Indiana Bat and Northern Long-eared Bat Habitat Conservation Plan

Wildcat Wind Farm Phase 1

Tipton and Madison Counties, Indiana

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1. Introduction

1.1 APPLICANT INFORMATION

Wildcat Wind Farm I, LLC (WWF) is the applicant responsible for implementing this Habitat Conservation Plan (HCP). WWF is a wholly owned subsidiary of E.ON Climate & Renewables, North America (E.ON), itself a division of a publicly traded company, E.ON AG, which has offices and power generation holdings throughout the world. Headquartered in Chicago, Illinois, E.ON develops, builds, owns and operates wind and solar energy projects throughout the United States and Canada.

1.2 OVERVIEW AND BACKGROUND

The Wildcat Wind Farm (Wildcat or the Project) is an existing wind energy project located in Tipton and Madison Counties, Indiana. The Project comprises a 200 megawatt (MW) wind farm, consisting of 125 1.6 MW wind turbine generators (WTGs) and associated access roads and collector line system. The Project is located in Madison and Tipton Counties on 24,434 acres of private land shown in Figure 2-1 leased from landowners whose primarily agricultural use of the land will not change due to the project (the Project Area).

Commercial operation of the Project began in December, 2012. Although construction and operation began prior to issuance of an Incidental Take Permit (ITP) for the Project, risk to endangered Indiana bats (*Myotis sodalis*) and threatened northern long-eared bats (*Myotis septentrionalis*) has been avoided through interim measures. To avoid take of the species during operations prior to issuance of an ITP for the Project, WWF developed and implemented a Mortality Minimization and Monitoring Proposal (Appendix A) calling for the curtailment of Project operations during periods of expected risk to the species. WWF obtained a technical assistance letter (TAL) from the USFWS dated June 18, 2012 (Appendix B) indicating that, if WWF partially curtailed operation of the Project to 6.9 m/s in accordance with the TAL during the fall migration period (August 1 - October 15), it was presumed that take would be avoided. WWF operated in accordance with the terms of this TAL and the supporting proposal through July 2015 while development of the HCP was underway. A second TAL was secured on July 2, 2015 that established a revised operational scenario (Appendix B). This second TAL again requires curtailment to 6.9 m/s during the fall migration period (August 1 – October 15) and added a requirement of 5.0 m/s during the spring migration period (March 15 – May 15). WWF is operating in accordance with the terms of the second TAL and the supporting proposal while review of the HCP is completed and until authorization is obtained for the incidental take that may occur in connection with less restrictive operation.

Because the Project Area is located within the range of both the Indiana and northern long-eared bat, the possibility of their presence – principally as a result of seasonal migration through the Project Area – cannot be completely ruled out. As a result of the potential risk to both species, WWF is applying for an ITP under Section 10(a)(1)(B) of the Endangered Species Act (ESA) that will cover both species. This HCP serves the purpose of documenting the steps taken by WWF to avoid and minimize the impacts of the Project on these species and to provide mitigation for the projected potential impacts.

1.3 PURPOSE AND NEED

Although wind energy projects produce renewable, non-polluting energy, operating wind turbines present a source of mortality to bats occurring within a wind energy site. WWF has determined that Project operation may result in incidental bat mortality, including mortality of two bat species listed under the ESA that have ranges overlapping the Project: the Indiana bat and the northern long-eared bat. In order to provide WWF or its assignees with long-term assurances that no unauthorized take of either the Indiana bat or the northern long-eared bat will occur that could give rise to liability for WWF or individuals associated with the operation of the Project, WWF is requesting the issuance of an ITP pursuant to Section 10(a)(1)(B) of the ESA. This HCP has been developed in support of the ITP application. Through this HCP, WWF seeks to maximize production of non-polluting energy by the Project while conserving these listed species and minimizing and mitigating to the maximum extent practicable the impacts of any incidental take of the listed species due to operation of the Project.

Specifically, WWF is seeking a permit under Section 10(a)(1)(B) of the ESA to authorize the incidental taking of Indiana bats and northern long-eared bats that would result from a proposed change in the curtailment regime described in the Mortality Minimization and Monitoring Proposal (Appendix A). WWF proposes to reduce cut-in speeds (i.e., the wind speed at which turbines begin generating power and sending it to the grid) to levels that may result in incidental take of the covered species for the purpose of increasing the renewable energy output of the Project. The increased output is necessary to enable the Project to meet certain financing commitments, to more closely approach the economic projections on which the Project was originally developed, and to meet certain objectives, including:

- To provide a reliable source of renewable energy to serve the regional electrical grid and energy demand that neither emits pollutants, contributes to global warming and the effects of climate change, nor generates the adverse impacts that accompany fossil fuel extraction, processing, waste and by-product disposal, transportation, and combustion; and

- To meet the renewable energy goals of the U.S. and Indiana (Indiana passed an incentivized voluntary Renewable Portfolio Standard in 2012 with the goal of producing 10% of the state's electrical consumption through renewable resources).

This HCP has been developed to describe how WWF will meet the issuance criteria for an ITP under Section 10(a)(1)(B) of the ESA. That section authorizes the issuance of an ITP if the applicant implements an HCP that meets the following criteria:

- Impacts of incidental take are minimized and mitigated to the maximum extent practicable; and

- Take will not appreciably reduce the likelihood of the survival and recovery of the covered species in the wild.

1.4 HCP CONTENTS

This HCP has been prepared in accordance with the requirements set forth under Section 10(a)(1)(B) of the ESA, as amended, and applicable U.S. Fish and Wildlife Service (USFWS) regulations and guidance.

The HCP has been prepared in support of an application for an ITP associated with operation of Wildcat. The Project's location is within the range of both the Indiana and northern long-eared bat, species listed as endangered and threatened, respectively, under the ESA. The Indiana bat is also listed as endangered under the Indiana Nongame and Endangered Species Conservation Act (INESCA). The northern long-eared bat is listed as a special concern species under INESCA. Based upon desktop and field surveys, WWF has determined that no suitable Indiana or northern long-eared bat habitat is located within the Project Area, and suitable habitat in the vicinity is limited to isolated woodlots located along Wildcat Creek and its tributaries, north of the Project Area. However, the possibility of incidental take of migrating bats of either species cannot be ruled out anywhere within the species' geographic ranges.

Under Section 10(a)(1)(B), applicants may be authorized, through issuance of an ITP, to conduct activities that may result in take of a listed species, as long as the take is incidental to, and not the purpose of, otherwise lawful activities. WWF is applying for an ITP to authorize any incidental take of either Indiana or northern long-eared bats that may occur as a result of the activities that are proposed for coverage under the ITP – specifically, the operation and decommissioning of Wildcat, and the implementation of mitigation activities pursuant to this HCP. Because Madison and Tipton Counties are within the range of only two federally listed species – the Indiana bat and the northern long-eared bat (USFWS 2015a) – they are the only species for which incidental take coverage is being sought in connection with this HCP.

WWF has prepared this HCP to support the issuance of an ITP for Indiana and northern long-eared bats during the operation and decommissioning of the Project pursuant to Section 10(a)(1)(b) of the ESA. Specifically, this HCP provides the following:

- An overview of the regulatory framework of wind projects as relates to species protection, including a summary of agency coordination;
- A discussion of the general environmental setting and biological resources within the Project Area;
- A description of the proposed Project, including its purpose and a description of activities to be covered under the HCP; alternatives considered; and public participation;
- A discussion of the life histories and presence of the Indiana and northern long-eared bat;
- Potential effects of the proposed action, including alternatives for minimizing risk to Indiana and northern long-eared bats;
- An estimate of the Project's take, and context defining its significance relative to overall population viability;
- A Conservation Plan, outlining measures to avoid, minimize and mitigate impact; conduct post-construction monitoring for effectiveness; and implement adaptive management measures as appropriate; and
- An implementation plan and Implementing Agreement (IA).

Incidental take authorized within the scope of a Section 10(a)(1)(B) permit issued to WWF will include, under specific circumstances and limits, direct mortality of migrating bats, and any incidental mortality, harassment and disturbance of bats in and around summer and winter habitat in connection with authorized mitigation activities. Because no maternity colonies are currently known to exist in proximity to the Project Area, no loss of potentially suitable summer habitat occurred. However, should any trees develop in the Project Area during the term of the ITP that could provide suitable habitat for Indiana bats or northern long-eared bats, WWF will avoid clearing those trees during periods when either species could be present in the Project Area, thereby avoiding any risk of take.

As part of the requirements for the issuance of an ITP, WWF has prepared this HCP to identify those actions that will minimize and mitigate for the impacts on the Indiana and northern long-eared bats that may occur as a result of the operation and decommissioning of, and mitigation for, Wildcat.

1.5 REGULATORY AND LEGAL FRAMEWORK

1.5.1 Federal Endangered Species Act

The purpose of the ESA is to provide a means whereby the ecosystems upon which threatened and endangered (T&E) species depend may be conserved, and to provide a program for the conservation of such T&E species.

Section 9 of the ESA prohibits the "take" of any fish or wildlife species listed under the ESA as endangered; under Federal regulation, take of fish or wildlife species listed as threatened is also prohibited unless otherwise specifically authorized by regulation. Take, as defined by the ESA, means "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect a listed species, or attempt to engage in any such conduct" (ESA § 3(19)). The USFWS' implementing regulations further define the term "harm" to mean "significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering." They also define harass as "an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering."

The 1982 amendments to the ESA established a provision in Section 10 of the ESA that allows for "incidental take" of endangered and threatened species of wildlife by non-Federal entities. Incidental take is defined by the ESA as take that is "incidental to, and not the purpose of, the carrying out of an otherwise lawful activity" (50 Code of Federal Regulations (C.F.R.) § 402.02). Under this provision, the Secretary of the Interior and Secretary of Commerce may, where appropriate, authorize the taking of federally listed fish or wildlife if such taking occurs incidentally to otherwise lawful activities. The USFWS was charged with regulating the incidental taking of listed species under its jurisdiction.

Section 10 of the ESA establishes a program whereby persons seeking to pursue activities that otherwise could give rise to liability for unlawful "take" of federally-protected species as defined in Section 9 of the ESA may receive an ITP authorizing such take. Under Section 10 of the ESA, applicants may be

authorized, through issuance of an ITP, to conduct activities that may result in take of a listed species, as long as the take is incidental to, and not the purpose of, otherwise lawful activities.

The submission of the ESA Section 10(a)(1)(B) permit application requires the development of an HCP (16 USC §§ 1539(a)(1)(B) 1539(a)(2)(A)) designed to ensure the continued existence and aid in the recovery of the listed species while allowing for any limited, incidental take of the species that might occur in connection with the proposed activity. The HCP must demonstrate that the impacts of incidental take have been minimized and mitigated to the maximum extent practicable. Incidental take may be permitted through the issuance of an ITP if the following six criteria of Section 10(a)(2)(B) and 50 C.F.R. § 17.22(b)(2) and 50 C.F.R. § 17.32 (b)(2) are met:

- The take will be incidental to otherwise lawful activities.
- The Applicant will, to the maximum extent practicable, minimize and mitigate the impacts of such taking.
- The Applicant will ensure that adequate funding for the HCP and procedures to deal with unforeseen circumstances will be provided.
- The taking will not appreciably reduce the likelihood of the survival and recovery of the listed species in the wild.
- The Applicant will ensure that other measures that the Service may require as being necessary or appropriate will be provided.
- The Service has received such other assurances as may be required that the HCP will be implemented.

An ITP can only be issued if the HCP addresses all of these requirements. To demonstrate that all six requirements have been adequately addressed, the HCP must document and describe:

- Impacts likely to result from the proposed taking of the species for which permit coverage is requested;
- Measures the project will undertake to monitor, minimize, and mitigate such impacts;
- Funding that will be made available to undertake such measures;
- Procedures to deal with unforeseen circumstances;
- Alternatives that were considered that would not result in incidental take, and the reasons why such alternatives are not being utilized; and
- Other necessary and appropriate measures the Service may require as necessary or appropriate for purposes of the plan.

In order to issue an ITP, the USFWS is required under Section 7 of the ESA to prepare a Biological Opinion (BO) that evaluates the impacts of the Proposed Action (i.e., issuance of an ITP) and establishes an overall effect determination. The BO analyzes the HCP and other relevant information for the effects on the listed species and analyzes whether the Proposed Action would be likely to jeopardize the continued existence of the species or destroy or adversely modify designated critical habitat. The resulting BO will encompass the issuance of the ITP and implementation of the HCP.

In addition to these necessary HCP elements, the Five-Point Policy (FR 65 35241-35257; USFWS and NOAA 2000), an addendum to the *Habitat Conservation Planning Handbook* (USFWS and NOAA 1996), describes five clarifying components that should be included in an HCP:

1. Biological Goals and Objectives – Biological goals are the broad guiding principles for the operating conservation program of the HCP and provide the rationale behind the minimization and mitigation strategies. Objectives describe the desired outcome of the plan and are described in terms of measurable targets for achieving the biological goals.

2. Adaptive Management – Adaptive management is an integrated method of addressing uncertainty over time. Adaptive management provides flexibility in the conservation program to examine alternative strategies for achieving the goals and objectives.

3. Monitoring – Monitoring is a mandatory element of an HCP under the Five-Point Policy. The monitoring plan must identify how compliance with the HCP will be evaluated, identify how biological goals and objectives will be met and provide information that will inform the adaptive management strategy.

4. Permit Duration – HCPs should clearly define the desired duration the permit will be in effect and discuss the factors considered in determining the length of the permit.

5. Public Participation – The Five-Point Policy expanded the public comment period for most HCPs from 30 days to 60 days, with the exception of large scale, regional or exceptionally complex HCPs where the comment period was extended to 90 days.

1.5.2 National Environmental Policy Act

The National Environmental Policy Act (NEPA) of 1969, as amended, requires Federal agencies to evaluate and disclose the effects of their proposed actions on the natural and human environment. The NEPA process is intended to help federal agencies make decisions that are based on an understanding of potential environmental consequences, and take actions that protect, restore, and enhance the environment. NEPA regulations provide the direction to achieve that purpose. The issuance of an ITP by the USFWS constitutes a federal action subject to NEPA compliance and review (42 USC §§ 4321-4347, as amended).

NEPA and the Council for Environmental Quality (CEQ) *Regulations for Implementing NEPA* (40 C.F.R. § 1501) contain "action-forcing" provisions to ensure that all federal agencies act according to the letter and spirit of NEPA. NEPA procedures must ensure that environmental information is available to public

officials and citizens before decisions are made and before actions are taken. Accurate scientific analysis, expert agency comments, and public scrutiny are essential to implementing NEPA. NEPA documents must concentrate on the issues that are truly significant to the action in question, rather than amassing needless detail.

Evaluation of the environmental effects of a proposed action can be conducted through preparation of an Environmental Assessment, or if warranted, a more comprehensive Environmental Impact Statement. The USFWS can issue an ITP only after the NEPA review process has been completed.

1.5.3 National Historic Preservation Act

According to the National Historic Preservation Act (NHPA) of 1966, as amended, 16 U.S.C. § 470, *et seq*., "the historical and cultural foundations of the Nation should be preserved as a living part of our community life and development in order to give a sense of orientation to the American people" (16 U.S.C. § 470(b)(2)). Further, the federal government has a responsibility to "foster conditions under which our modern society and our prehistoric and historic resources can exist in productive harmony" (16 U.S.C § 470-1(1)). In furtherance of these principles, Section 106 of the NHPA and its implementing regulations require federal agencies to take into account the impact of federal undertakings upon historic properties in the area of the undertaking (16 U.S.C. § 470f; 36 C.F.R. Part 800)(Revised January 2001).

1.5.4 Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA, 16 U.S.C. §§ 703-712) prohibits the taking, killing, injuring, or capture of listed migratory birds. Neither the MBTA nor its implementing regulations found in 50 C.F.R. Part 21 provide for the permitting of "incidental take" of migratory birds that may be killed or injured by wind turbines. The USFWS' Land-Based Wind Energy Guidelines (USFWS 2012a) call for the development of Bird and Bat Conservation Strategies ("BBCS") to minimize the impact of wind farms on migratory birds. WWF has developed and implemented a BBCS, which will remain in effect after approval of this HCP to ensure continued protection and monitoring of effects on migratory birds throughout the Project life.

1.5.5 Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act of 1940 (50 C.F.R. § 22.26), and its implementing regulations, provide additional protection to bald eagles (*Haliaeetus leucocephalus*) and golden eagles (*Aquila chrysaetos*) such that it is unlawful to take an eagle. In this statute the definition of "take" is 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 C.F.R. § 22.3 to include "to agitate or bother 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."

The USFWS published a final rule (Eagle Permit Rule) on September 11, 2009 under BGEPA authorizing limited issuance of permits to take bald eagles and golden eagles "for the protection of…other interests in

any particular locality" where the take is compatible with the preservation of the bald eagle and the golden eagle, is associated with and not the purpose of an otherwise lawful activity, and cannot practicably be avoided (FR 46836-46879).

On May 5, 2013, the USFWS announced the availability of the Eagle Conservation Plan Guidance: Module 1 – Land-based Wind Energy, Version 2 (78 FR 25758).[1] The Guidance provides a means of compliance with BGEPA by providing recommendations 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 C.F.R. 22.26 and 22.27, and does not impose any binding requirements beyond those specified in the regulations.

Pre-construction surveys conducted at the Project site in 2010 and 2011 did not identify any eagles in the Project Area. In 2014, during the development of this HCP, the USFWS confirmed for WWF that there are no known bald eagle nests within a 10-mile radius of the Wildcat turbine locations. Accordingly, WWF is not seeking coverage for bald eagles under this HCP or independently under the Eagle Permit Rule. However, WWF will continue to monitor eagle activity through its BBCS and ongoing communications with the USFWS, and should WWF determine that take coverage may be warranted based on changes in or expansion of eagle populations in the Project Area, WWF will contact the USFWS to discuss the most efficacious approach to securing such authorization.

1.5.6 Indiana Nongame and Endangered Species Conservation Act

The Indiana Nongame and Endangered Species Conservation Act (IC 14-22-34) (INESCA) is maintained by the Office of Code Revision Indiana Legislative Services Agency. Any species or subspecies of wildlife whose survival or reproductive parameters are in jeopardy or are likely to be within the foreseeable future and any species or subspecies designated as endangered under the Federal ESA are deemed endangered species under INESCA (IC 14-22-34-1).

INESCA prohibits the unlawful taking or possession of designated endangered species (IC 14-22-34-12), but authorizes the director of the Indiana Department of Natural Resources (IDNR) to permit take "for scientific, zoological, or educational purposes, for propagation in captivity or the wildlife, or for other special purposes" (IC 14-22-34-15). While there is no general provision under the Act for an ITP, Section 14-22-34-17 authorizes the director to adopt such rules as are necessary to carry out the purposes of the Act. Pursuant to that section, the IDNR has adopted rules authorizing the agency to issue limited take permits (312 IAC 9-10-18). According to 312 IAC 9-10-18, "(a) The department may issue a permit under

[1] http://www.fws.gov/windenergy/PDF/Eagle%20Conservation%20Plan%20Guidance-Module%201.pdf

this section to an individual, organization, corporation, or government agency to take a state endangered species. This permit may only be issued for state endangered species that are either federal proposed species or federal listed species. (b) The permit application under this section shall be made as follows: (1) The applicant must submit a Habitat Conservation Plan. (2) The division of fish and wildlife will supply an outline of information sections that must be included in the Habitat Conservation Plan. This outline will include, but not necessarily be limited to, the following sections: (A) Current status of the endangered species. (B) Description of area of impact. (C) Specific impacts to the species' habitat. (D) Conservation actions to be undertaken to ensure no detrimental effect to the endangered species. (E) Schedule for enacting the conservation actions. (F) Guarantees to ensure those enactment of conservation actions. (c) The permit application has to be available for a minimum of thirty (30) days for public review and comment. The director shall determine whether the permit will be issued after review of comments received during the review and comment period. (d) The permit may be revoked at any time if the provisions of the Habitat Conservation Plan are not enacted according to the schedule in the plan."

1.5.7 Local Regulations

Wind energy conversion facilities such as Wildcat are regulated primarily at the county level in Indiana. The Project Area consists of portions of two counties: Tipton and Madison. Both of these counties have adopted ordinances governing the siting and development of wind projects. While those ordinances encourage agency consultation, neither county has specific requirements relating to Indiana bats, northern long-eared bats, HCPs, or endangered species generally. WWF complied with the requirements of these ordinances and received local zoning approval from both counties.

1.6 PERMIT DURATION

WWF is seeking a 28-year ITP for Indiana and northern long-eared bats and anticipates the HCP to be in effect for, and the ITP to cover, the 28-year term. This HCP will establish specific avoidance, minimization, and mitigation measures that will be implemented for the Project. The 28-year period will include 27 years of operations and a one year decommissioning period, in which take is unlikely. At the close of the 28-year term, the ITP will expire if not renewed.

The 28-year permit term being sought under this HCP coincides with the 27-year operational life of the Project plus a decommissioning period, and therefore is a practical necessity for the ITP to hold the value for which it is being sought. WWF has leases with landowners on whose property the Project facilities and equipment are located with a duration of 27 years, and the economic modeling on which the Project was developed was based on that time period. In addition, WWF obtained third-party financing for the Project on the basis of certain contractual commitments regarding project capacity, output and economics. An ITP that authorizes take from Project operations for a period shorter than the operational life of the Project could result in WWF failing to meet these commitments.

1.7 COVERED LANDS

The Project Area for this Project, shown in Figure 2-1, is the outermost boundary of the parcels under lease for the Wildcat Project and covers 24,434 acres. The Project Area includes all areas physically

affected by activities associated with the operation of Wildcat. The requested ITP would cover the entire Project Area, as well as the lands upon which mitigation activities will occur. Collectively, the Project Area and mitigation lands make up the Plan Area that will be covered by this HCP and the ITP.

1.8 COVERED SPECIES

As noted above, the HCP is intended to address the Indiana and northern long-eared bat. No additional federally threatened, endangered or candidate species have the potential to be found in the Project Area based on historic geographic distribution and consultation with the USFWS and IDNR. Because the Indiana bat and northern long-eared bat are the only federally listed species with the potential to be incidentally taken by the proposed action, they are the only species to be covered by the ITP issued in association with this HCP.

2. Covered Lands and Covered Activities

2.1 PLAN AREA AND PROJECT SETTING

The Project Area is located in Tipton and Madison Counties in central Indiana, within the Till Plains section of the Central Lowland physiographic province. This region is characterized by flat to gently rolling topography produced by glacial processes. Tipton and Madison Counties include many small towns with residential, commercial and heavy industrial activity, connected by a comprehensive network of local and state roads, an interstate highway, active railways, and major and minor transmission lines. The counties are largely comprised of agricultural lands interspersed with creeks, drainages, and small clusters of residential and agricultural development. Forested areas in these counties are limited to fragmented, linear tracts and small forested bands associated with larger streams.

2.1.1 Land Use

Tipton and Madison Counties are comprised of small towns surrounded by farmsteads. Land use is primarily agricultural interspersed with commercial and industrial activity. Larger urban areas in the vicinity include: Kempton, Sharpsville, Tipton, and Windfall City in Tipton County; Elwood, Frankton, Alexandria, Summitville, Chesterfield, Anderson, Edgewood, Lapel, Pendleton, Ingalls, and Markleville in Madison County.

2.1.2 Topography

The Project Area straddles the border of the Bluffton Till Plain and Tipton Till Plain regions of Indiana. The plains formed when the bedrock and topographic features of the region were covered by glacial till deposits during the Wisconsin glaciations 70,000 years ago. Although broad expanses of the till plains are featureless, they are crossed by several low, poorly developed, end moraines. Elevation within Tipton and Madison Counties ranges from 803 to 997 feet (feet) (245 to 304 meters [m]) above sea level; there is even less topographic relief in the immediate area of the proposed action.

2.1.3 Geology

The geology of central Indiana is the product of the Wisconsin glaciations. Surficial geology within the Project Area is dominated by glacial deposits of sedimentary rocks which may be up to hundreds of feet thick. Bedrock within the Project Area is mostly of the Silurian period (approximately 440 to 410 million years ago), with Devonian bedrock in northwest Tipton County and Ordovician bedrock in Madison County (Indiana Geological Survey 2011). Most Silurian formations consist of limestones and dolostones with varying amounts of fossils and argillaceous material. Devonian bedrock is approximately 410 to 360 million years old and consists of carbonates and shale formations. Ordovician bedrock formed approximately 446 to 440 million years ago and consists mostly of gray, greenish-gray, and brown shales with a minor amount of shaly limestone (Thompson 2011). Bedrock depth is between zero and 130 ft (0 and 40 m) throughout the Project Area (Indiana Geological Survey 2011).

2.1.4 Soils

Madison County is comprised primarily of Brookston silty clay loam (24%), Crosby silt loam (26%), and small acreages of many other soil types. Brookston and some of the more minor soil types are hydric. Tipton County is comprised primarily of Del Rey (33%), Patton silty clay loam (49%), and Pella (9%). Of these soils, Patton and Pella are hydric. Similar to Madison County, many other soil types, less than half of which are hydric, are represented in smaller acreages in Tipton County.

2.1.5 Hydrology

The Project Area is located in the Wabash River watershed. Small, perennial creeks and drainages are common. Larger waterways in the Project vicinity include the Mississinewa River, the White River, Pipe Creek, Cicero Creek, and Wildcat Creek.

National Wetlands Inventory (NWI) data indicate that small wetlands are scattered throughout the Project Area, occurring in higher densities along the larger waterways. Madison County includes approximately 7,495 acres (3,033 hectares [ha]) of NWI wetlands, comprising 2.5% of the county. In Tipton County, NWI wetlands cover approximately 3,685 acres (1,491 ha), or 2.2% of the county. Wetlands within the Project boundary include emergent herbaceous wetlands, freshwater ponds and lakes, and riverine systems.

2.1.6 Land Cover

Based on the National Land Cover Database (2011), land cover within Madison and Tipton Counties is dominated by agriculture (ranging from 74% in Madison County to 90% in Tipton County), mostly row crops of corn, soybeans, and wheat. Cultivated crops comprise 93.4% of the land use within the Project Area (Table 2-1). Developed open space (5.1%), deciduous forest (0.5%), grassland/herbaceous cover (0.5%), pasture/hay (0.2%), and low intensity development (0.2%) cover nearly all of the remaining land within the Project Area. Forested tracts are fragmented and scattered across the landscape. Figure 2-2 shows the distribution of land cover within the Project Area.

Table 2-1 National Land Cover Database Land Cover Types and Extents within the Wildcat Wind Project Boundary (Tipton and Madison Counties, Indiana)

Land Cover Type	Acres (ha)	Approximate Percent Composition
Developed, Open Space	1,203.1 (486.9)	4.9%
Developed, Low Intensity	79.6 (32.2)	0.3%
Developed, Medium Intensity	11.6 (4.7)	<0.1%
Developed, High Intensity	2.0 (0.8)	<0.1%
Deciduous Forest	117.7 (47.6)	0.5%
Shrub/Scrub	10.5 (4.3)	<0.1%
Grassland/Herbaceous	109.4 (44.3)	0.4%
Pasture Hay	47.7 (19.3)	0.2%
Cultivated Crops	22,849.6 (9,246.9)	93.5%
Emergent Herbaceous Wetlands	2.5 (1.0)	<0.1%
Total	24,433.6 (9,887.9)	100%

ha = hectare

2.2 PROJECT DESCRIPTION

Wildcat is a state-of-the-art wind energy project located in Tipton and Madison counties, just north of the town of Elwood, in Sections 1 – 2, 11 – 14, 23 – 26, 35 – 36, T22N, R5E; Sections 5 – 10, 13, 15 – 36, T22N, R6E; Sections 30 and 31, T22N, R7E; Sections 1 - 2, 11 - 12 T21N, R5E; Sections 1-2, 4-8 T21N, R6E; and Section 6 T21N R7E. The Project is a 200 MW wind farm, with 125 GE 1.6 MW WTGs and associated access roads and collector line system. The boundaries of the Project (Figure 2-1) along with the lands upon which mitigation activities will occur comprise the Plan Area addressed in this HCP.

2.2.1 Site Selection

The Project Area was first identified through a review of available wind resource mapping in 2008. E.ON identified areas of potentially commercially viable wind resource in Madison and Tipton Counties, and subsequently validated the potential of the resource through onsite meteorological monitoring.

In addition to a potentially sufficient wind resource, a wind project requires a transmission line that will connect the generated power to the electrical grid. E.ON identified a nearby 138 kilovolt (kV) transmission line with capacity available to support the project and entered the transmission queue to begin the process of reaching an interconnection agreement with the utility that owns the line. Having identified the potential project area and transmission path, E.ON began contacting landowners to gauge their interest. WWF then contracted with ARCADIS to conduct a fatal flaw evaluation of a preliminary project area.

Wildcat's Project boundaries were refined over the next several years by carefully considering environmental, landowner and community concerns in the siting of WTGs and associated components within a given property. Throughout the process of designing the project, WWF placed great emphasis on avoiding stream and wetland areas wherever possible, as well as on avoiding the disturbance of mature trees. Wetland impacts were avoided during construction of the Project except for temporary disturbances associated with underground cable installation.

2.2.2 Public Participation

WWF has been active in the local community since 2008, meeting with prospective landowners and local officials. In addition to this long-term informal contact, each county requires a public hearing associated with its zoning review process for wind energy projects. On August 22, 2011, a public hearing was held in Tipton County. An overview of the Project was presented, including discussion of environmental studies associated with birds and bats. Other than clarifying questions, no specific issues were raised about bat activity at the Project Area, and the Conditional Use Permit was unanimously approved that evening. On September 13, 2011, a public hearing was held in Madison County. Environmental issues were also presented at that hearing, and the Special Exception Permit was unanimously approved.

2.2.3 Project Characteristics

The Project Area is located immediately north of the town of Elwood, Indiana. Land use throughout much of the Project Area is dominated by agriculture (i.e., row crops and pasture), with several creeks and unnamed drainageways found throughout the Project Area.

The Project is located on land leased from private landowners, who continue their existing use of the land. As a leaseholder, WWF's rights are limited to those incorporated in the lease agreement to allow for safe and effective construction, operation, maintenance and decommissioning of the Project. WWF has no control over landowner activities on the property within which the Project will be located to the extent not covered in specific lease provisions.

Construction began in October 2011 and was completed in December 2012. The Project was constructed using standard construction practices including erosion and sediment control best management practices to minimize impacts to the existing environment and habitat. Details of various Project components are provided in the following sections.

2.2.3.1 Turbines

The Project includes 125 GE 1.6 MW wind turbines. Each wind turbine consists of three major components: the tower, the nacelle, and the rotor. The Project includes towers of two different heights from foundation to top of tower ("hub height"): 76 towers of approximately 328 ft (100 m) and 49 towers of approximately 315 ft (96 m). The nacelle sits atop the tower, and the rotor hub is mounted to the front of the nacelle. Each rotor consists of three composite blades that are approximately 161 ft (49 m) in length (total rotor diameter of 328 ft [100 m]). The total turbine height (i.e., height at the highest blade tip position) is approximately 492 ft (150 m) for the 100 m towers and approximately 479 ft (146 m) for the 96 m towers.

Three independent electric pitch motors and associated controllers enable the adjustment of blade pitch angle during operations, thereby permitting control of rotor speed. The blade pitch adjustment, under normal operations, is informed by the wind speed and direction as measured by anemometry on each turbine nacelle, and when sent through the turbine's electronics, tells the blades to pitch or feather (i.e., blades pitched parallel with the wind direction, causing them to spin at very low revolutions per minute [RPM], if at all) into or out of the wind. When wind speeds are sufficient the blades will pitch into the

wind to allow the turbine to begin operating; during high wind events, the blades will pitch out of the wind. This pitch controls not only cut-in and cut-out but also adjusts pitch angle to maximize the turbine's efficiency across all wind speeds. The GE 1.6 MW turbines begin generating energy at wind speeds as low as 7.8 mph (3.5 meters per second [m/s]) and cut out when wind speeds reach 60 mph (25 m/s) for 10 minutes. During periods of curtailment the turbine will regulate its speed, cut-in or cut-out, according to adjusted (not manufacturer ratings) prescribed operational criteria programmed through the Project's Supervisory Control and Data Acquisition (SCADA) system. Operational adjustments based on the new curtailment criteria are also informed by the on-board turbine anemometry, and each turbine will adjust in and out accordingly based on real-time conditions.

2.2.3.2 Access Roads and Turbine Pads

The Project required the construction of new access roads and improvement of existing access roads to provide access to the turbines and substation site. The total length of access roads required to service all wind turbine locations is approximately 32 miles (51 km), some of which were upgrades to existing farm lanes. The roads are gravel-surfaced, and 16-18 ft (5-5.5 m) in width. Access to the individual turbines includes a 14 ft (4.3 m) wide ring-road around the turbine itself, often referred to as the turbine pad.

2.2.3.3 Collection System and Substation

A transformer located near the base of the tower raises the voltage of electricity produced by the turbine generator up to the 34.5 kV voltage level of the collection system. A buried 34.5 kV collection system connects the individual turbines to the substation located at the northwest corner of Madison County Roads 700W and 1500N. The cables range from approximately 2 to 5 inches (5 to 13 centimeters) in outside diameter. The total length of these collection lines is approximately 88 miles (142 km).

The collector substation steps up voltage from 34.5 kV to 138 kV to allow connection with the existing transmission line. The substation is approximately 200 ft by 300 ft (61 m by 91 m) in size, enclosed within a chain link fence, and accessed by a new gravel access road from either County Road 700W or 1500N.

2.2.3.4 Transmission Line

A newly-constructed transmission line connects the collector substation to the point of interconnect (a new switching station, discussed below). The transmission line consists of electrical cables mounted on monopole towers. The towers are located along Madison County Road 1500N, and run for approximately 1.5 miles (2.4 km) from Madison County Road 700W to 0.5 mile (0.8 km) east of Indiana State Road 37.

2.2.3.5 Switching Station

The switching station transmits the power from the Project to the existing transmission line. The switching station is approximately 200 by 300 ft (61 by 91 m) in size, enclosed within a chain link fence, and accessed by a new gravel access road from County Road 1500N.

2.2.3.6 Meteorological Tower

One 328-ft (100-m) tall meteorological tower was installed to collect wind data and support performance testing of the Project. The tower is a self-supporting lattice steel structure and is unguyed. The tower includes wind monitoring and SCADA instrumentation. Two separate additional meteorological towers also were installed to collect wind data and support performance testing. These towers are 197-ft (60-m) guyed lattice steel structures and include wind monitoring instruments. All three towers are located in agricultural fields within the boundaries of the current Project Area.

2.2.3.7 Operations and Maintenance Building

An operations and maintenance (O&M) building and associated storage yard was constructed in a former agricultural field to house operations personnel, equipment and materials, and provide staff parking. Site selection for the O&M building was based primarily upon typical constructability criteria. The O&M structure is 11,925 ft^2 (1108 m^2) in size and is located on 10 acres within the Project Area. The site is in a relatively level, well drained field, avoiding sensitive features such as surface waters and subsurface cultural resources.

2.3 COVERED ACTIVITIES

2.3.1 Operation

The most likely potential for take exists during the operation phase of the Project. During the spring (April 1 – May 15) and fall migratory periods (August 1 – October 15), the possibility exists that individual bats migrating through the Project Area may be injured or killed through interactions with rotating turbine blades. The impacts of Project operation are fully described and evaluated in Section 4.0.

As described in Section 1.2, WWF has been operating under the terms of TALs (Appendix B) and the supporting Mortality Minimization and Monitoring Proposal (Appendix A) while review of the HCP is completed and until such a time as an ITP is issued.

To avoid take of both species during operations prior to issuance of an ITP for the Project, WWF developed and implemented a Mortality Minimization and Monitoring Proposal (Appendix A) calling for the curtailment of Project operations during periods of expected risk to the species. USFWS issued a TAL to WWF on June 18, 2012 indicating that, if the Project operates in accordance with the terms of that Proposal, it is presumed that take will be avoided. A second TAL was issued on July 2, 2015, indicating that, if the Project operates in accordance with the terms of the revised TAL requirements, it is presumed that take will be avoided. Wildcat is currently operating under the terms of the second TAL and the supporting Proposal while review of the HCP is completed and until an ITP is issued. The TALs and Proposal are included in Appendix A and Appendix B.

Upon issuance of an ITP, the Project will operate with a more targeted, less restrictive set of avoidance and minimization measures more fully described in Section 5.0 of this HCP, including:

- Operational adjustments between August 1 and October 15 that will include a cut-in speed of 5.0 m/s and feathering of turbine blades at wind speeds below 5.0 m/s, thereby reducing Indiana and northern long-eared bat mortality;

- Feathering of turbine blades at wind speeds below the established cut-in speed[2] year-round, further minimizing mortality of non-covered and unlisted species of bats; and
- Monitoring the operational Project to verify compliance with the authorized take level and to allow for appropriate adaptive management if necessary.

2.3.2 Maintenance

Although take is not likely during Project maintenance activities, ongoing maintenance is included as a covered activity in this HCP. Project maintenance activities may include turbine maintenance as needed, vegetation control if necessary, periodic re-grading, and reviewing the Project drainage plans. Due to the absence of Indiana bat and northern long-eared bat habitat at the Project site, and the fact that maintenance activities take place during daylight hours, no potential for lethal take is anticipated to exist in association with Project maintenance activities. Should vegetation grow up around the Project during its operating life, the clearing necessary for access and/or other maintenance activities would need to consider the potential effect on Indiana and northern long-eared bats. Any areas of ground disturbance during maintenance activities will be re-graded, reseeded and restored. Avoidance and minimization measures employed during maintenance activities will be used, including:

- Personnel will maintain a speed limit of 25 mph on all access roads to reduce the chance of collision with wildlife;
- All personnel are required to immediately turn off internal lights in turbines at nights when lights are not required for safety or compliance purposes;
- All Project substation lights are equipped with downward facing shields;
- Travel will be restricted to designated roads, and no off-road travel will occur except if needed in emergencies;
- No tree clearing is anticipated; however, if necessary, tree clearing activities will be limited to the inactive season for bats, October 1 – March 31.

Given the characteristics of the Project site and measures intended to be implemented, WWF anticipates that maintenance activities will not pose a risk of mortality to Indiana or northern long-eared bats, but may result in incidental take in the form of harassment or disturbance of individuals of the species.

2.3.3 Decommissioning

Commercial wind turbine generators typically have a life expectancy of 20 to 30 years. Turbines will be decommissioned at the end of their operational life, or if they are non-operational for an extended period of time with no expectation of returning to operation. Decommissioning will be performed under the

[2] 3.5 m/s year-round, raised to 5.0 m/s from August 1 through October 15.

decommissioning plan that addresses removal of Project components/improvements as well as site/land reclamation. The decommissioning plan is included in Appendix C. Complete decommissioning of the facility or individual wind turbines will be completed within 12 months after the end of the useful life of the facility or of individual wind turbines. Decommissioning activities will have similar or lesser impacts as compared to construction and all applicable avoidance and minimization measures employed during construction will be applied. In addition, the following measures will be implemented in connection with decommissioning:

- Areas disturbed during decommissioning will be re-graded, reseeded, and restored to their original purposes when feasible.
- Existing roads and previously disturbed lands will be used for decommissioning where feasible, to reduce vegetation impacts within the Project area. Surface disturbance will be limited to that which is necessary for safe and efficient decommissioning.

Because decommissioning activities do not involve the operation of wind turbines, WWF anticipates that these activities will not pose a risk of mortality to Indiana or northern long-eared bats, but may result in incidental take in the form of harassment or disturbance of individuals of the species.

2.3.4 Mitigation and Monitoring

This HCP includes mitigation actions (see Section 5.2.2) that will be conducted to offset the impact of Indiana bat and northern long-eared bat take that may result from the Project. Mitigation actions may include maternity colony habitat enhancement or protection, or enhancement or protection activities at hibernacula. No Indiana or northern long-eared bat mortality is expected to result from the implementation of mitigation activities – indeed, it is expected that these activities will enhance the survival of Indiana and northern long-eared bats. However, these activities have the potential to temporarily disturb individual Indiana and northern long-eared bats in a manner that may constitute a take as that term is broadly defined in the ESA. Accordingly, effects of the mitigation activities will be covered within the ITP.

WWF will conduct post-construction mortality monitoring during the life of the ITP to ensure compliance with the ITP (see Section 5.3). During mortality monitoring, injured or dead Indiana and northern long-eared bats may be collected. WWF will notify the USFWS within 24 hours of collection of any Indiana or northern long-eared bats, and dead bats of either species will be delivered to the USFWS within 48 hours of collection.

3. Covered Species

3.1 INDIANA BAT

The Indiana bat (*Myotis sodalis*) was originally listed on March 11, 1967 as being in danger of extinction under the Endangered Species Preservation Act of 1966 (32 FR 4001). The species is currently listed as endangered under the ESA, as amended.

A USFWS Indiana Bat Recovery Plan was first developed and signed on October 14, 1983 (USFWS 1983). An agency draft of a revised recovery plan was released in March 1999 (USFWS 1999), but was never finalized. A third document, the "Indiana Bat (*Myotis sodalis*) Draft Recovery Plan: First Revision," was made available for public comment on April 16, 2007 (72 FR 19015-19016) (USFWS 2007) (Revised Draft Recovery Plan).

The Revised Draft Recovery Plan describes three recovery objectives for reclassification of the species as threatened (USFWS 2007):

1. Permanent protection of 80% of Priority 1 hibernacula.
2. A minimum overall population number equal to the 2005 estimate (457,000).
3. Documentation of a positive population growth rate over five sequential survey periods.

In addition, the Revised Draft Recovery Plan describes three recovery objectives for delisting of the species (USFWS 2007):

1. Permanent protection of 50% of Priority 2 hibernacula.
2. A minimum overall population number equal to the 2005 estimate.
3. Continued documentation of a positive population growth rate over an additional five sequential survey periods.

Information regarding the species' characteristics, habitat requirements, range, and status in the vicinity of the Project is provided in the sections below.

3.1.1 Species Description

Indiana bats are medium-sized, grayish brown bats with a forearm length of 1.4-1.6 inches (36-41 millimeters [mm]) and a total length of 2.8-3.8 inches (71-97 mm). The tragus (a fleshy projection arising from the base of the inner ear that directs sound into the ear) is short and blunt and measures slightly less than half the height of the ear. The tail is approximately 80% of the length of the head and body. The skull has a small sagittal crest and a small, narrow braincase. Indiana bats may be distinguished from the similar little brown bat (*Myotis lucifugus*) and the northern long-eared bat by the presence of a keeled calcar and toe hairs on the hind feet that are shorter than the claws.

3.1.2 Habitat Description

Indiana bats require specific hibernacula conditions (e.g., stable temperature, humidity and air movement), and typically hibernate in large, dense clusters that range from 300 individuals per square foot (Clawson et al. 1980) up to 100,000 individuals per cluster. Studies have found that over 90% of the range-wide population of Indiana bats hibernate in just five states; Indiana, Missouri, Kentucky, Illinois and New York (USFWS 2007).

The summer habitat requirements of Indiana bats are not fully understood. Until recently, it was believed that floodplain and riparian forests were the preferred habitats for roosting and foraging (Humphrey et al. 1977); however, recent studies have shown that upland forests are also used by Indiana bats for roosting and that suitable foraging habitats may include upland forests, old fields (clearings with early successional vegetation), edges of croplands, wooded fencerows, and pastures with scattered trees and/or farm ponds (USFWS 2007).

The presence of Indiana bats in a particular area during the summer appears to be determined largely by the availability of suitable, natural roost structures. The suitability of a particular tree as a roost site is determined by its condition (live or dead), the amount of exfoliating bark, the tree's exposure to solar radiation, and its location relative to other trees, a permanent water source and foraging areas (USFWS 2007).

Thirty-three species of trees have been documented as roosts for female Indiana bats and their young, with 87% of documented roosts located in various ash (*Fraxinus*), elm (*Ulmus*), hickory (*Carya*), maple (*Acer*), poplar (*Populus*), and oak (*Quercus*) species (USFWS 2007). However, the species of the roost tree appears to be a less important factor than the tree's structure (i.e., the availability of exfoliating bark with roost space underneath) and local availability. Studies show that Indiana bats have strong fidelity to summer habitats. Females have been documented returning to the same roosts from one year to the next (Humphrey et al. 1977; Gardner et al. 1991; Callahan et al. 1997) and males have been recaptured when foraging in habitat occupied during previous summers (Gardner et al. 1991).

3.1.3 Reproduction and Maternity Roost Habitat Requirements

Indiana bats mate during the fall, just prior to hibernation. Male and female bats congregate near the opening of a cave (usually their hibernacula) and swarm, a behavior in which large numbers of bats fly in and out of cave entrances from dusk to dawn, while relatively few roost in the caves during the day (Cope and Humphrey 1977). Swarming lasts over a period of several weeks with mating occurring during the latter part of that period. Once females have mated, they enter the hibernacula and begin hibernation, whereas males will remain active longer, likely attempting to mate with additional females as they arrive at the hibernacula. Adult females store sperm during the winter with fertilization delayed until soon after they emerge from hibernation.

