seen during this study in August may represent movement of migrating bats through the area, which may also explain the greater number of low-frequency bats at this time. Activity dropped drastically after July at the reference station. likely indicating that most resident bats had already migrated through the PRWRA. Activity also dropped drastically at the non-reference stations after September 29, indicating that most bats had migrated through these areas.

Fatality studies of bats at wind-energy facilities in the US have shown a peak in mortality in August and September and generally lower mortality earlier in the summer (Johnson 2005, Arnett et al. 2008). While the survey effort varies among the different studies, the studies that combine Anabat surveys and fatality surveys show a general association between the timing of increased bat call rates and timing of mortality, with both call rates and mortality peaking during the fall. Based on the available data for this studies survey period, it is expected that bat mortality at the PRWRA will be highest in late July and late August through early September.

Species Composition

Of the nine species of bat likely to occur in the PRWRA, seven are known fatalities at wind-energy facilities (Table 1). Approximately 60% of passes were by LF bats, suggesting higher relative abundance of species such as hoary, silver-haired, and big brown bats. Hoary bats made up less than 1% of all LF passes and were most active in late July, corresponding to the reproductive season for this species. There were likely more hoary bat passes at the PRWRA than what was reported due to the strict crieteria used for species identification. To date, some LF species, (e.g., hoary [36.76% of all bat fatalities] and silver-haired bats [10.41% of all bat fatalities]) have been found as fatalities in higher proportions than other LF species in the Midwest (Gruver et al. 2009; Koford et al. 2005; Howe et al. 2002; Johnson et al. 2002, 2003, 2004; Kerlinger et al. 2007). LF species also comprised a greater proportion of bat calls at raised versus ground units during this study. Hoary bats and silver-haired bats could potentially have a higher fatality risk within the PRWRA. However; big brown bats have also been reported as comprising a relatively high percentage of fatalities at a wind-energy facility in Wisconsin (Gruver et al. 2009).

Approximately 26% of passes at the PRWRA were classified as MF passes and less than 1% of those passes were classified as eastern red bats. In the Midwest, eastern red bats are the second most recorded fatality (22.31% of all bat fatalities) at wind-energy facilities during fatality searches (Gruver et al. 2009; Koford et al. 2005; Howe et al. 2002; Johnson et al. 2002, 2003, 2004; Kerlinger et al. 2007).. There were likely more eastern red bat passes at the PRWRA than what was reported due to the strict criteria employed for species identification. Eastern red bat may be the most at-risk MF bat species at the PRWRA.

At raised stations, LF passes outnumbered MF and HF passes, which most likely reflects different foraging behaviors among species. Generally, LF species tend to forage in less cluttered conditions (e.g., at greater heights) than HF species due to their wing morphology and echolocation call structure (Norberg and Rayner 1987). Due to this behavior, LF species, such as hoary bat and silver-haired bat, are potentially at a greater risk of turbine collisions than HF species, which typically fly at lower altitudes. LF species are also more commonly reported as fatalities at most-wind-energy facilities.

While LF species generally outnumber HF species as fatalities at most wind-energy facilities, two notable exceptions exist within the Midwest. More little brown bats (28.7%) were reported as fatalities than silver-haired bats (23.5%), big brown bats (19%), hoary bats (16.6%) and eastern red bats (7.3%) at the Blue Sky Green Field wind-energy facility in Wisconsin (Gruver et al. 2009). Little brown bats also comprised substantial proportion of the bat fatalities at a wind-energy facility in Iowa (Jain 2005). It is unclear why species composition of fatalities differed at these two wind-energy facilities, and more research regarding bat and wind-energy facility interactions are needed within the Midwest.

Regional Fatality Studies

To date, the highest levels of bat fatalities have been reported from turbines on forested Appalachian ridges (Arnett et al. 2008). However, recent reports of moderate to high levels of bat fatalities in agricultural settings (Jain 2005; Baerwald 2008; Gruver et al. 2009) suggest that open landscapes are no guarantee of low fatality rates.

Studies at wind-energy facilities across North America show a wide range of bat mortality rates, ranging from zero to 39.70 bat fatalities per megawatt (MW) per year (Table 5). Although the pool of available data for the Midwest is somewhat limited, studies from the Midwest have indicated that bat fatality rates for Midwestern wind-energy facilities have ranged between 0.76 and 24.57 bat fatalities/MW/year (Gruver et al. 2009; Koford et al. 2005; Howe et al. 2002; Johnson et al. 2002, 2003, 2004; Kerlinger et al. 2007). Only one study is currently publicly available of bat fatality rates within Illinois. Kerlinger et al. (2007) estimated 1.9 bat fatalities/MW/year occurred at the Crescent Ridge wind-energy facility in Bureau County, Illinois. This fatality estimate is low compared to other studies. However, the two lowest bat fatality rates at wind-energy facilities reported within the Midwest occurred at studies of facilities in tilled agriculture (corn and soybean) where crops were not cleared for the study (Johnson et al. 2002, 2003 and 2004; Kerlinger et al. 2007).

Potential Fatality Rates at the Pleasant Ridge Wind Resource Area

Assuming that a relationship between pre-construction bat activity and bat mortality exists, bat fatality levels at the PRWRA may be expected to be more similar to fatality rates observed at wind-energy facilities in the Midwest, and lower than the highest fatality rates observed in the eastern US. The relationship between bat passes and bat fatalities will be better defined as the results of monitoring at other wind-energy facilities in the Midwest become available.

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