Females emerge from the hibernacula ahead of the males, usually by mid- to late April, and migrate by the beginning of May to their summer roost habitats where they form small maternity colonies (Whitaker and Hamilton 1998). Maternity colonies generally have several separate roost areas located near one another that collectively provide the colony with the necessary roosting resources (including cover and correct temperature provided by exfoliating bark) needed during different environmental conditions. These colonies typically utilize one to a few primary roost trees (Callahan et al. 1997), which provide the proper roosting conditions most of the time, and are normally large, dead trees with exfoliating bark that are exposed to abundant sunlight (Miller et al. 2002, Whitaker and Brack 2002).

The habitat in which the primary roosts have been found varies considerably; roost trees have been found in dense or open woods, strips of riparian forest, small patches of woods, as well as open land; however, the roosts are normally located in open areas subjected to prolonged sunlight (Whitaker and Brack 2002,

Miller et al. 2002). During extreme environmental conditions, such as rain, wind, or temperature extremes, the maternity colony may use alternate roost trees, which likely provide the bats with microclimate conditions that the primary roost trees cannot during times of sub-optimal environmental conditions. The locations of these alternate roosts vary from open areas to the interior of forest stands. A study of bats in northern Missouri revealed that usage of dead trees in the forest interior increased significantly in response to unusually warm temperatures, and the usage of both interior live and dead trees increased during periods of precipitation (Miller et al. 2002). The primary roosts are typically inhabited by many females and young throughout the summer, whereas alternate roost trees receive only intermittent use by individuals or a small number of bats. Females give birth to a single young in June or early July (USFWS 2007).

3.1.4 Foods and Feeding

The Indiana bat is a nocturnal insectivore that feeds exclusively on flying insects, with both terrestrial and aquatic insects being consumed. Diet varies seasonally and variation is seen between different ages, sexes, reproductive status groups and geographic regions (USFWS 2007). A number of studies conducted on the diet of Indiana bats have found the major prey groups to include moths (Lepidoptera), caddisflies (Trichoptera), flies, mosquitoes and midges (Diptera), bees, wasps, and flying ants (Hymenoptera), beetles (Coleoptera), stoneflies (Plecoptera), leafhoppers and treehoppers (Homoptera) and lacewings (Neuroptera) (USFWS 1999), with Coleoptera, Diptera, Lepidoptera and Trichoptera contributing most to the diet (USFWS 2007).

Studies indicate that Indiana bats typically forage from 6 – 100 ft (1.8 – 30 m) above the ground and hunt primarily around, not within, the canopy of trees (USFWS 2007). Foraging areas are most often located in closed to semi-open forested habitats and forest edges, with radio-telemetry data consistently indicating that wooded areas are preferred as foraging sites, although open habitats such as old fields and agricultural areas may also be used (USFWS 2007). Sparks et al. (2005) found that woodlands were used by foraging Indiana bats nearly twice as often as availability alone would suggest, supporting the idea that Indiana bats preferentially forage in woodlands.

3.1.5 Migration

The timing of spring emergence from hibernacula varies across the range of the species, but in general, females emerge first, from mid- to late April, and males emerge later, from late April to mid-May (USFWS 2007). Females may leave for summer habitat immediately after emerging or shortly thereafter and often travel quickly to where they will spend the summer. Some individuals may travel several hundred miles from their hibernacula, but studies in Indiana and New York found Indiana bats using summer habitat only 30 – 50 miles (48 – 80 km) from their hibernacula (USFWS 2007). Maternity colonies begin breaking up in early August at which time females head back to their hibernacula (USFWS 2007).

3.1.6 Regional Status of the Species

3.1.6.1 Rangewide Status

A population decrease of 28% over the Indiana bat's total range was reported from 1960 to 1975 (Thomson 1982). The rangewide population estimate dropped 51% from 883,300 in 1965 to 451,554 in 2001 (USFWS 2007 and2013a), before rebounding to a high of 635,349 in 2007 (USFWS 2015b). The rangewide population has fluctuated annually since that 2007 peak but has remained above 500,000 since 2005, and the most recent available estimate put the rangewide population at 523,636 in 2015 (USFWS 2015b), with known hibernacula in 17 states (USFWS 2013b). The closest known Indiana bat hibernaculum is Lewisburg Mine located in Preble County, Ohio, approximately 75 miles (121 km) to the southeast of the Project Area (USFWS 2007).

Current threats to the Indiana bat include modifications to hibernacula that change airflow and alter the microclimate, human disturbance and vandalism during hibernation resulting in direct mortality, natural events during winter affecting large numbers of individuals, disease, and habitat degradation and loss (USFWS 2007).

A relatively recent, and potentially devastating, threat to Indiana bats is a disease known as white-nose syndrome (WNS). WNS is a fungal infection that was first identified in eastern New York during the winter of 2006-2007. It was named for the visible presence of a white fungus around the muzzles, ears, and wing membranes of affected bats. A previously unreported species of cold-loving fungus (*Pseudogymnoascus destructans*), which thrives in the darkness, low temperatures (40-50°F), and high levels of humidity (>90%) characteristic of bat hibernacula, is now thought to be the primary pathogen.[3] Bats afflicted with WNS wake more frequently from hibernation, causing them to lose fat reserves that are needed to survive hibernation.[4] It is thought that WNS is transmitted primarily from bat to bat; however, the possibility exists that it may also be transmitted by humans inadvertently carrying the fungus from cave to cave on their clothing and gear.

Since first being reported in New York, WNS has been confirmed to be present in 25 states, including Indiana, and suspected in 5 other states.[5] Most species of bats that hibernate in the northeast are now known to be affected, with the little brown bat, northern long-eared bat, and Indiana bat particularly hard hit[6]. WNS has caused 90 to 100 percent mortality at hibernacula in the northeastern United States, and population estimates in 2009 showed an overall Indiana bat population decline of approximately 17%[7] across their entire range. As of November 2015, WNS has been confirmed in nine counties in southern Indiana and suspected in two others.

3.1.6.2 Midwest Recovery Unit Status

The revised Draft Indiana Bat Recovery Plan divides the species' range into four recovery units based on several factors such as traditional taxonomic studies, banding returns, and genetic variation (USFWS 2007). The Project Area is located within the Midwest Recovery Unit, which includes the range of Indiana

[3] http://www.fort.usgs.gov/WNS/.

[4] http://www.fws.gov/northeast/pdf/white-nosefaqs.pdf.

[5] http://www.whitenosesyndrome.org/resources/map.

[6] http://www.fort.usgs.gov/WNS/.

[7] http://www.whitenosesyndrome.org/faq/what-effect-white-nose-syndrome-bats

bat within the states of Indiana, Kentucky, Ohio, Tennessee, Alabama, SW Virginia, and Michigan (USFWS 2007). According to the 2015 Rangewide Population Estimate (USFWS 2015b), the overall Indiana bat population in the Midwest Recovery Unit was approximately 225,477 in 2011, 226,365 in 2013, and 185,720 in 2015 (Table 3-1; USFWS 2015b). This represents approximately 35.5% of the overall 2015 population estimate for Indiana bats (USFWS 2015b). The overall population estimate for the Midwest Recovery Unit decreased by approximately 9.8% between 2013 and 2015 (Table 3-1; USFWS 2015b).

Table 3-1 Indiana Bat Population Estimates for the Midwest Recovery Unit

State	2005	2007	2009	2011	2013	2015
Indiana	206,610	238,068	213,244	225,477	226,572	185,720
Kentucky	65,611	71,250	57,325	70,598	62,233	66,024
Ohio	9,769	7,629	9,261	9,870	9,259	4,809
Tennessee	3,221	2,929	1,657	1,791	2,369	2,551
Alabama	296	258	253	261	247	247
SW Virginia	202	188	217	307	214	137
Michigan	20	20	20	20	20	20
Total	**285,729**	**320,342**	**281,977**	**308,324**	**300,914**	**259,508**

Source: USFWS 2013b, 2015b.

3.1.6.3 Indiana Status

The Indiana bat is listed as state endangered in Indiana. State-listed endangered species are protected under Indiana Code (IC 14-22-34) and regulatory authority under State law lies with IDNR. Known Indiana bat hibernacula are confined to a few counties in southern Indiana. Estimates of the size of hibernating populations of the Indiana bat vary across these counties, with estimates ranging from 160,300 in 1965 to the most recent estimate (2015) at 185,720 (USFWS 2015b). During the 2014-2015 winter, approximately 35.5% of the estimated range-wide population of Indiana bats hibernated in Indiana (USFWS 2015b). Recorded maternity colonies are known from 47 counties (USFWS 2007). Known hibernacula in Indiana include:

1. 7 – Priority 1 (current and/or observed historic winter populations of ≥ 10,000 bats and currently have suitable and stable microclimates)

2. 1 – Priority 2 (current or observed historic population of 1,000 – 10,000 bats)

3. 16 – Priority 3 (current or observed historic population of 50 – 1,000 bats)

4. 12 – Priority 4 (current or observed historic population of <50 bats)

5. 1 – Ecological Trap (hibernaculum having a history of repeated flooding or severe freezing events that have resulted in the mortality of most hibernating Indiana bats)

Of the 37 previously recorded hibernacula, 34 sites have recorded at least one bat since 1995 (USFWS 2007).

3.1.7 Status within the Plan Area

The Project is located within the current range of the Indiana bat; however, no records of Indiana bats are known from Tipton or Madison counties (USFWS 2007). Summer maternity records are known from Howard County, and maternity colonies and other summer records are known from counties located immediately adjacent to Tipton and Madison counties (USFWS 2007). The closest known Indiana bat hibernaculum is Lewisburg Mine located in Preble County, Ohio, approximately 75 miles (121 kilometers [km]) to the southeast of the Project Area (USFWS 2007).

Based on land cover data, approximately 117.7 acres (47.6 ha) of deciduous forest is found in the Project Area. None of the woodland tracts within the Project Area have characteristics of Indiana bat summer habitat, including low forest cover (<15%) and a lack of connectivity. However, suitable summer habitat may be present in areas outside of the Project Area. While suitable summer habitat may not be present in the Project Area, the potential does exist for Indiana bats to migrate through the Project Area due to its location within the known geographic range of the Indiana bat.

Acoustic surveys were conducted at one met tower in 2010 (Appendix D), at the same tower in 2011 (Appendix E), and along mobile transects in 2010 (Appendix D). While not a definitive indicator, particularly with regard to migratory bats, the acoustic surveys provide information about bat use of the Project Area, including bat species activity, richness, frequency and behavior, to inform an understanding of the spatial and temporal extent of bat use, including use by rare bat species. A total of 3,016 calls were recorded during the acoustic surveys, none of which were conclusively identified as Indiana bats.

A mist net survey was conducted in 2011 immediately north of the Project area along Wildcat Creek and its tributaries (Stantec 2011a). Mist netting was conducted at four sites identified by USFWS as suitable Indiana bat habitat. A total of 25 bats were captured, none of which were Indiana bats.

3.2 NORTHERN LONG-EARED BAT

3.2.1 Species Description

The northern long-eared bat is distinguished by its long ears, especially when compared to other Myotis species. It is a medium-sized bat of about 3 to 3.7 inches, with a wingspan of 9 to 10 inches. The fur color ranges from medium to dark brown on the back, and tawny to pale-brown on the underside.

The USFWS was petitioned to list the northern long-eared bat as threatened or endangered in August 2010 (Center for Biological Diversity [CBD] 2010). In October 2013, the USFWS released a 12-month finding on the petition in which it determined that listing the northern long-eared bat is warranted and proposed to list the species as an endangered species under the ESA (78 FR 61046). In April 2015, the USFWS released a final rule listing the northern long-eared bat as threatened under the ESA (80 FR 17974) effective May 4, 2015. Information regarding the species' characteristics, habitat requirements, range and status in the vicinity of the Project is provided in the sections below.

3.2.2 Habitat Description

Suitable summer habitat for northern-long eared bats is quite variable. They will utilize a wide variety of forested habitats for roosting, foraging and traveling, and may also utilize some adjacent and interspersed non-forested habitat such as emergent wetlands and edges of fields. Males and non-reproductive females may utilize cooler roost spots such as caves or mines. Northern long-eared bats emerge at dusk to forage (USFWS 2014a).

Winter habitat includes underground caves and cave-like structures such as mines and railroad tunnels. These hibernacula typically have high humidity, minimal air current, large passages with cracks and crevices for roosting, and maintain a relatively cool temperature (0-9 degrees Celsius) (USFWS 2014a). The hibernation season in Indiana is mid-November through late March. There are currently 25 known hibernacula (sites with one or more winter records) in Indiana (USFWS 2013a).

3.2.3 Reproduction and Maternity Roost Habitat Requirements

Roosting habitat includes linear or block forested areas with live trees and/or snags with a diameter at breast height (DBH) of at least 3 inches with exfoliating bark, cracks, crevices and/or other cavities. Trees are considered suitable if they meet those requirements, and are located within 1,000 ft of the nearest suitable roost tree, woodlot, or wooded fencerow (USFWS 2014a). Maternity habitat is defined as suitable summer habitat that is used by juveniles and reproductive females. The summer maternity season in Indiana is early April through late September (USFWS 2014a).

3.2.4 Foods and Feeding

Northern long-eared bats begin foraging at dusk, focusing on upland and lowland woodlots and tree-lined corridors, catching insects in flight. They will also feed by gleaning insects from vegetation and water surfaces (USFWS 2014a). They are known to feed on moths, flies, leafhoppers, caddisflies, and beetles.

3.2.5 Migration

Northern long-eared bats migrate between their winter hibernacula and summer habitat, typically between mid-March and mid-May in the spring, and mid-August and mid-October in the fall. They are considered a short-distance migrant (typically 40-50 miles), although their known migratory distances can vary greatly between 5 and 168 miles (USFWS 2014a).

3.2.6 Rangewide Status of the Species

Historically, the species has been found in greater abundance in the Northeast and portions of the Midwest and Southeast, and has been more rarely encountered along the western edge of the range (USFWS 2013a). The northern-long eared bat is a commonly encountered species throughout the majority of the Midwest, being commonly captured in mist-net surveys (USFWS 2013a). However, their distribution among hibernacula in the Midwest is not very well known, which may be due to their roosting habitat, often being found in small cracks and crevices with only the nose and ears visible, and roosting singly or in small groups (USFWS 2014a).

The northern long-eared bat has historically been quite common within the state of Indiana, and was the 4th or 5th most abundant species in the state in 2009 (USFWS 2013a). It has been captured in at least 51 counties within the state, and is the most common species trapped at mine entrances (USFWS 2013a).

3.2.7 Status within the Project Area

Because the northern long-eared bat has only recently been listed as a threatened species under the ESA (80 FR 17974), public records of captures are limited. However, the Project Area does fall within the known range of the northern long-eared bat, and they are likely present at certain times of the year.

A mist net survey was conducted in 2011 immediately north of the Project Area at four locations along Wildcat Creek and its tributaries (Stantec 2011a). A total of 25 bats were captured, including one (1) northern long-eared bat, confirming the species' presence near the Project Area.

3.3 PRE-CONSTRUCTION BAT SURVEYS

3.3.1 Pre-Construction Stationary Bat Surveys

Stationary detectors were used to determine species presence and relative activity levels at varying heights. One Remote Bat Acoustic Technology System (ReBAT™; Pandion Systems, Inc., Gainesville, Florida) array was deployed on one 197-ft (60-m) tall meteorological (met) tower. Two receivers were deployed on the tower at different heights in a vertical transect to capture information about bat species flying at variable altitudes. Based on accepted methodology, receivers were placed at 16.5 ft (5 m) and 190 ft (58 m; within the rotor swept zone). With a rotor-swept zone for this Project of 329 ft (100 m),[8] the detection zone for the ReBat monitors of 65 ft (20 m), and the location of the two monitors on the tower, the survey results in good data capture for bat activity at variable heights.

The ReBAT™ unit was operational between 17 April and 4 November in 2010, for a total of 402 detector nights (one detector for one night = one detector night; therefore, there are two detector nights for each night that both detectors are operational). The unit was operational between 8 April and 1 November in 2011 for a total of 378 detector nights.

Bats were recorded on 167 of 201 (83.1%) survey nights in 2010 and on 140 of 189 (74.1%) survey nights in 2011. A total of 1,509 classifiable bat passes (mean = 3.8 passes/night) were recorded by the stationary detectors during the 2010 activity season (Table 3-2). It is estimated that 291 unclassifiable passes were removed during the filtering process. Therefore, the adjusted total bat passes for the 2010 activity season is 1,800 (mean = 4.5 passes/night). A total of 1,414 classifiable bat passes (mean = 3.7 passes/night) were recorded by the stationary detectors during the 2011 activity season (Table 3-2). It is estimated that 331 unclassifiable passes were removed during the filtering process. Therefore, the adjusted total bat passes for the 2011 activity season is 1,745 (mean = 4.6 passes/night).

[8] During monitoring, the range of rotor-swept zone was assumed to be 167 ft (51 m) to 492 ft (150 m).

3.3.2 Pre-Construction Mobile Bat Survey

Surveys with mobile hand-held Anabat detectors (Titley Electronics, Australia) were used to supplement stationary surveys. As is the case for the stationary surveys, this information was intended to gain knowledge of general bat activity at the site.

Six mobile transects were selected along roads within the Project Area. Survey routes were selected in a variety of habitat types to adequately represent the Project Area (e.g., agricultural fields, woodlots, wetlands or stream corridors). Transects were driven at a slow rate of speed (<5 miles-per-hour [mph] [8 kilometers-per-hour (kph)]) by surveyors while holding the mobile bat echolocation detector outside of the vehicle. A total of 15 mobile surveys were conducted in 2010 (spring, 5; summer, 2; fall, 8), with emphasis placed on the critical fall migration period. Mobile surveys were not conducted in 2011.

During the 90 mobile surveys (15 surveys of 6 transects), 93 definitive bat passes (mean = 1.0 pass/transect/night) were recorded (Table 3-3).

3.3.3 Bat Species and Frequency Groups Detected during Surveys

Using classifiable calls and files that contained high quality bat passes, a species list was developed for the Project Area. In 2010, approximately 73% of the 1,509 classifiable calls recorded during the stationary survey and 71% of the 93 calls recorded during the mobile surveys were identifiable to species or species group (e.g., big brown bat/silver-haired bat, Myotis sp.). In 2011, approximately 75% of the 1,414 classifiable calls recorded were identifiable to species or species group. Five bat species were confirmed to be present at the Project Area:

- Big brown bat (*Eptesicus fuscus*)
- Silver-haired bat (*Lasionycteris noctivagans*)
- Eastern red bat (*Lasiurus borealis*)
- Hoary bat (*Lasiurus cinereus*)
- Tri-colored bat (*Perimyotis subflavus*)

Table 3-2 Summary of bat passes (mean per detector night) by detector height, season, and frequency group for stationary pre-construction surveys for the Wildcat Wind Farm (Tipton and Madison Counties, Indiana).

	2010			2011		
	5 Meter	**58 Meter**	**Total**	**5 Meter**	**58 Meter**	**Total**
Spring						
Low Freq. Bat Passes	56 (1.9)	17 (0.6)	73 (1.3)	12 (0.3)	71 (1.9)	83 (1.1)
Mid Freq. Bat Passes	0 (0.0)	2 (0.1)	2 (0.0)	3 (0.1)	6 (0.2)	9 (0.1)
High Freq. Bat Passes	6 (0.2)	0 (0.0)	6 (0.1)	2 (0.1)	0 (0.0)	2 (0.0)
Total Passes (Spring)*	**63 (2.2)**	**20 (0.7)**	**83 (1.4)**	**21 (0.6)**	**77 (2.0)**	**98 (1.3)**
Summer						
Low Freq. Bat Passes	426 (7.0)	177 (2.9)	603 (4.9)	213 (4.3)	72 (1.4)	285 (2.9)
Mid Freq. Bat Passes	4 (0.1)	8 (0.1)	12 (0.1)	10 (0.2)	8 (0.2)	18 (0.2)
High Freq. Bat Passes	17 (0.3)	5 (0.1)	22 (0.0)	5 (0.1)	3 (0.1)	8 (0.1)
Total Passes (Summer)*	**458 (7.5)**	**197 (3.2)**	**655 (5.4)**	**236 (4.7)**	**84 (1.7)**	**320 (3.2)**
Fall						
Low Freq. Bat Passes	240 (2.2)	384 (3.5)	624 (2.8)	376 (3.7)	454 (4.5)	830 (4.1)
Mid Freq. Bat Passes	3 (0.0)	45 (0.4)	48 (0.2)	11 (0.1)	83 (0.8)	94 (0.5)
High Freq. Bat Passes	33 (0.3)	17 (0.2)	50 (0.2)	24 (0.2)	17 (0.2)	41 (0.2)
Total Passes (Fall)*	**300 (2.7)**	**471 (4.2)**	**771 (3.5)**	**418 (4.1)**	**578 (5.7)**	**996 (4.9)**
Total Low Frequency Passes for Activity Season	**722 (3.7)**	**578 (2.3)**	**1300 (3.0)**	**601 (3.2)**	**597 (3.2)**	**1198 (3.2)**
Total Mid Frequency Passes for Activity Season	**7 (0.0)**	**55 (0.2)**	**62 (0.1)**	**24 (0.1)**	**97 (0.5)**	**121 (0.3)**
Total High Frequency Passes for Activity Season	**56 (0.3)**	**22 (0.1)**	**78 (0.1)**	**31 (0.2)**	**20 (0.1)**	**51 (0.1)**
Total Classifiable Passes for Activity Season*	**821 (4.1)**	**688 (3.4)**	**1509 (3.8)**	**675 (3.6)**	**739 (3.9)**	**1414 (3.7)**
Est. Total Unclassifiable Passes for Activity Season	291			331		
Adjusted Total Passes For Activity Season	**1800 (4.5)**			**1745 (4.6)**		

*Some recorded bat sound files contained both low and high frequency species or were too poor quality to characterize the call by frequency group. Therefore, the sum of bat passes for these groups may not equal the "Total Passes" recorded.

Table 3-3 Bat Passes (mean per transect per survey night) for Mobile Pre-Construction Surveys at the Wildcat Wind Farm (Tipton and Madison Counties, Indiana, 2010)

	Transect 1	Transect 2	Transect 3	Transect 4	Transect 5	Transect 6
Low Frequency Bat Passes	8 (0.5)	5 (0.3)	8 (0.5)	15 (1.0)	14 (0.9)	15 (1.0)
High Frequency Bat Passes	10 (0.7)	3 (0.2)	0 (0.0)	1 (0.1)	5 (0.3)	2 (0.1)
Total Passes	19 (1.3)	8 (0.2)	8 (0.5)	16 (1.1)	22 (1.4)	20 (1.3)
Total Passes for Activity Season*	93 (1.0)					

*Some recorded bat sound files contained both low and high frequency species. Therefore, the sum of bat passes for these groups may not equal the "Total Passes" recorded.

None of the species recorded in the Project Area are listed as state endangered or federally threatened or endangered. Four species detected during the surveys, the silver-haired bat, eastern red bat, hoary bat, and tri-colored bat, are listed as special concern species by the IDNR.

In 2010, four confirmed *Myotis* calls were recorded by the 16.5-ft (5-m) receiver during the stationary survey, representing only 0.4% of the identifiable calls recorded. A single call was recorded on 24 July, 27 July, 28 July and 5 August. All four calls exhibited characteristics found in both little brown bat and Indiana bat calls; however, due to the overlap in call characteristics between the two species, positive identification to species was not possible. Based on the detection zone of the receivers (approximately 65 ft (20 m)), bats recorded by the 16.5-ft (5-m) detector were not within the rotor swept zone (>167 ft [51 m]). *Myotis* calls were not recorded at the 190-ft (58-m) detector. Four additional possible *Myotis* calls were recorded during stationary surveys, all at the lower receiver: one on 26 August, two on 28 August, and one on 13 September. All four calls exhibited characteristics found in *Myotis* calls, but were also consistent with red bat calls; therefore, positive identification was not possible.

One confirmed *Myotis* call was recorded during mobile surveys along Transect 5 on 10 May. Positive identification of this call to species was not possible due to overlap in call characteristics between multiple *Myotis* species. *Myotis* calls represented 1.5 % of the identifiable calls recorded during the mobile survey.

In 2011, *Myotis* calls represented 0.0% (0 calls) of the identifiable calls recorded during the spring, 0.4% (1 call) of the identifiable calls recorded during the summer, and 0.3% (2 calls) of the identifiable calls recorded during the fall during the 2011 stationary acoustic survey. Positive identification of these calls to species was not possible. The summer *Myotis* call and one of the fall *Myotis* calls were recorded at the 16.5-ft (5-m) detector and were, therefore, not within the rotor-swept zone. The other fall *Myotis* call was recorded at the 190-ft (58-m) detector.

3.3.3.1 Seasonal Distribution of Bat Activity

During the 2010 activity season, bat activity at the stationary detectors was lowest during spring (83; mean 1.4 passes/detector/night) and highest during fall (771; mean 3.5 passes/detector/night). More bat passes were recorded by the lower detector in spring and summer but in fall the majority of passes were recorded at the upper detector. Bat activity recorded by the mobile surveys in 2010 was lowest during summer (5; mean 0.4 passes/transect/night) and highest during fall (76, mean 1.6 passes/transect/night). Low frequency species were recorded more often than high frequency species during both stationary and mobile surveys in all three seasons. Weekly bat activity spiked in late May/early June, in early July, and a third time in early August.

During the 2011 activity season, bat activity was lowest during spring (98, mean 1.3 passes/detector/night) and highest during fall (996, mean 4.9 passes/detector/night). More passes were recorded by the upper detector in spring and fall but the lower detector recorded most of the passes during summer. Low frequency species were recorded more often than mid-frequency and high frequency species throughout the entire 2011 survey. Weekly bat activity spiked in early July and peaked again from late July to mid-August, and remained higher throughout the fall.

4. Effects of the Proposed Action

4.1 DIRECT EFFECTS

4.1.1 Habitat Loss

No loss of summer maternity habitat is anticipated to occur as a result of the Project. The USFWS has indicated that the documented find of an Indiana bat along Wildcat Creek approximately two miles (3.2 km) north of the Project Area could indicate potential use of suitable vegetation along that corridor. However, that corridor is not within the Project Area and will not be impacted by the Project. Additionally, construction within the Project area did not impact any forested habitat, and no additional construction will occur during the remaining 27-year Project operational life.

4.1.2 Mortality

Prior to September 2009, no mortality of species listed as threatened or endangered under the federal ESA had been reported in connection with wind energy facilities, including the Indiana bat (Arnett et al. 2008). In September 2009, the first documented take of an endangered Indiana bat occurred at the Fowler Ridge Wind Farm (FRWF) located in Benton County, Indiana. A second Indiana bat was taken at FRWF in 2010. A total of eight Indiana bat fatalities have been documented in total, at five separate wind farms in the northeastern and Midwestern United States. A summary of these fatalities is provided in Table 4-1.

Little information is available regarding the circumstances under which northern long-eared bats may be at risk of collision with wind turbines. The species composes an extremely low proportion of the total

documented bat mortality at wind energy facilities. To date, 8 Indiana Bat and 36 northern long-eared bat fatalities have been recorded at North American wind-energy facilities (Table 4-1). The northern long-eared bat was not listed or proposed for listing when any of these fatalities occurred, however they do provide information on the rarity of northern long-eared bat fatalities, given the large number of wind energy facilities operating within their range. A summary of the documented northern long-eared bat fatalities is provided in Table 4-1.

Table 4-1 Summary of publicly available[9] Indiana and northern long-eared bat fatalities at wind energy facilities in North America.

Species	Wind Farm	State	Number Taken	Year(s)	Season	Source
Indiana Bat	Fowler Ridge	Indiana	2	2009, 2010	Fall	FRWF 2013
	North Allegheny	Pennsylvania	1	2011	Fall	USFWS 2011a
	Laurel Mountain	West Virginia	1	2012	Summer	USFWS 2012b
	Blue Creek	Ohio	1	2012	Fall	USFWS 2012c
	Undisclosed location	Ohio	2	2014	Spring & Fall	USFWS, personal communication
	Undisclosed location	Indiana	1	2015	Fall	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
	Kingsbridge I	Ontario	1	2006	Fall	Stantec Ltd. 2007
	Steel Winds [1]	New York	6	2007	Unknown	Grehan 2008
	Erie Shores	Ontario	6	2007	Summer (3) Fall (3)	James 2008,
	Mt. Storm	West Virginia	1	2008	Fall	Young et al. 2009
	Ellenburg	New York	1	2008	Unknown[10]	Jain et al. 2009
	Ripley	Ontario	2	2008	Fall	Jacques Whitford 2009
	Fowler	Indiana	1	2009	Fall	FRWF 2013
	Anonymous (Site 2-14)	Pennsylvania	1	2009	Fall	Taucher et al. 2012
	Cohocton and Dutch	New York	1	2010	Summer	Stantec 2011b

[9] The records included in this table are those that are publicly available. Additional fatalities that may have occurred and been reported to the USFWS but not published are not included.

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

	Hill					
	Wethersfield	New York	6	2010 (1) 2011 (5)	Summer (2) and Fall (4)	Jain et al. 2011, Kerlinger et al. 2011
	Criterion	Maryland	1	2011	Summer	Young et al. 2013
	PGC unknown site	Pennsylvania	1	2012	Summer	AWEA 2015

Due to the absence of significant Indiana and northern long-eared bat records, it is instructive to consider general information regarding bat mortality to understand what type of mortality has been recorded and for what species. Bat mortality has been documented at wind energy facilities worldwide (Arnett et al. 2008). The primary bat species affected by wind facilities are migratory, foliage- and tree-roosting bats that undergo long distance migrations and do not hibernate. Arnett et al. (2008) compiled data from 21 studies at 19 wind facilities in the United States and Canada and found that mortality has been reported for 11 of the 45 bat species known to occur north of Mexico. Of the 11 species, the hoary bat, eastern red bat and silver haired bat have the highest mortality rates, with the hoary bat comprising 61.7% of all fatalities (Arnett et al. 2008).

Bat mortality at wind facilities is typically the result of interaction between bats and spinning turbine blades, although the precise nature of most fatalities is uncertain. Mortality may be the result of direct impact with a spinning turbine blade (i.e., blunt-force trauma) or from barotrauma. Barotrauma involves tissue damage to air-containing structures (e.g., lungs) caused by rapid or excessive pressure change (Baerwald et al. 2008). As turbine blades spin, the blades create areas of low pressure. Bats flying through these areas may suffer barotrauma. Baerwald et al. (2008) found that approximately 90% of bat fatalities at wind facilities they studied involved hemorrhaging consistent with barotrauma, and that contact with turbine blades accounted for approximately 50% of the fatalities. Grodsky et al. (2011) found that approximately 74% of bat fatalities observed had bone fractures, particularly of the wings, and only 52% had any signs of hemorrhaging consistent with barotrauma.

As noted above, the lack of summer roosting habitat within the Project Area indicates that risk of direct mortality to Indiana and northern long-eared bats is low during the summer. This was further confirmed through conducting acoustic bat surveys during three seasons in 2010 (four confirmed *Myotis* calls) and 2011 (three confirmed *Myotis* calls) at the Project (see Section 3.3). None of these calls were of sufficient quality to permit identification to the species level. As a result, while the presence of Indiana and northern long-eared bats cannot be ruled out, these surveys also failed to confirm bat activity of either species within the Project Area. The surveys did confirm that *Myotis* activity generally is quite low in the Project Area. In fact, the *Myotis* passage rate recorded during fall migration at the stationary detector within the Project Area was moderate compared to *Myotis* passage rates recorded during fall migration at other wind energy sites surveyed by Stantec and at the FRWF (Table 4-2). However, little is known about the migration patterns of bats, specifically how they disperse across the landscape during migration and whether they echolocate during migration. Therefore, it is not possible to accurately predict an individual bat's route during migration. Based on this, migratory risk could exist anywhere within a species'

geographic range, and the potential does exist for Indiana bats and northern long-eared bats to migrate through the Project Area and for take to occur.

Table 4-2 Comparison of Fall Migration *Myotis* Activity at Wind Energy Facilities in the Midwest Surveyed by Stantec[1] and at Fowler Ridge Wind Farm

Wind Energy Facility Site Location	Total # *Myotis* Passes (Mean/Detector Night) Passive Survey Fall Migration Season
Northwest Ohio	216 (0.32)[2]
Central Iowa	33 (0.150)
Fowler Ridge, Indiana[5] (Good et al. 2011)	(0.100)[1,2,3]
Northwest Missouri	11 (0.050)
Southern Michigan	7 (0.032)[4]
Wildcat Wind	7 (0.017)
East Central Illinois	6 (0.027)
Northern Indiana	8 (0.019)[4]
Northwest Missouri	3 (0.018)
Northeastern Illinois	2 (0.018)
Eastern Illinois	1 (0.005)

[1]Data are all from unpublished private reports unless otherwise stated.
[2]Indiana bat presence confirmed at site based on mist-netting or post-construction monitoring results.
[3]Number of *Myotis* calls not reported; passage rate data reported only for spring and fall seasons combined.
[4]Indiana bat probable absence presumed at site based on mist-netting results.

4.2 INDIRECT EFFECTS

Indirect effects are those effects that are caused by or will result from the proposed action and are later in time, but are still reasonably certain to occur. For the purposes of an HCP, the indirect effects in question must be reasonably foreseeable, a proximate consequence of the covered activities proposed under the HCP, and must rise to the level of take (USFWS and NMFS 1996) if they are to be included as a covered activity. Indirect effects of the Project are not likely to result in take of either Indiana or northern long-eared bats.

Wildcat is supplying electricity to the regional electrical grid to address existing and projected future energy needs. As such, significant local community growth is not anticipated as a consequence of the Project's energy contribution. The operation of the Project also is not expected to result in significant local community growth. The Project is staffed by six to nine full-time personnel. Agricultural, recreational, and other customary activities on the lands surrounding the turbines continue to take place as they did prior to the construction of the wind farm.

The mitigation associated with Wildcat (increase protection of potential summer habitat and potentially hibernacula improvements) is not anticipated to result in an indirect negative effect to either species, but should directly enhance species viability.

4.3 TAKE ESTIMATES

As a key element of the ITP requested for the Project, take estimates must be established. Because the potential for take in the form of mortality at the Project is only expected during fall migration, the USFWS' recommended basis for estimating take potential associated with Project operations within the Plan Area is to scale best available information regarding Indiana and northern long-eared bat mortality that has occurred at currently operating facilities. Though take of Indiana bats has occurred at five separate facilities, FRWF is the only one of those five that has developed a take estimate at this time (USFWS 2011a and 2012b, c). Therefore, the Indiana bat take estimate from the FRWF has been used as the basis for this Project's Indiana bat take estimate.

Northern long-eared bat fatalities have been documented at at least 13 facilities in North America (Table 4-1). Of the facilities with take estimates for a covered species of bat, FRWF provides the closest surrogate for the Project, being the only Midwestern wind energy facility to have documented take of a northern long-eared bat and developed a publicly available take estimate. While several other facilities have estimates for northern long-eared bat take, all are located in the eastern United States along forested ridgelines or in agriculture mixed with woodlots, rather than the heavily agricultural land use patterns seen at projects in the Midwest. For these reasons, the FRWF data was chosen to be used as the basis for this Project's northern long-eared bat take estimate.

4.3.1 Estimation of Take

Following the first documented Indiana bat mortality event at FRWF, the operator of FRWF undertook an extensive program of study to not only develop a take estimate for the facility but to evaluate operational

adjustments and other modifications that could contribute to minimizing that projected take. The resulting studies that have been made publicly available provide information potentially relevant to sites with similar landform characteristics, such as Wildcat. Both FRWF and Wildcat have a lack of summer roosting habitat and are in active agricultural use. Both sites have minimal topography and, while drainage channels extend within both Project areas, associated tree cover is minimal. Wildcat is located approximately 80 miles from the FRWF, both located in Indiana. The FRWF is substantially larger than the Project, incorporating a maximum build out of 449 turbines over 64,000 acres. The information developed for FRWF, therefore, will be adjusted to account for the smaller size of Wildcat (125 turbines and 24,434 acres).

As a result of the discovery of the Indiana bat carcass during the fall 2009 monitoring at the facility, FRWF was issued a two-year Scientific Research and Recovery Permit for the Indiana bat (TE 15075A) by USFWS Region 3 to help build a better scientific basis for the potential minimization and mitigation measures for Indiana bat HCP development. As part of the research conducted under the permit, carcass searches were conducted in 2010 and 2011 at the FRWF. The results of these carcass searches were used to develop bat fatality estimates and to approximate the proportion of Indiana bats to all other bats killed at the wind energy facility. Curtailment studies were also conducted under the permit to assess the effectiveness of raising cut-in speeds and feathering turbines below various cut-in speeds in reducing bat mortality.

Similar to FRWF, take at the Project is expected to occur only during the fall migration season (August 1-October 15), based on the seasonal distribution of bat activity recorded at the Project Area and the lack of suitable summer habitat and hibernacula within the Project Area (Section 3.1.7 and 3.2.7). There is no summer roosting habitat within the Project Area; therefore, take is unlikely to occur during the summer months.

It was originally believed that Indiana bats were not at risk for migratory take in the spring season, but in April of 2014 take of a migrating Indiana bat was reported at a project in western Ohio, indicating there is risk of take in the spring. In addition, the USFWS has advised WWF that the Project Area is centrally located within the Midwest Recovery Unit, between areas with high populations of hibernating Indiana bats (southern Indiana and Kentucky) and areas with known summer habitat in northern Indiana, northwest Ohio and southern Michigan. Notwithstanding this information, actual data from the Project's pre-construction surveys and post-construction monitoring in the spring season suggest that the risk of spring take is low (Appendix F - H), and there are no data on which to base a take estimate for spring as there is for fall. Accordingly, WWF has not augmented the take estimate to account for additional spring take, but will feather turbines below cut-in speed year round, and will conduct mortality monitoring during the spring season for the life of the Project, or until five years of monitoring at manufacturer's rated cut-in speed (3.5 m/s) (three during Preliminary Monitoring plus two during Baseline Monitoring) confirm that the Project does not present a risk of spring take. In the event that take of an Indiana or northern long-eared bat is detected during the spring, that take will be authorized under and counted against the fall-based take estimate, and monitoring and take coverage will continue to apply during the spring. If WWF determines that additional take authorization is necessary for continued spring permit coverage, it will seek a major permit amendment in accordance with Section 8.3.2.3. If no Indiana or northern long-eared bat take is detected during the five years of spring monitoring, spring monitoring will

be discontinued and take will no longer be authorized during the spring season for the remainder of the permit term.

Using information collected at FRWF during the 2010 and 2011 monitoring efforts, fall bat fatality was estimated to average 17.85 (90% CI = 14.56-21.97) bats/MW/fall season at FRWF. Of the 1,246 total bat carcasses found during the three (2009-2011) fall search seasons at FRWF, two carcasses were Indiana bats and one carcass was a northern long-eared bat. The percent composition of Indiana bat fatality was therefore calculated to be 0.16% of the total bat fatality, and northern long-eared bats comprised 0.08% of all bat mortality. Applying the FRWF average fatality estimate to Wildcat (17.85 bats/MW/fall season x 200 MW) produces a bat fatality estimate of 3,570 (90% CI = 2,912-4,394) bats/fall season. Considering that 0.16% of all bat fatalities are estimated to be Indiana bats, approximately 6 (90% CI = 5-7) Indiana bats would be taken at Wildcat each fall, without minimization measures. For northern long-eared bats, 0.08% of fatalities would result in approximately 3 (90% CI = 2-4) northern long-eared bats/fall season.

The minimization measures to be implemented at the Project are expected to reduce the estimated take below this figure. Curtailment measures will involve all Project turbines being feathered at or below 11.2 mph (5.0 m/s) during the fall migration season (August 1 – October 15) from sunset to sunrise when ambient temperature is above 50° F (10° C; FRWF 2013) based on a 10 minute rolling average, and at or below 7.8 mph (3.5 m/s) during the remainder of the year.

4.3.2 Proposed Take Limits

Based on the cumulative estimated average annual take over the 27-years of operations under the 28-year ITP term (6 Indiana bats/year x 27 years and 3 northern long-eared bats/year x 27 years) WWF requests a take authorization of 162 Indiana bats and 81 northern long-eared bats. The minimization measures required by this HCP are expected to reduce actual take to approximately 50% of the authorized levels. However, the species composition approach used to establish the Project's unminimized take estimate was based on the take estimate from a nearby wind farm (FRWF), and the predicted effects of minimization are based on a limited number of curtailment studies (see Section 5.2.1). This results in uncertainty regarding the actual effectiveness of the proposed curtailment regime, which limits WWF's ability to establish a precise take estimate. Therefore, WWF has conservatively requested take authorization for predicted pre-minimization levels of take. However, WWF will implement all minimization measures as required in this HCP, providing a significant buffer between authorized take and expected take that will provide additional conservation benefit to the covered species. Due to annual variation in environmental factors that may affect Indiana bat population size and migration, annual mortality can be expected to differ from year to year. In an effort to be responsive to this variation, and to ensure that the 28-year take limits are not exceeded, this HCP includes annual post-construction monitoring and adaptive management procedures, which are described in detail in Sections 5.3 and 5.4. This expanded timeframe for take compliance will allow, if necessary, for changes to be made to the minimization measures that will ensure that take will not exceed the cumulative take authorization of 162 Indiana bats and 81 northern long-eared bats. Cumulative records of calculated annual Indiana bat mortality and northern long-eared bat mortality using the Evidence of Absence software (EOA) as more fully described in Section 5.4.2.1 (EOA Calculated Take) will be kept throughout the 27-year operational

life of the Project and will provide the basis for the amount of mitigation required, as described in Section 5.2.2.

5. Conservation Plan

5.1 BIOLOGICAL GOALS AND OBJECTIVES

The biological goals, as outlined by USFWS (USFWS 2000) define the expected outcome of this conservation plan. These goals are broad, representing the guiding principles for operation of the conservation program described in this HCP and forming the basis for the minimization and mitigation strategies employed. The biological objectives represent the steps through which the biological goals will be achieved, and provide a basis for measuring progress towards and achievement of those goals.

The biological goals and objectives of this conservation plan are set forth in Table 5-1.

Table 5-1 Biological Goals and Objectives of the Wildcat HCP

Number	Goal	Objective
1	Maintain the integrity of Indiana and northern long-eared bat migration through the Project area.	Implement an operational strategy that will decrease fall bat mortality by at least 50% compared to levels predicted under normal operation, thereby decreasing mortality of all bats including Indiana bats and northern long-eared bats over the remaining 27-year operational life of the Project.
2	Increase survival and reproductive capacity of Indiana and northern long-eared bats on their summer range, thereby promoting population growth of maternity colonies in nearby populations.	Implement a mitigation project that will protect and restore a minimum of 253 acres of summer habitat within the State of Indiana, thereby promoting population growth of Indiana bat maternity colonies in the MRU and local northern long-eared bat maternity colonies
3	Minimize long-term environmental stressors on Indiana and northern long-eared bats by optimizing carbon-free power generation from the Project, reducing carbon emissions that have been shown to contribute to global climate change, identified as a potential risk to Indiana and northern long-eared bats (USFWS 2007 and 2013a)	Maximize the efficiency of the minimization and mitigation measures implemented by the Project, thereby displacing the greatest amount of fossil fuel-fired power generation to minimize contribution to climate change while also minimizing incidental take of Indiana and northern long-eared bats.

Measures that will be used to achieve these goals and objectives, and the criteria that will be used to evaluate their success, are described in detail in the following sections.

5.2 MEASURES TO ACHIEVE BIOLOGICAL GOALS AND OBJECTIVES

5.2.1 Minimization of Direct Mortality

While the site does not contain suitable habitat for either Indiana or northern long-eared bats, the potential for migratory risk exists at any location within the species' ranges. WWF will minimize the potential for direct mortality of migrating bats by reducing the risk posed by turbine operations on nights during the fall migratory period (1 August through 15 October) when the ambient temperature is above 50° F (10° C; FRWF 2013) based on a 10 minute rolling average - when migrating bats are anticipated to be at highest risk of mortality. After 15 October, migrating Indiana and northern long-eared bats are not expected to occur within the Project Area due to the distance (75 miles [121 km]) to the nearest hibernaculum. Average nightly temperatures typically begin to decline throughout September, constraining bat activity and inducing bats to enter hibernation (USFWS 2007). To arrive at hibernacula within the fall swarming and mating season (typically mid-August through mid-October), Indiana and northern long-eared bats are expected to pass through the Project Area and surrounding vicinity by the end of September.

To achieve the greatest level of minimization under this scenario, feathering of turbines below cut-in speeds (7.8 mph or 3.5 m/s) will be implemented on a year-round basis for all turbines. During the fall migratory period (August 1 to October 15), when temperatures are above 50°F turbines will be feathered until wind speeds reach or exceed 11.2 mph (5.0 m/s). Turbines will remain fully feathered until the designated temperature and/or wind conditions are reached, as measured by the SCADA system and anemometry located on each turbine. When those conditions are reached over a 10-minute rolling average[11], blades will be pitched into the wind to enable the turbine to begin spinning and generating electricity. Under this approach, the turbines will cut-in or feather throughout the night as wind speed fluctuates above and below the applicable cut-in speed.

This curtailment schedule targets the season during which the majority of all bat mortalities have occurred at wind energy facilities (Cryan 2008a). It also includes the period when migrating/dispersing bats, which appear to comprise most bat mortalities at wind energy facilities (Erickson et al. 2002), are expected to be present in the Project Area and the only time period during which Indiana and northern long-eared bat take are expected to occur at the Project. The addition of feathering below cut-in speeds[12] year-round will minimize rotation of the blades to less than approximately one RPM when turbines are not generating power. This measure alone has been shown to reduce all bat mortality by approximately 36% (Good et al. 2011).

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[11] E.ON has developed proprietary control logic for its SCADA system that will average the wind speeds over the preceding 10-minute time period to control the cut-in or feathering of the individual turbine on an instantaneous basis.

[12] 3.5 m/s year-round, raised to 5.0 m/s from August 1 through October 15.

All curtailment studies to-date show a consistent inverse relationship between cut-in speeds and bat mortality (Baerwald et al. 2009, Arnett et al. 2009, Good et al. 2011, Kerns et al. 2005, Fiedler 2004). Baerwald et al. (2009) found that increasing turbine cut-in speed to 12.3 mph (5.5 m/s) or turbine feathering at wind speeds less than 12.3 mph (5.5 m/s) reduced fatality of hoary bats and silver-haired bats by 50% to 70%. Arnett et al. (2009) found that increasing turbine cut-in speed to 11.2 mph (5.0 m/s) or 13.4 mph (6.0 m/s) resulted in reductions in average nightly bat fatality ranging from 53% to 93%. Similarly, Good et al. (2011) found that bat fatalities at FRWF were reduced by a mean of 50% when cut-in speeds were increased to 11.2 mph (5.0 m/s). Curtailment actions effective at reducing risk of collision for all bat species are assumed to also be effective for Indiana and northern long-eared bats.

Nightly bat activity, including Indiana and northern long-eared bat activity, is also correlated with temperature both over an annual time period and on a nightly basis (USFWS 2007, Reynolds 2006, Fiedler 2004, O'Farrell and Bradley 1970, Vaughan et al. 1997).

A study of the relationship between weather conditions and bat mortality at FRWF, conducted under the research permit discussed above, found that bat casualty rates were highest on nights with higher mean temperature and increasing variance in temperature (Good et al. 2011). Specifically, 91% of all bat fatalities during the fall migration period occurred on nights with mean nightly temperatures above 68° F (20° C). Regression analysis indicated that bat mortalities increased by 15% for every 1.8° F (1.0° C) increase in average nightly temperature at the FRWF (Good et al. 2011).

Based upon results of studies conducted at FRWF, 98.2% to 99.7% of all fatalities occur when the average nightly temperatures were above 50°F (10° C) (FRWF 2013). Given the relatively large proportion of fatalities that occurred above 50°F (10° C), and the small proportion of nights likely to fall below this threshold, feathering of the turbine blades below 5.0 m/s when temperatures are above this temperature threshold is expected to adequately minimize risk to bats and achieve at least a 50% reduction in all bat mortality levels (FRWF 2013). Additionally, the general conclusion among experts is that all bat species activity declines in heavy rain, high wind, and cold weather (some specifically mentioned temperatures below 50-55° F [10-13° C]) (USFWS 2011b).

Based on the results of these studies, and the uncertainty in the estimated reductions in bat mortality, specifically Indiana and northern long-eared bat mortality, WWF conservatively estimates that feathering turbines blades below a cut-in speed of 5.0 m/s during the fall migration season when temperatures are above 50°F and below the manufacturer's rated cut-in speed (3.5 m/s) during the remainder of the year would reduce all bat mortality, including Indiana and northern long-eared bat mortality, by at least 50%, although the actual reduction in mortality may be greater than 50%.

5.2.2 Mitigation for Impact of the Taking

5.2.2.1 Impact of the Estimated Take

To assess the overall impacts of the estimated take for the Project, an understanding must be developed of the likely demographics of the affected individuals and the subpopulations and metapopulations to which they belong. As described above, the WWF is seeking authorization to take an estimated 162 Indiana bats

and 81 northern long-eared bats over the 27-year operational life of the Project, an average of six (6) Indiana bats/year and three (3) northern long-eared bats/year.

Due to the location of the Project Area in an agricultural area devoid of any summer or winter habitat, but centrally located between the numerous known hibernacula in southern Indiana and Kentucky, and areas of northern Indiana and southern Michigan known to contain summer habitat, any Indiana or northern long-eared bats taken at Wildcat will likely originate from more than one maternity colony and more than one hibernaculum. However, as migratory corridors for bats in the Midwest remain generally unknown, it cannot be predicted with certainty from which maternity colonies or hibernacula bats migrating through the Project Area may originate. Because WWF does not expect take from the Project to inordinately affect any single maternity colony or hibernaculum, it does not expect this take to result in permanent loss of the reproductive potential of any maternity colony, or of any maternity colony itself. However, based on the maximum known migration distance for Indiana bats (357 miles [574 km]) (USFWS 2011b), it is expected that Indiana bats taken by the Project will belong to the Midwest Recovery Unit population.

Northern long-eared bats are shorter-distance migrants, migrating on average 35-55 miles (56-89 km), though they have been known to migrate up to 168 miles (270 km). Thus, it is expected that northern long-eared bats taken by the Project will belong to local populations from within 168 miles (270 km).

Bats taken by the Project may include non-reproductive juveniles as well as adult female and male bats. Mortality statistics are skewed towards males of the four most commonly killed species at wind energy facilities: the hoary bat, eastern red bat, silver-haired bat, and tri-colored bat (Arnett et al. 2008). Mating behavior-based risk factors associated with the congregation of male bats at tall trees and other structures on the landscape have been hypothesized to increase the exposure potential for male tree-bats at turbines during late summer and fall (Cryan 2008b).

However, there are no data that suggest that male *Myotis* bats may be more vulnerable to wind turbine mortality during the fall swarming and migration seasons (USFWS 2011b). Male *myotis* bats are not known to congregate around tall trees and other structures while engaging in mating behavior (USFWS 2007). Little information is available on the sex of the known northern long-eared bat fatalities. Both Indiana bat fatalities found at the FRWF during the fall migration season were female bats (Good et al. 2011), as was the Indiana bat killed at the North Allegheny wind energy facility in Pennsylvania in September 2011 (USFWS 2013c). The Indiana bat found at the Laurel Mountain project was an adult male; however, that fatality occurred during the 2012 summer breeding season; the project is located in a forested landscape with an abundance of roost sites, foraging habitat, and a known small Indiana bat population in the vicinity (USFWS 2013c). The Indiana bat found during the fall migration season in October at the Blue Creek Wind Farm in Ohio was a female (USFWS 2012c). The most recent fatalities occurred in Ohio during 2014, and included a spring take of a female and a fall take of unknown gender (USFWS, personal communication). Gruver et al. (2009) recorded an equal number of male and female *Myotis* fatalities at a wind energy facility in WI and BHE Environmental (2010) recorded more female *Myotis* fatalities than male *Myotis* fatalities at another wind energy facility in WI. These limited data (n=5) suggest that female Indiana bats may be at higher risk from wind turbines.

Although the overall ratio of females to males in the Indiana bat population is assumed to be 1:1, female Indiana bats are expected to occur more frequently than males in the population as distance from hibernacula increases. Female Indiana bats disperse from hibernacula to join summer maternity colonies, while male Indiana bats typically remain closer to hibernacula throughout the summer. Therefore, more female Indiana bats than male Indiana bats are expected to migrate through the Project Area, based on the distance of the Project Area from the nearest hibernaculum (75 miles [121 km]). The USFWS estimates a 3:1 ratio of female to male Indiana bats migrating through the Project Area each fall (USFWS 2012d). Consequently, approximately 75 percent of the Indiana bats taken at WWF are expected to be female, for an estimated take of 4.5 female bats/year or 121.5 total female bats over the 27-year operational Project life. The loss of female bats also represents lost reproductive potential from these individuals.

Due to their recent listing, research into the sex ratios of northern long-eared bats has been limited. However, there is no evidence to suggest that a 1:1 sex ratio is improbable. Unlike Indiana bats, the northern long-eared bat shows less dispersal from hibernacula (USFWS 2014a), suggesting that females and males may be expected to migrate through the Project Area in equal proportions. Consequently, of the 81 northern long-eared bats that could be taken at Wildcat, 50% (40.5 bats) are expected to be female, for an estimated take of 1.5 female bats/year over the 27-year operational Project life. The loss of female bats also represents lost reproductive potential from these individuals.

The reproductive potential which may be lost from the population due to the estimated take of 121.5 female Indiana bats and 40.5 female northern long-eared bats at the Project was calculated based on the following assumptions developed by the USFWS (USFWS 2014b):

1. Taken bat is reproductively active adult female (at least 2 years old); and

2. There is a 1:1 sex ratio in offspring.

The number of young that each taken female bat would have produced was calculated using the USFWS' Draft Region 3 Indiana Bat Resource Equivalency Analysis Model for Wind Energy Projects (REA Model; USFWS 2014b). The REA model uses parameters from studies on Indiana bats, which represents the best substitute at this time for northern long-eared bat population dynamic parameters.

The lost future reproductive potential from each taken female bat was calculated as:

$$FG = \frac{1}{2} b_a \left(\frac{1 - S_A^{T+1}}{1 - S_A} \right)$$

Where FG is the number of daughters a female would have produced over her reproductive life span (T=0…,4), S_A is the adult survival probability, and b_A is the adult breeding rate. The entire expression is multiplied by 0.5 to account for the 1:1 sex ratio. The median reproductive life span of a female is 6.78 years, however this model assumes that a female is killed after her second year of breeding, so that the lost reproduction time is 5 (4.78) years of reproduction. The model also takes into account the potential offspring of each taken female's pups (i.e., second generation pups [SG]) calculated as:

$$SG = \frac{1}{2} S_P \left[b_J + S_J b_A \left(\frac{1 - S_A^{T+1}}{1 - S_A} \right) \right]$$

Where S_p is the survival probability of the pup, S_J is the survival probability of the juvenile, and b_J is the lower birth rate for first-year breeding. The outside term represents the probability of a pup surviving, while the term within brackets represents the reproductive potential of the pup.

Based upon the stepwise matrix model for Indiana bat demographics developed by Thogmartin et al., the following demographic parameter values (for a stationary population) were used: b_A=0.601, S_A=0.873, S_p=0.636, S_J=0.697 and b_J=0.143 (USFWS 2014b). The model returns an average of 2 (1.9) lost young (female pups) that would have been produced by each taken female over 5 breeding seasons and her subsequent female offspring. Therefore, over the life of the Project, if the full amount of authorized take were to occur, it is estimated that the lost reproductive potential of 121.5 female Indiana bats taken by the Project would result in the additional loss of 230.9 female juvenile bats. The estimated lost reproductive potential of 40.5 female northern long-eared bats taken by the Project would result in the additional loss of 77.0 female juvenile bats. The actual number of bats removed from the population over the 27-year operational life of the Project includes the number of bats actually taken plus the lost reproductive contribution of the female bats taken. As described in the foregoing Section 5.2.1, based on the application of minimization measures it is expected that the number of bats actually taken will be at least 50% less than the amount authorized in Section 4.3.2, and that the actual number of bats removed from the population will be correspondingly less as well.

In addition to the effect of the operational minimization measures, it is anticipated that the effects of WNS may reduce the amount of take that occurs during the ITP term. As WNS spreads into the Midwest, it may significantly affect both the Midwest Recovery Unit Indiana bat population and the local northern long-eared bat population. WNS is causing severe declines in the populations of cave-hibernating bats throughout the northeastern U.S. A recent study found that over the entire range, the Indiana bat population has declined by 10.3% since WNS was discovered in the US, and by 9% (95% confidence interval of 3% to 21%) within the Midwest Recovery Unit (Thogmartin et al. 2012). Furthermore, there has been a sharp decline in the northern long-eared bat population in the northeastern part of its range due to WNS, and WNS has been confirmed on northern long-eared bats in New York, Tennessee, Kentucky and Ohio (USFWS 2014c), indicating that they are highly susceptible to the disease. The decline within surveyed hibernacula from 8 states is approximately 99% for the northern long-eared bat (USFWS 2014a). The projected take from the Project would represent a greater proportion of the future reduced populations, but if WNS does indeed result in a continued decline in local populations, fewer bats will be extant on the landscape and it is reasonable to assume that take from the Project would be reduced accordingly. The possible effects of WNS on the local populations and, subsequently, the Project's mitigation and conservation measures, are addressed in Section 8.2, Unforeseen and Changed Circumstances.

5.2.2.2 Acceptable Mitigation

Although take of 162 Indiana bats and 81 northern long-eared bats is authorized, WWF is expecting take of an average of 3 Indiana bats per year and 1.5 northern long-eared bats per year after the implementation of the avoidance and minimization measures described in Section 5.2.1 above for a total

expected take of 81 Indiana bats (60.75 adult females) and 41 northern long-eared bats (20.25 adult females) over the 27-year operational life of the project. Accordingly, WWF will initially mitigate for the impact of the full amount of take expected to occur. Following issuance of the ITP, Indiana bat and northern long-eared bat mortality will be estimated and tracked using the Evidence of Absence software (EOA) as more fully described in Section 5.4.2.1, and if that EOA Calculated Take estimate indicates that total take is exceeding expectations, additional mitigation will be performed sufficient to offset the impact of the total EOA Calculated Take over the 28-year permit term. The procedures for determining the need for additional mitigation are described in Section 5.4.2.1.

The USFWS is currently using the REA model to evaluate the sufficiency of proposed mitigation measures to off-set the take of Indiana bats from wind energy projects (USFWS 2014b). Due to similarities between the species, it is believed that any mitigation efforts for Indiana bats will also be beneficial to the northern long-eared bat population. Per the USFWS guidance, if habitat is suitable for multiple listed species that are being impacted by a Project, a single mitigation area may be used for both species for that particular project (USFWS 2003). The primary interest with regards to the take of Indiana and northern long-eared bats is reproduction, and specifically, lost female reproductive potential (the lost female plus her and her offspring's future reproductive potential). Based on the methodology described in Section 5.2.2.1, the impact of the expected take of 60.75 adult female Indiana bats and 20.25 adult female northern long-eared bats will result in a loss of 115.4 future female Indiana bat pups and 38.5 future northern long-eared bat pups, for a total expected take of 176.2 lost female Indiana bats and 58.7 lost female northern long-eared bats.

The REA model currently evaluates three types of mitigation options for Indiana bats: summer habitat protection, summer habitat restoration, and winter habitat protection. It requires all mitigation projects to have a summer habitat component, a minimum of 46 acres protected at each site, and that any restored habitat is permanently protected. Due to the similarities between the species, it is believed that both Indiana bats and northern long-eared bats can benefit from carefully selected projects. While the two species utilize similar habitat, they occupy slightly different niches in that habitat, utilizing different types of roost trees, different prey and other resources. However, some competitive pressures are assumed to exist between the species, meaning that mitigation for northern long-eared bats in addition to Indiana bats will require additional mitigation acreage beyond that stipulated by the REA model for Indiana bats alone. It was determined, through consultation with the USFWS that these competitive pressures would require that additional mitigation be performed for half of the northern long-eared bat take in addition to the mitigation for Indiana bats (which is assumed to also mitigate for half of the northern long-eared bat impacts). This strategy will likely compensate for the competitive pressures between the species.

5.2.2.2.1 Summer Habitat Protection

All summer habitat mitigation will be conducted within the home range of a known maternity colony. If a mitigation site is proposed for which acoustic or mist-netting data are not available within the previous two years, then WWF shall conduct mist-netting to establish the presence of Indiana and northern long-eared bats prior to USFWS approval of the mitigation site. Summer habitat protection can include the protection of roosting and foraging habitat, foraging-only habitat, a functional travel corridor, or habitat

that serves for roosting, foraging, and a corridor. Any potential mitigation project will meet the following requirements of the REA model:

- Part of occupied maternity colony habitat that is currently under potential threat from development, forestry, or other tree clearing activities;
- The habitat has a reasonably high risk level defined as one of the following:
    - Imminent demonstrable threat (the quality of the habitat would decrease in the next ten years if not protected), or
    - Habitat limitation threat (the percent of forest cover within the home range of the maternity colony is less than 20%)
- Any functional travel corridor will be the only connection between two isolated (more than 500 feet apart) forest blocks of at least 5 acres of suitable habitat.

Surveys will be conducted to confirm the presence of both Indiana and northern long-eared bats in the area of any proposed summer habitat mitigation site (protection or restoration) and only occupied sites will be eligible for use as mitigation. "Occupied" shall be defined in accordance with the USFWS' then-current summer survey guidelines. Any new, pre-mitigation surveys required will be in compliance with current mist-netting guidelines published by the USFWS.

5.2.2.2.2 Summer Habitat Restoration

Restoration projects could include the restoration of roosting and foraging habitat, the restoration of corridor habitat, or a combination of the two. Any restoration project will be within an existing maternity colony (2.5 mile radius around a known roost tree) which is currently habitat-limited, and the project will include permanent protection. Additional requirements for the restoration of roosting and foraging habitat would include:

- Restoration would be within 500 feet of occupied habitat
- Restoration would be greater than 5 acres
- Any corridor restoration would be greater than 500 feet in length, with a width of around 98 feet.

5.2.2.2.3 Winter Habitat Mitigation

The only winter mitigation which the REA model currently supports is gating of a known hibernaculum, and the model provides only minimal credit for such projects due to concerns over the efficacy of hibernacula gating in mitigating for the impact of taking bats. WWF is not proposing to perform any winter mitigation as part of the initial mitigation for the impact of the take expected to occur in light of the minimization measures. However, if additional mitigation proves necessary, winter habitat mitigation will remain an option.

If any winter mitigation is proposed, the hibernaculum will meet the criteria set forth in the then-current version of the REA model. Currently, those criteria include the following conditions, some or all of which must be met to qualify for mitigation credits:

- Evidence of disturbance and/or vandalism
- Easily accessible
- Bats are located in accessible cave locations
- Ceilings where bats hibernate are 10 feet or lower
- Accessible bats are clustered in groups
- Hibernacula entrance or cavern is at risk of collapse or other impairment to ingress and egress of bats.

WWF will develop a specific plan in cooperation with USFWS and for design and implementation of any gates, braces or other protective or stabilization measures to be implemented as part of a winter habitat mitigation project.

5.2.2.3 Proposed Mitigation

WWF is working with a third-party mitigation services provider to identify and implement appropriate mitigation projects meeting the above criteria. WWF has identified two sites in the Middle Wabash-Little Vermillion watershed in northern Indiana that contain quality roosting and foraging habitat for both Indiana and northern long-eared bats:

1. Site 1 - Located within 2.5 and 4.0 miles of two known Indiana bat maternity roost sites and less than 2.0 miles from an Indiana bat summer capture record. This site contains over 138 acres of forested habitat with over 90 additional acres of land suitable for potential restoration. The forested portions of the site consist of a mix of small- (4 - 8 inch DBH) to medium-sized trees (9 - 15 inch DBH) with few scattered large trees (>15 inch DBH) and a fairly to moderately cluttered midstory. Topography within the forested areas is hilly, consisting of steeply sloping ravines, valleys and ridgetops with numerous ephemeral streams. One intermittent stream located in the southern third of the property. Dominant tree species within the overstory include white oak (*Quercus alba*), northern red oak (*Quercus rubra*), shingle oak (*Quercus imbricaria*), Chinquapin oak (*Quercus muehlenbergii*), shagbark hickory (*Carya ovata*), black walnut (*Juglans nigra*), American beech (*Fagus grandifolia*), tulip poplar (*Liriodendron tulipifera*), American sycamore (*Platanus occidentalis*), sugar maple (*Acer saccharum*), and hackberry (*Celtis occidentalis*). Numerous potential maternity roost trees are present on the site, including snags displaying characteristic roost tree conditions (i.e., exfoliating bark, hollow limbs or boles) and live shagbark hickory. Approximately 138.6 acres of forest are present on the site, all of which are considered to be suitable summer Indiana and northern long-eared bat summer habitat

based on suitability requirements identified in the USFWS 2015 Rangewide Indiana Bat Summer Survey Guidelines (USFWS 2015c).

2. Site 2 - Located within 1.4 miles of a northern long-eared bat hibernaculum and contains over 300 acres of forested habitat with over 90 additional acres of land suitable for potential restoration. The forested portions of the site consist of a mix of deciduous upland and forested wetland, with primarily small to medium-sized trees (9 - 15 inch DBH) and few scattered large trees (>15 inch DBH). Topography within the upland forested areas is hilly, consisting of ridges and steep ravines containing numerous ephemeral and intermittent streams. One perennial stream is located on the site that meanders through forested wetland, riparian woodland, and areas of open grassland. Dominant tree species within the overstory of the upland forest community include white oak, shingle oak, northern red oak, black walnut, tulip poplar, shagbark hickory, sugar maple, American beech, American sycamore, and sassafras (*Sassafras albidum*). Dominant tree species within the overstory of the forested wetland include eastern cottonwood, hackberry, and American sycamore. Numerous potential maternity roost trees are present on the site, including snags displaying characteristic roost tree conditions (i.e., exfoliating bark, hollow limbs or boles) and live shagbark hickory. Approximately 302.5 acres of forest are present on the site, all of which are considered to be suitable summer Indiana and northern long-eared bat summer habitat based on suitability requirements identified in the USFWS 2015 Rangewide Indiana Bat Summer Survey Guidelines (USFWS 2015c).

Based on application of the REA model, the impact of the expected take of 81 Indiana bats and 40.5 northern long-eared bats will be equivalent to 176.2 Indiana bats and 58.7 northern long-eared bats, as set forth in Section 5.2.2.1. Assuming that the Indiana bat mitigation can account for 50% of the northern long-eared bat mitigation as described in Section 5.2.2.2, it will initially be necessary for WWF to mitigate for a take of 2.625 females bats per year (2.25 Indiana bats and 0.375 northern long-eared bats, as half of the northern long-eared bat take would need to be accounted for), which results in a direct take of 70.9 female adults and the lost reproductive potential of 134.7 juvenile bats, for a total of 205.6 bats. That impact of take (205.6 bats) would be satisfied by approximately 253 acres of summer habitat preservation. WWF will coordinate with the USFWS to select an appropriate amount of acreage from each of the two tracts identified above in order to achieve this result in a manner that will provide the greatest benefit to the species.

WWF anticipates that the specific parcels selected will be acquired, and the preservation and/or restoration activities will be implemented, by the third-party mitigation provider on behalf of WWF. WWF currently anticipates engaging First Indiana Resource, LLC (FIR), a subsidiary of Resource Environmental Solutions, LLC (RES) to serve as the mitigation implementing entity; however, WWF may select a different entity at its discretion, provided that any alternative entity must be satisfactory to the USFWS. Similarly, if acquiring control over either or both of the proposed tracts proves impracticable, WWF may substitute alternative tracts, provided that such alternative lands shall be subject to the review and approval of the USFWS subject to the specifications of Section 5.2.2.2.

WWF or FIR will either acquire the mitigation lands in fee, or legally encumber them with a permanent conservation easement to be held by a 501(c)(3) non-profit organization. Details on the implementation

of the mitigation, including final determination of the specific parcel or parcels from those described above or comparable parcels satisfactory to the USFWS, will be set forth in a Summer Habitat Mitigation Plan (SHMP) to be provided by FIR (or an alternate implementing entity) for approval by the USFWS. A performance bond will be provided in an amount sufficient to carry out the actions required in the approved SHMP (including the mitigation monitoring requirements set forth in Section 0), and the easement holder will be provided with an endowment sufficient to ensure that funds are available to enforce the terms of the easement, which will include stipulations on use and management of the land to ensure that the essential functions and values of the habitat are permanently protected.

5.2.2.4 Mitigation Monitoring

5.2.2.4.1 Summer Habitat Mitigation Monitoring

Following implementation of a mitigation project, compliance monitoring will be conducted on all protected and restored summer habitat. The following target metric values will be used to evaluate compliance:

- Tree density: 381 native trees/acre[13]
- Snag density: 5 snags/acre
- Native understory composition: woody invasive species < 20% cover in the understory

Compliance monitoring for restored and protected habitat includes the following (USFWS 2012d):

1. Initial confirmation that any restoration site was planted using an appropriate species mix, spacing and site preparation; and
2. After three years, monitoring to confirm a 70% survival rate of planted species, and again at seven years to confirm a minimum stand density of planted and volunteer native trees equal to at least 70% of the planted density; and
3. Monitoring every two (2) years for the life of the permit from aerial photographs (or a report from the land managing agency) confirming that mitigation requirements are being met (i.e., trees have been planted and survived); and
4. Monitoring every seven (7) years for the life of the permit for invasive species. Should any invasive species that threaten the function of the mitigation for Indiana and northern long-eared bat habitat be present, they must be controlled to remove that threat within three years.

5.2.2.4.2 Winter Habitat Mitigation Monitoring

[13] The planted density should be on 8x10 spacing, or 544 trees/acre. A 70% survival rate would result in a minimum tree density of 381 native trees/acre (USFWS 2012d)

If WWF conducts any winter habitat mitigation under this HCP, it will perform compliance monitoring to evaluate the effectiveness of the measures implemented at the hibernaculum, as well as the need for and priority of additional future measures. The winter habitat compliance monitoring will include the following (USFWS 2012d):

1. Ensure that gate and/or stabilization structures were properly installed according to the design specification and are not hindering the ingress/egress of bats or air; and

2. Yearly monitoring for the duration of the impact of take for which the gating project is providing mitigation to ensure no unauthorized visits have occurred.

To monitor whether or not a newly installed gate is affecting the ingress/egress of bats or air, the entrance of the cave will be monitored with night-vision equipment during the first fall migration/swarming season after installation. The timing, frequency, and duration of any abnormal flight behaviors (e.g., bats landing on the gate or crawling through the gate rather than flying) will be recorded. Additionally, any observations of potential predators or a predation event will be recorded.

The security of the gate will be checked by the managing agency for the first 12-years after gating to verify that the lock is intact and to document any evidence of tampering. Upon any report of security breaches at the gate, WWF will deploy a team to repair the gate or any associated damage within 48 hours. If at any time during the ITP the managing agency can no longer continue gate security monitoring efforts, WWF will provide funding and/or personnel to complete this monitoring effort.

5.2.2.5 Mitigation Reporting

WWF (or its third-party mitigation implementing entity, on WWF's behalf) will submit annual reports to the IDNR and USFWS Bloomington Field Office by January 31 following each calendar year in which a mitigation action or monitoring is actively conducted. Reports will describe the methods and results of any summer or winter habitat mitigation projects. Reports for any summer habitat mitigation will include the number of acres preserved and/or restored, as well as the details of all restoration actions taken and measurements of success criteria.

5.3 MORTALITY MONITORING AND REPORTING

5.3.1 Background and Goals

The post-construction monitoring plan set forth in this Section 5.3 has been developed to provide a means of monitoring and ensuring the Project's compliance with the take numbers estimated in this HCP and authorized in the ITP, and assessing the effectiveness of the HCP in meeting the biological objective of minimizing direct mortality to Indiana and northern long-eared bats set forth in Section 5.1 of this HCP.

For the reasons set forth in Section 4, Indiana and northern long-eared bat mortalities are expected to occur infrequently at the Project. When mortalities do occur, practical limitations on search effort and detection probability will likely result in many of the carcasses escaping detection – a problem that is unavoidable in mortality monitoring at wind energy facilities. As a result of these limitations, post-

construction mortality monitoring at wind facilities traditionally has relied upon species composition or other surrogate approaches to develop estimates of mortality of covered species based on the numbers of other bats or all bats found. The USFWS has expressed concern about the reliability of these estimates given the variability of species composition between sites, differences in behavior and activity patterns between bats of various genera and species, and other sources of natural and statistical variability. In response to these concerns, the U.S. Geological Survey (USGS) has developed a statistical model called Evidence of Absence (EOA) (Dalthorp 2014) that relies upon observed carcasses of the rare covered species to determine the likelihood that actual mortality of those species has not exceeded the authorized amount. This statistical model can also be used to develop post-construction monitoring plans to increase the likelihood of detecting a rare event, such as the carcass of a threatened or endangered species.

WWF will employ the EOA model to measure compliance with the level of take authorized by the ITP pursuant to this HCP, as further described in Section 5.4. The post-construction monitoring regime set forth herein has been designed to be sufficiently robust to enable the EOA model to function properly and avoid undesirable outcomes as a result of inadequate data. The plan entails carcass searches at each of the Project turbines; however, the entire area around each turbine will not be searched as such a study would require extensive ground surveys and considerable expense for the purpose of attempting to detect every single unlikely event. Rather, cleared plot searches will be conducted at a subset of turbines during preliminary and baseline monitoring, and those data will provide a site-specific estimate of the number of carcasses which may be missed by road and pad searches at the remaining turbines and during follow up monitoring. That information, along with results of searcher efficiency trials and carcass removal trials, will be used to measure and correct for sources of bias in the monitoring results and develop a probability of detection (*g)* for the search effort, a critical input for the EOA model.

5.3.2 Species to be Monitored

The post-construction monitoring program will record all bird and bat fatalities observed within the Project Area. However, while all species observed will be recorded and reported in the annual reports required by Section 5.3.5.2, only Indiana bat and northern long-eared bat data will be evaluated with the EOA model.

5.3.3 Permits and Wildlife Handling Procedures

5.3.3.1 Permits

State and federal collecting/salvaging permits will be acquired from the IDNR and the USFWS by WWF's consultants prior to commencement of the post-construction monitoring to enable searchers to collect and handle carcasses in compliance with laws pertaining to the collection and possession of wildlife and migratory birds.

5.3.3.2 Wildlife Handling Procedures

All bat carcasses found will be labeled with a unique number. Hair and tissue samples will be collected and submitted to the USFWS Bloomington Field Office from all bat carcasses other than covered species. Fresh carcasses of unlisted bat species may be used in searcher efficiency and carcass removal trials. All

other bat carcasses will be individually bagged and retained in a freezer at the Project O&M building. A copy of the original data sheet for each carcass will be placed in the bag with each frozen carcass. In the event that a carcass of an ESA- or state-listed bat species is found, WWF will notify the appropriate agency within 24 hours and the carcass will be transported to the appropriate agency within 48 hours. If an injured bird or bat is found, the animal will be sent to a local wildlife rehabilitator, when possible. All bird carcasses will be identified in the field, if possible, and left in place. Digital photographs and location information of all bird carcasses will be taken and used for confirming identification when necessary.

5.3.4 Monitoring Protocols

5.3.4.1 Study Design

Four stages of mortality monitoring have been conducted or are planned for WWF:

- Preliminary Monitoring: conducted during the first three and a half years of Project operation under the TALs prior to approval of this HCP, this included monitoring during the fall migration period (1 August to 15 October) when cut-in speeds were raised to 7.0 m/s in 2012 through 2014 and 6.9 m/s in 2015, and during the spring migration period (1 April to 15 May) when cut-in speeds were maintained at the rated cut-in speeds of 3.5 m/s in 2012 through 2015 and raised to 5.0 m/s in 2016 at 100% of the turbines. Preliminary monitoring consisted of weekly searches of 100% of Project turbines. Full, cleared plot (80 m x 80 m) searches were conducted at 20% of the turbines, while roads and pads were searched at the remaining 80% of turbines. The results of Preliminary Monitoring to-date can be found in Appendix F through Appendix H.

- Baseline Monitoring: conducted during the fall migration period (1 August to 15 October) for the first three years of Project operation under the ITP, and during the spring migration period (1 April to 15 May) for the first two years of Project operation under the ITP. Baseline Monitoring will consist of weekly searches of 100% of Project turbines. Full, cleared plot (80 m x 80 m) searches will be conducted at 50% of the turbines (63 full plots and 62 roads and pads), while roads and pads will be searched at the remaining 50% of turbines (see Section 5.3.4.3.1 for details).

- Implementation Monitoring: follow-up monitoring conducted every year during the fall migration period (1 August to 15 October) after the completion of the Baseline Monitoring period for the life of the Permit term. Adaptive Management Monitoring will pre-empt Implementation Monitoring in years where Adaptive Management Monitoring is conducted. Implementation Monitoring will consist of roads and pads searches of 100% of Project turbines, on a weekly basis, as further described in Section 5.3.4.3.2. Implementation Monitoring will be conducted in the spring only if spring Baseline Monitoring indicates that take is occurring.

- Adaptive Management Monitoring: supplemental monitoring for two consecutive years following any reduction in cut-in speeds to evaluate the effect of changes made through adaptive management during the fall migration period (1 August to 15 October). Adaptive Management Monitoring will utilize the same search protocols as Baseline Monitoring, consisting of weekly searches of 100% of Project turbines, with full, cleared plot (80 m x 80 m) searches at 50% of the

turbines and roads and pads searches at the remaining 50% of the turbines (see Section 5.3.4.3.1 for details). Adaptive Management Monitoring will be conducted in the spring only if spring Baseline Monitoring indicates that take is occurring.

Results of Preliminary Monitoring have estimated that there was no take of either Indiana or northern long-eared bats in the spring, as the upper 90% confidence interval for take of both species has been below 0.5 bat/spring for three consecutive years (2012-2015) despite operating at the rated cut-in speed of 3.5 m/s during those years. While this monitoring was designed and implemented prior to EOA availability, with the entire confidence interval below 0.5 bat, this number would round down to zero bats for both species, indicating no spring take. Spring monitoring will continue for the first two years of Baseline Monitoring, and should the results continue to indicate no spring take of either species at the rated cut-in speed over five years (three years of Preliminary Monitoring in 2012-2015 plus two years of Baseline Monitoring), indicated by the absence of any carcass detection, WWF will discontinue spring monitoring at the Project. No Implementation Monitoring or Adaptive Management Monitoring will be conducted during the spring should the results following the first two years of Baseline Monitoring confirm that no spring take is occurring. In that case, take coverage would no longer apply during the spring.

Each monitoring period will include searcher efficiency trials and carcass removal trials in addition to the standardized carcass searches. Standardized carcass searches will allow statistical analysis of the search results, calculation of overall fatality estimates, and assessment of correlations between fatality rates and potentially-influential variables (e.g., weather, location). Searcher efficiency and carcass removal rates are two sources of field bias in mortality studies that have been proven to be highly variable and site- and researcher-specific; mortality estimators are highly sensitive to these parameters (Huso 2010). Kunz et al. (2007a) and the USFWS (2012d) Land-Based Wind Energy Guidelines 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.

5.3.4.2 Monitoring Objectives

The post-construction mortality monitoring program has been designed with three primary objectives:

(1) <u>High Detectability</u> - to achieve a high probability of detection of the take of a covered species, recognizing the practical limitations to detecting a presumably rare event;

(2) <u>Confirm take is, and remains, within authorized limit</u> - to provide sufficient data for evaluation using the EOA model to ensure that the take of Indiana bats and northern long-eared bats at the Project has not exceeded and is not projected to exceed the authorized take of each species, and indicate when adaptive management actions are necessary or would be advisable to avoid such an exceedance as described in Section 5.4; and,

(3) <u>Confirm adequacy of mitigation</u> - to provide a basis for determining whether actual take has exceeded or is projected to exceed the level of expected take for which initial

mitigation is being performed (as described in Section 5.2.2.3), such that additional mitigation is required to offset the impact of the additional take.

5.3.4.3 Field Methods

The field methods to be used during post-construction mortality monitoring will be subject to modification at WWF's discretion as necessary or appropriate to increase detection probability and/or respond to the results or projections obtained from the EOA software. Any changes in monitoring protocols expected to influence detection probabilities will be noted in the annual report. The following sections describe the field methods that will be used during initial post-construction mortality monitoring (Section 5.3.4.3), and the statistical methods that will be used to correct for sources of bias in field sampling (Section 5.3.4.4). Following that presentation, Section 5.3.4.5 explains the detection probability that WWF anticipates achieving during the three stages of post-construction mortality monitoring.

5.3.4.3.1 Plot Size, Vegetation Mowing, Visibility Classes

During Baseline Monitoring and Adaptive Management Monitoring, at 50% of the turbines sampled, only the turbine pads and access roads out to 262 ft (80 m) from the turbine will be searched. This method targets the areas shown to support the highest searcher efficiency while greatly reducing the financial and logistical restraints associated with clearing and searching large study plots, enabling much broader sampling coverage of the facility. At the remaining 50% of the turbines sampled, 262 ft x 262 ft (80 m x 80 m) plots will be cleared and searched using a full-coverage transect methodology. Each 262 ft x 262 ft (80 m x 80 m) search plot will be centered on a turbine location. Thirteen 20-ft (6-m) 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. Searchers will notify WWF staff whenever mowing is necessary during the study period to ensure vegetation does not hinder search results.

Several studies have indicated that 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; Piorkowski and O'Connell 2010; USFWS 2010). This plot size will exceed one-half the maximum turbine rotor height of the Project turbines (246 ft [75 m]). This should minimize the number of fatalities or injured bats that land or move outside of the search plots and thereby reduce the number of carcasses that would be undetected, causing underestimation of overall fatalities. Turbines will remain assigned to either the roads and pads search group or the cleared plot search group throughout the entire search year. The subset of full-plot turbines will provide a reference for estimating the number of fatalities that may fall outside the searched area at the other turbines. This mixed sampling methodology is consistent with other post-construction monitoring studies being conducted (e.g. Good et al. 2011) and will enable comparison of study results.

During Implementation Monitoring 100% of Project turbines will be searched. The search area will consist of turbine pads and access roads out to 262 feet (80 m) from the turbines. Search plots will not be used during Implementation; the road and pad adjustment factor (see Section 5.3.4.4.5) calculated during the Preliminary and Baseline Monitoring efforts will be applied to the Implementation Monitoring.

5.3.4.3.2 Search Interval

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. A weekly search interval for fatality monitoring was deemed adequate by Kunz et al. (2007a) 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. The USFWS' Land-Based Wind Energy Guidelines recommend that "carcass searching protocol should be adequate to answer applicable…questions at an appropriate level of precision to make general conclusions about the project" (USFWS 2012a). The initial search interval during Preliminary Monitoring was once weekly for all turbines; however, this search interval was increased to twice weekly (3.5 days) for the roads and pads search group for the fall monitoring period after the second year of monitoring indicated that more frequent searches were needed (carcass persistence was less than 7 days during the fall; Appendix G and H). Future post-construction monitoring will continue to evaluate carcass persistence, and the search interval will be adjusted accordingly. Planned changes in the search interval will be described in the annual report.

5.3.4.3.3 Standardized Carcass Searches

Carcass searches will be conducted by independent and qualified biologists, operating under applicable permits and 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 in the Project Area. Prior to initiation of survey work under the ITP, the USFWS will be provided information regarding the selected search team to indicate their qualifications for completing survey efforts. Any unknown bats, suspected Indiana bats, or suspected northern long-eared bats discovered during fatality searches will be sent to a qualified USFWS-approved bat expert for positive identification. Any unknown birds will be thoroughly photographed, and photos of the carcass will be sent to a qualified USFWS-approved bird expert for possible 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, nightly temperatures, and general weather conditions for nights preceding search.

A digital picture of each detected carcass will be taken before the carcass is handled and removed. As previously mentioned, all bat carcasses will be labeled with a unique number, bagged, and stored frozen (with a copy of the original data sheet) at the Project O&M building. Bird carcasses will be thoroughly photographed and left where found.

Bat carcasses found in non-search areas and any bird carcasses found 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. If maintenance personnel find a carcass at a turbine scheduled to be searched that day, the carcass will be left in place until after the search has been conducted. This is done to give the searcher the opportunity to find the carcass. Any carcasses found by maintenance personnel and left in place, but not found by searchers, will be considered incidental finds. Incidental finds will be included in survey summary totals, but will not be input into the EOA model because the lack of standardized search effort, search area and bias correction information prohibits calculations of detection probability necessary for that model, while the calculations performed by the model account for the fact that not all carcasses occurring at the site will be detected.

5.3.4.3.4 Searcher Efficiency and Carcass Removal Trials

Searcher efficiency trials will be used to estimate the percentage of all bat fatalities that are detected during the carcass searches. Similarly, carcass removal trials will be used to estimate the percentage of bat fatalities that are removed by scavengers prior to being located by searchers. When considered together, the results of these trials will represent the likelihood that a bat fatality that falls within the searched area will be recorded.

Trials will be conducted during each study period by placing "trial" carcasses in the searched areas (one trial during each of the spring and fall monitoring seasons) to account for changes in personnel, searcher experience, weather, and scavenger densities. The number of bat carcasses used will depend on the number of carcasses available following initial carcass searches in the Project Area; commercially-available substitute carcasses, such as brown mice, will be used to increase the number of trial carcasses as necessary. Searcher efficiency and carcass removal trials will be limited to one trial per monitoring season to avoid attracting scavengers to the Project Area with carcasses and potentially artificially inflating the carcass removal rate.

Each trial carcass will be discretely marked and labeled with a unique number so that it can be identified as a trial carcass. Prior to placement, the date of placement, species, turbine number, and distance and direction from turbine will be recorded. 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 the 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.

Carcass removal trials will be conducted immediately following the 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 when possible based on schedule and weather. The status of each trial carcass will be recorded throughout the trial.

5.3.4.4 Statistical Methods for Correcting for Sampling Bias and Calculating the Probability of Detection (*g*)

Fatality estimate bias correction factors include (1) searcher efficiency, (2) carcass persistence rates, and (3) estimate percent of casualties which likely fall in non-searched areas. Variance and 90% confidence intervals will be calculated using bootstrapping methods (Erickson et al. 2003 and Manly 1997 as presented in Young et al. 2009). These bias correction factors are then input into EOA software to determine the detection probability (*g*) each season, which will then be used to estimate the fatality rates of Indiana and northern long-eared bats.

5.3.4.4.1 Mean Observed Number of Casualties (c)

The estimated mean observed number of casualties (c) per turbine per study period (spring or fall of each monitoring year) 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 searched area or by maintenance personnel) will not be included in this calculation, nor in the estimated fatality rate. The estimated mean observed number of casualties per turbine per study period will be calculated separately for each search method (roads and pads, full plots) when applicable.

5.3.4.4.2 Estimation of Searcher Efficiency Rate (p)

Searcher efficiency (p) will represent the average probability that a carcass was detected by searchers. The searcher efficiency rates will be calculated by dividing the number of trial carcasses observers found by the total number that remained available during the trial (non-scavenged). Searcher efficiency will be calculated each year for each season (spring, fall) and for both search methods (roads and pads, full plots) when applicable.

5.3.4.4.3 Estimation of Carcass Removal Rate (t)

Carcass removal rates will be estimated to adjust the observed number of casualties to account for scavenger activity at the Project Area. Mean carcass removal time (t) will represent the average length of time a planted carcass remained at the Project Area 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. 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 each year for each season (spring, fall) and for both search methods (roads and pads, full plots) when applicable.

5.3.4.4.4 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:

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

where I is the interval between searches. Initially for this study, I=7 or I=3.5 depending on whether weekly or twice-weekly searches were conducted. During each monitoring effort, π will be calculated separately for each season (spring, fall) and both search methods (roads and pads, full plots) using the respective searcher efficiency and carcass removal rates.

5.3.4.4.5 Search Area Adjustment (A)

Approximation of A, the adjustment for areas that were not searched, will follow methods established and data collected during post-construction mortality studies at the FRWF (Good et al. 2011). For the Wildcat project, A_{RP} will represent the adjustment for the proportion of carcasses which likely fell outside of the area searched at roads and pads turbines, and A_{FP} will represent the adjustment for the proportion of carcasses which likely fell outside of the area searched at full plot turbines.

The value for A_{RP} will be approximated using the following formula:

$$A_{RP} = \frac{C_{FP}}{\pi_{FP}} \Big/ \frac{C_{RPFP}}{\pi_{RP}} * A_{FP}$$

where π_{FP} is the π value calculated for full plot searches, C_{FP} is the number of observed casualties on full plots, π_{RP} is the π value calculated for roads and pads searches, and C_{RPFP} is the number of observed casualties on roads and pads of the full plot turbines. A_{RP} will be calculated separately for spring and fall, using parameter values specific to each season.

The value for A_{FP} will be equal to the correction factor calculated for the Fowler study:

$$A_{FP} = 1.305$$

as the Fowler study estimated that 23.4% of fatalities fell outside of 262 foot x 262 foot (80 m x 80 m) square plots.

5.3.4.5 Detection Probabilities and Confidence Levels for Rare Event Detection

5.3.4.5.1 Overall Probabilities of Detection

WWF will utilize the EOA software developed by Dalthorp, et al. (2014) to estimate the probability of detection (g). This value represents the probability of detecting a carcass of either covered species that occurs at the site during the relevant monitoring season based on the post-construction monitoring effort performed during that season. The EOA model utilizes the probability of detection (g) and the number of covered carcasses found (X), to determine with a certain degree of confidence that the number of covered individuals actually killed did not exceed a specified number. The confidence level that the specified threshold has not been exceeded decreases significantly with every mortality actually found. The confidence level builds with each additional year of monitoring, such that for any given monitoring protocol, the confidence level that a specified take number was not exceeded if X dead bats of that species are actually found increases each year. Higher probabilities of detection result in greater confidence levels and thus reduce the potential that the EOA model will indicate an exceedance of a given level of take when no such exceedance has actually occurred.

The estimate of the overall probability of detection (g) is a function of several factors, including the scavenging rate/carcass persistence, searcher efficiency, search area, search frequency, and other factors (Dalthorp et al. 2014). Because covered species mortalities are expected to be rare events, probabilities of detection are inherently low, but WWF has designed the monitoring regimes in this HCP to achieve comparatively high detection probabilities when compared with previous norms for wind energy facilities. WWF determined the appropriate level of monitoring effort and associated detection probability for each stage based on limits of practicability in light of site conditions, relationships between factors (*e.g.* search frequency and carcass persistence, searcher efficiency and cleared plots vs. roads and pads, etc.), and cost-effectiveness of various regimes (number of searchers required, cost of clearing agricultural plots, etc.).

As described in Section 5.3.4.1, Baseline Monitoring will consist of weekly searches at 100% of Project turbines. Searches at 50% of the turbines will consist of full, 80m x 80m cleared plots, while searches at the remaining 50% of the turbines will consist of roads and pads only. Based on the searcher efficiencies, carcass persistence and other relevant data from the Preliminary Monitoring conducted at the Project, the Baseline Monitoring regime is expected to achieve a detection probability (g) of between 0.25 (25%) and

0.30 (30%), and WWF will modify its protocols as the previous year's data suggests may be necessary to achieve a *g* within that range. While WWF does not have complete control over all factors which determine *g* (such as searcher efficiency or carcass persistence), by increasing area searched (ratio of full plots to roads and pads) or the search interval, the overall *g* can be maintained. Adaptive Management Monitoring will utilize the same search protocols as Baseline Monitoring, and thus is expected to achieve the same probability of detection.

In the absence of operational changes, patterns and frequency of bat mortality are not expected to change significantly or rapidly; therefore, Implementation Monitoring protocols were designed to ensure a very high level of confidence in detecting increases (or decreases) in the overall bat mortality rate, and a detection probability sufficient to support the data requirements of the EOA model. This can be achieved through weekly searches of roads and pads exclusively at 100% of the Project turbines. This protocol is expected to achieve a detection probability (*g*) of around 0.10 (10%), or between 0.08 (8%) and 0.12 (12%). Should g fall below this target range, changes designed to influence *g* (to search interval, area searched, etc.) will be made for the following monitoring year.

5.3.5 Data Analysis and Reporting

5.3.5.1 Data Analysis

Data analysis from Baseline, Implementation and Adaptive Management Monitoring will be performed primarily using the EOA software in accordance with Section 5.4. However, additional data analysis will be performed to evaluate the influence of factors such as date, temperature, and turbine location on fatality rates. Any trends identified will be discussed in annual reports and if appropriate, may be used as a basis for revising or recalibrating application of the minimization measures, although no changes in minimization measures will be implemented without USFWS approval.

5.3.5.2 Reporting

WWF will provide an annual mortality monitoring report to the USFWS by January 31 following the completion of each year of post-construction monitoring. The report will include documentation demonstrating that WWF evaluated and monitored turbine operations and confirming that turbines were operated in accordance with requirements of this HCP, results provided by the EOA software, all-bat fatality estimates, data summaries, and assessment of correlations between fatality rates and potentially influential variables such as weather, location, turbine operation, etc. Fatalities will be expressed both in terms of fatalities/turbine/season and in terms of fatalities/MW/season, as recommended by the USFWS' Land-Based Wind Energy Guidelines (USFWS 2012a) 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. The annual report will include an updated calculation of the Project's total take to-date of Indiana and northern long-eared bats over its operating life, compared with the authorized take numbers of 162 Indiana bats or 81 northern long-eared bats, as well as the number of Indiana bat and northern long-eared bat carcasses detected during the preceding year.

In addition to the mortality monitoring reports, WWF will promptly report fatalities of ESA-listed species or eagles to the USFWS within 24 hours of discovery. In the event the EOA software indicates that any short or long-term adaptive management trigger has been met, WWF will notify the USFWS within 48 hours with the information and resulting operational change plan. Any adaptive management measures implemented or planned for implementation shall be described in the annual fatality monitoring report.

5.4 ADAPTIVE MANAGEMENT

Post-construction mortality monitoring will provide important feedback on the effectiveness of the minimization measures implemented pursuant to this HCP. In addition, during a 28-year permit term, the possibility exists that new summer habitat or other conditions could arise within the Project Area that could increase the risk presented by the Project. Changes may also occur in the populations of Indiana and northern long-eared bats and our scientific understanding of their behaviors and requirements. This HCP contains provisions designed to respond to this feedback and address these possibilities. First, the adaptive management provisions of this Section 5.4 will dictate changes to the minimization measures in response to observed Indiana or northern long-eared bat fatalities, ensuring that any ineffectiveness of proposed measures, or changes in habitat or other conditions in the Project Area or vicinity will not result in take above the permitted limits. Second, the changed circumstances and unforeseen circumstances provisions of Section 8.2 ensure that in the event such circumstances occur, appropriate measures will be taken in response to ensure the continued effectiveness of this HCP.

Adaptive management will allow WWF to minimize the effect of uncertainty associated with gaps in scientific information or biological requirements. Information used in the adaptive management process will come from the post-construction mortality monitoring activities described in Section 5.3 and from other new research as it becomes available. Monitoring data will be analyzed to determine if the objectives of this HCP are being met. If the conservation measures are not producing the desired results, adjustments will be made to the operational parameters of the Project or other conservation measures described in this HCP as may be necessary to achieve the biological objectives of this HCP. If post-construction mortality monitoring indicates that the conservation measures specified in this HCP exceed that necessary to achieve the biological objectives, adaptive management will enable WWF to conservatively recalibrate the minimization measures to reduce the impact on the Project's operations while still avoiding and minimizing direct mortality to the Indiana and northern long-eared bat. Adaptive management will not be used to reduce cut-in speeds below 5.0 m/s during the fall season.

Adaptive management at Wildcat will be implemented as described below. All references to a monitoring year shall mean one fall season (1 August through 15 October) of monitoring and one spring season (1 April through 15 May) provided that spring monitoring has not been discontinued in accordance with Section 5.3.4.1. All cut-in speed limitations shall be applied only during the period from sunset until sunrise when the ambient temperature is above 50° F (10° C) during the fall season.

5.4.1 Evidence of Absence Framework

WWF will utilize the EOA software package, version 1.06, to evaluate post-construction monitoring results and guide adaptive management decisions relating to Project operations. The EOA model utilizes results of post-construction mortality monitoring in conjunction with the detection probability (g)

achieved during each monitoring year to determine, with a certain degree of confidence (α), the likelihood that a certain threshold of take (τ) of each covered species was not exceeded based on the number of carcasses of the respective covered species found (X) during that monitoring year. The software measures compliance with the total take authorization (T) through a long term trigger, and continually measures take over a rolling three year period against a short-term trigger to ensure that the rate of take being observed is sustainable in light of the total take authorization and the number of years remaining in the permit term. In addition, the EOA software includes a reversion trigger, designed to allow the easing of minimization measures when observed take is significantly lower than expected. In summary, there are three adaptive management triggers within EOA which answer the following questions:

1. Short-term Trigger – Is actual average take rate larger than expected?

2. Reversion Trigger – Is actual average take rate small enough to safely reverse an existing operational constraint?

3. Long-term Trigger – Does total cumulative take exceed the long-term authorized amount?

These triggers and the actions to be taken in response to each are described in the following sections. The short-term trigger does not apply during the Baseline Monitoring period, as that initial period of intensive monitoring is designed to establish a three-year baseline for establishing the effectiveness of minimization measures and the observed rate of take before any adaptive management measures are implemented.

5.4.1.1 Short-Term Triggers for Adaptive Management

The short-term trigger in the EOA model is intended to answer the question of whether the observed rate of take is sustainable over the remaining permit term without exceeding the total take authorization. Accordingly, it is designed to fire when the number of carcasses over the course of a few years combined with the estimated detection probability indicate that an average rate of $\tau = \mathrm{T}/n$ per year has likely been exceeded. The short-term trigger acts as a precaution against unexpectedly high fatality rates, as a warning signal that the total authorized take is likely to be exceeded unless additional measures are taken to reduce take rate, and as a mechanism to signal significant changes in fatality rates. In response to short-term trigger firing, incremental adaptive management actions (AMAs) will be implemented (Dalthorp 2015). These AMAs may consist of changes to the mortality monitoring protocols described in Section 5.3.4 to increase monitoring intensity and detection probability, thereby improving the precision of mortality estimates for the covered species, or incremental changes in the cut-in speed regime described in Section 5.2.1 to increase the degree of minimization and bring take rates more in line with the annual rate of the expected take.

Even though the estimated average annual take at the Project, τ, might be "correct" and reflect the true annual take rate that is occurring (λ), the actual number of fatalities that occur will not be exactly the same every year, due simply to natural variation and random chance. The short-term trigger is designed to allow for some annual variation in actual take and to guard against “hair-trigger” decision points. The trigger fires when the observed data (carcass counts combined with detection probabilities) are incompatible with the permitted rate. In other words, if it is too unlikely (i.e., $\leq \alpha'$, where α' is the

significance level for the short term rate of take) that the number of carcasses counted would be as high as observed if the true fatality rate really were in line with the permitted rate, then the short-term trigger would fire (Dalthorp 2015). The test is conducted each year on a three-year running average basis, using α=0.01. If the total number of carcasses observed in any consecutive three years is not compatible with what would be expected if the rate were equal to the permitted level, the trigger will fire and WWF will implement appropriate AMAs.

5.4.1.2 Reversion Trigger for Reduction in Minimization Measures

It is assumed that implementation of operational curtailment will lower fatality rates by a factor of ρ, $(0 < \rho \leq 1)$ compared with rates expected under operations free from such constraints (i.e., the fatality rate would be λ for operations without the constraints and $\rho\lambda$ with the constraints). For example, under the operational curtailment regime proposed in this HCP, fatalities are expected to be lowered by at least 50% (a ρ of 0.5). The reversion trigger is used to answer the question of whether the actual take rate is low enough to safely reverse an existing operational constraint without resulting in the firing of the short or long-term trigger (Dalthorp 2015).

The reversion trigger in the EOA model is designed to fire when the number of carcasses over the course of a few years combined with the estimated detection probability indicate that an average rate of take per year ($\tau = \mathrm{T}/n$) has been lower than $\tau\rho$ at a credibility level of $1 - \alpha_r$ according to a test on average rate over the years since the then-current operational curtailment protocol was implemented (Dalthorp 2015).

Activation of the reversion trigger will allow WWF to incrementally reduce cut-in speeds from those in effect at the time the trigger is activated. However, because WWF has committed to implement baseline minimization measures designed to reduce mortality by 50% from authorized levels ($\lambda/\tau = 0.5$), WWF will not apply the reversion trigger until the take rate is demonstrated to be lower than $0.5\tau\rho$, ensuring that any reduction in cut-in speeds will still be expected to result in minimization at least 50% below authorized levels. Any such reduction in cut-in speeds in response to the reversion trigger being activated will be followed by cycle of Adaptive Management Monitoring to verify that the effect of the reduced minimization remains at or below that level. WWF may not apply the reversion trigger to reduce cut-in speeds below 5.0 m/s during the fall season.

5.4.1.3 Long-Term Trigger for Take Avoidance

Total take at the Project will accumulate from year to year. Progress toward the total authorized take limit of T will be tracked using the "Multiple Year Total" module in the EOA software. The long-term trigger answers the question of whether total cumulative take is likely to have exceeded the long-term authorized amount. Since actual take totals (M_i) through year i are not known, estimated cumulative totals (M_i^*) must be used instead. Exceedance of the long-term limit ($M_i^* > \mathrm{T}$) based on $\alpha = 0.5$ will trigger implementation of an AMA. Because the firing of the long-term trigger signals that the total take authorization has been reached, additional minimization or an increase in monitoring intensity will not be sufficient, and avoidance measures must be implemented. Avoidance will require raising turbine cut-in speeds to 6.9 m/s during the fall migration period (1 August to 15 October) for the remainder of the Project's operating life. If spring monitoring and coverage has not been discontinued in accordance with Section 5.3.4.1, then cut-in speeds will be raised to 5.0 m/s during the spring migration period (1 April to

15 May) for the remainder of the Project's operating life. Implementation Monitoring will continue following the implementation of avoidance measures, to confirm that no further take occurs.

5.4.2 Adaptive Management for Mitigation

For mitigation to be effective at offsetting the impacts of the taking from Wildcat, it is essential that mitigation efforts are both sufficient and successful. In the event that mitigation efforts were insufficient or ineffective, the mitigation would no longer serve to offset the impacts of the take. Initial mitigation may prove insufficient if the observed take as calculated by EOA is greater than initially expected when accounting for the effect of minimization. The effectiveness of the mitigation projects may be affected by some potential foreseeable changed circumstances, which are described in Section 8.2 along with corresponding corrective actions. However, these are not the only circumstances which could lead to inadequacies in the mitigation. Should proposed mitigation fail to fully compensate for the impact of the unavoidable take, corrective action will be implemented by WWF, as described below.

5.4.2.1 Adaptive Management for Insufficiency of Initial Mitigation

The mitigation projects that WWF will implement in accordance with Section 5.2.2.3 are assumed to be sufficient to offset the impact of the take that will actually occur over the life of the Project, given the expected reduction in authorized take resulting from implementation of minimization measures described in Section 5.2.1. WWF will verify that assumption at three checkpoints during the 28-year permit term, and if necessary WWF will identify and undertake additional mitigation in order to compensate for any anticipated deficiency.

In year 15 following issuance of the ITP, WWF will determine the actual take that is estimated to have occurred by EOA through that date (M_{15}^{*}), and project actual take through year 21 (M_{21}^{*}) assuming that the average rate of mortality observed in years 1 through 15 remains constant from years 15 through 21. WWF will then determine the impact of take equal to the projected M_{21}^{*} using the current version of the REA model, subject to the "No Surprises" assurances described in Section 8.2. If the original mitigation effort was sufficient to mitigate for the impact of the take projected to occur through year 21, then no additional mitigation will be necessary at that time. However, if the original mitigation effort was not sufficient, then within three years WWF will identify and perform an amount of additional mitigation expected to be sufficient to make up the projected shortfall and cover the next 10 years of expected take (years 15-25). Similar check-ins will be conducted after year 21 and year 27 (the final year of operations under the ITP), with additional mitigation being conducted if necessary to cover any additional, unmitigated take projected to occur through the end of the permit term. Any additional mitigation proposed will be subject to the approval of the USFWS, consistent with the guidelines set forth in Section 5.2.2.2 and 5.4.2.2.

This process will ensure that WWF performs sufficient mitigation over the term of the ITP to fully offset the impact of the take that actually occurs at Wildcat. Providing the bulk if not all of the mitigation in the first few years of the permit term before the associated take actually occurs will enhance the value received from the mitigation. Further, if actual take over the permit term proves to be less than initially expected, WWF will have provided more mitigation than necessary to offset the impact of the take, providing a net benefit to the species. Alternatively, if actual take proves to be greater than expected, take of each species will still remain below authorized limits due to the effect of minimization measures and

the prophylactic effect of the EOA short- and long-term triggers, but additional mitigation will be conducted to ensure that the impacts of the additional take are fully offset.

5.4.2.2 Adaptive Management for Summer Mitigation

Adaptive management for the summer habitat mitigation will ensure that any mitigation performed is working as intended and offsetting the impact of the take based upon the results of mitigation monitoring (Section 5.2.2.4.1). If summer mitigation efforts fail to meet the compliance criteria set forth below, then WWF, or the third-party mitigation provider on its behalf, will implement adaptive management to take corrective actions and follow management recommendations from the USFWS and other appropriate land management agencies.

Summer mitigation projects shall take place only within the home range of known Indiana and northern long-eared bat maternity colonies, based on acoustic monitoring or mist-netting data from within the previous two years, or confirmed by WWF through new acoustic or mist-netting surveys. Should an area not contain any suitable habitat, an alternative area will be chosen. In the event that implementation of mitigation at a particular site does not take place within two years of the last survey to confirm presence of the bats at that site, new surveys will be conducted to confirm continued presence, and if presence cannot be established an alternative site will be selected that meets the foregoing criteria.

Triggers and responses for adaptive management include:

- Seed species mix, spacing or site preparation inadequate – additional trees and/or land areas will be planted within one year to address the mitigation failure. Personnel from USFWS, WWF, the third-party mitigation provider (if applicable), and any involved land management agencies will meet to determine the cause/source of this failure, and make management recommendations.

- Survival rate of planted trees is < 70% after 3 years – additional trees and/or land areas will be planted within one year to address the mitigation failure. Personnel from USFWS, WWF, the third-party mitigation provider (if applicable), and any involved land management agencies will meet to determine the cause of mitigation failure and make management recommendations.

- Stand density is <70% of planted density after 7 years - additional trees and/or land areas will be planted within one year to address the mitigation failure. Personnel from USFWS, WWF, the third-party mitigation provider (if applicable), and any involved land management agencies will meet to determine the cause of mitigation failure and make management recommendations.

- One or more invasive species that threaten the success of the mitigation project are documented that were not previously present – invasive species will be removed or the threat posed by the invasive species will be controlled using best management practices, as soon as practicable but no later than 12 months.

5.4.2.3 Adaptive Management for Winter Mitigation

WWF is not proposing to perform any winter mitigation as part of the initial mitigation for the impact of the take expected to occur in light of the minimization measures. However, if additional mitigation proves necessary, winter habitat mitigation will remain an option. Triggers for adaptive management for winter mitigation will include any of the following after installation of the gate:

- Abnormal flight behaviors and/or predation;
- Differences in the microclimate (e.g., temperature or humidity);
- Unauthorized entry (≥1 visit/year); and/or
- Damage to the gate affecting operation of performance.

Should any of these events occur (as indicated by mitigation monitoring; Section 5.2.2.4.2), a meeting will be held between USFWS, the IDNR, the third-party mitigation provider (if applicable), and WWF to discuss the issue. Abnormal behaviors or differences in microclimate will need to be analyzed to determine if the installation of the gate could have caused these changes. Potential courses of action include additional monitoring, gate modification, re-positioning of the gate, or gate removal. USFWS will make the final determination on the appropriate action, and if immediate action is required, WWF is committed to implementing that action immediately. Otherwise, WWF will implement that action within one year of consultation.

5.4.3 Reporting

WWF shall provide written notification to the USFWS Bloomington Field Office prior to the implementation of any adaptive management measures set forth in this section. Annual mortality monitoring reports submitted in accordance with Section 5.3.5.2 of this HCP shall also include a discussion of the effectiveness of the minimization and mitigation measures implemented, as well as projections towards the Project's lifetime take as authorized under the ITP.

6. Funding

The avoidance, minimization, and monitoring measures identified in this HCP require a financial commitment on the part of WWF to ensure that adequate funds are available for their implementation and maintenance. WWF has met or will meet these commitments as described in the following sections.

6.1 AVOIDANCE MEASURES

Avoidance measures implemented at Wildcat consist of layout sensitivity to avoid potentially suitable summer roost habitat. The cost of this modification due to reduction in the Project's power output is difficult to determine precisely, but the resulting impact on the Project power estimate has been

accounted for in the economic projections for the Project going forward. No additional funding is required for this conservation measure.

6.2 MINIMIZATION MEASURES

Minimization measures implemented at Wildcat consist of an increase in cut-in speeds from the designed 7.8 mph (3.5 m/s) to 11.2 mph (5.0 m/s) from sunset to sunrise during the fall migratory period (1 August through 15 October) when ambient temperatures exceed 50°F based on a 10-minute rolling average. This increase in cut-in speeds will reduce the annual power output of the Project and result in loss of revenues that WWF would otherwise expect to earn. However, as with the avoidance measures described above, although this minimization measure does put additional pressure on the economic model of the Project, it does not require out-of-pocket expenditure by WWF.

6.3 POST-CONSTRUCTION MORTALITY MONITORING

WWF will conduct post-construction mortality monitoring and reporting in accordance with the plan outlined in Section 5.3. Baseline Monitoring is expected to cost approximately $522,000 per year for the first two years after issuance of the ITP (spring and fall seasons), and $276,000 for the third year (assuming no further spring monitoring in year 3). Implementation Monitoring is expected to cost $71,000 per year every year for the remainder of the permit term. Adaptive Management Monitoring is expected to cost $276,000 per year for two years following each reversion event. These figures incorporate costs for monitoring and, in the case of Baseline and Adaptive Management Monitoring, for clearing full plots (80 m x 80 m) around 50% of Project turbines during the relevant seasons. Data analysis and reporting is estimated to require an additional $10,000 each monitoring year. WWF will select qualified contractors to complete this work, with cost only a secondary factor. Costs, therefore, may be greater or lesser than identified here, depending upon seasonal, weather, market or other factors. WWF has accounted for this cost and potential variability in the cost in, and will fund monitoring activities out of, the Project's annual operations budget. Prior to initiation of survey work under the ITP, the USFWS Bloomington Field Office will be provided information regarding the selected search team to indicate their qualifications for completing survey efforts.

6.4 MITIGATION MEASURES

Although details have not yet been developed regarding the proposed mitigation, planning-level costs have been identified for the current mitigation strategy. Costs have been estimated for:

- Acquisition of ownership or control of 253 acres of land located within the in the Middle Wabash-Little Vermillion watershed in northern Indiana, and associated management fees and costs for conservation activities. Presumed purchase cost of $TBD/acre x __ acres = $____. Assuming __ acres will be targeted for restoration (tree planting) and __ acres will be preserved as-is, a cost of $____ is assumed for the implementation of tree planting, with an additional cost of $____ for seeding and stabilization. This cost includes confirmatory surveys in year 3 and year 7 following completion of the habitat enhancements and every seven (7) years thereafter, and establishment of an endowment for long-term management and conservation.

6.5 FUNDING

As indicated above, certain avoidance measures have already been implemented and require no funding. The principal minimization measure – raised cut-in speeds – does not require material out-of-pocket expense for implementation; rather, it reduces the amount of power and resulting revenues generated. Therefore, no discrete funding source is required. Funding is required for post-construction monitoring and mitigation activities. The following Table 6-1 summarizes the activities which require funding for implementation and the estimated cost of those activities:

Table 6-1 Habitat Conservation Plan Implementation Budget for the Wildcat Wind Farm.

Conservation Measure	Implementation Schedule	Annual Cost	Total Projected Cost
Mortality Monitoring			
Baseline Monitoring (Spring and Fall)	For 2 years after issuance of ITP	$522,000	$1,044,000
Baseline Monitoring (Fall Only)	For third year following issuance of ITP	$276,000	$276,000
Implementation Monitoring (Fall only)	Annually following Baseline Monitoring unless preliminary data show the need for continued spring monitoring;	$71,000	$1,704,000 (24 events)
Post-Construction Monitoring Reporting	Submitted to USFWS by 31 January following monitoring years	$10,000	$270,000 (27 events)
Summer Habitat Mitigation			
Summer Habitat Acquisition (253 acres)	___acres restoration (tree planting) 253 acres preservation [need to determine a schedule for land acquisition, i.e., # of acres in which years, based on negotiations with conservation organizations]	TBD	TBD
Summer Habitat Restoration & Maintenance	**Tree Installation (___ acres)** – A total of 544 trees will be installed per acre in 8x10-foot plant spacing. 32,640 bare-root trees will be mechanically planted, 1-2 years in age with a minimum of 8 inches in height. A minimum of three tree species will be planted and species will be determined based on site suitability and availability at the time of planting.	$TBD	$TBD
	Native grass seed and temporary cover crop installation (___ acres) – A low	$TBD	$TBD

	diversity, short stature native grass mix will be installed with an appropriate temporary cover crop. Seed will be installed with a broadcast seeder or other suitable method based on site conditions.		
	Site management (mowing) (___ acres) - Two mowing events will be conducted per year for years 1 – 5 following planting. Mowing will occur between trees rows to reduce competition of herbaceous weeds and invasive shrub establishment.	$TBD	$TBD
Summer Mitigation Monitoring & Reporting	Includes 2 habitat surveys: one 3 years after restoration to check 70% survival rate; and one 7 years after restoration to check 70% survival rate and to document the presence of invasive species that may pose a threat to the establishment of Indiana and northern long-eared bat habitat; specifically the presence of invasive shrub species. Tree density determinations will be based on sample plot counts. Surveys assume ___ acres will need to be surveyed (i.e., the restored acres). A summary report describing the restoration status of the site will be prepared following the two monitoring events. Cost includes survey time, travel expenses, report preparation, and project management. Cost based on 2012 estimate	$8,500	$17,000

[NOTE FOR DRAFT: Costs provided are planning-level estimates only based on the specific scope and assumptions identified. Costs are subject to change pending discussion of appropriate scope and assumptions, and as a result of bids received from contractors through future RFP processes.]

As indicated on Table 6-1, the total cost for the monitoring and mitigation components of this HCP are anticipated to be approximately $_____. Monitoring costs will be incurred simultaneous with operations, and will be paid out of the Project's operations budget. No financial assurance is required for monitoring costs because take authorization is contingent upon compliance with this HCP, and monitoring must occur simultaneous with Project operations. If WWF fails to conduct required monitoring, the USFWS can suspend or revoke the ITP, but it is not possible to go back and conduct mortality monitoring after the fact.

Costs for the initial proposed mitigation will be paid to FIR or an alternate mitigation provider up-front. WWF will provide the USFWS with written evidence that payment has been made. However, financial assurance is necessary to ensure that funds are available to mitigate for the impact of any take that may

occur in excess of that expected and accounted for by the initial mitigation effort. WWF and/or the third-party mitigation provider will provide a Letter of Credit (LOC) to assure the USFWS that the commitments of this HCP will be met. The LOC will be in an amount sufficient to fund the additional potential mitigation obligations that may be necessary under this HCP, for the impact of up to 50% of the authorized take. Accordingly, the remaining mitigation component of the LOC will be for an amount equal to the mitigation costs presented in Table 6-1 for the initial mitigation project, or $_____. The LOC will renew on an annual basis, in an amount sufficient to ensure that mitigation funding is always available for the impacts of any remaining authorized take for which mitigation has not yet been performed, but may be reduced periodically in an amount agreed upon by the USFWS to reflect the reduced risk based on results of mortality monitoring that EOA Calculated Take will be greater than expected. The LOC will remain in place until all required mitigation under the HCP has been completed.

In addition to the LOC that WWF will provide for the cost of remaining mitigation potentially required under this HCP, FIR (or the alternate mitigation provider) will provide financial assurances for the initial mitigation effort including potential changed circumstances described in Section 8.2.2 which may occur during the permit term. This financial assurance will be in the form of a performance bond, the value of which will coincide with the performance criteria outlined in the Summer Habitat Mitigation Plan (SHMP) and the costs estimated to accomplish those milestones as set forth in Table 6-1, as well as the additional sum of $_____ to account for the occurrence of changed circumstances at the mitigation projects.

The beneficiary of both the LOC and the bond will be a third party entity acceptable to the USFWS.

7. Alternatives

Section 10(a)(2)(A) of the ESA and federal regulation 50 C.F.R. §§ 17.22(b)(1), 17.32(b)(1), and 222.22 require an HCP to provide a description of alternative actions that were considered to reduce impacts to listed species, in this case, the Indiana and northern long-eared bat. The Habitat Conservation Planning Handbook (USFWS and NMFS 1996) states that at least two types of alternatives are commonly included in HCPs:

- A No-Action Alternative, which means that the federal action (i.e., issuance of an ITP by the USFWS) would not occur, and no HCP would be needed to minimize and mitigate impacts to the listed species; and

- Any alternative that would reduce incidental take below levels anticipated as a result of Covered Activities.

In addition to the Proposed Alternative, WWF considered a No Action Alternative, which would reduce take below levels anticipated as a result of the Covered Activities by avoiding take altogether. WWF also considered a third alternative that would entail less onerous minimization measures than are included in this HCP. Each of these alternatives is described below:

7.1 NO ACTION ALTERNATIVE

To avoid risk to the species during operations prior to issuance of an ITP for the Project, WWF developed and implemented a Mortality Minimization and Monitoring Proposal (Proposal; Appendix A) calling for the curtailment of Project operations during periods of expected risk to the species. USFWS issued a Technical Assistance Letter to WWF on June 18, 2012 indicating that, if the Project operates in accordance with the terms of that Proposal, it is presumed that take will be avoided (Appendix A). WWF operated in accordance with the terms of this TAL and the supporting Proposal through July 2015 while development of the HCP was underway. WWF submitted a revised Proposal on June 25, 2015, and a second TAL was secured on July 2, 2015 that established a revised operational scenario (Appendix B). This second TAL requires curtailment to 6.9 m/s during the fall migration period (August 1 – October 15) and 5.0 m/s during the spring migration period (March 15 – May 15). WWF is operating in accordance with the terms of the modified TAL and the supporting proposal while review of the HCP is completed and until authorization is obtained for the incidental take that may occur in connection with less restrictive operation. In developing this HCP, WWF considered operating under the terms of the revised Proposal and TAL on a permanent basis. This scenario would be expected to avoid take, alleviating the need for the Project to prepare a HCP or obtain an ITP, and therefore constitutes the No Action Alternative.

Under the second TAL, the No Action Alternative would entail operating under very stringent restrictions for the life of the Project. The revised Proposal includes the following measures:

- Maintain cut-in speeds at 15.4 mph (6.9 m/s) (elevated from the rated 7.8 mph (3.5 m/s)) for the period from August 1 to October 15 each year, and at 11.2 mph (5.0 m/s) for the period from March 15 – May 15 each year, for the life of the Project, from 30 minutes before sunset to 30 minutes after sunrise. The hub would not be locked, but blades would be feathered to the wind such that RPMs would be minimal during periods when wind speed is less than the applicable cut-in speed.

- Conduct post-construction monitoring at specified intervals over the life of the Project, as outlined in the Proposal, to confirm avoidance of take.

The purpose of the Project is to provide a reliable source of renewable energy to serve the regional electric grid and help meet the renewable energy goals of the U.S. and Indiana, including Indiana's voluntary Renewable Portfolio Standard (RPS) of 10% renewable electricity by 2025. This alternative would significantly reduce the amount of renewable electricity generated by the Project. As a result, this alternative was considered but rejected as not meeting the purpose and need of the Project, and not being practicable or economically sustainable over the projected operating life of the Project.

7.2 RESTRICTIVE OPERATIONS ALTERNATIVE

WWF considered an alternative that would involve an HCP with significant restrictions on operations, but less restrictive than currently authorized under the TAL, with the addition of off-site combined mitigation for the impact of the take. Specifically, the Restrictive Operations Alternative consisted of the following:

- Reduce cut-in speeds to 14.5 mph (6.5 m/s) (compared with 15.7 mph (7.0 m/s) under the TAL) for the period from August 1 to October 15 each year, from sunset to sunrise, when the ambient temperature is above 50°F (10°C). This operational protocol was developed based on a study at FRWF (Good et al. 2011) that indicated that a 6.5 m/s cut-in speed could result in a 78% reduction in bat mortality. Turbines would remain fully feathered (i.e., turbine blades are pitched parallel with the wind direction, causing them to spin at very low RPMs, if at all) until the cut-in speed is reached. At that time, blades would be pitched into the wind to enable the turbine to begin spinning and generating electricity. The feathering/cut-in process would be computer-controlled in real-time by the Project's SCADA system, based on a 10-minute rolling average. Accordingly, turbines would cut-in and feather throughout the night as the 10-minute rolling average wind speed and temperature fluctuated above and below 14.5 mph (6.5 m/s) and 50°F (10°C), respectively.

- Post-construction monitoring would be conducted for the life of the Project, similar to the Proposed Alternative described below.

- Based upon the results of the monitoring, adjustments would be made to increase or decrease cut-in speeds, similar to the adaptive management provisions described for the Proposed Alternative.

- Mitigation would be conducted at off-site locations in an amount sufficient to offset the impacts of the expected take. Although take estimates were not developed, based on the expected reduction in mortality based on the above-referenced studies, it is assumed that estimated take would be slightly lower. Therefore, it is assumed that slightly less mitigation would be required under this alternative.

WWF did not select this alternative because it is uncertain to what extent a 6.5 m/s cut-in speed would minimize take to a greater degree than a 5.0 m/s cut-in speed. While the study at FRWF (Good et al. 2011) observed a greater reduction in bat mortality at a 6.5 m/s cut-in speed, a similar study did not produce similar results (possibly due to insufficient periods of operation at studied cut-in speeds) (Arnett et al. 2010). Furthermore, the 76.5% average reduction in mortality observed at 6.5 m/s in two studies (Arnett et al. 2010, Good et al. 2011) is only slightly greater than the average 64% reduction observed in studies testing a 5.0 m/s cut-in speed (Arnett et al. 2010, Good et al. 2011). Meanwhile, the significant renewable energy production lost by the additional 1.5 m/s rise in cut-in speeds over the Proposed Alternative would be proportionally much greater, and would place the Project at significant risk of not meeting its production targets. Therefore, this alternative was determined not to be practicable.

7.3 LESS RESTRICTIVE OPERATIONS ALTERNATIVE

WWF considered an alternative that would involve an HCP with fewer restrictions on operations, combined with off-site mitigation for the impact of the take. Specifically, the Less Restrictive Operations alternative consisted of the following:

- Reduce cut-in speeds to 8.95 mph (4.0 m/s) (compared with the current 15.4 mph (6.9 m/s) under the TAL) for the period from August 1 to October 15 each year, from sunset to sunrise, when the ambient temperature is above 50°F (10°C). This operational protocol was developed

based on the results of two publicly available studies (Baerwald et al. 2009, Young et al. 2011) that indicate that a 4.0 m/s cut-in speed would result in an average 47% reduction in bat mortality. Turbines would remain fully feathered (i.e., turbine blades are pitched parallel with the wind direction, causing them to spin at very low RPMs, if at all) until the cut-in speed is reached. At that time, blades would be pitched into the wind to enable the turbine to begin spinning and generating electricity. The feathering/cut-in process would be computer-controlled in real-time by the Project's SCADA system, based on a 10-minute rolling average. Accordingly, turbines would cut-in and feather throughout the night as the 10-minute rolling average wind speed and temperature fluctuated above and below 8.95 mph (4.0 m/s) and 50°F (10°C), respectively.

- Post-construction monitoring would be conducted for the life of the Project, similar to the Proposed Alternative described below.
- Based upon the results of the monitoring, adjustments would be made to increase or decrease cut-in speeds, similar to the adaptive management provisions described for the Proposed Alternative.
- Mitigation would be conducted at off-site locations in an amount sufficient to offset the impacts of the expected take. Although take estimates were not developed, based on the expected reduction in mortality based on the above-referenced studies, it is assumed that estimated take would be higher. Therefore, it is assumed that more mitigation would be required under this alternative.

WWF did not select this alternative because, although available data suggests that a 4.0 m/s cut-in speed would significantly reduce bat mortality, by an average of 47%, that is based on just two studies. The limited basis for this data would result in less confidence in the effectiveness of the minimization measures and a concern that disproportionately larger mitigation commitments may be required through adaptive management. Although the cost savings that could be realized by operating at 4.0 m/s cut-in speed versus the Proposed Alternative would be significant, those cost savings would be blunted somewhat by the cost of the additional mitigation and the increased uncertainty regarding the likelihood of adaptive management changes being required in the future. Considering the uncertainty involved with estimating take at 4.0 m/s, the impact of the mitigation costs under this alternative, and most importantly, the preference for greater minimization over mitigation, WWF rejected this proposed alternative.

7.4 PROPOSED ALTERNATIVE

The Proposed Alternative is the result of consideration of the range of alternatives described in this chapter to select a Project scenario that best meets Project goals while minimizing potential threats to the Indiana bat and northern long-eared bat to the maximum extent practicable.

The Proposed Alternative incorporates the following features:

- Reduce cut-in speeds to 11.2 mph (5.0 m/s) (compared with the current 15.4 mph (6.9 m/s) under the TAL) for the period from August 1 to October 15 each year, from sunset to sunrise, when the ambient temperature is above 50°F (10°C). This operational protocol was developed based on the best available scientific information (see Section 5.2.1). Turbines will remain fully feathered until

the cut-in wind speed is reached. At that time, blades will be pitched into the wind to enable the turbine to begin spinning and generating electricity. The feathering/cut-in process will be computer-controlled in real-time by the Project's SCADA system, based on a 10-minute rolling average. Accordingly, from August 1 to October 15, turbines will cut-in or feather throughout the night as the 10-minute rolling average wind speed and temperature fluctuate above and below 11.2 mph (5.0 m/s) and 50°F (10°C), respectively. Turbines will be fully feathered below the manufacturer's rated cut-in speed (3.5 m/s) during the remainder of the year, regardless of temperature.

- Post-construction monitoring conducted for the life of the Project (see Section 5.3). Baseline Monitoring will be conducted at 100% of the turbine sites during the spring (April 1 through May 15) and fall (August 1 through October 15) seasons for the first two years of operation following issuance of the ITP. If no spring mortality of the covered species is detected, during the third year following issuance of the ITP, Baseline Monitoring will be conducted during the fall only. During the Preliminary Monitoring period, 80% of turbine sites were searched using a road-and-pad method and 20% were searched using cleared plots (as detailed in Section 5.3.4). Baseline Monitoring will be conducted at 100% of the turbines as well, but with 50% of turbine sites searched with a road-and-pad methods and 50% searched using full plots (as detailed in Section 5.3.4). Once the Baseline Monitoring concludes, Implementation Monitoring will be conducted every year during the fall (August 1 through October 15) at 100% of the Project turbines using road-and-pad searches once every week for the life of the permit. Implementation monitoring will not be conducted during the spring should the results following the first two years of Baseline Monitoring confirm that no spring take is occurring.

- Based upon an analysis of the results of the monitoring using the EOA software, adjustments may be made to increase or decrease cut-in speeds. In accordance with the adaptive management provisions of Section 5.4, following each cut-in speed reduction, an additional two-year Adaptive Management Monitoring period will be implemented during which 100% of the Project turbines will be searched, with 50% of the turbine sites using the road-and-pad method and 50% of turbines using full plots.

- Although risk to both Indiana and northern long-eared bats is considered extremely low, mitigation measures have been incorporated in the Project to provide a long-term benefit to the species that would mitigate for the impacts of the expected take. The number of Indiana bats removed from the population over the 27-year operational life of the Project is expected to be 81 (after accounting for the effect of minimization measures), or an average of 3 per year. The number of northern long-eared bats removed from the population over the 27-year operational life of the Project is expected to be 40.5 (after accounting for the effect of minimization measures), or an average of 1.5 per year. The impacts of these levels of take, including the lost reproductive contributions of the taken female bats, are expected to total approximately 176.2 female Indiana bats and 58.7 female northern long-eared bats. WWF will mitigate for the unavoidable impacts of the taking of this number of female Indiana and northern long-eared bats up front by coordinating, providing funding for, and monitoring the protection and restoration of summer habitat (USFWS 2014b) as described in Section 5.2.2. Additional mitigation will be

performed later in the Project life if results of mortality monitoring indicate that a greater proportion of the take authorized is occurring than initially expected. All mitigation will be implemented in close cooperation with and approved by USFWS and IDNR.

The Proposed Alternative was selected because it represents the maximum extent practicable to which WWF can both minimize and mitigate for the impacts of the authorized takes. This level of minimization is rationally related to the expected take because, although less feasible economically than the Less Restrictive Operations Alternative, it provides a high degree of certainty, based on the best available science, that the reduction in take achieved will be similar to the reduction that could be expected at higher cut-in speeds. Publicly available studies that have tested a 5.0 m/s cut-in speed have observed an average 68% reduction in bat mortality (Arnett et al. 2010, Good et al. 2011), while studies that have tested a 5.5 m/s cut-in speed have observed an average 67% reduction in mortality (Baerwald et al. 2009, Good et al. 2012). While studies that have tested a 6.5 m/s cut-in speed observed a marginally higher average of 78% reduction in mortality (Arnett et al. 2010, Good et al. 2011), raising cut-in speeds to that level would be close to the level already analyzed in the No Action Alternative, which was determined not to serve the purpose and need of the Project or be practicable or economically sustainable over the life of the Project. Therefore, WWF has proposed this alternative as the best approach for minimizing and mitigating the estimated Indiana and northern long-eared bat take from the Project.

8. Implementation of the HCP

As the permit holder, WWF will have the authority and responsibility to implement decisions related to the ITP and the HCP. The HCP will be implemented through an Implementing Agreement (IA). The IA defines the roles and responsibilities of WWF regarding implementation of the HCP. The IA and the HCP are complementary to each other. The processes for addressing changed and unforeseen circumstances, amending the HCP, reviewing implementation of the HCP, and funding of the conservation measures included in the HCP are discussed in the HCP and/or the IA.

8.1 WWF COMMITMENTS

For the duration of the ITP, WWF will provide staffing and resources for the implementation of the HCP as described below.

8.1.1 HCP Administration

The WWF Operations Manager will be designated by WWF as the HCP coordinator with responsibility for overseeing the implementation of the HCP.

8.1.2 Implementation Schedule

Table 8-1 provides a schedule for implementation of the various conservation measures. Note that additional conservation measures may be implemented, or above measures may be modified, through adaptive management as set forth in Section 5.4.

Table 8-1 Implementation schedule for conservation measures at the Wildcat Wind Project (Madison and Tipton Counties, Indiana)

Conservation Measure	Implementation Schedule
Avoidance of habitat loss	Already implemented
Cut-in Speed Restriction (11.2 mph [5.0 m/s]), unless post-construction monitoring indicates an adaptive management change to the cut-in speed.	Annually from 1 August – 15 October
Baseline Monitoring	First three years during fall and first two years during spring under the ITP
Implementation Monitoring	Annually following Baseline Monitoring for the life of the Project
Adaptive Management Monitoring (relevant season)	For two years after any reduction in cut-in speeds through adaptive management
Post-construction Monitoring Report	Submitted to USFWS by 31 January following monitoring years
White-Nose Syndrome Changed Circumstance Check-In	Every 5 years following issuance of the ITP
Mitigation Requirement Review	Years 15, 21 and 27 following issuance of the ITP

8.2 UNFORESEEN AND CHANGED CIRCUMSTANCES

The HCP Assurances (No Surprises) Final Rule defined and clarified unforeseen circumstances and changed circumstances (63 FR 8859-8873). These two types of circumstances are key elements of the USFWS and National Marine Fisheries Service (jointly referred to as the Services) No Surprises Rule developed to provide ITP applicants with long-term economic and regulatory certainty. The differentiation between *unforeseen* and *changed* circumstances is important, because depending on the type of event that occurs, WWF may or may not be responsible for implementing additional conservation measures.

Unforeseen circumstances means changes in circumstances affecting a species or geographic area covered by a conservation plan that could not reasonably have been anticipated by plan developers and the Services at the time of the conservation plan's negotiation and development, and that result in a substantial and adverse change in the status of a covered species (63 FR 8870-8871).

Changed circumstances means changes in circumstances affecting a species or geographic area covered by a conservation plan that can reasonably be anticipated by plan developers and the Services and that can be planned for (e.g., the listing of new species, or a fire or other natural catastrophic event in areas prone to such events) (63 FR 8870).

8.2.1 Unforeseen Circumstances

The "No Surprises" rule stipulates that if unforeseen circumstances arise, the USFWS will not require, without the consent of the permittee, the commitment of additional mitigation in the form of land, water, or funds nor will it require additional restrictions on the use of land, water, or funds from any permittee who is adequately implementing or has implemented an approved HCP (63 FR 8868). If additional conservation and mitigation measures are deemed necessary to respond to unforeseen circumstances, the

USFWS may require additional measures of the permittee where the HCP is being properly implemented, but only if such measures are limited to modifications to the conservation measures set forth in the HCP. The assurances of the No Surprises regulations apply only "where the conservation plan is being properly implemented, and apply only with respect to species adequately covered by the conservation plan" (63 FR 8867).

If extraordinary circumstances occur that could have a significant negative effect on Indiana or northern long-eared bats or could affect the ability of WWF to effectively implement activities under this HCP, WWF will discuss the unforeseen circumstance with USFWS personnel and other affected parties, as applicable. If the extraordinary circumstances warrant additional mitigation measures and WWF is in compliance with its obligations under this HCP, any additional mitigation measures must be limited to modifications to the HCP's operating conservation program for the Indiana and northern long-eared bats, maintaining the original terms of the HCP to the maximum extent possible. Unless agreed to by WWF, additional mitigation measures will not involve the commitment of additional land, water, or financial compensation, will not impose additional restrictions on the use of land, water, or other natural resources otherwise available for development or use under the original terms of the HCP, and will not impose new restrictions or financial compensation on WWF's activities or operations.

8.2.2 Changed Circumstances

WWF and the USFWS anticipate that circumstances could change during the term of the ITP that could affect the ability of WWF to properly implement the HCP. Events that could occur during the term of the HCP that are identified as changed circumstances are addressed below. Financial assurance for changed circumstances in the form of a performance bond will be provided on behalf of WWF, as described in Section 6.5.

8.2.2.1 Listing of a New Species

If a currently unlisted species is federally listed as endangered or threatened pursuant to the ESA after the ITP has been issued, WWF will make a determination if there is a potential for incidental take of the newly listed species to occur while conducting activities covered by the HCP, and consult with the USFWS regarding that determination. If it is determined that such potential exists, WWF may choose to modify its operations in coordination with the USFWS to ensure that incidental take of the species will be unlikely to occur, or seek to include the newly listed species under the ITP through a major permit amendment pursuant to Section 8.3.2.3. If a permit amendment is deemed necessary it is likely that the application would be submitted prior to the listing being finalized and becoming effective, to avoid the need for temporary operational restrictions; however, temporary restrictions will be implemented as necessary in the event authorization is not obtained prior to the listing becoming effective to ensure that unauthorized take does not occur.

Note that some of the species most likely to be listed, such as the little brown bat, may be covered under the Midwest Wind Energy Regional Multi-Species Habitat Conservation Plan (MSHCP) currently under development. Should conditions warrant and the MSHCP permit, WWF may in the future seek incidental take authorization for such species under the framework of the Regional MSHCP rather than through modification of this HCP.

8.2.2.2 Delisting of a Species

If the Indiana bat, northern long-eared bat, or other listed species covered by this HCP (through a permit amendment) is delisted by the USFWS during the life of the ITP, the requirements and restrictions under the ITP and conservation measures under this HCP may cease to be relevant for species protection. In such a circumstance, WWF presumes that coverage under the ITP would no longer be necessary and the Project would return to unrestricted operations.

8.2.2.3 Widespread Impact of White Nose Syndrome Within Local Populations

WNS is a poorly understood infectious disease currently affecting hibernating bats in eastern North America. The condition is named for a distinctive white fungal (*Pseudogymnoascus destructans*) growth around the muzzles and on the wings of affected animals. WNS was first identified in Howe Cave near Albany, New York in 2006. The disease spread rapidly and bats with WNS have been confirmed in 25 states[14] in the northeastern, central and mid-Atlantic regions in the U.S., as well as in five provinces in eastern Canada.[15,16] The fungus *P. destructans* has been confirmed in five additional states.[17] The disease had been confirmed in at least 115 hibernacula by 2010, some of which are located more than 746 miles (1,200 km) from Howe Cave (Frick et al. 2010). Following the 2012-2013 hibernation season, WNS had been confirmed in 71 counties within the Indiana bat's Midwest Recovery Unit; these counties are located in Indiana, Ohio, Kentucky, Virginia, Tennessee, and Alabama. However, the widespread mortality associated with WNS in the eastern U.S. has begun to affect the Midwest Recovery Unit; the USFWS has estimated that the Midwest Recovery Unit's Indiana bat population decreased by 9.8% from 2013 to 2015 (USFWS 2015b).

The fungus is directly associated with the deaths of bats (Puechmaille et al. 2010) and is widely considered to be the causal agent of WNS (USGS 2010). Loss of winter fat stores, pneumonia, and the disruption of hibernation and feeding cycles are associated with the death of infected bats. A study indicates that WNS mortality may result from the catastrophic disruption of wing-dependent physiological functions (including water balance, circulation, cutaneous respiration, thermoregulation, and flight) caused by *P. destructans* damage to wing tissue (Cryan et al. 2010). Infected hibernacula are experiencing annual population decreases ranging from 30% to 99%, with a mean of 73% throughout eastern North America. The USFWS currently estimates that WNS has killed more than 5.7 million bats in North America.[18] All hibernacula surveyed have become infected within two years of WNS arriving in their respective regions. WNS is causing unprecedented mortality among at least six species of hibernating bats (Frick et al. 2010), five of which may occur within the Project Area: little brown bat, northern long-eared bat, Indiana bat, tri-colored bat, and big brown bat (USGS 2010). All 25 North American bat species that rely on hibernation

[14] New York, Vermont, New Hampshire, Maine, Massachusetts, Connecticut, Pennsylvania, New Jersey, Delaware, Ohio, West Virginia, Maryland, Virginia, Indiana, Kentucky, Tennessee, North Carolina, Missouri, Alabama, Illinois, Georgia, South Carolina, Michigan, Wisconsin and Arkansas.
[15] Nova Scotia, New Brunswick, Quebec, Ontario, and Prince Edward Island
[16] http://www.whitenosesyndrome.org/resources/map
[17] Oklahoma, Iowa, Nebraska, Mississippi and Minnesota.
[18] http://www.whitenosesyndrome.org/about-white-nose-syndrome

may potentially be affected by WNS (USGS 2010). Resistance or decreased susceptibility to WNS does not appear to develop; survivors attempting to overwinter in contaminated sites may quickly become re-infected (Cameron 2010). However, there is evidence that some little brown bats infected with WNS exhibit rapid wing healing rates after hibernation (Fuller et al. 2011), indicating that some individuals may be able to recover from the disease. In addition to extreme mortality, the disease may be further impacting bat populations by lowering the reproductive rates of surviving colony members (Frick et al. 2009). Overall, the cumulative effects from WNS are being monitored closely by the USFWS and state conservation agencies.

Trigger

WWF will meet and confer with the USFWS every five years during the permit term and on an as-needed basis to determine if WNS has become more widespread within the local populations, including the Indiana bat's Midwest Recovery Unit. The intent of the meetings will be to review the impact of WNS on population levels, determine whether the Indiana bat and northern long-eared bat take authorized under the ITP is likely to cause jeopardy to the species in light of that impact, and consider whether any specific, additional minimization or mitigation measures are required to ensure that the incidental take from the Project does not result in jeopardy to the species.

Response

Should it be determined at some point in the future through these conferences that WNS is causing widespread mortality within the local populations of Indiana bats and northern long-eared bats, and, that the take authorized for the Project is likely to cause jeopardy to the local populations due to the reduced populations, WWF will coordinate with the USFWS to determine appropriate changes to the HCP, if any. For example, it may be the case that a reduced population of either species will result in fewer bats of that species on the landscape, and thus a lower level of take resulting from the project. However, the impact of each take will be greater due to the increased importance of each individual bat to the population. WWF and the USFWS will evaluate available data to determine what, if any, additional minimization and mitigation measures are necessary to ensure that the approved measures remain proportional to the take. If additional measures are determined to be necessary, WWF will consult with the USFWS to determine whether (i) incremental increases in cut-in speed in accordance with the adaptive management provisions of Section 5.4, or (ii) additional summer or winter habitat mitigation, would be more efficacious and cost-effective. Alternatively, new methodologies or technologies may be available that would provide an alternative to the conservation measures currently provided for in this HCP, such as deterrent technologies. After appropriate measures are selected, the effectiveness of the selected measures would be monitored in accordance with the relevant monitoring protocols set forth in this HCP.

WWF is not proposing to perform any winter mitigation as part of the initial mitigation for the impact of the take expected to occur in light of the minimization measures. However, if additional mitigation proves necessary, winter habitat mitigation will remain an option. Should WWF choose to perform winter mitigation and white nose significantly reduce or eliminate the wintering population of bats at a winter

mitigation site (should a winter mitigation project be deemed necessary), the mitigation will be ineffective at offsetting the impacts of the take from Wildcat.

Trigger

Impacts of WNS on winter mitigation projects would trigger corrective action if WNS causes a reduction of 50% or more in the wintering population, as measured by two consecutive biennial surveys. For this circumstance to be triggered, the bats from the hibernaculum must be infected by *Pseudogymnoascus destructans* confirmed by genetic testing, the population must decrease by 50% or more, and no other impacts can be documented that would likely have caused the population decline even in the absence of the effects of WNS. It is assumed that in the absence of changed or unforeseen circumstances, mitigation actions will lead to an increase in the bat populations at the mitigation sites over time, but a 50% reduction is provided to allow for some background variation in the population or in census results as a product of observer bias or other factors.

Response

Should it be determined that WNS has caused a reduction of Indiana or northern long-eared bat populations of >50% at a winter mitigation site, WWF, in coordination with USFWS, will identify an alternate hibernaculum in an area that either has not yet been infected by WNS, or that has shown stabilized populations after having documented WNS for five or more years. In this case, a stable population is one that has fluctuated by 25% or less during two consecutive biennial surveys. Any alternate mitigation site (winter or summer) that is selected must compensate for the remaining impact of take that has not already been mitigated for by the original mitigation project(s).

If no suitable alternative mitigation sites are available due to WNS or other factors, WWF will work with USFWS and its partners to identify additional recovery techniques. Due to the uncertainties surrounding WNS, effective actions and the timeframes for their implementation are difficult to predict, but may include actions such as captive recovery programs, artificial cave construction, cave fumigation or disinfecting strategies, or other options that may become available in the future to combat WNS or restore surviving populations. WWF will contribute financially to these recovery strategies to such a practicable extent that the recovery achieved is commensurate with the remaining impact of take that has not been mitigated for by the original mitigation project(s). The funding amount will be put forward within one year following the identification of the alternative recovery technique necessitated due to WNS.

8.2.2.4 Climate Change

Climate change refers to changes in the values or variability of states of the climate (e.g., temperature, precipitation, etc.) that can be statistically identified and persist for extended periods, typically decades or longer (Intergovernmental Panel on Climate Change [IPCC] 2007). Warming of the climate system is now considered unequivocal, based on observed increases in global average temperatures, widespread melting of snow and ice, and rising global average sea level (IPCC 2007). Carbon dioxide and other

greenhouse gases released into the atmosphere by human activities are largely responsible for recent climate change (United States Environmental Protection Agency [USEPA] 2013a and IPCC 2007).

In the Midwest, average annual temperatures increased over the last several decades. Heat waves are becoming more frequent and cold periods are becoming rarer. Heavy downpours now occur twice as frequently as they did a century ago. Average summer temperatures are predicted to increase by 3°F (1.67°C) over the next few decades and could increase by over 10°F (5.56°C) by the end of the century (USEPA 2013b). Precipitation in the Midwest is likely to fall more frequently in heavy downpours, increasing the potential for flooding events. Between heavy rainfall events, there will likely be longer periods without precipitation. Combined with longer and more intense heat waves, these periods without rainfall are likely to result in more droughts in the Midwest (USEPA 2013b).

8.2.2.4.1 Climate change alters Indiana or northern long-eared bat life histories

The effects of climate change on wildlife are expected to vary widely. Species with certain traits, including: specialized habitat requirements, poor ability to disperse to a new range, dependence on specific environmental triggers for life history events, and dependence on inter-species interactions are more likely to be negatively affected by climate change (International Union for Conservation of Nature [IUCN] 2007). The Indiana bat and northern long-eared bat have specific requirements for maternity habitat and hibernacula and rely on environmental cues for spring dispersal and fall migration. Additionally, the Indiana bat and northern long-eared bat are already vulnerable endangered and threatened species, respectively, that have several traits which may worsen the impacts of climate change effects, including low reproductive rates and small population sizes (IUCN 2007). Climate change has been identified by the USFWS as an anthropogenic factor that may affect the continued existence of Indiana bats (USFWS 2009), and presumably other bat species such as the northern long-eared bat as well. Warmer temperatures or changes in regional weather patterns may alter the spring and fall bat dispersal and migration periods. Parmesan and Yohe (2003) demonstrated that even 10 years ago, 62% of the species available for review (n=677) already indicated trends of life history event timing, such as migration and dispersal, occurring earlier in the year than expected from climate change. There was a mean shift towards earlier timing of 2.3 days per decade.

Trigger

A USFWS announcement through an official, public medium, such as in a revised recovery plan, five-year status review, or the USFWS Region 3 Indiana or northern long-eared bat websites, of a shift in the Indiana or northern long-eared bat dispersal and migration periods would trigger corrective action.

Response

WWF has committed to increasing turbine cut-in speeds from the designed 7.8 mph (3.5 m/s) to 11.2 mph (5.0 m/s) on nights during the current Indiana and northern long-eared bat fall migration periods in Indiana (1 August through 15 October). If the changed circumstance trigger is met, WWF will modify the timing of operational restrictions such that they are implemented for the duration of the new Indiana or northern long-eared bat fall migration period in Indiana. Changes to the operational protocol will take effect in the first fall migration season after the USFWS announcement is made.

Warmer temperatures or changes in regional weather patterns may cause the Indiana or northern long-eared bat ranges to shift in response to prey distributions, habitat suitability, or other factors. Evidence from a wide range of species shows that recent warming is strongly affecting terrestrial biological systems, including upward shifts in species ranges (IPCC 2007). Parmesan and Yohe (2003) also assessed species for range shifts associated with climate change; of the 434 species appropriate for review 10 years ago, 80% demonstrated range shifts northward as expected from climate change. The analysis showed that the range limits had shifted northward at an average rate of 3.4 miles (6.1 km) per decade. Climate change models have predicted a northern expansion of the hibernation range of the little brown bat; the USFWS considers it likely that modeling for Indiana bat range shifts would have a similar prediction (USFWS 2009).

Trigger

A USFWS announcement through a public medium, such as in a revised recovery plan, five-year status review, or the USFWS Region 3 Indiana or northern long-eared bat websites, of a shift in the Indiana or northern long-eared bat range would trigger corrective action.

Response

A USFWS-announced shift in the range of either the Indiana bat or the northern long-eared bat would prompt thorough review by WWF to evaluate the location of the Project and the mitigation projects relative to the species' new range. If the species' new range excludes the location of the summer or winter habitat mitigation project, mitigation efforts at the current site will be suspended and WWF will identify a new location for the mitigation project within the new range. WWF will implement the mitigation at the new site as soon as practicable, but no later than three years after the USFWS announcement. If the species' new range excludes the Project, WWF will consult with USFWS regarding termination of the ITP and/or the operational protocol and mitigation projects set forth in this HCP.

More than two dispersal or migration period shifts and more than one range shift triggering corrective action during the 28-year ITP Term will be considered unforeseen circumstances, based on the average rates of species responses to climate change thus far (Parmesan and Yohe 2003).

8.2.2.4.2 Climate change affects mitigation projects

Climate change may impact the effectiveness of the mitigation measures proposed in Section 5.2.2 by increasing the frequency and magnitude of natural disasters above historic patterns (see Section 8.2.2.5, below). As described above, climate change is expected to increase the frequency and severity of droughts, consequently also increasing the potential for wildfires (IPCC 2007). Heavy precipitation events are expected to continue to increase and become more severe, making floods more likely (IPCC 2007); in particular, winters and springs in Indiana are expected to become wetter. Climate change may also result in more frequent and more violent severe weather episodes, including thunderstorms and tornadoes. However, there is currently insufficient evidence to determine whether trends associated with climate change exist in small-scale phenomena such as tornadoes, hail, lightning, and other storms (IPCC 2007). The influence of climate change on the frequency and magnitude of natural disasters impacting mitigation efforts cannot be predicted. However, the triggers and management responses described for

each foreseeable natural disaster below are based on the effects of the natural disaster and will therefore accommodate more frequent (to a practicable degree) or more severe events resulting from climate change. Because these factors are addressed in subsequent sections, summer habitat mitigation will not be addressed further in this section.

8.2.2.4.2.1 Climate change affects winter mitigation project

Warming caused by climate change has the potential to adversely impact hibernacula and render them unsuitable for wintering bats by altering the temperature and moisture conditions. If warmer temperatures associated with climate change negatively affect a chosen mitigation cave, bats may not be able to meet basic life requirements and the bats may be forced to disperse to more suitable hibernacula. These new hibernacula may not have the protection from threats present at the mitigation site, limiting the bats' chances for survival. WWF is not proposing to perform any winter mitigation as part of the initial mitigation for the impact of the take expected to occur in light of the minimization measures. However, if additional mitigation proves necessary, winter habitat mitigation will remain an option. Should WWF choose to perform winter mitigation and the Indiana bat or northern long-eared bat population occupying a chosen winter mitigation cave be forced to abandon that site in the future due to warmer temperatures, the mitigation would no longer serve to offset the impacts of take by WWF.

Trigger

Any increase in the average annual and seasonal air temperature within a mitigation hibernacula as documented by data loggers within the hibernacula accompanied by a 25% or more reduction in the total number of Indiana bats or northern long-eared bats wintering in that hibernacula between any two consecutive surveys. Based on the best scientific information available at the time, the population decrease in the hibernacula must be attributed to any documented temperature increases in the cave and must coincide with regional increases in winter temperatures that are attributable to climate change. For this changed circumstance to be triggered, the decrease in the bat population cannot be the product of other impacts to the hibernacula that could result in changes in internal temperatures or other external factors, such as WNS. It is expected that in the absence of changes or unforeseen circumstances, mitigation actions will lead to an increase in the Indiana bat and northern long-eared bat population at the mitigation site over time, but a 25% reduction is provided to allow for some background variation in the population or in the census resulting from observer bias or other factors.

Response

An increase in hibernacula temperature attributable to climate change accompanied by a decrease in the Indiana bat or northern long-eared bats wintering population by more than 25% would result in WWF either developing a hibernacula restoration plan to restore the hibernacula to the level necessary to support hibernating Indiana bats or identify an alternate mitigation site. Restoration actions would be implemented within one year of determining that the original mitigation effort had failed. Otherwise, WWF will coordinate with USFWS to identify several alternative hibernacula suitable for mitigation that have a

relatively stable Indiana bat or northern long-eared bat population (i.e., have fluctuated less than 25% during consecutive USFWS biennial surveys). Temperature and moisture conditions in the alternate hibernacula must be suitable for Indiana bat or northern long-eared bat hibernation, and should provide the same mitigation credits as the original hibernacula. Mitigation actions at the new hibernaculum would be completed within one year of determining that the original mitigation project had failed.

If no suitable alternate hibernacula are available for mitigation (either because they are already protected or would not yield results needed to fully mitigate for the impacts of the take), WWF, in coordination with USFWS, will identify an alternate mitigation project to account for the unmitigated balance that would include protection and/or restoration of additional summer habitat. A plan for the alternate mitigation project would be identified and developed within one year of mitigation failure, and the alternate mitigation project would be implemented within one year after development of the plan.

8.2.2.5 Natural Disasters

8.2.2.5.1 Drought

Drought is a deficiency in precipitation over an extended period of time. It is a normal, recurrent feature of climate that occurs in nearly all climate zones. Drought may develop quickly due to extreme heat and/or wind or more gradually due to more subtle climate changes that persist over a long period of time. The duration of droughts varies widely; drought may last for a relatively short period of time or span multiple years or even decades (National Weather Service [NWS] 2012). Drought is difficult to measure due to the wide variety of disciplines affected by drought and the diversity of its geographical and temporal scales. Two indices are primarily used to measure drought in the U.S.: the Palmer drought index (PDI) and the Standardized Precipitation Index (SPI). The PDI is comprised of water balance indices that consider water supply, demand, and loss. The SPI is a probability index that considers only precipitation. Both indices are negative for drought and positive for wet conditions, increasing in scale with the severity of the conditions (National Climatic Data Center [NCDC] 2012a). The U.S. Drought Monitor (http://www.droughtmonitor.unl.edu/monitor.html) provides a map of weekly drought condition data from across the U.S., ranked in intensity from Abnormally Dry (D1) to Drought - Exceptional (D4).

A study of the historic drought patterns and projected future climate in Indiana and Illinois identified eight major drought spells between 1916 and 2007: 1916-21, 1934-36, 1940-45, 1953-57, 1960-66, 1971-72, 1976-77, and 1987-89 (Mishra et al. 2010). Within this time period, 20 years with Extreme (D3) to Exceptional (D4) drought conditions were identified. Meteorological drought of Extreme (D3) or Exceptional (D4) intensity was found to have been in effect during about 12.5% of the early-century (1916-1945) and mid-century (1946-1975) 30-year periods, decreasing to about 11.3% of the late-century (1976-2007) 30-year period. Results of Mishra et al.'s (2010) large-scale hydrology model indicated that although droughts are a common phenomenon in Indiana, the state has been experiencing reduced extreme and exceptional droughts with lesser geographic extent in recent decades. This pattern was attributed to the observed increase in total and extreme precipitation in most of Indiana in recent years. However, 2012 was characterized by large areas of the U.S., including Indiana, experiencing dry and very

warm weather that persisted for much of the year and hit record extremes. Indiana's six-month SPI values for March-August 2012 ranged from severely dry (-1.99 to -1.50) to moderately dry (-1.49 to -1.00) (NCDC 2012b).

Although droughts often cause increased tree mortality and can result in increases in snag density, which may improve roosting habitat available to Indiana bats and northern long-eared bats, severe or prolonged droughts can cause extreme tree mortality and result in unsuitable habitat for Indiana and northern long-eared bats.

Trigger

Mitigation metrics (e.g., tree density, snag size-class density metrics, understory composition, etc.) would be monitored the first full growing season following an Extreme (D3) to Exceptional (D4) drought as determined by the U.S. Drought Monitor (http://www.droughtmonitor.unl.edu/monitor.html). Negative impacts of drought on the summer habitat mitigation project would trigger corrective action if the mitigation metrics are >25% below the target values. A 25% reduction is provided to allow for some background variation in mitigation metrics as a product of observer bias or other factors. See Section 5.2.2.4.1 for mitigation metric values.

Response

Within one year of confirmation of the trigger, one or more of the following restoration actions will be taken, depending on the mitigation metric(s) affected by the drought:

- Tree planting in areas where the tree density is >25% below the mitigation metric target value,
- Non-native woody invasive species control in areas where the native understory composition is >25% below the mitigation metric target value.

Effective restoration actions will be funded out of the Project's operations budget, and guaranteed by the Changed Circumstances fund, but cannot be implemented until after the drought is over.

Prolonged drought lasting beyond the 28-year ITP Term will constitute an unforeseen circumstance. Additionally, Extreme (D3) or Exceptional (D4) intensity droughts occurring during more than 15% of the 28-year ITP Term will be considered unforeseen circumstances based on the historic and projected patterns of droughts in Indiana (Mishra et al. 2010).

8.2.2.5.2 Fire

Fire is a naturally occurring component of most ecosystems although the frequency and severity of fire regimes varies greatly. In the Midwest, historical fire regimes differed based on land cover: forested areas were ruled by low severity or mixed severity fires occurring with a zero to 35 year frequency while the prairie plains were ruled by stand replacement severity fires occurring with a zero to 35 year frequency (Fire, Fuel and Smoke Science Program [FFS] 2000a). Throughout grasslands in the western, northern, and central areas of Indiana, the historical fire regime was dominated by low severity fires that occurred with zero to 35 year frequency. Fire regimes in the eastern and central areas of the state consisted of

mixed severity and stand replacement severity fires that occurred with a 35 to 100+ year frequency. In forested areas in the northwestern corner of Indiana the historical fire regime was comprised of stand replacement severity fires that occurred with a zero to 35 year frequency. Currently, most of Indiana is classified as agricultural and non-vegetated areas (FFS 2000b). The fragments of forested or grassland habitat in the state are mostly classified as having fire regimes that have been moderately to significantly altered from their historical range. These classifications (Condition Class 2 and 3) indicate that fire frequencies have departed from historical frequencies and landscape patterns and vegetation attributes have been altered from their historical range. Consequently, there is a moderate to high risk of losing key ecosystem components in these areas and fire size, intensity, and severity patterns have changed (Schmidt et al. 2002).

Human-caused wildfires have been a regular disturbance factor in Indiana's ecosystem for centuries (IDNR Division of Forestry, Fire Control 2013). Studies of tree rings in southern Indiana indicate that Native Americans burned forests on a five to seven-year cycle to drive game or improve forage habitat for game. The practice of burning forests to increase agricultural productivity and reduce pests to livestock was common with Irish and Scotch settlers and farmers throughout much of the state in the 1800s and early 1900s. More recently, Indiana has had a history of wildfires caused by carelessly tended brushpile or garden fires. Lightning strikes or other natural causes account for less than 1% of the wildfires in Indiana (IDNR Division of Forestry, Fire Control 2013 and FFS 1999). Drought conditions have led to some of the most severe and destructive wildfires in Indiana's history (IDNR Division of Forestry, Fire Control 2013).

Although wildfires often cause increased tree mortality and can result in increases in snag density, which may improve roosting habitat available to Indiana bats and northern long-eared bats, severe wildfires can cause extreme tree mortality and result in unsuitable habitat for Indiana bats and northern long-eared bats.

Trigger

Mitigation metrics (e.g., tree density, snag size-class density metrics, understory composition, etc.) would be monitored the first full growing season following a wildfire. A wildfire that physically impacts the summer mitigation project would trigger corrective action if the mitigation metrics are >25% below the target values. A 25% reduction is provided to allow for some background variation in mitigation metrics as a product of observer bias or other factors. See Section 5.2.2.4.1 for mitigation metric values.

Response

Within one year of confirmation of the trigger, one or more of the following restoration actions will be taken, depending on the mitigation metric(s) affected by the wildfire:

- Tree planting in areas where the tree density is >25% below the mitigation metric target value,
- Non-native woody invasive species control in areas where the native understory composition is >25% below the mitigation metric target value.

These actions will be funded out of the Project's operations budget, and guaranteed by the Changed Circumstances fund.

Fires determined to be caused by arson[19] will constitute an unforeseen circumstance. Additionally, more than two wildfires triggering corrective action during the 28-year ITP Term will be considered unforeseen circumstances based on the historic pattern of wildfire frequency and severity in Indiana (FFS 2000a).

8.2.2.5.3 Flood

Flooding is a recurrent disturbance in Indiana. Much of Indiana is susceptible to severe flooding due to the state's numerous major rivers and tributaries and the fact that approximately 24% of the state was historically covered by wetlands (Gustin 2011). Major, devastating floods occurred in Indiana in 1913, 1937, and 2008 but more localized flooding is a frequent occurrence throughout the state (IDHS 2008). Historically, the state has experienced annualized flooding along one or more of its rivers or streams. Nearly all of Indiana's counties are regularly affected by flooding, although the southern third of the state is most prone to repeated flooding. Although measures have been taken in many riverside towns and farmlands in Indiana to control the flood stages of rivers by constructing flood gates, levees, and pumping stations, these measures are prone to failure under severe flooding conditions (Gustin 2011). Additionally, flood control measures may have unintended consequences for areas downstream because they restrict flood water to narrower channels, increasing flow velocities and erosion potential as well as limiting the floodplain's capacity to store flood waters. The National Climatic Data Center (NCDC) of the National Oceanic and Atmospheric Administration (NOAA) maintains a database of all storm events, including flooding, by county.

Trigger

Mitigation metrics (e.g., tree density, snag size-class density metrics, understory composition, etc.) would be monitored the first full growing season following a flood event documented by the NCDC. Negative impacts of flooding on the summer habitat mitigation project would trigger corrective action if the mitigation metrics are >25% below the target values. A 25% reduction is provided to allow for some background variation in mitigation metrics as a product of observer bias or other factors. See Section 5.2.2.4.1 for mitigation metric values.

Response

Within one year of confirmation of the trigger, one or more of the following restoration actions will be taken, depending on the mitigation metric(s) affected by the flooding:

- Tree planting in areas where the tree density is >25% below the mitigation metric target value,
- Non-native woody invasive species control in areas where the native understory composition is >25% below the mitigation metric target value.

[19] Arson is defined as the crime of intentionally and maliciously setting fire to an area.

Effective restoration actions will be funded out of the Project's operations budget, and guaranteed by the Changed Circumstances fund, but cannot be implemented until after the flood is over.

Based on the long history of flood events and flood management in Indiana, the occurrence of more than three flood events triggering corrective action during any five-year period within the 28-year ITP Term will constitute an unforeseen circumstance. Response actions will be consistent with existing ITP obligations, such that the mitigation is still sufficient for the proposed level of take.

8.2.2.5.4 Tornadoes

Tornadoes are a frequent severe weather event throughout Indiana. Historical tornado maps indicate that tornadoes have occurred in almost all sections of the state and at all elevations, from hilltops to valley bottoms (IDHS 2008). However, the greatest number of tornadoes have been observed in central and northern Indiana. There are records of tornadoes occurring in Indiana as far back as 1814. Between 1950 and 2011, a total of 546 tornadoes were documented in Indiana (IDHS 2011). Tornadoes have most frequently occurred during the months of March, April, May, and June in Indiana. The direction from which tornadoes strike Indiana has been reported for about 75% of the tornadoes on record; of these, 80% were found to come from the west or southwest (IDHS 2008). Most of the recorded tornadoes have been at the low end of the Enhanced Fujita (EF) damage-based scale (EF0=118, EF1=197, EF2=129) but EF 3 (68), EF4 (29) and even EF5 (3) tornadoes have occurred (2 were not rated) (IDHS 2011). The annual number of tornadoes in Indiana has ranged from zero to 72 (in 2011), averaging 8.8 tornadoes per year between 1950 and 2011. Tippecanoe County had the greatest (22) number of tornado touch downs during that time period, although no county in Indiana was without a tornado. The NCDC includes tornadoes in its database of all storm events by county.

Trigger

Mitigation metrics (e.g., tree density, snag size-class density metrics, understory composition, etc.) would be monitored the first full growing season following a tornado documented by the NCDC in the vicinity of a summer mitigation area. A tornado that physically impacts a summer mitigation project would trigger corrective action if the mitigation metrics are >25% below the target values. A 25% reduction is provided to allow for some background variation in mitigation metrics as a product of observer bias or other factors. See Section 5.2.2.4.1 for mitigation metric values.

Response

Within one year of confirmation of the trigger, one or more of the following restoration actions will be taken, depending on the mitigation metric(s) affected by the tornado:

- Tree planting in areas where the tree density is >25% below the mitigation metric target value,
- Non-native woody invasive species control in areas where the native understory composition is >25% below the mitigation metric target value.

These actions will be funded out of the Project's operations budget, and guaranteed by the Changed Circumstances fund.

More than two tornados triggering corrective action during the 28-year ITP Term will be considered unforeseen circumstances based on the historic pattern of tornadoes in Indiana (IDHS 2011).

8.3 PERMIT RENEWAL AND AMENDMENTS

8.3.1 Permit Renewal

When the ITP expires, WWF is no longer protected from take that may occur as a result of their operation of Wildcat, provided that either or both the Indiana bat or northern long-eared bat are still listed at the expiration of the permit. WWF may apply for a renewal of the ITP. If a written request for ITP renewal is on file with the issuing USFWS office at least 30 days prior to the permit's expiration, the permit will remain valid while the renewal is being processed, provided the existing permit is renewable (50 C.F.R. § 13.22). The renewal request must (USFWS and NMFS 1996):

1. Be in writing;
2. Reference the permit number;
3. Certify that the statements and information in the original application are still correct or include a list of changes;
4. Provide specific information concerning what take has occurred under the existing permit and what portions of the project are still to be completed. Additional information that may be provided if appropriate, includes conservation measures to be added to, or eliminated from, the HCP; and
5. Request renewal.

The permit becomes invalid after the expiration date if the permittee fails to file a renewal request 30 days prior to permit expiration. Renewal of the permit constitutes extension of the HCP for the agreed-upon time, subject to any modifications that the USFWS may require at the time of renewal.

8.3.2 Modifications and Amendments

8.3.2.1 Administrative Modifications

WWF may make minor administrative modifications to this HCP. Minor administrative modifications shall include, by way of example but without limitation:

- corrections of typographic, grammatical, and similar non-substantive errors that do not change the intended meaning or requirements of the document; and
- revisions to any figures or exhibits in the document to correct minor errors in reporting of data or mapping or to reflect previously approved changes in the ITP or HCP.

Administrative modifications will not (a) result in effects on a covered species that are new or different than those analyzed in the HCP, NEPA Document, or the BO, (b) result in take beyond that authorized by the ITP, (c) negatively alter the effectiveness of the HCP, or (d) have consequences to aspects of the human environment that have not been evaluated. WWF will document each administrative change in writing and provide the USFWS with a summary of all changes, as part of its annual report, along with any replacement pages, maps, and other relevant documents for insertion in the revised HCP.

8.3.2.2 Minor Amendments

Minor amendments are changes to the HCP the effects of which on covered species, the conservation strategy, and WWF's ability to achieve the biological goals and objectives of the HCP are either beneficial or not significantly different than those described in the HCP. Minor amendments will not result in net effects on the covered species, their habitats, or the environment that are significantly different than those analyzed in the HCP, NEPA document, and the BO or increase the levels of take beyond that authorized by the ITP. A minor amendment shall be initiated by submitting a signed letter to the USFWS referencing the ITP number. The minor amendment request shall explain the specific amendment requested and provide the basis for same, along with appropriate supporting documentation. Minor amendments will not require any additional Section 7 consultation or NEPA analysis.

Minor amendments may include, but are not limited to, the following: corrections/changes in land ownership; minor changes in the conservation land; minor changes to the biological goals or objectives; minor changes in Project equipment; adoption of new take avoidance measures; corrections of any text, maps or exhibits to reflect previously approved changes in the ITP or HCP; and minor changes to the survey, monitoring or reporting protocol, in each case that is not contemplated by the this HCP.

The USFWS will use reasonable efforts to respond to proposed minor amendments within thirty (30) days of receipt of such notice. Proposed minor amendments will become effective upon written approval of the USFWS. The USFWS will not propose or approve minor amendments to the HCP if it determines that the minor amendments would result in operational protocols that are significantly different from those analyzed in connection with this HCP, adverse effects on the environment that are new or significantly different from those analyzed in this HCP, or additional take not accounted for in this HCP and already analyzed under NEPA. Such amendments shall be processed as major amendments to the HCP in accordance with Section 8.3.2.3.

8.3.2.3 Major Amendments

A major amendment is any proposed change or modification that does not satisfy the criteria for an administrative change or minor amendment. Major amendments to the HCP and ITP are required for any substantive changes that would result in operational protocols significantly different from those analyzed in connection with this HCP, adverse effects on the environment that are new or significantly different from those analyzed in this HCP, or additional take not accounted for in this HCP and already analyzed under NEPA. If the major amendment is sought to obtain ITP coverage for a newly listed species, WWF shall confer with the USFWS to determine if the conservation measures in this HCP addressing the Indiana and northern long-eared bat are adequate for conservation of the newly listed species. If the existing measures are determined by the USFWS to be adequate, WWF may revise this

HCP to include the newly listed species without substantive modification of the minimization, mitigation and monitoring sections of the HCP, and request addition of that species to the ITP. If conservation of the newly listed species is not adequately assured by the existing HCP, then WWF will coordinate further with the USFWS to develop a revised or supplementary HCP that incorporates such additional conservation measures as may be necessary to support incidental take authorization.

To request a major amendment, WWF shall submit a signed application to the USFWS referencing the ITP number along with the appropriate processing fee. The amendment application shall describe the specific amendment requested and the reason for the change, along with supporting documentation analyzing the effects of the amendment, including its effects on project operations and Covered Species.

The USFWS shall process the major amendment request in the same manner as the original HCP; provided, however, that additional Section 7 consultation, NEPA review or modifications to the IA shall be necessary only if and to the extent that the amendment involves an issue or action that was not addressed in the original consultation, NEPA analysis or IA, respectively. If the circumstances necessitating the major amendment were addressed in the original documents, then no additional Section 7 consultation, NEPA analysis or changes to the IA or ITP itself shall be necessary.

Changes that would require a major amendment to the HCP and/or ITP include, but are not limited to: revisions to the covered lands or activities that do not qualify as a minor amendment; increases in the amount of take allowed for covered activities; additional species listings; and renewal or extension of the permit term.

8.4 ENFORCEMENT

The provisions of this HCP are enforceable under the terms and conditions set forth in the IA and the ITP issued by the USFWS.

8.5 SUSPENSION/REVOCATION

The USFWS may suspend or revoke all or part of the privileges authorized by the ITP if the permittee does not comply with the conditions of the permit or with applicable laws and regulations governing the permitted activity. Suspension or revocation of the ITP, in whole or in part, by the USFWS shall be in accordance with 50 C.F.R. § 13.27-29, as may be amended over time, and with the IA.

9. List of Preparers

This document was prepared in consultation with the USFWS. The following companies and key individuals contributed to its preparation:

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10. Literature Cited

American Wind Energy Association (AWEA). 2015. AWEA Comments: Proposed Rule and Reopening of Comment Period; Listing the Northern Long-Eared Bat With a Rule Under Section 4(d) of the Act. 13 March 2015. http://www.regulations.gov/#!documentDetail;D=FWS-R5-ES-2011-0024-3387

ARCADIS. 2011. Wildcat Wind Farm – Avian Risk Assessment. Madison and Tipton Counties, Indiana. Prepared for Wildcat Wind Farm, LLC. April 29, 2011. 38 pp.

Arnett, E.B., W.P. Erickson, J. Kerns, and J. Horn. 2005. Relationships Between Bats and Wind Turbines in Pennsylvania and West Virginia: An Assessment of Fatality Search Protocols, Patterns of Fatality, and Behavioral Interactions with Wind Turbines. Final Report prepared for the Bats and Wind Energy Cooperative. Bat Conservation International, Austin, Texas. June 2005.

Arnett, E.B., W.K. Brown, W.P. Erickson, J.K. Fiedler, B.L. Hamilton, T.H. Henry, A. Jain, G.D. Johnson, J. Kerns, R.R. Koford, C.P. Nicholson, T.J. O'Connell, M.D. Piorkowski, and R.D. Tankersley. 2008. Patterns of bat fatalities at wind energy facilities in North America. J. Wildlife Management 72:61–78.

Arnett, E.B., M. Shirmacher, M.M.P. Huso, and J.P. Hayes. 2009. Effectiveness of changing wind turbine cut-in speed to reduce bat fatalities at wind facilities. An annual report submitted to the Bats and Wind Energy Cooperature. Bat Conservation International. Austin, Texas, USA.

Arnett, E. B., M. MP Huso, M.R. Schirmacher and J. P. Hayes. 2010. Altering turbine speed reduces bat mortality at wind-energy facilities. Front Ecol Environ 2010; doi:10.1890/100103

Baerwald, E.F., G.H. D'Amours, B.J. Klug and R.M.R. Barclay. 2008. Barotrauma is a significant cause of bat fatalities at wind turbines. Current Biology 18(16):R695-R696.

Baerwald, E. F., J. Edworthy, M. Holder and R. M. R. Barclay. 2009. A large-scale mitigation experiment to reduce bat fatalities at wind energy facilities J. Wildlife Management 73(7): 1077–1081.

BHE Environmental, Inc. (BHE). 2010. Post-Construction Bird and Bat Mortality Study, Cedar Ridge Wind Farm, Fond du Lac County, Wisconsin, Interim Report. Prepared for Wisconsin Power and Light. February 2010. 123pp

Brack, V., Jr. 2006. Autumn activity of *Myotis sodalis* (Indiana bat) in Bland County, Virginia. Northeastern Naturalist 13(3):421-434.

Callahan, E.V., R.D. Drobney, and R.L. Clawson. 1997. Selection of summer roosting sites by Indiana bats (*Myotis sodalis*) in Missouri. J. Mamm. 78:818-825.

Cameron, S. 2010. White-Nose Syndrome: 2010 Update. US Fish and Wildlife Service Presentation.

Clawson, R.L., R.K. LaVal, M.L. LaVal, and W. Caire. 1980. Clustering behavior of hibernating *Myotis sodalis* in Missouri. J. Mamm. 61:245-253.

Cope, J.B., and S.R. Humphrey. 1977. Spring and autumn swarming behavior in the Indiana bat, *Myotis sodalis*. J. Mamm. 58-93-95.

Cryan, P. 2008a. Overview of Issues Related to Bats and Wind Energy. Web Version of Presentation to the Wind Turbine Guidelines Advisory Committee Technical Workshop & Federal Advisory Committee Meeting, Washington, D.C., 26 February, 2008: U.S. Geological Survey General Information Product. 71pp.

Cryan, P. 2008b. Mating behavior as a possible cause of bat fatalities at wind turbines. Journal of Wildlife Management 72:845-849.

Cryan, P. M., Meteyer, C. U., Boyles, J. G., and D. S. Blehert. 2010. Wing pathology of white-nose syndrome in bats suggests life-threatening disruption of physiology. BMC Biology 2010, 8:135.

Dalthorp, D., Huso, M., Dail, D, and Kenyon, J. 2014. Evidence of Absence Software User Guide. U.S. Department of the Interior, U.S. Geological Survey. Data Series 881.

Dalthorp, D. and Huso, M. 2015. A Framework for Decision Points to Trigger Adaptive Management Actions in Long-term Incidental Take Permits. Open-File Report 2015-xxxx. U.S. Department of the Interior, U.S. Geological Survey, Reston, Virginia: 201x First release: 201x. Revised: Month 201x (ver. x.x)

Erickson, W., G. Johnson, D. Young, D. Strickland, R. Good, M. Bourassa, K. Bay, and K. Sernka. 2002. Synthesis and Comparison of Baseline Avian and Bat Use, Raptor Nesting and Mortality Information from Proposed and Existing Wind Developments. Bonneville Power Administration c/o WEST, Inc. Cheyenne, WY.

Erickson, W.P., Gritski, B., and K. Kronner. 2003. Nine Canyon Wind Power Project Avian and Bat Monitoring Report, August 2003. Technical report submitted to energy Northwest and the Nine Canyon Technical Advisory Committee.

Fiedler, J.K. 2004. Assessment of Bat Mortality and Activity at Buffalo Mountain Windfarm, Eastern Tennessee. M.S. Thesis. University of Tennessee, Knoxville.

Frick, W. F., Reynolds, D. S., and T. H. Kunz. 2009. Influence of climate and reproductive timing on demography of little brown myotis Myotis lucifugus. Journal of Animal Ecology. pp 1-9.

Frick, W. F., Pollock, J. F., Hicks, A. C., Langwig, K. E., Reynolds, D. S., Turner, G. G., Butchkoski, C. M., and T. H. Kunz. 2010. An Emerging Disease Causes Regional Population Collapse of a Common North American Bat Species. Science: 329. pp 679-682.

Fire, Fuel, and Smoke Science Program (FFS). 1999. National Fire Occurrence. Federal and State Lands, 1986-1996. Version 1999. U.S. Department of Agriculture Forest Service, Rocky Mountain Research Station Missoula Fire Sciences Laboratory, Missoula, MT. http://www.firelab.org/ScienceApps_Files/downloads/coarsescale/fo1999.jpg Accessed 16 January 2013.

FFS. 2000a. Historical Natural Fire Regimes. Version 2000. U.S. Department of Agriculture Forest Service, Rocky Mountain Research Station Missoula Fire Sciences Laboratory, Missoula, MT. http://www.firelab.org/ScienceApps_Files/downloads/coarsescale/fr2000.jpg Accessed 16 January 2013.

FFS. 2000b. Fire Regime Current Condition Classes. Version 2000. U.S. Department of Agriculture Forest Service, Rocky Mountain Research Station Missoula Fire Sciences Laboratory, Missoula, MT. http://www.firelab.org/ScienceApps_Files/downloads/coarsescale/cc2000.jpg Accessed 16 January 2013.

Fowler Ridge Wind Farm (FRWF). 2013. Fowler Ridge Wind Farm Habitat Conservation Plan. November 2013.

Fuller, N.W., J.D. Reichard, M.L. Nabhan, S.R. Fellows, L.C. Pepin, and T.H. Kunz. 2011. Free-ranging Little Brown Myotis (Myotis lucifugus) Heal from Wing Damage Associated with White-Nose Syndrome. EcoHealth. DOI: 10.1007/s10393-011-0705-y.

Gardner, J. E., J. D. Garner, and J. E. Hoffman. 1991. Summary of *Myotis sodalis* summer habitat studies in Illinois: with recommendations for impact assessment. Special Report. Illinois Natural History Survey, Illinois Dept. of Conservation, Champagne, Illinois. 28pp.

Good, R. E., W. Erickson, A. Merrill, S. Simon, K. Murray, K. Bay, and C. Fritchman. 2011. Bat Monitoring Studies at the Fowler Ridge Wind Energy Facility, Benton County, Indiana, April 13 – October 15, 2010. Western EcoSystems Technology, Inc. January 28, 2011.

Good, R.E., A. Merrill, S. Simon, K. Murray, and K. Bay. 2012. Bat Monitoring Studies at the Fowler Ridge Wind Farm, Benton County, Indiana: April 1 – October 31, 2011. Prepared for the Fowler Ridge

Wind Farm. Prepared by Western EcoSystems Technology, Inc. (WEST), Bloomington, Indiana. January 31, 2012.

Grehan, J. R. 2008. Steel Winds Bird Mortality Study, Final Report, Lackawanna, New York. Prepared for Steel Winds LLC. April 2008.

Grodsky, S.M., M.J. Behr, A. Gendler, D. Drake, B.D. Dieterle, R.F. Rudd, and N.L. Waltrath. 2011. Investigating the causes of death for wind turbine-associated bat fatalities. Journal of Mammalogy 92(5):917-925.

Gruver, J., Sonnenburg, M., Bay, K., and W. Erickson. 2009. Post-Construction Bat and Bird Fatality Study at the Blue Sky Green Field Wind Energy Center, Fond du Lac County, Wisconsin. July 21, 2008-October 31, 2008 and March 15, 2009-June 4, 2009. 104pp.

Gustin, A. 2011. Geologic Hazards-Flooding in Indiana: Not "If", but "When". Indiana Geological Survey. Indiana University, Bloomington, IN. http://igs.indiana.edu/Hazards/Flooding.cfm Accessed 16 January 2013.

Humphrey, S.R., A.R. Richter and J.B. Cope. 1977. Summer habitat and ecology of the Indiana bat, *Myotis sodalis*. J. Mamm. 58:334-346.

Huso, M.M.P. 2010. An estimator of wildlife fatality from observed carcasses. Environmetrics, n/a. doi: 10.1002/env. 1052.

Indiana Department of Homeland Security (IDHS). 2008. The State of Indiana Standard Hazard Mitigation Plan. 2008 Edition. Chapter Three-Risk Assessment. http://www.in.gov/dhs/3181.htm Accessed 16 January 2013.

IDHS. 2011. Indiana Tornado Map. Indiana Tornadoes: Tracks and Number of Touchdowns per County, 1950-2011. http://www.in.gov/dhs/files/Tornadoes_1950_to_2011.pdf Accessed 16 January 2013.

Indiana Department of Natural Resources (IDNR). 2011. Bald Eagle. http://www.in.gov/dnr/fishwild/3383.htm

IDNR Division of Forestry, Fire Control. 2013. Indiana Wildfire Information and History. http://www.indianawildfire.com/ Accessed 16 January 2013.

Indiana Geological Survey. 2011. Indiana Map. http://inmap.indiana.edu/viewer.htm

Intergovernmental Panel on Climate Change (IPCC). 2007. Climate Change 2007: Synthesis Report. An Assessment of the Intergovernmental Panel on Climate Change. Geneva, Switzerland. 104 pp.

International Union for Conservation of Nature (IUCN). 2007. Report—Workshop: Species Vulnerability Traits. 22-25 October 2007. Silwood Park, Imperial College, Berkshire, UK. 14 pp.

Jacques Whitford Stantec Limited (Jacques Whitford). 2009. Ripley Wind Power Project Post-construction Monitoring Report. Project No. 1037529.01. Report to Suncor Energy Products Inc., Calgary, Alberta, and Acciona Energy Products Inc., Calgary, Alberta. Prepared for the Ripley Wind Power Project Post-Construction Monitoring Program. Prepared by Jacques Whitford, Markham, Ontario. April 30, 2009.

Jain, A., P. Kerlinger, R. Curry, and L. Slobodnik. 2007. Annual Report for the Maple Ridge Wind Power Project: Post-Construction Bird and Bat Fatality Study – 2006. Final report. Prepared for PPM Energy and Horizon Energy and Technical Advisory Committee for the Maple Ridge Project Study.

Jain, A., P. Kerlinger, R. Curry, L. Slobodnik, A. Fuerst, and C. Hansen. 2009. Annual Report for the Noble Ellenburg Windpark, LLC Postconstruction Bird and Bat Fatality Study – 2008. April 13, 2009. Prepared for Noble Environmental Power, LLC.

Jain, A., P. Kerlinger, R. Curry, L. Slobodnik, A. Fuerst, and C. Hansen. 2009. Annual Report for the Noble Ellenburg Windpark, LLC Postconstruction Bird and Bat Fatality Study – 2008. April 13, 2009. Prepared for Noble Environmental Power, LLC.

James, R. D. 2008. Erie Shores Wind Farm Port Burwell, Ontario: Fieldwork Report for 2006 and 2007 During the First Two Years of Operation. Report to Environment Canada, Ontario Ministry of Natural Resources, Erie Shores Wind Farm LP - McQuarrie North American and AIM PowerGen Corporation. January 2008.

Kerns, J., and P. Kerlinger. 2004. A Study of Bird and Bat Collisions at the Mountaineer Wind Energy Center, Tucker County, West Virginia: Annual Report for 2003. Prepared for FPL Energy and the Mountaineer Wind Energy Center Technical Review Committee. Technical report prepared by Curry and Kerlinger, LLC. February 14, 2004. 39 pp. http://www.wvhighlands.org/Birds/MountaineerFinalAvianRpt-%203-15-04PKJK.pdf

Kerns, J, W. P. Erickson, and E. B. Arnett. 2005. Bat and bird fatality at wind energy facilities in Pennsylvania and West Virginia. Pages 24–95 in E. B. Arnett, editor. Relationships between bats and wind turbines in Pennsylvania and West Virginia: an assessment of bat fatality search protocols, patterns of fatality, and behavioral interactions with wind turbines. A final report submitted to the Bats and Wind Energy Cooperative. Bat Conservation International, Austin, Texas, USA.

Kerlinger, P., J. Guarnaccia, L. Slobodnik, and R. Curry. 2011. A Comparison of Bat Mortality in Farmland and Forested Habitats at the Noble Bliss and Wethersfield Windparks, Wyoming County, New York. Report Prepared for Noble Environmental Power. Report prepared by Curry & Kerlinger, LLC, Cape May Point, New Jersey. November 2011.

Kunz, T. H., Arnett, E. B., Cooper, B. M., Erickson, W. P., Larkin, R. P., Mabee, T., Morrison, M. L., Strickland, M. D., and J. M. Szewczak. 2007a. Assessing Impacts of Wind-Energy Development on Nocturnally Active Birds and Bats: A Guidance Document. Journal of Wildlife Management 71(8): 2449-2486.

Manly, B.F.J. 1997. Randomization, Bootstrap, and Monte Carlo Methods in Biology. Second edition. Chapman and Hall, New York. 399 pp.

Miller, N.E., R.D. Drobney, R.L. Clawson and E.V. Callahan. 2002. Summer habitat in northern Missouri. Pp. 165-171 *In* The Indiana Bat: Biology and Management of an Endangered Species (A. Kurta and J. Kennedy, Eds.). Bat Conservation International, Austin, Texas.

Mishra, V., K.A. Cherkauer, and S. Shukla. 2010. Assessment of Drought due to Historic Climate Variability and Projected Future Climate Change in the Midwestern United States. Journal of Hydrometeorology. Volume 11: 46-68.

National Climatic Data Center (NCDC). 2012a. Climate of 2012 – November. U.S. Standardized Precipitation Index. U.S. Department of Commerce National Oceanic and Atmospheric Administration. 7 December 2012. http://www.ncdc.noaa.gov/oa/climate/research/prelim/drought/spi.html Accessed 15 January 2013

NCDC. 2012b. State of the Climate: Drought for Annual 2012. U.S. Department of Commerce National Oceanic and Atmospheric Administration. Issued 8 January 2013. http://www.ncdc.noaa.gov/sotc/drought/ Accessed 15 January 2013.

National Weather Service (NWS). 2012. Drought Fact Sheet. U.S. Department of Commerce National Oceanic and Atmospheric Administration. October 2012. http://www.nws.noaa.gov/om/csd/graphics/content/outreach/brochures/FactSheet_Drought.pdf Accessed 15 January 2013.

O'Farrell, M.J. and W. G. Bradley. 1970. Activity Patterns of Bats over a Desert Spring. Journal of Mammology 51(1):18-26.

Parmesan, C. and G. Yohe. 2003. A globally coherent fingerprint of climate change impacts across natural systems. Nature. Vol 421: 37-42. January 2003.

Piorkowski, M.D., and T. J. O'Connell. 2010. Spatial Pattern of Summer Bat Mortality from Collisions with Wind Turbines in Mixed-grass Prairie. Am. Midl. Nat. 164:260-269.

Puechmaille, S. J., Verdeyroux, P., Fuller, H., Ar Gouilh, M., Bekaert, M., and E. C. Teeling. 2010. White-nose syndrome fungus (Geomyces destructans) in bat, France. Emerg Infect Dis. 2010 Feb; [Epub ahead of print]. 8pp.

Reynolds, D.S. 2006. Monitoring the Potential Impact of a Wind Development Site on Bats in the Northeast. Journal of Wildlife Management 70(5):1219-1227.

Schmidt, K.M, J.P. Menakis, C.C. Hardy, W.J. Hann, and D.L. Bunnell. 2002. Development of Coarse-Scale Spatial Data for Wildland Fire and Fuel Management. General Technical Report RMRS-87. U.S. Department of Agriculture Forest Service, Rocky Mountain Research Station. Fort Collins, CO. 50pp.

Shoenfeld, P. 2004. Suggestions regarding avian mortality extrapolation. Technical memo provided to Florida Power and Light. West Virginia Highlands Conservancy, Davis, West Virginia.

Sparks, D.W., C.M. Ritzi, J.E. Duchamp and J.O. Whitaker, Jr. 2005. Foraging habitat of the Indiana bat (*Myotis sodalis*) at an urban-rural interface. J. Mamm. 84(4):713-718.

Stantec Consulting Ltd. (Stantec). 2007. Kingsbridge I Wind Power Plant Post-Construction Bird and Bat Monitoring Report: 2006. Guelph Ontario.

Stantec Consulting Services Inc. (Stantec). 2011a. Wildcat Wind Farm, Madison, Tipton, Howard and Grant Counties, Indiana. 2011 Federally Endangered Indiana Bat (*Myotis sodalis*) Survey. August 2011. Prepared for Wildcat Wind Farm, LLLC.

Stantec. 2011b. Cohocton and Dutch Hill Wind Farms Year 2 Post-Construction Monitoring Report, 2010. January 2011. Prepared for Canandaigua Power Partners, LLC and Canandaigua Power Partners II, LLC.

Taucher, J., T.L. Mumma, and W. Capouillez. 2012. Pennsylvania Game Commission Wind Energy Voluntary Cooperation Agreement, Third Summary Report. Bureau of Wildlife Habitat Management. December 27, 2012. 72 pp.

Tesky, J. L. 1994. Aquilea chrysaetos. In: Fire Effects Information System, [online]. U.S. Department of Agriculture, Forest Service, Rocky Mountian Research Station, Fires Sciences Laboratory (Producer). http://www.fs.fed.us/database/feis/animals/bird/aqch/all.html#DISTRIBUTION AND OCCURRENCE

Thogmartin, W.E., R.A. King, P.C. McKann, J.A. Szymanski and L. Pruitt. 2012. Population-level impact of white-nose syndrome on the endangered Indiana bat. Journal of Mammalogy 93(4): 1086-1098.

Thompson, T.A. 2011. Bedrock Geology in Indiana: Getting to the bottom of Indiana's varied geological formations. Indiana Geological Survey. http://www.naturalheritageofindiana.org/learn/bedrock.html

Thomson, C.E. 1982. *Myotis sodalis*. Mamm. Species 163:1-5.

U.S. Environmental Protection Agency (USEPA). 2013a. Causes of Climate Change. http://www.epa.gov/climatechange/science/causes.html# Accessed 15 January 2013.

USEPA. 2013b. Midwest Impacts & Adaptation. http://www.epa.gov/climatechange/impacts-adaptation/midwest.html#impacts Accessed 15 January 2013.

U.S. Fish and Wildlife Service (USFWS). 1983. Recovery plan for the Indiana Bat. Region 3, U.S. Fish and Wildlife Service, Fort Snelling, Minnesota. 80 pp.

USFWS. 1999. Indiana Bat (*Myotis sodalis*) Revised Recovery Plan. Region 3, U.S. Fish and Wildlife Service, Fort Snelling, Minnesota. 53 pp.

USFWS. 2000. The HCP Handbook Addendum of "Five Point Policy". June 2000. http://www.fws.gov/midwest/endangered/permits/hcp/pdf/HCPAddendum.pdf

USFWS. 2003. Guidance for the Establishment, Use and Operation of Conservation Banks. U.S. Fish and Wildlife Service, Washington, D.C. May 2, 2003.

USFWS. 2007. Indiana Bat (*Myotis sodalis*) draft recovery plan: first revision. Region 3, U.S. Fish and Wildlife Service, Fort Snelling, Minnesota. 258 pp.

USFWS. 2009. Indiana Bat (Myotis sodalis) 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service Midwest Region—Region 3. Bloomington Ecological Services Field Office. Bloomington, IN. September 2009. 45 pp.

USFWS. 2010. Wind Turbine Guidelines Advisory Committee Recommendations. Washington, DC. 84 pp.

USFWS. 2011a. Pennsylvania Field Office News. Indiana bat fatality at Pennsylvania wind facility. http://www.fws.gov/northeast/pafo/index.html

USFWS. 2011b. Questions and Answers Pertaining to Effects Analyses for Indiana bats and Wind Energy Projects. Revised: 26 October 2011. 63 pp.

USFWS. 2012a. Land-Based Wind Energy Guidelines. March 23, 2012. 71 pp http://www.fws.gov/windenergy/docs/WEG_final.pdf

USFWS. 2012b. West Virginia Field Office, Northeast Region News: Indiana bat fatality at West Virginia wind facility. August 23, 2012. http://www.fws.gov/westvirginiafieldoffice/ibatfatality.html

USFWS. 2012c. Midwest Region News Release: Endangered Indiana Bat Found Dead at Ohio Wind Facility; Steps Underway to Reduce Future Mortalities. November 29 2012. http://www.fws.gov/midwest/news/604.html

USFWS 2012d.Bloomington Field Office Draft Indiana Bat (*Myotis sodalis*) Mitigation Guidance for Wind Energy Habitat Conservation Plans. November 28 2012.

USFWS 2013a. Endangered and Threatened Wildlife and Plants: 12-month Finding on a Petition to List the Eastern Small-Footed Bat and the Northern Long-Eared Bat as Endangered or Threatened Species: Listing the Northern Long-Eared Bat as an Endangered Species. October 2, 2013.

USFWS 2013b. Rangewide Population Estimate for the Indiana Bat (*Myotis sodalis*) by USFWS Region. August 26 2013. http://www.fws.gov/midwest/endangered/mammals/inba/pdf/2013inbaPopEstimate26Aug2013.pdf

USFWS 2013c. Indiana Bat Fatalities at Wind Energy Facilities. July 2013. http://www.fws.gov/midwest/wind/wildlifeimpacts/pdf/IndianaBatFatalitiesSummaryJuly2013.pdf

USFWS 2014a. Northern long-eared bat interim conference and planning guidance. USFWS Regions 2, 3, 4, 5, & 6. January 6 2014.

USFWS. 2014b. Region 3 Indiana Bat Resource Equivalency Analysis Model for Wind Energy Projects. Volume 1.3. March 29 2014.

USFWS. 2014c. 1/17/2014 Bat White Nose Syndrome (WNS) Occurrence by County/District. http://whitenosesyndrome.org/resources/map

USFWS. 2015a. Indiana County Distribution of Federally-Listed Threatened, Endangered, Proposed, and Candidate Species. List revised November 2015. http://www.fws.gov/midwest/Endangered/lists/indiana-cty.html

USFWS. 2015b. 2015 Population Estimates for the Indiana Bat (Myotis sodalis) by USFWS Region. Revised 8-25-2015. http://www.fws.gov/midwest/endangered/mammals/inba/pdf/2015IBatPopEstimate25Aug2015v2.pdf

USFWS. 2015c. Revised Rangewide Indiana Bat Summer Survey Guidance dated April 2015. U.S. Fish and Wildlife Service. 41 pp.

USFWS and National Oceanic and Atmospheric Administration (NOAA). 1996. Habitat conservation planning and incidental take permit processing handbook. U.S. Fish and Wildlife Service and National Marine Fisheries Service, Washington D.C. 113 pp + appendices.

U.S. Fish and Wildlife Service (USFWS) and National Oceanic and Atmospheric Administration (NOAA). 2000. Availability of a Final Addendum to the Handbook for Habitat Conservation Planning and Incidental Take Permitting Process; Notice. U.S. Fish and Wildlife Service and National Marine Fisheries Service, Washington, D.C. Federal Register Vol. 65, No. 106. Thursday, June 1, 2000. 35242-35257.

U.S. Geological Survey (USGS). 2010. White-Nose Syndrome Threatens the Survival of Hibernating Bats in North America. http://www.fort.usgs.gov/WNS/

Vaughan, N., G. Jones, and S. Harris. 1997. Habitat use by bats (Chiroptera) assessed by means of a broad-band acoustic method. Journal of Applied Ecology 34:716-730.

Western EcoSystems Technology (WEST), Inc. 2013. Fowler Ridge Wind Farm, Benton County, Indiana: Indiana Bat Habitat Conservation Plan. November 2013. Prepared for Fowler Ridge Wind Farm, LLC.

Whitaker, J.O., Jr. and V. Brack, Jr. 2002. Distribution and summer ecology in Indiana. Pp. 48-54 *In* The Indiana Bat: Biology and Management of an Endangered Species (A. Kurta and J. Kennedy, Eds.). Bat Conservation International, Austin, Texas.

Whittaker, J.O., and W.J. Hamilton, Jr. 1998. Mammals of the eastern United States. Cornell University Press. Ithaca, New York. Third Edition.

Young, D.P., Erickson, W.P., Bay, K., Nomani, S., and W. Tidbar. 2009. Mount Storm Wind Energy Facility, Phase 1 Post-Construction Avian and Bat Monitoring. July-October 2008. Prepared for NedPower Mount Storm, LLC. 54 pp.

Young, D.P., S. Nomani, W. Tidhar, and K. Bay. 2011. NedPower Mount Storm Wind Energy Facility, Post-Construction Avian and Bat Monitoring: July – October 2010. Prepared for NedPower Mount Storm, LLC, Houston, Texas. Prepared by Western Ecosystems Technology (WEST) Inc., Cheyenne, WY. February 10, 2011.

Young, D., C. Nations, M. Lout and K. Bay. 2013. 2012 Post-Construction Monitoring Study, Criterion Wind Project, Garrett County, Maryland, April- November 2012. Prepared for Criterion Power Partners, LLC. Prepared by Western EcoSystems Technology, Inc.

FIGURE 2-1

PROJECT AREA

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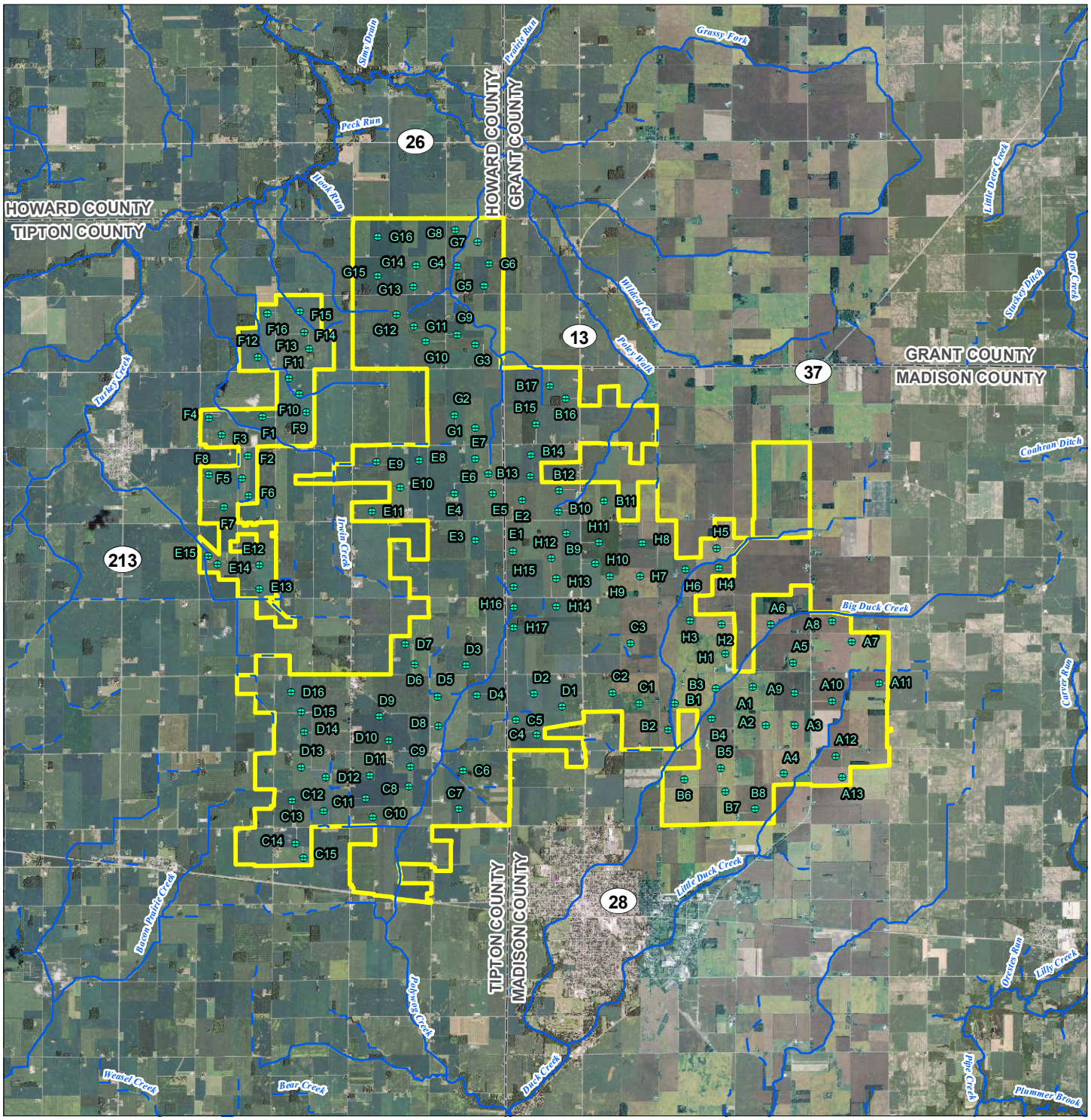

Legend

- Phase I Project Boundary
- Phase I As-Built Turbine Locations

National Hydrography Database

- Perennial Stream
- Intermittent Stream

Notes

1. Coordinate System: NAD 1983 StatePlane Indiana East FIPS 1301 Feet
2. Data Sources Include: Stantec, USGS, and NADS
3. Orthophotography: 2014 NAIP

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Figure No.
2-1

Title
Project Area

Client/Project
Wildcat Windfarm I, LLC
Wildcat Windfarm Phase I

Project Location
Tipton and Madison Co., Indiana

193702527
Prepared by SF on 2016-01-15
Technical Review by CP on 2016-01-15
Independent Review by MG on 2016-01-19

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Stantec

FIGURE 2-2

NATIONAL LAND COVER DATASET

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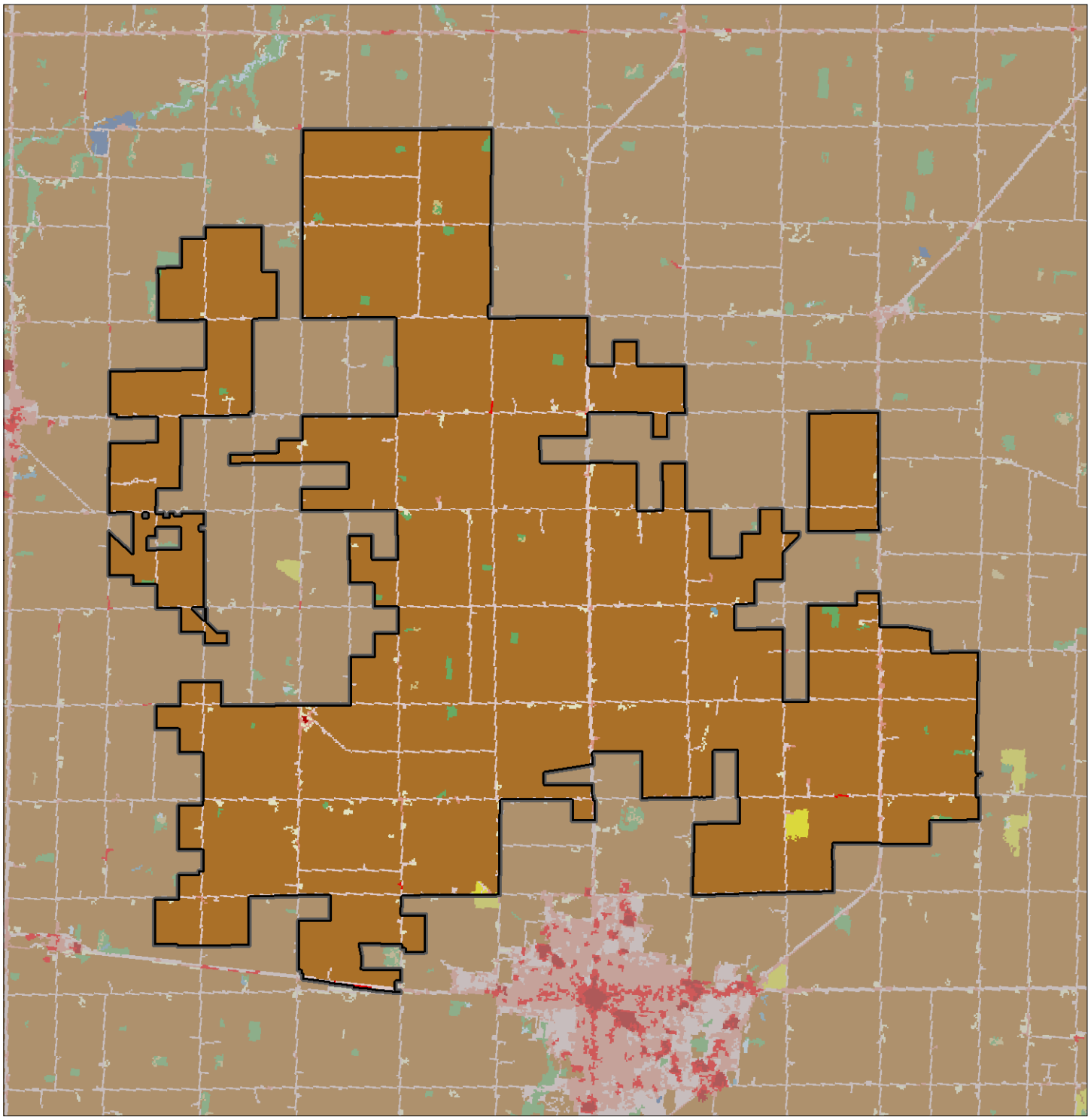

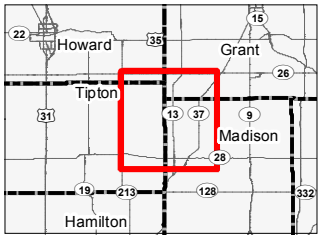

Notes

1. Coordinate System: NAD 1983 StatePlane Indiana East FIPS 1301 Feet
2. Data Sources Include: Stantec, USGS
3. Background: NLCD 2011

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Legend

Phase I Project Boundary

NLCD 2011

- Developed, Open Space
- Developed, Low Intensity
- Developed, Medium Intensity
- Developed, High Intensity
- Deciduous Forest
- Shrub / Scrub
- Herbaceuous
- Hay/Pasture
- Cultivated Crops
- Emergent Herbaceuous Wetlands

Figure No.

2-2

Title

National Land Cover Dataset

Client/Project

Wildcat Windfarm I, LLC
Wildcat Windfarm Phase I

Project Location

Tipton and Madison Co., Indiana

193702527
Prepared by SF on 2016-01-15
Technical Review by CP on 2016-01-15
Independent Review by MG on 2016-01-19

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APPENDIX A

MORTALITY MINIMIZATION
AND MONITORING PROPOSAL

Mortality Minimization and Monitoring Proposal

Wildcat Wind Farm

Tipton and Madison Counties, Indiana

June 2015

Prepared for:

Wildcat Wind Farm, LLC
c/o E.ON Climate and Renewables
353 N. Clark, 30th Floor
Chicago, IL 60654

Prepared by:

Stantec

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1 PROJECT DESCRIPTION

Wildcat Wind Farm (Project) is a 200 megawatt (MW) wind energy project located in Tipton and Madison Counties, Indiana. The Project consists of 125 1.6 MW wind turbine generators and associated access roads and collector line system, located on active agricultural land leased from participating landowners. The Project is located in central Indiana, within the Till Plains section of the Central Lowland physiographic province. This region is characterized by flat to gently rolling topography produced by glacial processes. Tipton and Madison counties are largely comprised of agricultural lands interspersed with creeks. Forested areas are limited in these counties.

The Project is located within the migratory range of the Indiana bat (*Myotis sodalis*) and the northern long-eared bat (*Myotis septentrionalis*). Migratory risk is present at any site within either species' range, despite the lack of summer or winter habitat within the Project area. Wildcat Wind Farm, LLC (WWF), the developer of the Project, designed the Project to avoid impacting potential Indiana and northern long-eared bat habitat, and has been operating under a technical assistance letter (TAL) issued by the U.S. Fish & Wildlife Service (Service) on June 18, 2012, prior to the threatened listing of the northern long-eared bat, concurring that an incidental take permit for Indiana bats was not recommended for the Project. WWF originally developed this Mortality Minimization and Monitoring Proposal (Proposal) to support the issuance of that TAL by the Service. WWF is now updating this Proposal to include northern long-eared bats as well as the spring migratory period for both species, following the listing of the northern long-eared bat and the issuance of updated draft TAL requirements from the USFWS Bloomington Field Office (BFO).

WWF is requesting a TAL to cover a period of 11 years. This period would cover the third year of baseline monitoring in the fall season (2015) and an additional, fourth year of baseline monitoring in the spring season (2016), as well as the first two follow-up monitoring efforts at years five and ten of the TAL (see Section 3.4). However, WWF is actively developing a Habitat Conservation Plan (HCP) for Indiana bats and northern long-eared bats that will support the issuance of an incidental take permit (ITP) for the Project pursuant to section 10(a)(1)(B) of the Endangered Species Act. Upon issuance of an ITP, the terms of the HCP and ITP would supplant the measures outlined in this Proposal and the associated TAL.

2 MORTALITY MINIMIZATION

To avoid take of Indiana and northern long-eared bats and minimize mortality of all bats in general, WWF has committed to raising turbine cut-in speeds from the manufacturer's rated cut-in speed of 7.8 miles per hour [mph] (3.5 meters/second [m/s]) to 15.4 mph (6.9m/s) from 0.5 hour before sunset to 0.5 hour after sunrise during the fall migratory period from 1 August through 15 October, and to 11.2 mph (5.0 m/s) from 0.5 hour before sunset to 0.5 hour after sunrise during the spring migratory period from 15 March through 15 May. During these time periods, turbines will remain fully feathered (i.e., turbine blades are pitched parallel with the wind direction, causing them to spin at very low RPMs, if at all) until the cut-in wind speed (i.e., the wind speed at which turbines begin generating power and sending it to the grid) is reached. At that time, blades will be pitched into the wind to enable the turbine to begin spinning and generating electricity. The feathering/cut-in process will be computer-controlled on a real-time basis. Accordingly, turbines will cut-in or feather throughout the night as the wind speed fluctuates above and below 11.2 mph (5.0 m/s) in the spring or 15.4 mph (6.9 m/s) in the fall, based on a 10-minute rolling average.

All curtailment studies to date show a consistent inverse relationship between cut-in speeds and bat mortality (Baerwald et al. 2009, Arnett et al. 2009, Good et al. 2011, Kerns et al. 2005, Fiedler 2004). Baerwald et al. (2009) found that increasing turbine cut-in speed to 12.3 mph (5.5 m/s) or turbine feathering at wind speeds less than 12.3 mph (5.5 m/s) reduced fatality of hoary bats (*Lasiurus cinereus*) and silver-haired bats (*Lasionycteris noctivagans*) from 50 to 70%. Arnett et al. (2009) found that increasing turbine cut-in speed to 11.2 mph (5.0 m/s) or 13.4 mph (6.0 m/s) resulted in reductions in average nightly bat fatality ranging from 53 to 93%. Similarly, Good et al. (2011) found that bat fatalities were reduced by a mean of 50% when cut-in speeds were increased to 11.2 mph (5.0 m/s).

Based on the results of these studies, raising the nighttime cut-in speed at the Project to 11.2 mph (5.0 m/s) would be expected to significantly reduce overall bat mortality. Tree bat species, including red bat (*Lasiurus borealis*), hoary bat, and silver-haired bat, would be particularly likely to benefit from this turbine operation measure, as these species are expected to comprise the majority of bat mortality at the Project. During the fall, the cut-in speed of the Project will be raised even higher than the wind speeds demonstrated in previous studies to significantly reduce bat mortality, to 15.4 mph (6.9 m/s), in an effort to ensure that take of Indiana and northern long-eared bats is avoided during the time period when take is considered most likely.

These operational Indiana and northern long-eared bat avoidance measures will be implemented every night during the spring migration season, from 15 March through 15 May, and during the fall migration season, from 1 August through 15 October. During the summer months (16 May through 31 July), Indiana and northern long-eared bats are not expected to occur within the Project area due to the absence of summer habitat. Between 15 October and 15 March, migrating Indiana and northern long-eared bats are not expected to occur within the Project area due to the distance (75 miles [120 km]) to the nearest hibernaculum. To arrive at hibernacula, especially those farther from the Project area, within the fall swarming and mating season (typically mid-August through mid-October), Indiana and northern long-eared bats are expected to have passed through the

Project area and surrounding vicinity by the middle of October at the latest. Additionally, average nightly temperatures typically begin to decline throughout September and October, constraining bat activity and inducing bats to enter hibernation (USFWS 2007). Therefore, a nighttime cut-in speed of 15.4 mph (6.9 m/s) from 1 August through 15 October and a nighttime cut-in speed of 11.2 mph (5.0m/s) from 15 March through 15 May is expected to avoid take of Indiana and northern long-eared bats and greatly reduce overall bat mortality.

WWF will monitor bat fatalities at the site in accordance with the monitoring plan presented in Section 3 to verify the effectiveness of the mortality minimization strategy at avoiding take of Indiana and northern long-eared bats and reducing bat mortality in general.

3 MORTALITY MONITORING

3.1 Monitoring Goals

The goals of the post-construction monitoring are to determine overall bat fatality rates from the Project, monitor for Indiana or northern long-eared bat mortality, and evaluate the circumstances under which fatalities occur. Included in the post-construction monitoring plan are standardized carcass searches, searcher efficiency trials, and carcass removal trials.

3.2 Species to be Monitored

The post-construction monitoring plan will address all bat fatalities observed within the Project area. Indiana and northern long-eared bat mortalities are not expected to occur; therefore, the monitoring plan is designed to detect carcasses of all bat species and calculate bat fatality estimates with enough precision to determine if the mortality minimization strategy is effective in avoiding Indiana and northern long-eared bat fatalities and reducing overall bat fatalities at the Project. The monitoring plan is also designed to enable comparison with other operating wind energy projects. Within the overall bat fatality estimates, estimates by species will be made, if possible, based on the number of carcasses detected. The entire area around each turbine will not be searched for bat carcasses; such a study would require extensive ground surveys and considerable expense for the purposes of attempting to detect every single unlikely event. The 25 turbines at which full plots will be searched will provide a site-specific estimate of the number of carcasses which may be missed by road and pad searches at all other turbines.

3.3 Permits and Wildlife Handling Procedures

3.3.1 Permits

State and federal collecting/salvaging permits will be acquired from the Indiana Department of Natural Resources and the USFWS by WWF's consultants prior to commencement of the post-construction monitoring to enable searchers to collect and handle carcasses in compliance with laws pertaining to the collection and possession of wildlife.

3.3.2 Wildlife Handling Procedures

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

3.4 Intensive Monitoring

3.4.1 Study Design

The results of post-construction monitoring efforts intended to provide an estimate of overall bat 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 bats that may land or move to areas not included in the search plots (Kunz et al. 2007). WWF's proposed post-construction mortality 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.

Three years of baseline post-construction mortality monitoring have been conducted in the spring and two years of baseline post-construction mortality monitoring have been conducted in the fall at the Project under the previous TAL. Accordingly, future monitoring will involve baseline monitoring during the third year of fall operations (1 August to 15 October, 2015) and the fourth year of spring operations (15 March to 15 May, 2016), and follow-up monitoring conducted once every five years thereafter during the spring migratory season (15 March to 15 May) and the fall migratory season (1 August to 15 October) beginning in 2020 for the duration of the TAL. The fourth year of spring baseline monitoring is proposed to verify the expected reduction in bat mortality from the increase in cut-in speeds during the first spring season (2016) in which that avoidance measure will be applied.

Both baseline and follow-up monitoring will include searcher efficiency trials and carcass removal trials in addition to the standardized carcass searches. Standardized carcass searches will allow statistical analysis of the search results, calculation of overall fatality estimates, and assessment of correlations between fatality rates and potentially-influential variables (e.g., weather, location). Searcher efficiency and carcass removal rates are two sources of field bias in mortality studies that have been proven to be highly variable and site- and researcher-specific; mortality estimators are highly sensitive to these parameters (Huso 2010). Kunz et al. (2007) and the USFWS (2012) Land-Based Wind Energy Guidelines 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 bat carcasses that may occur within searched areas of the Project area, as well as support the development of fatality estimates for all bat species found during the mortality searches.

Sample Size

Baseline post-construction monitoring will be conducted at 100% of the Project turbines. This study design will provide full coverage of the facility and serve as a control against which follow-up monitoring results can be compared. Follow-up monitoring will also be conducted at 100% of the Project turbines to provide a representative sample of mortality at the Project.

Search Interval

The search interval will be once weekly for all of the turbines during baseline monitoring as well as during the follow-up monitoring every fifth year. 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 Project, the search intervals will be modified accordingly. The Service's Land-Based Wind Energy Guidelines recommend that "carcass searching protocol should be adequate to answer applicable… questions at an appropriate level of precision to make general conclusions about the project" (USFWS 2012). 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.

3.4.2 Field Methods

Plot Size, Vegetation Mowing, Visibility Classes

Under the previous TAL, WWF completed three years of baseline monitoring in the spring and two years of baseline monitoring in the fall, consisting of searching cleared 262-foot x 262-foot (80-m x 80-m) plots at 25 turbines (exceeding the USFWS BFO's requirement of 10% full plots), and searching roads and pads out to 262 ft (80 m) at the remaining 100 turbines. This method targets the areas shown to support the highest searcher efficiency while greatly reducing the financial and logistical restraints associated with clearing and searching large study plots, enabling much broader sampling coverage of the facility. The subset of full-coverage turbines searched under the previous TAL provides a reference for estimating the number of fatalities that may fall outside the searched area at the other turbines. This mixed sampling methodology is consistent with other post-construction monitoring studies being conducted (e.g., Good et al. 2011) and enables comparison of study results. The same search plots will be used for the remaining two seasons of baseline monitoring (fall 2015 and spring 2016).

Follow-up monitoring conducted under this Proposal and TAL will consist of road and pad searches out to 262 ft (80 meters [m]) from the turbine at 100% of the Project turbines. Cleared search plots will not be used during the follow-up monitoring efforts.

Timing and Duration

During the remaining two seasons of baseline monitoring (fall 2015 and spring 2016) and the two scheduled intervals of followup monitoring (fall 2020/spring 2021 and fall 2025/spring 2026), carcass searches will be conducted within the Project area for a total of eight weeks during spring (15 March to 15 May) and a total of 11 weeks during fall (1 August to 15 October.

Standardized Carcass Searches

Carcass searches will be conducted by searchers experienced in appropriate methods for conducting fatality searches, including proper handling and reporting of carcasses. Searchers will be familiar with and able to accurately identify bat species likely to be found in the Project area. Any unknown bats or suspected Indiana or northern long-eared bats discovered during fatality searches will be sent to a qualified USFWS-approved 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, all carcasses will be labeled with a unique number, bagged, and stored frozen (with a copy of the original data sheet) at the Project Operations and Maintenance building.

Bat carcasses found in non-search areas and any bird carcasses found 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 bat fatalities that are detected during the carcass searches. Similarly, carcass removal trials will be used to estimate the percentage of bat fatalities that are removed by scavengers prior to being located by searchers. When considered together, the results of these trials will represent the likelihood that a bat fatality that falls within the searched area will be recorded and considered in the final fatality estimates.

Trials will be conducted during each study period by placing "trial" carcasses in the searched areas (one trial during each of the spring and fall monitoring seasons) to account for changes in personnel, searcher experience, weather, and scavenger densities. The number of bat carcasses used will depend on the number of carcasses available following initial carcass searches in the

Project area; commercially-available substitute carcasses, such as brown mice, will be used to increase the number of trial carcasses as necessary. Searcher efficiency and carcass removal trials will be limited to one trial per monitoring season to avoid attracting scavengers to the Project area with carcasses and potentially artificially inflating the carcass removal rate.

Each trial carcass will be discretely marked and labeled with a unique number so that it can be identified as a trial carcass. Prior to placement, the date of placement, species, turbine number, and distance and direction from turbine will be recorded. 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 the 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.

Carcass removal trials will be conducted immediately following the baseline searcher efficiency trials using the same trial carcasses. Trial carcasses will be left in place by searchers and monitored for a period of up to 30 days. Carcasses will be checked on days 1, 2, 3, 4, 5, 6, 7, 10, 14, 20, and 30. The status of each trial carcass will be recorded throughout the trial.

3.5 Statistical Methods for Estimating Fatality Rates

The methodology for estimating overall bat fatality rates will largely follow the estimator proposed by Erickson et al. (2003), as modified by Young et al. (2009). Huso (2010) has recently proposed an estimator that may offer less bias than the Erickson estimator. The positive bias and different sensitivity to searcher efficiency and carcass removal rates associated with the Huso estimator may make comparisons to estimates derived using the Erickson (2003) or Shoenfeld (2004) estimators, which tend towards negative biases, problematic. Therefore, maintaining the same biases and assumptions in estimating overall bat fatality at the Project will be useful for developing fatality estimates that can be compared to other sites.

Following Erickson et al. (2003), the estimate of the total number of wind turbine-related casualties will be based on four components: (1) observed number of casualties, (2) searcher efficiency, (3) scavenger removal rates, and (4) estimated percent of casualties that likely fall in non-searched areas, based on percent of area searched around each turbine. Variance and 90% confidence intervals will be calculated using bootstrapping methods (Erickson et al. 2003 and Manly 1997 as presented in Young et al. 2009).

3.5.1 Mean Observed Number of Casualties (c)

The estimated mean observed number of casualties (c) per turbine per study period (spring or fall of each monitoring year) will be calculated as:

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

where n is the number of turbines searched, and cj is the number of casualties found at a turbine. Incidental mortalities (those found outside of the searched area or by maintenance personnel) will not be included in this calculation, nor in the estimated fatality rate. The estimated mean observed number of casualties per turbine study period will be calculated separately for each search method (roads and pads, full plots) during the baseline monitoring effort.

3.5.2 Estimation of Searcher Efficiency Rate (p)

Searcher efficiency (p) will represent the average probability that a carcass was detected by searchers. The searcher efficiency rates will be calculated by dividing the number of trial carcasses observers found by the total number that remained available during the trial (non-scavenged). Searcher efficiency will be calculated for each season (spring, fall) and for both search methods (roads and pads, full plots) during the baseline monitoring effort. Searcher efficiency will also be calculated for each follow-up monitoring effort.

3.5.3 Estimation of Carcass Removal Rate (t)

Carcass removal rates will be estimated to adjust the observed number of casualties to account for scavenger activity at the Project. Mean carcass removal time (t) will represent the average length of time a planted carcass remained at the Project 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. 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 (spring, fall) and for both search methods (roads and pads, full plots) during the baseline monitoring effort. Carcass removal rate will also be calculated for each follow-up monitoring effort.

3.5.4 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:

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

where I is the interval between searches. For this study, I=7 for baseline carcass searches and for the follow-up carcass searches. During the baseline monitoring effort, π will be calculated separately for each season (spring, fall) and both search methods (roads and pads, full plots) using the respective searcher efficiency and carcass removal rates. Additionally, π will be recalculated for each follow-up monitoring effort.

3.5.5 Search Area Adjustment (A)

Approximation of *A*, the adjustment for areas which were not searched, will follow methods established and data collected during post-construction mortality studies at Fowler Ridge Wind Farm in Indiana (Good et al. 2011). For the WWF fatality estimates, A_{RP} will represent the adjustment for the proportion of carcasses which likely fell outside of the area searched at roads and pads turbines, and A_{FP} will represent the adjustment for the proportion of carcasses which likely fell outside of the area searched at full plot turbines.

The value for A_{RP} will be approximated using the following formula:

$$A_{RP} = \frac{C_{FP}}{\pi_{FP}} \Big/ \frac{C_{RPFP}}{\pi_{RP}}$$

where π_{FP} is the π value calculated for full plot searches, C_{FP} is the number of observed casualties on full plots, π_{RP} is the π value calculated for roads and pads searches, and C_{RPFP} is the number of observed casualties on roads and pads of the full plot turbines. A_{RP} will be calculated separately for spring and fall, using parameter values specific to each season.

The value for A_{FP} will be equal to the correction factor calculated for the Fowler study:

$$A_{FP} = 1.305$$

as the Fowler study estimated that 23.4% of fatalities fell outside of 262 foot x 262 foot (80 m x 80 m) square plots.

3.5.6 Estimation of Facility-Related Mortality (m)

Mortality estimates will be calculated generally 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 which bats may have fallen but which was not searched. Mortality estimates will be calculated separately for each season (spring, fall) and both search methods during the baseline monitoring using the appropriate parameter values as described above. Mortality estimates will also be calculated for each follow-up monitoring effort.

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

3.6 Data Analysis and Reporting

3.6.1 Data Analysis

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

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

3.6.2 Reporting

WWF will provide an annual mortality monitoring report to the USFWS following the completion of each year of post-construction monitoring. The report will be submitted by December 31 of that year, and will include fatality estimates, data summaries, and assessment of correlations between fatality rates and potentially influential variables such as weather, location, turbine operation, etc. Fatalities will be expressed both in terms of fatalities/turbine/season and in terms of fatalities/MW/season, as recommended by the Service's Land-Based Wind Energy Guidelines (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, WWF will promptly report fatalities of ESA-listed species to the USFWS.

4 LITERATURE CITED

Arnett, E.B., W.P. Erickson, J. Kerns, and J. Horn. 2005. Relationships Between Bats and Wind Turbines in Pennsylvania and West Virginia: An Assessment of Fatality Search Protocols, Patterns of Fatality, and Behavioral Interactions with Wind Turbines. Final Report prepared for the Bats and Wind Energy Cooperative. Bat Conservation International, Austin, Texas. June 2005.

Arnett, E.B., M. Schirmacher, M.M.P. Huso, and J.P. Hayes. 2009. Effectiveness of changing wind turbine cut-in speed to reduce bat fatalities at wind facilities. An annual report submitted to the Bats and Wind Energy Cooperative. Bat Conservation International. Austin, Texas.

Baerwald, E.F., J. Edworthy, M. Holder, and R.M. Barclay. 2009. A Larger-Scale Mitigation Experiment to Reduce Bat Fatalities at Wind Energy Facilities. Journal of Wildlife Management 73(7):1077-1081.

Brack, V., Jr. 2006. Autumn activity of *Myotis sodalis* (Indiana bat) in Bland County, Virginia. Northeastern Naturalist 13(3):421-434.

Erickson, W.P., Gritski, B., and K. Kronner. 2003. Nine Canyon Wind Power Project Avian and Bat Monitoring Report, August 2003. Technical report submitted to energy Northwest and the Nine Canyon Technical Advisory Committee.

Fiedler, J.K. 2004. Assessment of Bat Mortality and Activity at Buffalo Mountain Windfarm, Eastern Tennessee. M.S. Thesis. University of Tennessee, Knoxville.

Good, R.E., W. Erickson, A. Merrill, S. Simon, K. Murray, K. Bay, and C. Fritchman. 2011. Bat Monitoring Studies at the Fowler Ridge Wind Energy Facility Benton County, Indiana, April 13 – October 15, 2010. Prepared for: Fowler Ridge Wind Farm. Prepared by Western EcoSystems Technology, Inc., Cheyenne, Wyoming. January 28, 2011.

Gruver, J., M. Sonnenburg, K. Bay, and W. Erickson. 2009. Post-Construction Bat and Bird Fatality Study at the Blue Sky Green Field Wind Energy Center, Fond du Lac County, Wisconsin. July 21, 2008-October 31, 2008, and March 15, 2009-June 4, 2009. Western EcoSystems Technology, Inc., Cheyenne, Wyoming. 104 pp.

Huso, M.M.P. 2010. An estimator of wildlife fatality from observed carcasses. Environmetrics, n/a. doi: 10.1002/env. 1052.

Jain, A., P. Kerlinger, R. Curry, and L. Slobodnik. 2007. Annual Report for the Maple Ridge Wind Power Project: Post-Construction Bird and Bat Fatality Study – 2006. Final report. Prepared for PPM Energy and Horizon Energy and Technical Advisory Committee for the Maple Ridge Project Study.

Kerns, J., and P. Kerlinger. 2004. A Study of Bird and Bat Collision Fatalities at the MWEC Wind Energy Center, Tucker County, West Virginia: Annual Report for 2003. Technical report prepared by Curry and Kerlinger, LLC. for FPL Energy and MWEC Wind Energy Center Technical Review Committee.

Kerns, J, W. P. Erickson, and E. B. Arnett. 2005. Bat and bird fatality at wind energy facilities in Pennsylvania and West Virginia. Pages 24–95 in E. B. Arnett, editor. Relationships between bats and wind turbines in Pennsylvania and West Virginia: an assessment of bat fatality search protocols, patterns of fatality, and behavioral interactions with wind turbines. A final report submitted to the Bats and Wind Energy Cooperative. Bat Conservation International, Austin, Texas, USA.

Kunz, T.H., E.B. Arnett, B.M. Cooper, W.P. Erickson, R.P. Larkin, T. Mabee, M.L. Morrison, M.D. Strickland, and J.M. Szewczak. 2007. Assessing impacts of wind-energy development on nocturnally active birds and bats: a guidance document. Journal of Wildlife Management 71:2449-2486.

Manly, B.F.J. 1997. Randomization, Bootstrap, and Monte Carlo Methods in Biology. Second edition. Chapman and Hall, New York. 399 pp.

Piorkowski, M.D., and T. J. O'Connell. 2010. Spatial Pattern of Summer Bat Mortality from Collisions with Wind Turbines in Mixed-grass Prairie. Am. Midl. Nat. 164:260-269.

Shoenfeld, P. 2004. Suggestions regarding avian mortality extrapolation. Technical memo provided to Florida Power and Light. West Virginia Highlands Conservancy, Davis, West Virginia.

U.S. Fish and Wildlife Service (USFWS). 2007. Indiana Bat (*Myotis sodalis*) Draft Recovery Plan: First Revision. U.S. Department of Interior, Fish and Wildlife Service, Region 3, Fort Snelling, Minnesota. 260 pp.

USFWS. 2011. Pennsylvania Field Office News. Indiana bat fatality at Pennsylvania wind facility. http://www.fws.gov/northeast/pafo/index.html

USFWS. 2012. Land-Based Wind Energy Guidelines. March 23, 2012. 71 pp http://www.fws.gov/windenergy/docs/WEG_final.pdf

Young, D.P., Jr., W.P. Erickson, K. Bay, S. Nomani, and W. Tidhar. 2009. Mount Storm Wind Energy Facility, Phase 1 Post-Construction Avian and Bat Monitoring, July – October 2008. Prepared for*:* NedPower Mount Storm, LLC, Houston, Texas. Prepared by: Western EcoSystems Technology, Inc., Cheyenne, Wyoming.

APPENDIX B

TECHNICAL ASSISTANCE LETTERS (TALS)

United States Department of the Interior
Fish and Wildlife Service

Bloomington Field Office (ES)
620 South Walker Street
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Phone: (812) 334-4261 Fax: (812) 334-4273

June 18, 2012

Paul Bowman
Senior VP of Development
E.ON Climate & Renewables North America, Inc.
353 N. Clark Street, 30th Floor
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paul.bowman@eon.com

Re: Wildcat I Wind Farm, LLC and Wildcat II Wind Farm, LLC (collectively, "WCWF")
Wildcat Wind Farm project, Phases I and II

Dear Mr. Bowman:

The purpose of this letter is to acknowledge and respond to E.ON Climate & Renewables' (the Company's) request for technical assistance dated June 8, 2012 concerning the effects of the above-referenced project on Endangered Species Act (ESA)-listed species under the jurisdiction of the U.S. Fish and Wildlife Service (USFWS).

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 USFWS 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).

The USFWS has reviewed the information you have provided regarding the presence of Indiana bats and other ESA-listed species and their habitat in the vicinity of the Wildcat Wind Farm site, and the measures set forth in that *Mortality Minimization and Monitoring Proposal, Wildcat Wind Farm (Phases I and II)* (proposal), dated June 2012, that WCWF will implement to avoid any potential take of such species and their habitat, including fully feathering the wind turbine generators below a wind speed of 7.0 meters per second between one half hour before sunset to one half hour after sunrise during the Indiana bat's fall migratory period, August 1 – October 15. Based on USFWS' review of this information, these operating restrictions and the other measures set forth in the proposal will serve to address the concerns of the USFWS until such time as an incidental take permit could be obtained. However, the USFWS recognizes that WCWF is currently pursuing an incidental take permit, and if an incidental take permit is

successfully obtained, the avoidance measures that WCWF has committed to implement as the basis for this letter would be replaced by the avoidance, minimization and mitigation measures and other provisions set forth in the Habitat Conservation Plan upon which the incidental take permit is based.

The USFWS reached this conclusion through coordination and ongoing discussions with the Company including the Company's commitment, in writing to the USFWS, that proven avoidance measures will be implemented throughout the life of the project.

This office is not authorized to provide guidance in regards to the USFWS 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 takes of listed species, even if such takes occur despite the implementation of appropriate take avoidance measures. However, the Office of Law Enforcement 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 takes. As of this date, the Bloomington, IN Ecological Services Field Office concludes that the proposed project will not or is unlikely to result in take of ESA listed species.

We appreciate E.ON Climate & Renewables' and WCWF's efforts to coordinate with our office in determining what measures could be implemented to avoid take of any ESA-listed species or their habitat at the project site. Should any new information become available, we request that E.ON Climate & Renewables promptly notify the USFWS. If new information becomes available to the USFWS that other measures could be implemented to avoid take that would not require additional commitment by the Company, such as wind speeds shown to preclude foraging by Indiana bats, USFWS will notify the Company as soon as possible.

Sincerely,

Scott Pruitt
Field Supervisor

United States Department of the Interior
Fish and Wildlife Service

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July 2, 2015

Paul Bowman
Senior VP of Development
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353 N. Clark Street, 30th Floor
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Re: Wildcat Wind Farm, LLC (WCWF), Wildcat Wind Farm project

Dear Mr. Bowman:

The purpose of this letter is to acknowledge and respond to E.ON Climate & Renewables' (the Company's) request for technical assistance dated June 25, 2015 concerning the effects of the above-referenced project on Endangered Species Act (ESA)-listed species under the jurisdiction of the U.S. Fish and Wildlife Service (USFWS).

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 USFWS 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).

The USFWS has reviewed the information you have provided regarding the presence of Indiana and northern long-eared bats and other ESA-listed species and their habitat in the vicinity of the Wildcat Wind Farm site, and the measures set forth in that *Mortality Minimization and Monitoring Proposal, Wildcat Wind Farm, Tipton and Madison Counties, Indiana* (proposal), dated June 2015, that WCWF will implement to avoid any potential take of such species and their habitat, including fully feathering the wind turbines below 5.0 meters per second wind speed during the spring migratory season (March 15 – May 15) and below a wind speed of 6.9 meters per second during the fall migratory season (August 1 – October 15) from one half hour before sunset to one half hour after sunrise. Based on USFWS' review of this information, these operating restrictions and the other measures set forth in the proposal will serve to address the concerns of the USFWS until such time as an incidental take permit could be obtained. However, the USFWS recognizes that WCWF is currently pursuing an incidental take permit,

and if an incidental take permit is successfully obtained, the avoidance measures that WCWF has committed to implement as the basis for this letter would be replaced by the avoidance, minimization and mitigation measures and other provisions set forth in the Habitat Conservation Plan upon which the incidental take permit is based.

The USFWS reached this conclusion through coordination and ongoing discussions with the Company including the Company's commitment, in writing to the USFWS, that proven avoidance measures will be implemented throughout the life of the project.

This office is not authorized to provide guidance in regards to the USFWS 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 takes of listed species, even if such takes occur despite the implementation of appropriate take avoidance measures. However, the Office of Law Enforcement 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 takes. As of this date, the Bloomington, IN Ecological Services Field Office concludes that the proposed project will not or is unlikely to result in take of ESA listed species.

We appreciate E.ON Climate & Renewables' and WCWF's efforts to coordinate with our office in determining what measures could be implemented to avoid take of any ESA-listed species or their habitat at the project site. Should any new information become available, we request that E.ON Climate & Renewables promptly notify the USFWS. If new information becomes available to the USFWS that other measures could be implemented to avoid take that would not require additional commitment by the Company USFWS will notify the Company as soon as possible.

Sincerely,

Scott Pruitt
Field Supervisor

APPENDIX C

DECOMMISSIONING PLAN

TO COME

APPENDIX D

BAT SCREENING ANALYSIS
AND PRE-CONSTRUCTION
BAT SURVEY 2010

BAT SCREENING ANALYSIS AND PRE-CONSTRUCTION BAT SURVEY

WILDCAT WIND FARM
TIPTON AND MADISON COUNTIES, INDIANA

Project No. 193700141
December 2010

PREPARED FOR:

E.ON Climate and Renewables
c/o ARCADIS U.S., Inc.
Two Executive Drive, Suite 303
Chelmsford, MA, 01824

PREPARED BY:

Natural Resources Consulting, Inc. ***now Stantec Consulting Services, Inc.***
2300 Swan Lake Boulevard
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1.0 INTRODUCTION

Wind energy is one of the fastest growing sources of renewable energy in the United States (AWEA 2007). However, construction and operation of wind energy projects has the potential to impact bird and bat populations through habitat fragmentation, displacement, and mortality due to collision with or proximity to Wind Turbine Generator (WTG) blades. An important step in the process of siting and developing potential wind energy sites is to evaluate wildlife use for the project area. Stantec (formerly NRC) was retained to perform a bat screening analysis and one activity season of pre-construction bat activity surveys at the Wildcat Wind Farm.

1.1. Background Information Regarding Bat Mortality at Wind Farms

Commercial wind facilities have been found to affect many bat species (Arnett et al. 2008). These impacts may include displacement of individuals, fragmentation of habitat, and direct mortality from collisions with or proximity to WTG blades (Kunz et al. 2007a). Whether bats are attracted to WTGs and the exact mechanisms by which WTGs cause mortality are unclear (reviewed in Kunz et al. 2007b); however, several hypotheses have recently been put forth and tested, including the role of land cover and environmental conditions in attracting bats to WTG sites, behavioral factors that might make WTGs attractive to bats, pressure changes from rotating blades causing “barotrauma”, or direct impact of unsuspecting migrant bats (Baerwald et al. 2008; Horn et al. 2008; Johnson et al. 2004; Kerns et al. 2005; reviewed in Kunz et al. 2007b). Determining the effects of wind farms on bats is of critical importance to the future conservation of these poorly understood mammals.

The influence of landcover on bat mortality at WTG sites is unclear (Arnett et al. 2008). Johnson et al. (2004), for example, found no significant relationship between bat fatalities and landcover type within 100 meters of WTGs. They also found no significant relationship between bat mortality and distance to wetlands or woodlands (Johnson et al. 2004). Weather conditions, such as wind speed, rainfall, and temperature, have a significant impact on bat mortalities (Arnett et al. 2008). Bat mortality and insect activity are high on nights with low wind speed when WTGs are adjusted to rotate near their maximum revolutions per minute (rpm) (Kerns et al. 2005). Bat fatalities drop with increases in wind speed and precipitation intensity (Kerns et al. 2005).

The primary bat species affected by wind facilities are believed to be migratory, foliage- and tree-roosting species that mostly emit low frequency calls (Johnson et al. 2004; reviewed by Kunz et al. 2007b). Arnett et al. (2008) compiled data from 21 studies at 19 wind facilities in the United States and Canada and found that mortality has been reported for 11 of the 45 bat species known to occur north of Mexico. Of the 11 species, nearly 75% were the migratory, foliage roosting Hoary Bat (*Lasiurus cinereus*), Eastern Red Bat (*Lasiurus borealis*), and Silver-haired Bat (*Lasionycteris noctivagans*) (Kunz 2007a).

Prior to September 2009, no mortality of species listed as threatened or endangered under the federal Endangered Species Act had been reported, including the Indiana Bat (*Myotis sodalis*) (Arnett et al. 2008). In September 2009, the first documented take of an endangered Indiana Bat at a wind facility occurred at BP Wind Energy’s Fowler Ridge wind farm located in Benton County, Indiana.

Some researchers have suggested that bats that roost in foliage of trees for most of the year may be attracted to WTGs because of their migratory and mating behavior patterns (e.g. Kunz et al. 2007b; Cryan 2008). At dawn, these tree bats may mistake wind WTGs for roost trees, thereby increasing the risk of mortality (Kunz et al. 2007b). Cryan (2008) suggested that male

tree bats may be using tall trees as lekking sites, calling from these sites to passing females. If this is the case, then tree bats may be more attracted to WTG sites post-construction. Migrating tree bats are also thought to depend on sight for navigation rather than echolocation, possibly resulting in the bats being unaware of the presence of WTGs during migration (Cryan and Brown 2007). As further support for these hypotheses, the majority of bat fatalities occur mid-summer through fall, approximately the same time frame as southward migration of tree bats (Arnett et al. 2008). Tree bats tend to be larger species that emit low frequency calls. Bats that use low frequency calls may be more inclined to forage above the treeline where there are few obstructions. Migratory bats may also fly higher to maximize efficiency. Thus, tree bats may be more likely to fly in the rotor swept zone of WTGs when compared to smaller bat species that have different foraging and migration strategies.

Although the number of bat fatalities recorded at wind facilities varies regionally, reports of mortality have been highest along forested ridgetops in the eastern U.S. and lowest in open landscapes of Midwestern and western states (Kunz et al. 2007b). However, it is difficult to make direct comparisons among projects due to differences in study length, metrics used for searches and calculations for compensating bias (Arnett et al. 2008). In the Midwestern U.S., bat fatalities range from 0.2 to 8.7 bats killed/megawatt (MW) generated, but higher fatality rates (up to 53.3 fatalities/MW generated) have been reported in the eastern U.S. (Arnett et al. 2008).

1.2. Project Description

The Wildcat Wind Farm is a state-of-the art wind energy project located in Tipton and Madison County, Indiana just north of the town of Elwood in Sections 31 and 32, T23N, R6E; Sections 5-11, and 13-36 T22N, R6E; Sections 1-2, 5-8 T21N, R6E; Sections 1, 11-12, T21N, R5E; Section 6 T21N R7E (Figure 1).

Currently, the wind project is proposed to be a 200 MW farm with 1.6 MW wind turbine generators (WTGs) and associated access roads and collector line system. Steel reinforced concrete foundations will be constructed to anchor each WTG. A pad mount transformer will be installed at the base of each WTG and will collect electricity generated by each turbine through cables routed down the inside of the tower.

An underground power collection system will be trenched in between the pad mount transformers and a collector substation. This power collection system will consist of a series of underground cables ranging from approximately 2 to 5 inches in outside diameter. In addition to the WTGs and power collection system, the Wildcat Wind Farm project will construct service roads allowing access to the turbines during and after construction.

The site is located immediately north of the town of Elwood. Land use throughout much of the project area is dominated by agriculture (i.e. rowcrops and pasture); however, several creeks and unnamed drainageways are found throughout the project limits (Figure 2). Forest cover is limited throughout the project area (Figure 2).

1.3. Purpose and Objectives

The purpose of this report is to identify and summarize general bat use within the project area, based on review of existing literature and data collected during surveys. The process used to evaluate the project area generally follows recommended project siting guidelines of the U.S. Fish and Wildlife Service (2010).

The objectives of the pre-construction bat use surveys have been developed to provide a scientific pre-permitting/pre-construction bat study of sufficient duration and focus to address the potential impact concerns through collection of site-specific baseline data. The survey objective is to characterize general bat use by collecting site-specific baseline data on bat species activity, richness, frequency, and behavior in order to:

1. Estimate the spatial and temporal extent of bat use of the project area;
2. Determine the spatial and temporal extent of rare bat species use of the project area;

This report includes the results of literature and database reviews and observations made during pre-construction field surveys.

2.0 METHODS

2.1. Bat Screening Analysis and Baseline Data Collection

Information on the ecology and distribution of bats is sparse for the entire upper Midwestern United States, including Indiana (Kurta 2000; Whitaker and Mumford 2008). Therefore, the bat screening analysis relied on what little information currently exists, which included a review of publicly available literature and bat resources. Indiana Gap Analysis Program (GAP) landcover data were used to provide information on available habitat and sensitive environmental areas that may influence bat abundance, distribution, or movement within or near the project area. Each of these screening level components is described in more detail below.

2.1.1. Bat Data Acquisition and Analysis

A literature and database review was used to identify bat species known to occur within or in close proximity to the project area, including review of distribution and ecological information provided by Bat Conservation International (BCI; www.batcon.org). BCI is the foremost bat conservation association in the world. Headquartered in Austin (TX) and founded in 1982, BCI currently has a membership of over 14,000 individuals, spread across 70 countries. They have been involved in cutting edge research and educational products on the subject of bat ecology and conservation. BCI provides not only accessible information on bat ecology, but also provides recommendations on how to monitor and conserve them on a global scale. In addition, literature resources, such as Harvey et al. (1999), Kurta (2000) and Whitaker and Mumford (2008) were reviewed for general ecology and distribution information regarding species found in Indiana.

2.1.2. Spatial Data Acquisition and Landcover Analysis

In addition to bat data acquisition, aerial photograph interpretation via a Geographic Information System (GIS) was used to locate and evaluate land features within the project area. Spatial data layers used in the GIS included base orthophotography, the 24K hydrology layer, USGS 24K topography, and Indiana GAP Landcover data. A desktop review of maps and GIS data was performed to evaluate the physical attributes of the project area, as well as the sensitive environmental areas within or near the project area that may influence bat movement and concentration patterns. Examples of physical attributes that could influence bat use include project size, topography, weather, infrastructure, and environmental corridors. Examples of sensitive environmental areas include State or County Natural Areas, State Wildlife Areas, and National Wildlife Refuges.

2.1.3. Indiana Bat Habitat Assessment

A desktop analysis was conducted to determine the presence of potential Indiana bat habitat within the project area. Suitable Indiana bat summer habitat is considered to have the following characteristics within a 0.5 mile radius of permanent water (USFWS Rock Island Field Office guidance 2010):

- Forest cover of 15% or greater
- One or more of the following tree species: shagbark and shellbark hickory that may be dead or alive, and dead bitternut hickory, American elm, slippery elm, eastern cottonwood, silver maple, white oak, red oak, post oak, and shingle oak with slabs or plates of loose bark
- Potential roost trees with 10% or more peeling or loose bark

Aerial photography and ArcMap GIS data were used to evaluate habitat suitability within the entire project area. A 0.5-mile radius plot was drawn centered on a permanent water source (e.g., perennial and intermittent streams, farm ponds, etc) to determine if the area met the 15% forest cover requirement within 0.5 mile of permanent water. For the purposes of this analysis, it was assumed that all waterways identified as “blue line” streams on USGS 1:24,000 scale topographic maps contained water for the majority of the year; however, the presence of water was not field verified. The area of the woodland tracts located within the 0.5 mile buffer was measured to determine the percent cover of woodland.

No walking surveys or field verification were conducted as part of this determination. Therefore, habitat suitability was based on the presence of 15% or greater forest cover within 0.5 mile of permanent water.

2.2. Pre-Construction Bat Activity Surveys

2.2.1. Acoustic Data Capture

Pre-construction bat activity surveys at the project site incorporated both stationary (i.e. passive) and mobile (i.e. active) echolocation detectors, which have been proven to be an acceptable methodology for bat/wind farm screening (e.g., Kunz et al. 2007a; Redell et al. 2006). These detectors record the real-time ultrasonic calls emitted by echolocating bats. The data produced by these detectors are sonograms of the bat calls recorded by the unit’s receiver. In many cases, bat calls can be identified to species group, and tallied. In addition, the number of “bat passes”, or times in which a bat was recorded by the receiver, can be determined, which yields a rough estimate of activity or bat use of the area being sampled. Bat activity surveys were conducted at the site from 17 April through 4 November 2010. Surveys were divided among time periods, or seasons, generally recognized as appropriate for pre-construction screening level surveys at wind farms (Table 1).

Table 1. Timing and frequency of bat surveys conducted at the Wildcat Wind Farm (Tipton and Madison Counties, Indiana)

Screening Survey Period	2010																											
	April				May				June				July				August				September				October			
Spring Migration		x	x	x	x	x																						
Summer										x		x																
Fall Migration															x		x	x	x		x		x		x		x	

Seasonal stationary detector survey periods

x Mobile field survey visits

2.2.1.1. Stationary Survey

Stationary detectors were used to determine species presence and relative activity levels at varying heights. One Remote Bat Acoustic Technology System (ReBAT™; Pandion Systems, Inc., Gainesville, Florida) array was deployed on one 60-meter tall meteorological (MET) tower located within the project area (Figure 2).

Two receivers were deployed on the tower at different heights in a vertical transect to capture information about bat species flying at variable altitudes. Based on accepted methodology, receivers were placed at 16.5 ft (5 m) and 190 ft (58 m; within the rotor swept zone). Acoustic receivers were protected from the elements in weather-resistant aluminum housing units that are raised and lowered on a pulley system attached to the tower. To avoid microphone damage from precipitation, the microphones were positioned within the protective aluminum housing pointing straight down. A plastic reflector plate was attached to the aluminum housing at a 45° angle to allow for maximum bat detectability.

The array was programmed to record bat acoustic data nightly from one hour before sunset to one hour after sunrise. Recordings were triggered based on frequency (kHz) and decibel (dB). Recorded sound files were 1.7 seconds in duration. Data from the acoustic receivers were transmitted to a custom-built computer located at the base of the tower. The data were transmitted via cellular signal to Pandion Systems, Inc. for storage and then transmitted to Stantec staff for analysis. The entire system was powered through a series of batteries and solar panels. All critical components were secured and stored in weatherproof housing at the base of the portable tower.

2.2.1.2. Mobile Survey

Surveys with mobile hand-held Anabat detectors (Titley Electronics, Australia) were used to supplement stationary surveys. Landcover analysis was used to select transect locations. Transects were ground-truthed on-site to ensure the selected locations were appropriate for mobile bat surveys. Six mobile transects were selected along roads within the project area (Figure 2). Survey routes were selected in a variety of habitat types to adequately represent the project area (e.g., agricultural fields, woodlots, wetlands or stream corridors). Transects were driven at a slow rate of speed (<5 mph) by surveyors while holding the mobile bat echolocation detector outside of the vehicle. Hand-held units have a limited range and only detect bats in the lower altitudes. However, by conducting mobile surveys, the chances of detecting a species or species group not captured by detectors on the MET tower are increased because the surveyor could follow a bat as it was calling and record long call sequences suitable for call identification.

A total of 15 mobile surveys were conducted (spring-5, summer-2, fall-8), with emphasis placed on the critical fall migration period (Table 1). This information was used for comparison with data from stationary detectors on the MET tower to determine variation in bat activity based on location within the project area.

2.2.2. Acoustic Data Analysis

2.2.2.1. Stationary Survey

Qualitative analysis of echolocation calls recorded by the ReBAT™ unit was performed on all operational detector nights using SCAN'R (Binary Acoustic Technology 2007) filtering software to remove noise files. Stantec staff further filtered the files using the Sonobat Batch Scrubber 3 (Sonobat, Arcata, CA).

2.2.2.2. Mobile Survey

To analyze sound files recorded with Anabat detectors, a rough "activity filter" was created in AnalookW Software v. 3.7i (Titley Electronics, Australia). This filter was designed to eliminate non-bat noise. The filter parameters were mainly the settings of the default filter, with slight modifications: minFc=12, maxFmean=90, minFmean=12, smooth=80 and bodyover=1000 microseconds. Files retained by the filter were visually inspected to confirm that the associated sound was produced by a bat. Files containing confirmed bat calls were then analyzed by applying slight modifications to the existing activity filter that divided call sequences into either a "low frequency species" category (highstart=yes, smooth=12, maxFmin=34) or a "high frequency species" category (highstart=yes, smooth=12, minFmin=35). Bat passes were considered any file with equal to or greater than one call or pulse. The total number of bat files, and the number that met the criteria in each frequency category were summed.

2.2.2.3. Call Classification

Data collected were analyzed by trained Stantec staff using SonoBat v. 2.9.5 and 3.0.5 acoustic analysis software (stationary data) and AnalookW Software v. 3.7i (Titley Electronics, Australia) (mobile data). Bat activity was measured by the number of "bat passes", or times in which a bat was recorded by the receiver, which yields a rough estimate of activity or bat use of the area being sampled. A "pass" was defined as any file with ≥ 2 echolocation pulses. Bat pass data represent levels of activity rather than numbers of individuals because individuals cannot be distinguished by their calls. The total number of bat passes divided by the number of detector nights (i.e. one detector for one night = one detector night) was used as an index of bat activity.

Bat calls were classified as either high frequency (≥ 34 kHz) bats (e.g., Eastern Red Bat *(Lasiurus borealis),* Little Brown Bat *(Myotis lucifugus*), Northern Myotis (*Myotis septentrionalis*), Indiana Bat (*Myotis sodalis*), Tri-colored Bat (*Perimyotis subflavus*) and Evening Bat (*Nycticeius humeralis*)), or low frequency (<34 kHz) bats (e.g. Big Brown Bat (*Eptesicus fuscus*), Silver-haired Bat (*Lasionycteris noctivagans*) and Hoary Bat (*Lasiurus cinereus*)).

The Sonobat Batch Scrubber 3 rejects calls less that 2 msec and those with weak signals. As a result, some poor quality, unclassifiable calls will get filtered (scrubbed) out. These unclassifiable calls are the weakest calls and are not classifiable as high or low frequency or for species identification. However, in order to accurately represent total bat activity at the site, the number of unclassifiable calls that were scrubbed out (i.e. false negatives) was estimated and added to the total classifiable calls to produce an adjusted total bat activity number.

The number of unclassifiable calls was estimated by analyzing the scrubbed files of a random sample of 25% of the survey nights distributed among the three seasons (i.e. spring, summer, and fall). The scrubbed files for each of the sample nights were visually inspected to determine the number of false negative calls. A correction factor was then calculated by dividing the total number of false negatives in the random sample by the total number of bat calls (false negatives + positives) in the random sample. The total number of classifiable bat passes for the activity season was then multiplied by the correction factor to produce the estimated total unclassifiable bat passes for the activity season.

2.2.2.4. Species Identification

Where possible, attempts were made to identify bat species or species groups (e.g. *Myotis*) utilizing high quality bat passes and comparing those calls with the species' known call parameters and with known calls found in established call libraries. Although each bat species has specific call characteristics, there is considerable overlap among call parameters between species. In addition, bats can vary their calls based on habitat conditions (e.g. open vs. cluttered environments). Due to the known overlap in echolocation call characteristics occurring among some sympatric species (i.e. closely related species occurring in the same geographic area) (Barclay 1999), a portion of the acoustic data was classified to species groups rather than to individual species. Classification to species or species group was possible only for calls with a low signal-to-noise ratio and minimal echo. If the species or species group could not be determined because of call quality, or if calls were assignable to more than three species due to overlap in echolocation call parameters, the call was categorized as "unknown."

3.0 RESULTS

3.1. Bat Screening Analysis and Baseline Data Collection

3.1.1. Project Specific Landcover Characteristics

Landcover within the project area is highly agricultural (i.e. rowcrop and pastureland), with narrow wooded drainageways and small woodlots scattered across the site (Figure 2). Indiana GAP landcover data indicate a total of eight landcover categories within the project area, including cultivated crops, grassland/pasture, deciduous woodland/forest, open water and developed land (Table 2; Figure 3). Of these, cropland comprises 93.2% of the project area, with the next most abundant landcover type being developed land (5.2%). Deciduous forest comprises <1% of the landcover (Table 2; Figure 3).

Table 2. Landcover type and amount within the proposed project area determined through analysis of Indiana GAP Landcover Data

Landcover	Total Acres	Percent of Total
Cultivated Crops	24801.4	93.2
Developed	1392.6	5.2
Deciduous Forest	164.0	0.6
Grassland/Herbaceous	135.3	0.5
Pasture/Hay	89.0	0.3
Shrub/Scrub	21.1	0.1
Emergent Herbaceous Wetlands	2.7	0.01
Woody Wetlands	2.5	<0.01

Four named streams are located within the project area: Poley Walk Creek in the north central portion of the project area; Big Duck Creek and Little Duck Creek along the eastern edge of the project area; and Polywog Creek immediately west of the town of Elwood along the southwestern edge of the site (Figure 2). A series of unnamed streams are present throughout the project area (Figure 2). In general, the woodlots and wooded riparian areas that are present in the project area tend to be fragmented, small and/or narrow.

Several bat species native to Indiana prefer woodlands for feeding or roosting at some time during the year. In addition, many species of bats feed along wooded stream corridors or over water. Several of the more common species, such as the Little Brown Bat and Big Brown Bat, are known to roost in attics or the peaks of other large buildings. Natural habitat features or resource areas that typically attract bats are limited within the project area. However, large outbuildings associated with agricultural settings may provide suitable roosting locations for some of the more common bat species.

3.1.2. Designated Natural Resource Areas

No designated natural resource areas occur within or near the project area. Three natural areas are located within 20 miles of the project area:

- Botany Glen – A 45 acre forested tract located approximately 12.5 miles to the northeast of the project area.

- Ginn Woods – Located 17 miles east of the project area, this woodland is a 161 acre area that has the second largest stand of old growth forest in Indiana. Managed by Ball State University.

- Mounds State Park – A 290 acre area managed by the Indiana Department of Natural Resources (DNR) located 16 miles to the southeast of the project area.

Woodlands associated with all three areas may provide both roosting and foraging habitat for bats.

3.1.3. Bat Species Potentially Present and Species of Concern

A total of 12 species of bats occur in Indiana. Nine species, all members of the family Vespertilionidae, have geographic distributions that include Tipton and Madison counties (Simon et al. 2002; Whitaker and Mumford 2008; Batcon.org 2010) (Table 3). Of these, the Indiana Bat (*Myotis sodalis*) is listed as Indiana-state and federally endangered, and the

Evening Bat (*Nycticeius humeralis*) is listed as Indiana-state endangered. Six species, the Little Brown Bat (*Myotis lucifugus*), Northern Myotis (*Myotis septentrionalis*), Silver-haired Bat (*Lasionycteris noctivagans),* Red Bat *(Lasiurus borealis),* Hoary Bat *(Lasiurus cinereus),* and Tri-Colored Bat (*Perimyotis subflavus)*, are listed as special concern species by the Indiana DNR (IDNR 2010). The Big Brown Bat (*Eptesicus fuscus*) is the only one of the nine bat species potentially found in the project area that is not listed as either endangered or special concern. Currently, a petition has been submitted to the USFWS requesting that the Northern Myotis and Little Brown Bat be listed under the Endangered Species Act. At present, these species are not yet listed; however, it may be prudent to consider these species during the project planning process.

No records of Indiana Bats are known from either Tipton or Madison counties (USFWS 2007). However, maternity colonies and other summer records are known from several counties located immediately adjacent to Tipton and Madison counties (USFWS 2007). The closest known Indiana bat hibernaculum is Lewisburg Mine located in Preble County, Ohio, approximately 75 miles to the southeast of the site (USFWS 2007).

All nine bat species use woodland habitat for feeding or roosting at some time during the year. In addition, many species of bats feed along stream corridors or over water. A limited number of narrow, linear tracts of woodland associated with stream corridors and small woodlots associated with farmsteads are found within the project area (Figure 2). These areas may, at times, provide potentially suitable foraging and roosting habitat for bats.

Indiana GAP data were used to identify those areas that may provide Indiana Bat habitat. GAP predicted areas are based on specific modeling criteria that produce a geographic range extent for the species. In addition, GAP data identify those areas with GIS features or conditions to which the species is likely to be associated. These areas are identified as possible habitat.

Indiana GAP data indicate approximately 16,280 acres of predicted Indiana Bat habitat in Madison County, and 2,874 acres of predicted Indiana Bat habitat in Tipton County. Indiana GAP data indicate approximately 146 acres of predicted Indiana Bat habitat within the project area, comprised primarily of small woodlots associated with farmsteads that are scattered across the site.

Approximately 164 acres of forest is found within the project area (Table 2; Figure 3). Results of the desktop Indiana Bat habitat assessment indicate that no woodland tracts within the project area meet the minimum forest cover requirement of >15% for suitable Indiana Bat summer habitat; therefore, no suitable summer habitat is present within the project area. However, suitable summer habitat may be present in areas outside of the project area. While suitable summer habitat may not be present in the project area, due to the site's location within the known geographic range of the Indiana Bat, the potential does exist for Indiana Bats to migrate through the project area.

Although the desktop assessment indicates that no suitable Indiana Bat habitat is present within the current project boundary, habitat impacts are not the only potential impacts to Indiana Bats posed by a wind facility. Although it may be possible to avoid impacts to Indiana Bat habitat all together, the presence of the turbines, even in open, non-forested areas, may pose a risk of bat mortality due to rotor strikes and/or barotrauma.

Table 3. Abundance, call frequency group and winter habits of bat species with potential to occur in Tipton and Madison Counties, Indiana.

Scientific Name	Common Name	Abundance[1]	Frequency Group[2]	Winter Habits
Myotis lucifugus	Little Brown Bat	Common Locally Special Concern Species	High	Short Distance Migrants (<300 km)
Myotis sodalis	Indiana Bat	Rare (Federal and State Endangered) Species of Greatest Conservation Need	High	Short Distance Migrants (<300 km)
Myotis septentrionalis	Northern Myotis	Common Locally Special Concern Species	High	Short Distance Migrants (<300 km)
Lasionycteris noctivagans	Silver-haired Bat	Common Locally Special Concern Species	Low	Long Distance Migrants (>500 km)
Perimyotis subflavus	Tri-colored Bat	Common Locally Special Concern Species	High	Short Distance Migrants (<300 km)
Eptesicus fuscus	Big Brown Bat	Common Locally	Low	Short Distance Migrants (<300 km)
Lasiurus borealis	Eastern Red Bat	Common Locally Special Concern Species	High	Long Distance Migrants (>500 km)
Lasiurus cinereus	Hoary Bat	Common Locally Special Concern Species	Low	Long Distance Migrants (>500 km)
Nycticeius humeralis	Evening Bat	Uncommon Special Concern Species	High	Probably Long Distance Migrant

[1]Indiana Department of Natural Resources 2010.

[2]Low frequency bats are considered to be those using calls in which the highest minimum frequency is 34 kHz, while high frequency bats are considered to be those using calls in which the lowest minimum frequency is ≥34 kHz.

3.2. Pre-Construction Bat Activity Surveys

The ReBAT™ unit was operational between 17 April and 4 November, for a total of 402 detector nights (one detector for one night = one detector night; therefore, there are two detector nights for each night that both detectors are operational). Bats were recorded on 167 of 201 (83.1%) survey nights at the tower. A summary of ReBAT™ operational data by season is shown in Table 4.

Table 4. Summary of ReBAT™ operational Data by Season at the Wildcat Wind Farm (Tipton and Madison County, Indiana, 2010)

	No. Survey Nights	No. Detector Nights[1]	No. Survey Nights Bats Recorded	% of Survey Nights Bats Recorded
Spring	29	58	18	62.1
Summer	61	122	54	88.5
Fall	111	222	95	85.6
Total	**201**	**402**	**167**	**83.1**

[1]One detector for one night = one detector night

A total of 1509 classifiable bat passes (mean = 3.8 passes/night) were recorded by the stationary detectors during the activity season (Table 5). It is estimated that 291 unclassifiable passes were removed during the filtering process. Therefore, the adjusted total bat passes for the 2010 activity season at the Wildcat Wind Farm is 1800 (mean = 4.5 passes/night) (Table 5). Bat activity by month is shown in Figure 4. Total bat activity at the site was fairly consistent from May through September, with August recording the most activity.

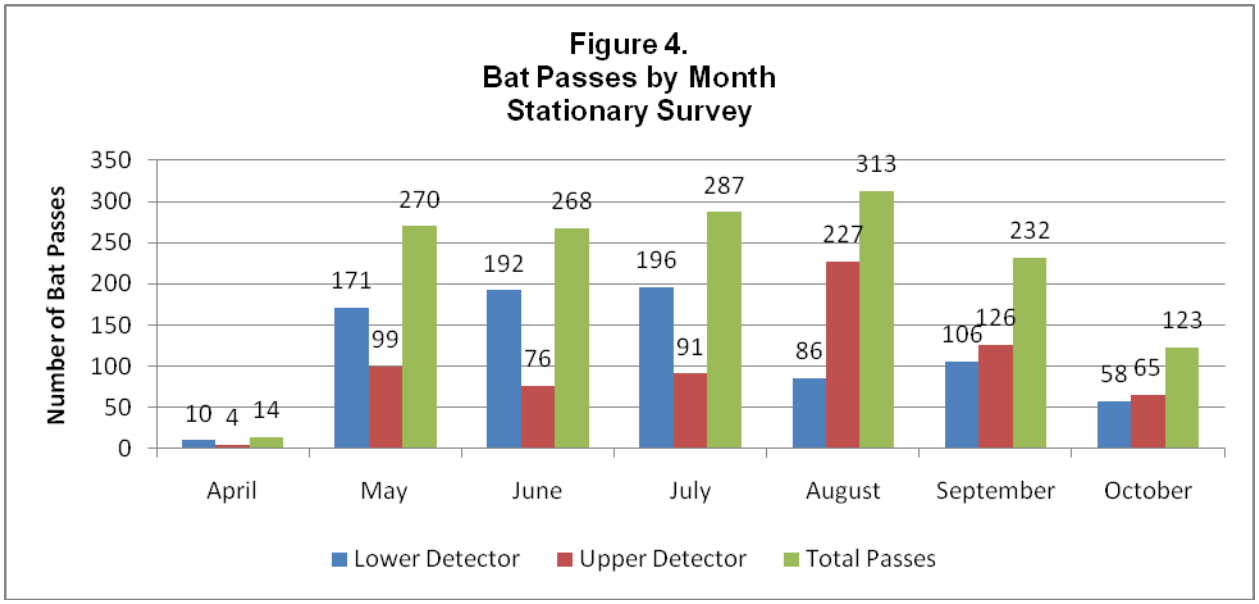


Table 5. Summary of bat passes (mean per night) by detector height, season and frequency group for stationary pre-construction surveys at the Wildcat Wind Farm (Tipton and Madison County, Indiana, 2010).

	5 Meter		58 Meter		Total	
Spring						
Low Freq. Bat Passes	56	(1.9)	19	(0.7)	75	(1.3)
High Freq. Bat Passes	6	(0.2)	0	(0.0)	6	(0.1)
Total Passes (Spring)*	**63**	**(2.2)**	**20**	**(0.7)**	**83**	**(1.4)**
Summer						
Low Freq. Bat Passes	429	(7.0)	182	(3.0)	611	(5.0)
High Freq. Bat Passes	17	(0.3)	7	(0.1)	24	(0.2)
Total Passes (Summer)*	**458**	**(7.5)**	**197**	**(3.2)**	**655**	**(5.4)**
Fall						
Low Freq. Bat Passes	241	(2.2)	410	(3.7)	651	(2.9)
High Freq. Bat Passes	35	(0.3)	35	(0.3)	70	(0.3)
Total Passes (Fall)*	**300**	**(2.7)**	**471**	**(4.2)**	**771**	**(3.5)**
Total Low Frequency Passes for Activity Season	**726**	**(3.6)**	**611**	**(3.0)**	**1337**	**(3.3)**
Total High Frequency Passes for Activity Season	**58**	**(0.3)**	**42**	**(0.2)**	**100**	**(0.2)**
Total Classifiable Passes for Activity Season*	**821**	**(4.1)**	**688**	**(3.4)**	**1509**	**(3.8)**
Est. Total Unclassifiable Passes for Activity Season			**291**			
Adjusted Total Passes For Activity Season			**1800**	**(4.5)**		

*Some recorded bat sound files contained both low and high frequency species or were too poor quality to characterize the call by frequency group. Therefore, the sum of bat passes for these groups may not equal the "Total Passes" recorded.

During the 90 mobile surveys (15 surveys of 6 transects), 93 definitive bat passes (mean = 1.0 pass/transect/night) were recorded (Table 6). Among the transects, Transect 5, located along the west fork of Big Duck Creek in the east central portion of the project area (Figure 2), recorded the highest number of total bat passes at 22 (mean = 1.5/night) (Table 6). Transect 2 and 3, located in the west central half of the project area (Figure 2), recorded the lowest total number of bat passes at only 8 (mean = 0.5/night) (Table 6).

Table 6. Bat passes (mean per transect per survey night) by season for mobile pre-construction surveys at the Wildcat Wind Farm (Tipton and Madison Counties, Indiana, 2010).

	Transect 1	Transect 2	Transect 3	Transect 4	Transect 5	Transect 6
Low Frequency Bat Passes	8 (0.5)	5 (0.3)	8 (0.5)	15 (1.0)	14 (0.9)	15 (1.0)
High Frequency Bat Passes	10 (0.7)	3 (0.2)	0 (0.0)	1 (0.1)	5 (0.3)	2 (0.1)
Total Passes	19 (1.3)	8 (0.2)	8 (0.5)	16 (1.1)	22 (1.4)	20 (1.3)
Total Passes for Activity Season*	93 (1.0)					

*Some recorded bat sound files contained both low and high frequency species. Therefore, the sum of bat passes for these groups may not equal the "Total Passes" recorded.

3.2.1. Bat Species and Frequency Groups Detected During Surveys

Using classifiable calls and files that contained high quality bat passes, a species list was developed for the project area. Approximately 73% of the 1509 classifiable calls recorded during the stationary survey and 71% of the 93 calls recorded during the mobile surveys were identifiable to species or species group (e.g. Big Brown Bat/Silver-haired Bat, *Myotis* sp.). Five bat species were confirmed to be present at the site:

- Big Brown Bat
- Silver-haired Bat
- Eastern Red Bat
- Hoary Bat
- Tri-colored Bat

None of the species recorded in the project area are listed as state or federally threatened or endangered. Four species detected during the survey, the Silver-haired Bat, Eastern Red Bat, Hoary Bat, and Tri-colored Bat, are listed as special concern species by the IDNR (Table 3; IDNR 2010). Four confirmed *Myotis* calls were recorded by the 5 m receiver during the stationary survey. A single call was recorded on 24 July, 27 July, 28 July and 5 August. All four calls exhibit characteristics found in both Little Brown Bat and Indiana Bat calls; however, due to the overlap in call characteristics between the two species, positive identification to species is not possible. Based on the detection zone of the receivers, bats recorded by the 5 m detector are not within the rotor swept zone (>38.75 m). One confirmed *Myotis* call was recorded during mobile surveys along Transect 5 on 10 May. *Myotis* calls represent 1.5% of the identifiable calls recorded during the mobile survey, but only 0.4% of the identifiable calls recorded during the stationary survey.

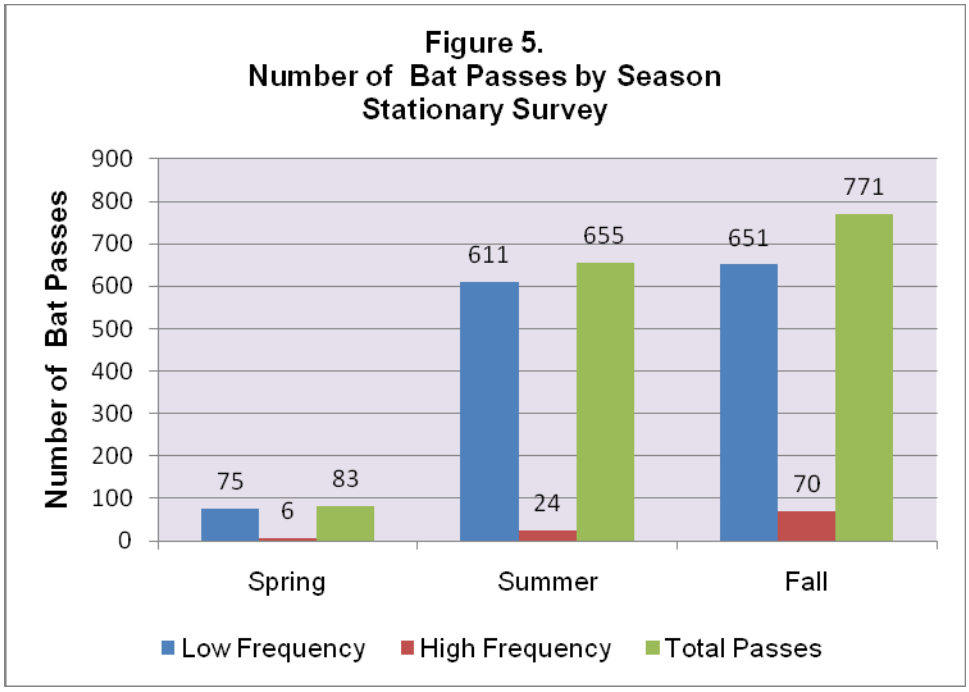
Four additional possible *Myotis* calls were recorded during stationary surveys, all at the lower receiver: one on 26 August; two on 28 August; and, one on 13 September. All four calls exhibit characteristics found in *Myotis* calls, but are also consistent with Red Bat calls; therefore, positive identification is not possible.

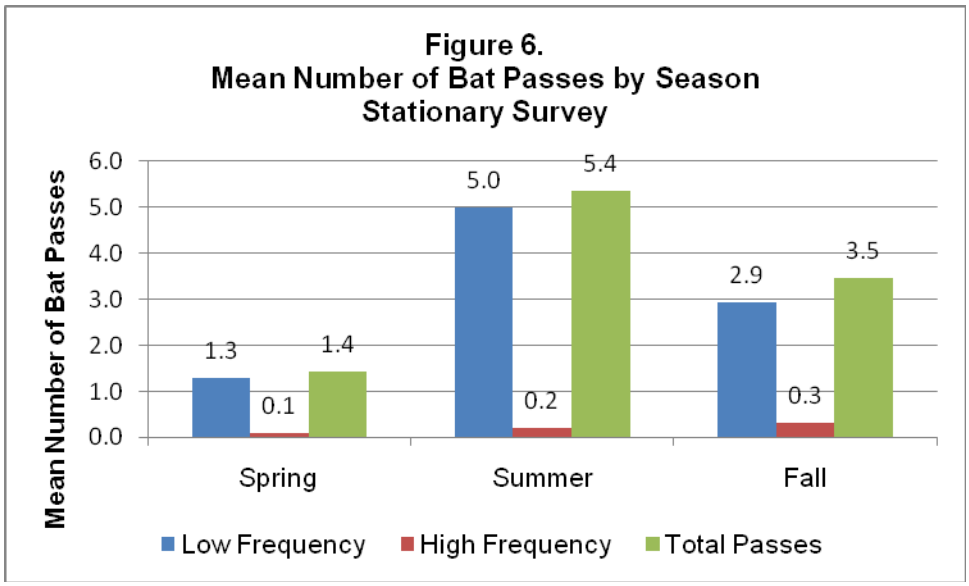
Both low and high frequency bat species were recorded during stationary and mobile surveys. During stationary surveys, specifically when all receiver heights and time periods are considered together, on average, low frequency species were recorded more often than high frequency

species (mean = 3.3 and 0.2 passes/night, respectively); and the total number of passes per species group was substantially greater for the low frequency species (1337 passes) vs. high frequency species (100 passes) (Table 5). During mobile surveys, passes from high frequency species (65 total passes; mean = 4.3 bats/night) were more than double that of low frequency species (28 total passes; mean = 1.9 bats/night) (Table 6).

3.2.2. Seasonal Distribution of Bat Activity

A summary of bat activity by season at the Wildcat Wind Farm site is shown in Figures 5 and 6 and a discussion by season is presented below.





3.2.2.1. Spring (15 April – 15 May)

The total number of bat passes at the stationary detector during the spring season (83) was the lowest among the three seasons; as well as having the lowest average number of passes/night (1.4) (Table 5; Figure 5 and 6). Low frequency species were recorded substantially more often than high frequency species during both the stationary and mobile surveys (Tables 5, 6 and 7). Total bat passes recorded during spring mobile surveys (12) was higher than in the summer (5), but only approximately 25% of what was recorded in the fall (76) (Table 7).

The approximate distribution of the classifiable bat passes recorded at the stationary unit where species identification was possible is shown below and in Figure 7:

- Silver-haired Bat 54%
- Big Brown Bat/Silver-haired Bat group 24%
- Hoary Bat 15%
- Red Bat 7%

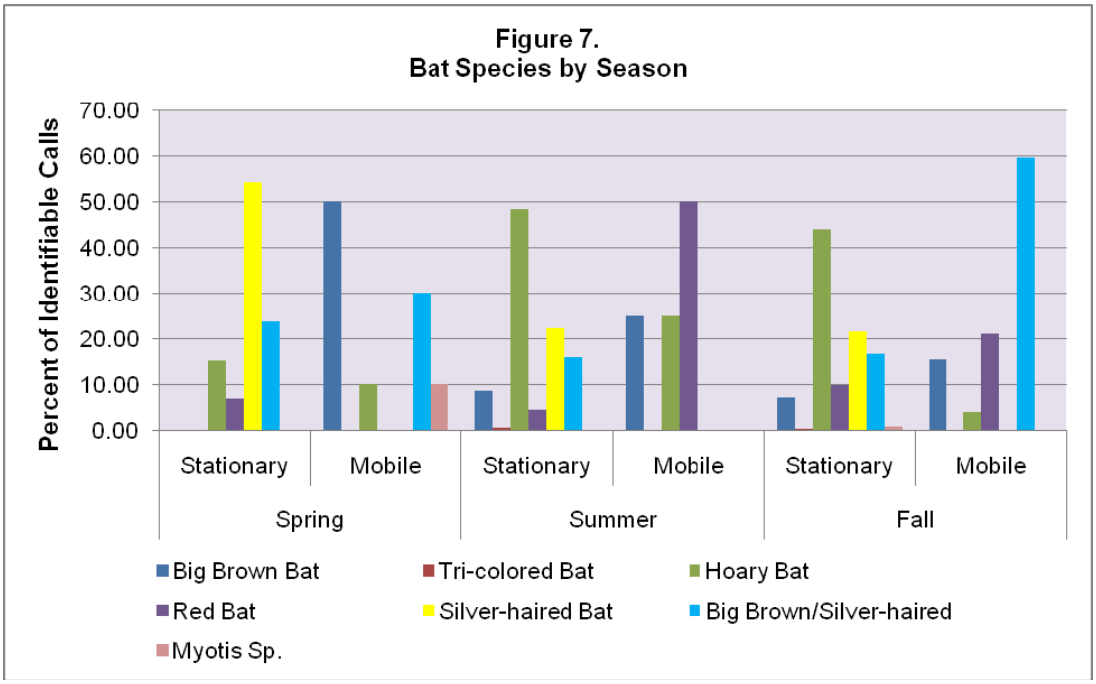
The approximate distribution of identifiable bat passes recorded during mobile surveys where species identification was possible is shown below and in Figure 7:

- Big Brown Bat 50%
- Big Brown Bat/Silver-haired Bat group 30%
- Hoary Bat 10%
- *Myotis* sp. 10%

Table 7. Bat passes (mean per transect per survey night) by season for mobile pre-construction surveys at the Wildcat Wind Farm (Tipton and Madison Counties, Indiana, 2010).

	Spring	Summer	Fall
Low Frequency Bat Passes	10 (0.3)	3 (0.3)	52 (1.1)
High Frequency Bat Passes	1 (0.0)	1 (0.1)	19 (0.4)
Total Passes	12 (0.0)	5 (0.4)	76 (1.6)
Total Passes for Activity Season*	**93 (1.0)**		

*Some recorded bat sound files contained both low and high frequency species. Therefore, the sum of bat passes for these groups may not equal the "Total Passes" recorded.



3.2.2.2. Summer (16 May – 15 July)

The total number of bat passes at the stationary detector during the summer season (655) increased substantially over what was observed during the spring season (83); and the average number of passes/night increased from 1.4 to 5.4 (Table 5; Figures 5 and 6). Low frequency species were recorded considerably more often than high frequency species (611 total passes vs. 24 total passes) (Table 5; Figures 5 and 6). Bat activity recorded during summer mobile surveys was lower than the spring season (5 total passes vs. 12 total passes), with only three low frequency bats and one high frequency bat recorded (Table 7).

The approximate distribution of the classifiable bat passes recorded at the stationary unit where species identification was possible is shown below and in Figure 7:

- Hoary Bat 48%
- Silver-haired Bat 22%
- Big Brown Bat/Silver-haired Bat group 16%
- Big Brown Bat 9%
- Red Bat 4%
- Tri-colored Bat <1%

The approximate distribution of identifiable bat passes recorded during mobile surveys where species identification was possible is shown below and in Figure 7:

- Red Bat 50%
- Big Brown Bat 25%
- Hoary Bat 25%

3.2.2.3. Fall (16 July – 31 October)

The total number of bat passes at the stationary detector during the fall season (771) was the highest among the three seasons; however, the average number of passes/night (3.5) was lower to that seen in the summer (5.4) (Table 5; Figures 5 and 6). Low frequency species were recorded at the stationary detector substantially more often than high frequency species (651 total passes vs. 70 total passes), as was the case in the summer (Table 5; Figures 5 and 6). Total bat passes recorded during fall mobile surveys (76) was six times that recorded in the spring (12) and 15 times that recorded in the summer (5) (Table 7).

The approximate distribution of the classifiable bat passes recorded at the stationary unit where species identification was possible is shown below and in Figure 7:

- Hoary Bat 44%
- Silver-haired Bat 22%
- Big Brown Bat/Silver-haired Bat group 17%
- Red Bat 10%
- Big Brown Bat 7%
- *Myotis* sp <1%
- Tri-colored Bat <1%

The approximate distribution of identifiable detections recorded during mobile surveys where species identification was possible is shown below and in Figure 7:

- Big Brown Bat/Silver-haired Bat group 60%
- Red Bat 21%
- Big Brown Bat 15%
- Hoary Bat 4%

3.2.3. Vertical Distribution of Bat Activity – Stationary Survey

More total bat calls were recorded at the 5 m height (821 total passes; mean = 4.1 passes/night) than at the 58 m height (rotor-swept zone) (688 total passes; mean = 3.4 passes/night) (Table 5; Figure 8). Bat passes at the 5 m height generally outnumbered those at the 58 m height from the beginning of the survey period (17 April) through 16 July, at which time, passes at the 58 m height exceeded those at the 5 m height and continued to do so for the most part through the end of the survey (3 November) (Figure 8). This change in activity at the 58 m height near the end of July through October coincides with the fall migration period.

Low frequency calls substantially outnumbered high frequency calls at both the 5 m height and 58 m height (rotor-swept zone) (Table 5; Figure 8). The total number of bat passes on a single day ranged from 0 – 39, with the largest daily total recorded on 25 September, of which, 79% were recorded at the 58 m height.

Red Bats, Hoary Bats, Silver-haired Bats, and Big Brown Bats were all detected at both detector heights (Figure 10). Tri-colored Bats and Myotis sp. were only detected at the 5 m height (Figure 10). Hoary Bats were the most frequently recorded species at both the 5 m and 58 m height. Within the rotor swept zone, the migratory, foliage roosting Red Bat, Hoary Bat and Silver-haired Bat were the most frequently recorded species, accounting for at least 67% of all detections, and 87% of all identifiable calls, at that height.

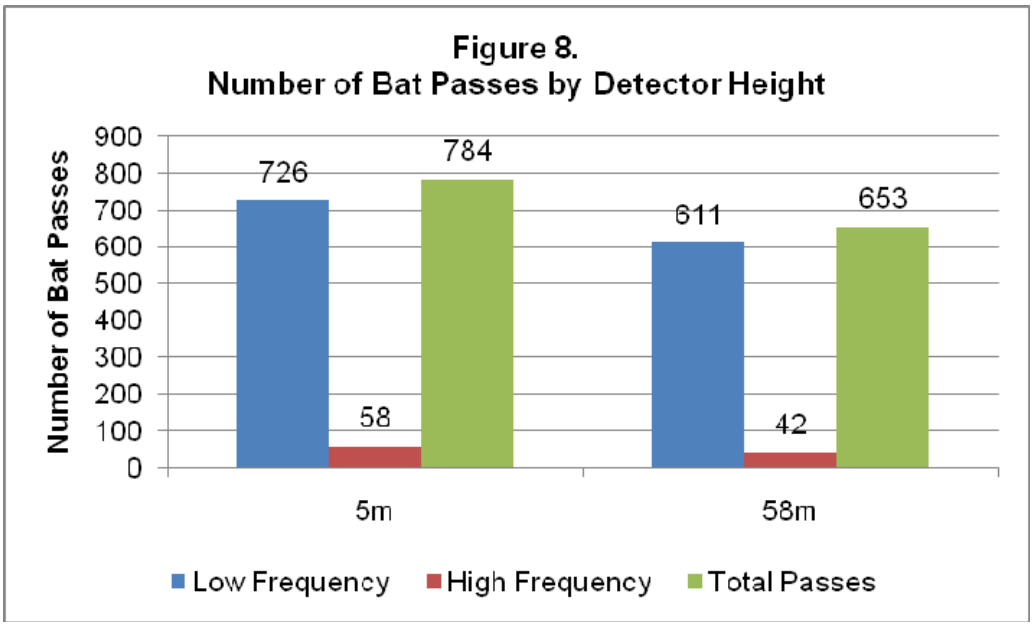


Figure 8.
Number of Bat Passes by Detector Height
Number of Bat Passes
900
800
700
600
500
400
300
200
100
0
726
58
784
611
42
653
5m
58m
Low Frequency
High Frequency
Total Passes

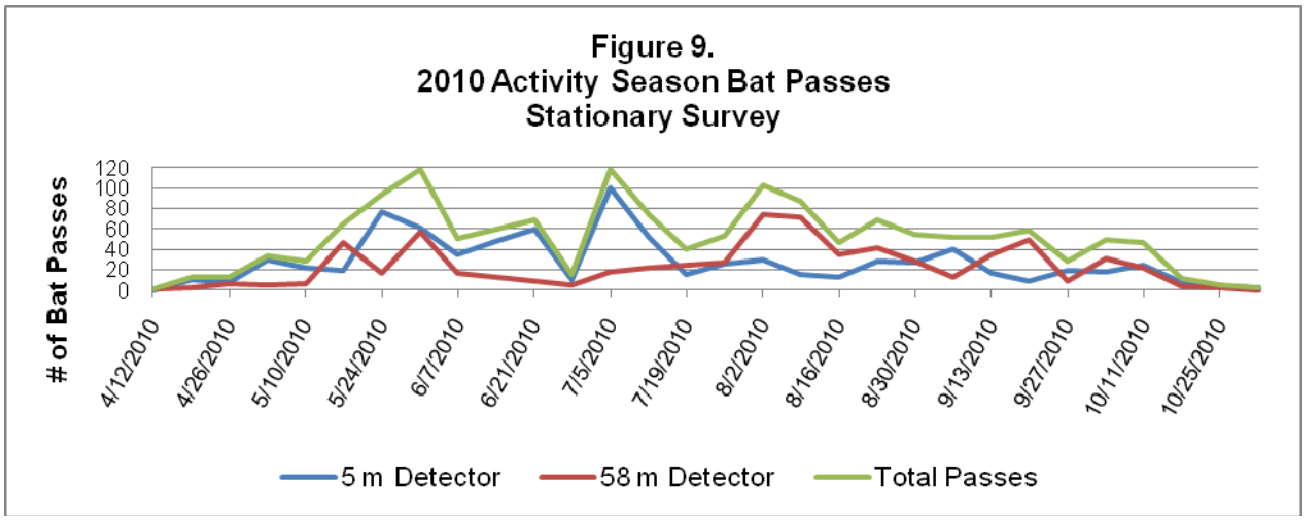
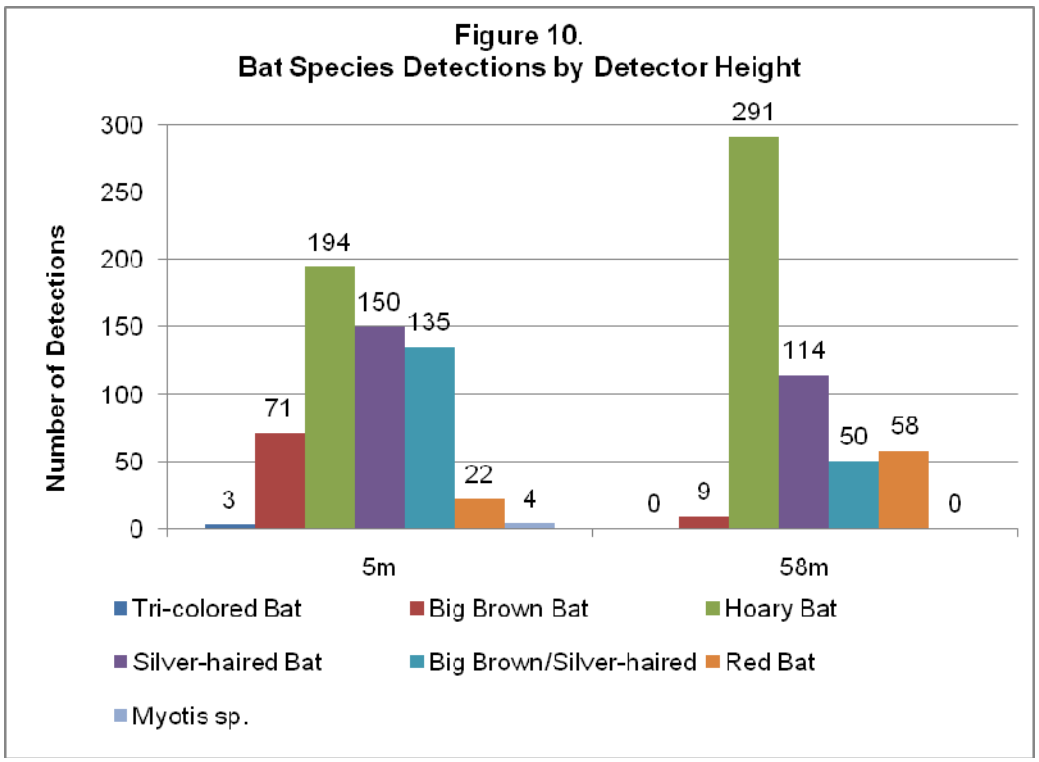


Figure 9.
2010 Activity Season Bat Passes
Stationary Survey
# of Bat Passes
120
100
80
60
40
20
0
4/12/2010
4/26/2010
5/10/2010
5/24/2010
6/7/2010
6/21/2010
7/5/2010
7/19/2010
8/2/2010
8/16/2010
8/30/2010
9/13/2010
9/27/2010
10/11/2010
10/25/2010
5 m Detector
58 m Detector
Total Passes



4.0 DISCUSSION

4.1. Summary and Conclusions

The Wildcat Wind Farm project area is located in an agricultural setting dominated by farmsteads, livestock operations, pastures and fields used for rowcrop production. Natural habitat features, such as woodlands, woodlots and wooded riparian corridors that typically attract bats, are limited within the project area, and those that are present, are often small and fragmented. Larger blocks of woodland are found outside of the project area to the northeast and southeast, including the Ginn Woods, Botany Glen, and Mounds State Park; however, the closet is at least 12.5 miles from the project area.

The majority of the bat species found in Indiana prefer to roost in woodlands and many species forage along wooded stream corridors or over water (Harvey et al. 1999; Whitaker and Mumford 2008). The Wildcat project area provides limited roosting or foraging habitat in the form of woodland or open water. Limited information is available on how bats use agricultural areas in the Midwest; however, species such as the Big Brown and Little Brown Bat will roost, and even overwinter, in attics or large buildings. The farmsteads located in the project area, with their farmhouses and large outbuildings, likely provide suitable roosting locations for species such as these. Likewise, buildings in the town of Elwood also likely provide suitable roosting and possibly overwintering sites for species such as the Big Brown and Little Brown Bat.

Bat activity at the stationary survey location (i.e. MET tower location), as measured by number of bat passes, was relatively average when compared to other wind farm sites in the Midwest. Table 7 provides a comparison of the bat activity at the Wildcat site with activity at other wind farm sites surveyed by Stantec in Iowa, Illinois and Wisconsin. Landcover within a project area, specifically forest cover, likely plays a large role in the amount of bat activity observed at a site.

Table 7. Comparison of bat activity at wind farms in the Midwest surveyed by Stantec.

Wind Farm Site Location	Total # Bat Passes (Mean/Night) Stationary Survey	Total # Bat Passes (Mean/Night) Mobile Survey	Land Use
Northeast Iowa	2313 (6.0)	105 (2.8)	83% Agricultural 2% Forest
Northwest Illinois	1905 (4.8)	196 (2.6)	>90% Agricultural >6% Forest
Wildcat Wind Farm	1800 (4.5)	93 (1.0)	93% Agricultural 0.6% Forest
Southwest Illinois	1721 (5.1)	26 (0.3)	90% Agricultural 1.2% Forest
East Central Wisconsin	1647 (3.9)	95 (1.5)	88% Agricultural 2% Forest
Eastern Illinois	1269 (3.2)	58 (0.6)	96% Agricultural <0.01% Forest
Central Iowa	183 (0.4)	95 (4.5)	81% Agricultural 0.1% Forest

Based on geographic distribution, nine of the 12 bat species known to occur in Indiana have the potential to be found in the Wildcat project area (Whitaker and Mumford 2008; Batcon.org). Five bat species, the Hoary Bat, Big Brown Bat, Eastern Red Bat, Silver-haired Bat, and Tri-colored Bat, were confirmed to be present during the survey. Of these, none are listed as threatened or endangered, but the Hoary Bat, Eastern Red Bat, Silver-haired Bat, and Tri-colored Bat are listed as a special concern species by the Indiana DNR (Table 3).

In addition to the species listed above, calls of species within the genus *Myotis* were also recorded in the project area. Five confirmed *Myotis* calls were recorded during the stationary and mobile surveys, representing only 0.3% of the total bat passes recorded at the site. Due to overlap in call characteristics between members of the genus *Myotis*, positive classification to species is not possible. However, based on habitat within the project area, it is likely that many of these calls are Little Brown Bats.

No records of Indiana Bats or Indiana Bat maternity colonies are known from Tipton or Madison counties (USFWS 2007). A habitat assessment conducted at the site indicates that no suitable Indiana Bat summer habitat is found within the project area, primarily due to the lack of sufficient forest cover. Nevertheless, habitat impacts are not the only potential impacts to Indiana Bats posed by a wind facility, and migratory risk could exist anywhere within the species' geographic range.

A total of 1800 stationary and 93 mobile bat passes, representing both low and high frequency species were recorded during the survey. On average, low frequency bats were recorded substantially more often than high frequency bats at the stationary detectors. However, because low frequency sound attenuates less quickly than high frequency sound, the receivers may detect low frequency sounds at greater distances; therefore, it is possible that low frequency bats may not be more common in the area, but rather that their calls are being recorded more frequently.

Bats were detected less often in the rotor-swept zone (i.e. 58 m height) during the spring and summer seasons, but more often in the rotor-swept zone during the fall, specifically between 16 July – 4 November. Red Bats, Hoary Bats, Silver-haired Bats, and Big Brown Bats were all recorded within the rotor-swept zone, with Red Bats, Hoary Bats and Silver-haired Bats being the most frequently recorded species, accounting for at least 67% of all detections, and 87% of all identifiable calls, at that height.

Post-construction and pre-construction data may not fully predict fatality risks (Cryan 2008). Although considerable variation exists in the data among projects, peaks in bat fatalities associated with numerous wind farms have been reported during late summer and fall (reviewed by Arnett et al., 2008). Bat activity at the Wildcat site was highest during the fall, with a rise in activity at the 58 m height near the end of July through October, coinciding with the fall migration period.

The results of this survey suggest that the Wildcat Wind Farm site has relatively average bat activity when compared to some other wind farm locations in the Midwest. No species listed as a state or federally threatened or endangered species were recorded during the survey. However, four species listed as special concern by the Indiana DNR were confirmed to be present. Currently, there are no published reports linking pre-construction activity rates to post-construction fatality rates, and therefore, it is not possible to accurately predict post-construction fatality rates.

4.2. Limitations of Pre-Construction Bat Activity Surveys

The results of the pre-construction bat activity survey should be viewed with the following limitations in mind:

1. Duration of the Survey – The survey included nightly passive survey events along a vertical transect in one location over the course of one activity season. Fifteen mobile surveys were conducted during this time as well. Because annual bat activity can vary due to weather, the results of this one activity season survey may not be representative of the full range of bat activity in the project area.

2. Spatial Limitations of Vertical and Mobile Transects – Due to resource limitations, vertical transects, which survey bat activity at the height of the rotor-swept zone, were only conducted in one location. Although mobile surveys were conducted at more locations throughout the project area, it is unlikely that handheld units could detect bats at the height of the rotor swept zone. This pre-construction survey has only assessed bat activity in a small fraction of the overall rotor swept zones that will be occupied by WTGs.

The results of this survey should be used as baseline information regarding bat activity in the area and cannot be used to accurately predict what, if any, bat mortality would occur as a result of operation of the Wildcat Wind Farm. A standard method of determining impacts to bats resulting from operation of a wind energy facility is to perform post-construction monitoring of bat species' presence, activity and mortality. If impacts are determined to be significant, then appropriate mitigation measures can be considered.

LITERATURE CITED

Aldridge, H. D. J. N., and I. L. Rautenbach. 1987. Morphology, echolocation, and resource partitioning in insectivorous bats. Journal of Animal Ecology, 56:763-778.

Arnett, E.B., W.K. Brown, W.P. Erickson, J.K. Fiedler, B.L. Hamilton, T.H. Henry, A. Jain, G.D. Johnson, J. Kerns, R.R. Koford, C.P. Nicholson, T.J. O'Connell, M.D. Piorkowski, and R.D. Tankersley. 2008. Patterns of bat fatalities at wind energy facilities in North America. Journal of Wildlife Management 72: 61-78.

American Wind Energy Association [AWEA]. 2007. AWEA Wind Energy Fact Sheets [Online]. Available http://awea.org/pubs/factsheets.html accessed August 17, 2007.

Baerwald, E.F., G.H. D'Amours, B.J. Klug, and R.M.R. Barclay. 2008. Barotrauma is a significant cause of bat fatalities at wind turbines. Current Biology 18: R695-R696. Canadian Wildlife Service. 2006. Wind turbines and birds: a guidance document for environmental assessment. Environment Canada, Canadian Wildlife Service. Gatineau, Quebec.

Barclay, R. M. R. 1999. Bats are not birds – A cautionary note on using echolocation calls to identify bats: A comment. Journal of Mammalogy, 80(1):290-296.

Cryan, P. M. 2008. Mating behavior as a possible cause of bat fatalities at wind turbines. Journal of Wildlife Management 72:845-849.

Cryan, P. M., and A. C. Brown. 2007. Migration of bats past a remote island offers clues toward the problem of bat fatalities at wind turbines. Biological Conservation 139:1–11.

Harvey, M.J., J.S. Altenbach, and T.L. Best. 1999. Bats of the United States. Published by the Arkansas Game and Fish Commission, In Cooperation with the Asheville Field Office of the U.S. Fish and Wildlife Service.

Horn, J.W., E.B. Arnett and T. H. Kunz. 2008. Behaviorial responses of bats to operating wind turbines. Journal of Wildlife Management 72(1):123-132.

Indiana Department of Natural Resources. July 2009. Indiana's Species of Greatest Conservation Need. Retrieved December 14, 2010 from http://www.in.gov/dnr/fishwild/files/fw-Indiana_Species_of_Greatest_Conservation_Need.pdf

Johnson, G.D., M.K. Perlik, W.P. Erickson, and M.D. Strickland. 2004. Bat activity, composition, and collision mortality at a large wind plant in Minnesota. Wildlife Society Bulletin 32:1278-1288.

Kerns, J, W. P. Erickson, and E. B. Arnett. 2005. Bat and bird fatality at wind energy facilities in Pennsylvania and West Virginia. Pages 24–95 in E. B. Arnett, editor. Relationships between bats and wind turbines in Pennsylvania and West Virginia: an assessment of bat fatality search protocols, patterns of fatality, and behavioral interactions with wind turbines. A final report submitted to the Bats and Wind Energy Cooperative. Bat Conservation International, Austin, Texas, USA.

Kunz, T.H., E.B. Arnett, B.M. Cooper, W.P. Erickson, R.P. Larkin, T. Mabee, M.L. Morrison, M.D. Strickland, and J.M. Szewczak. 2007a. Assessing impacts of wind-energy development on nocturnally active birds and bats: a guidance document. Journal of Wildlife Management 71:2449-2486.

Kunz, T.H., E.B. Arnett, W.P. Erickson, A.R. Hoar, G.D. Johnson, R.P. Larkin, M.D. Strickland, R.W. Thresher and M.D. Tuttle. 2007b. Ecological impacts of wind energy development on bats: questions, research needs and hypotheses. Frontiers in Ecology and the Environment 5:315-324.

Kurta, A. 2000. Mammals of the Great Lakes Region. University of Michigan Press, Ann Arbor, MI.

Redell, D., E.B. Arnett, J.P. Hayes, and M.M.P. Huso. 2006. Patterns of pre-construction bat activity determined using acoustic monitoring at a proposed wind facility in south-central Wisconsin. A final report submitted to the Bats and Wind Energy Cooperative. Bat Conservation International. Austin, TX, USA.

Simon, T.P., J.O. Whitaker, Jr., J.S. Castrale and S.A. Minton. 2002. Checklist of the Vertebrates of Indiana. Proceedings of the Indiana Academy of Science 101:95-126.

U.S. Fish and Wildlife Service. 2007. Indiana Bat (Myotis sodalis) Draft Recovery Plan: First Revision. Region 3, U.S. Fish and Wildlife Service, Fort Snelling, Minnesota. 258 pp.

U.S. Fish and Wildlife Service [USFWS]. 2010. Wind Turbine Guidelines Advisory Committee Recommendations. Washington, DC. 84 pp.

Whitaker, Jr., J. O. and W. J. Hamilton, Jr. 1998. Mammals of the eastern United States. Comstock Publishing Associates, Cornell University Press, Ithaca, NY. 583 pp.

Whitaker, Jr., J. O. and R. E. Mumford. 2008. Mammals of Indiana. Indiana University Press, Bloomington, IN. 668 pp.

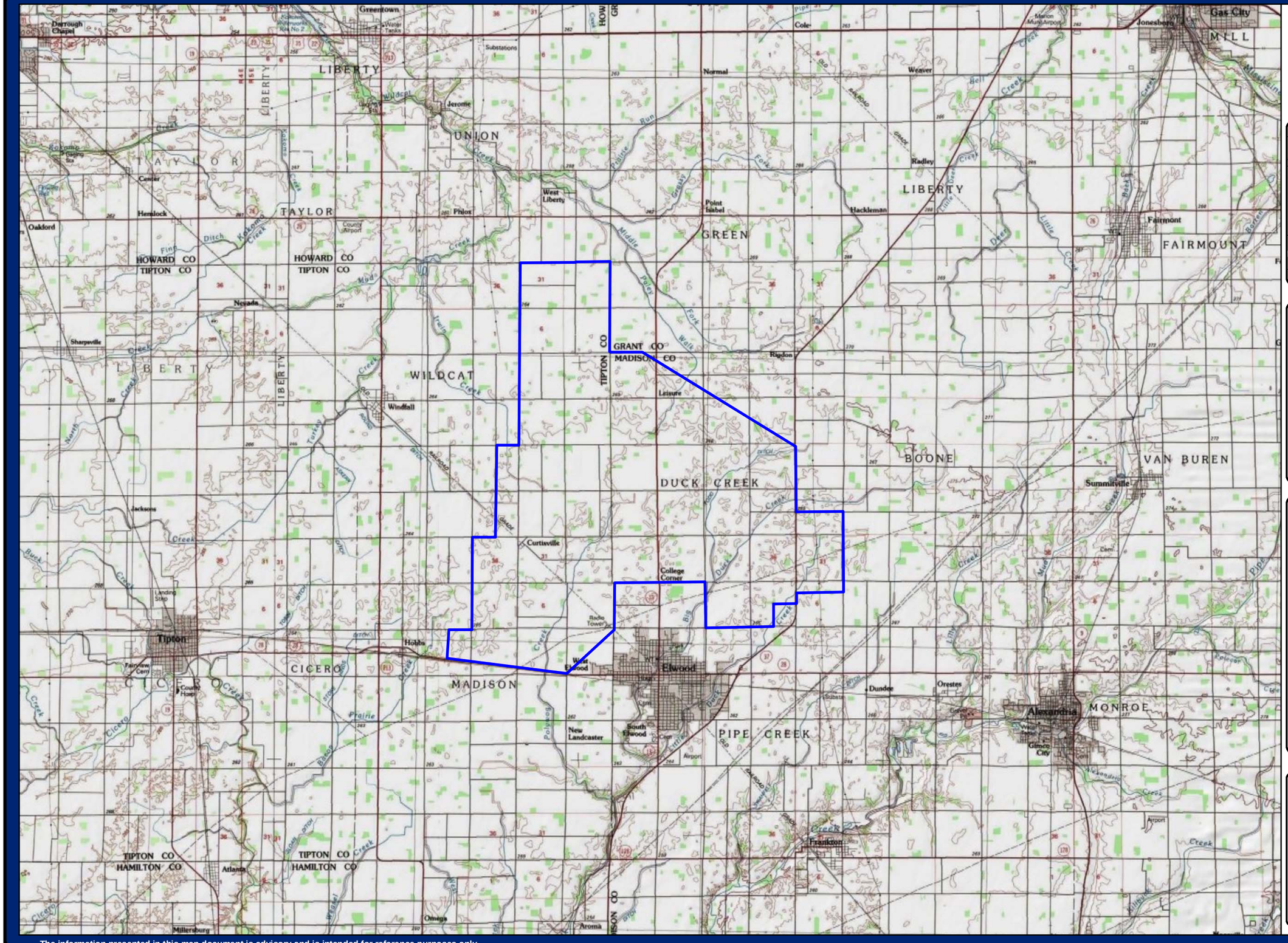
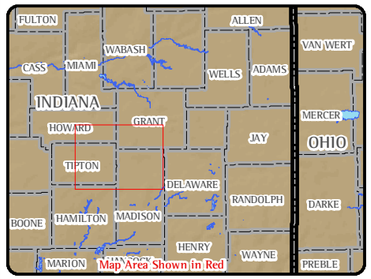


Figure 1.
Project Location and Topography
Wildcat Wind Farm



Location

Tipton and Madison Counties, IN

0 1 2 Miles

Project Information

Project Number : 0010-0077-01
Modified December 06, 2010

Legend

Approximate Project Location

Data Sources include USGS 30'x60' Topographic Quadrangles; Lafayette and Muncie

NRC Natural Resources Consulting, Inc.
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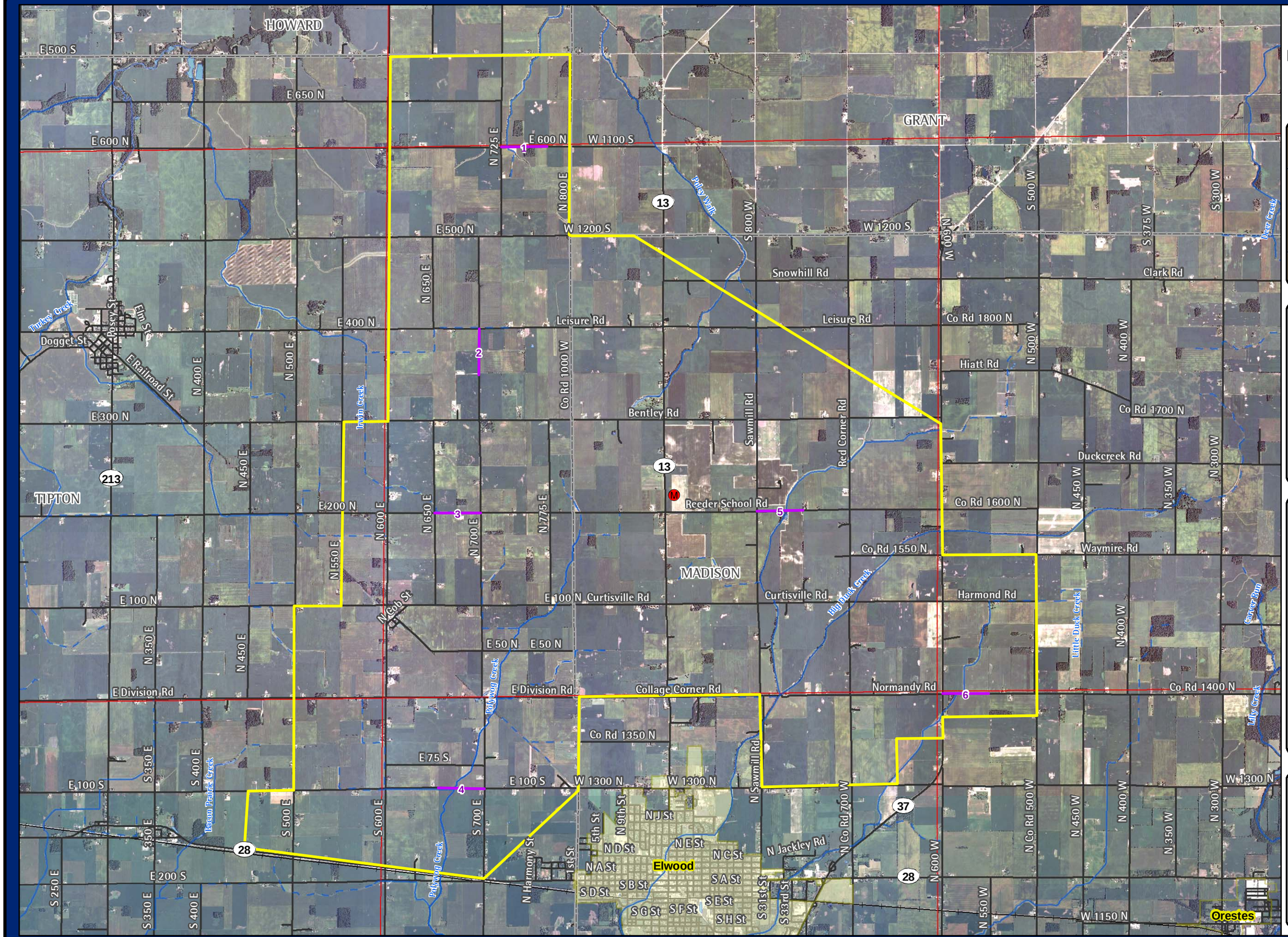
The information presented in this map document is advisory and is intended for reference purposes only.

Figure 2.
Mobile Bat Survey Transects and Met Tower Locations
Wildcat Wind Farm



Location

Tipton and Madison Counties, IN

0 0.5 1 Miles

Project Information

Project Number : 0010-0077-01
Modified December 06, 2010

Legend

- Approximate Project Location
- Mobile Bat Transects
- Met Tower Location
- City
- Town
- Township Line
- County Lines
- Road
- Railroad

National Hydrography Data

- Perennial Stream
- Intermittent Stream
- Waterbody

Data Sources include 2010 USDA NAIP Imagery, USGS, USCB

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Mobile_Bat_Survey_Transects_20101206.mxd Map Created by D. Giblin

APPENDIX E

BAT SCREENING ANALYSIS
AND PRE-CONSTRUCTION
BAT SURVEY 2011

BAT SCREENING ANALYSIS AND PRE-CONSTRUCTION BAT SURVEY

WILDCAT WIND FARM
TIPTON AND MADISON COUNTIES, INDIANA

Project No. 193700141
June 2012

PREPARED FOR:

E.ON Climate and Renewables
c/o ARCADIS U.S., Inc.
Two Executive Drive, Suite 303
Chelmsford, MA, 01824

PREPARED BY:

Stantec Consulting Services Inc.
2300 Swan Lake Boulevard
Suite 102
Independence, IA 50644

Stantec

2011 PRE-CONSTRUCTION BAT SURVEY

WILDCAT WIND FARM
Phase I
TIPTON AND MADISON COUNTIES, INDIANA

June 2012

Prepared For:

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1.0 INTRODUCTION

Wind energy is one of the fastest growing sources of renewable energy in the United States (AWEA 2007). However, construction and operation of wind energy projects has the potential to impact bird and bat populations through habitat fragmentation, displacement, and mortality due to collision with or proximity to Wind Turbine Generator (WTG) blades. An important step in the process of siting and developing potential wind energy sites is to evaluate wildlife use of the project area. Stantec was retained to perform a second season of pre-construction bat activity surveys at Phase I of the Wildcat Wind Farm in Tipton and Madison Counties, Indiana.

1.1. Background Information Regarding Bat Mortality at Wind Farms

Commercial wind facilities have been found to affect many bat species (Arnett et al. 2008). These impacts may include displacement of individuals, fragmentation of habitat, and direct mortality from collisions with or proximity to WTG blades (Kunz et al. 2007a). Whether bats are attracted to WTGs and the exact mechanisms by which WTGs cause mortality are unclear (reviewed in Kunz et al. 2007b); however, several hypotheses have recently been put forth and tested, including: the role of land cover and environmental conditions in attracting bats to WTG sites, behavioral factors that might make WTGs attractive to bats, pressure changes from rotating blades causing “barotrauma”, or direct impact of unsuspecting migrant bats (Baerwald et al. 2008; Horn et al. 2008; Johnson et al. 2004; Kerns et al. 2005; reviewed in Kunz et al. 2007b). Determining the effects of wind farms on bats is of critical importance to the future conservation of these poorly understood mammals.

The influence of landcover on bat mortality at WTG sites is unclear (Arnett et al. 2008). Johnson et al. (2004), for example, found no significant relationship between bat fatalities and landcover type within 328 feet (ft) (100 meters [m]) of WTGs. They also found no significant relationship between bat mortality and distance to wetlands or woodlands (Johnson et al. 2004). Weather conditions, such as wind speed, rainfall, and temperature, have a significant impact on bat mortalities (Arnett et al. 2008). Bat mortality and insect activity are high on nights with low wind speed when WTGs are adjusted to rotate near their maximum revolutions per minute (rpm) (Kerns et al. 2005). Bat fatalities drop with increases in wind speed and precipitation intensity (Kerns et al. 2005).

The primary bat species affected by wind facilities are believed to be migratory, foliage- and tree-roosting species that mostly emit low frequency calls (Johnson et al. 2004; reviewed by Kunz et al. 2007b). Arnett et al. (2008) compiled data from 21 studies at 19 wind facilities in the United States and Canada and found that mortality has been reported for 11 of the 45 bat species known to occur north of Mexico. Of the 11 species, nearly 75% were the migratory, foliage-roosting hoary bat (*Lasiurus cinereus*), eastern red bat (*Lasiurus borealis*), and silver-haired bat (*Lasionycteris noctivagans*) (Kunz 2007a).

Prior to September 2009, no mortality of species listed as threatened or endangered under the federal Endangered Species Act had been reported, including the Indiana bat (*Myotis sodalis*) (Arnett et al. 2008). In September 2009, the first documented take of an endangered Indiana bat at a wind facility occurred at BP Wind Energy’s Fowler Ridge wind farm located in Benton County, Indiana. A second Indiana bat was taken at Fowler Ridge in 2010. In September 2011, a single Indiana bat was taken at a second facility, Duke Energy Corporation’s North Allegheny Wind Farm located in Cambria and Blair counties, Pennsylvania (USFWS 2011).

Some researchers have suggested that bats that roost in foliage of trees for most of the year may be attracted to WTGs because of their migratory and mating behavior patterns (e.g., Kunz et al. 2007b; Cryan 2008). At dawn, these tree bats may mistake wind WTGs for roost trees,

thereby increasing the risk of mortality (Kunz et al. 2007b). Cryan (2008) suggested that male tree bats may be using tall trees as lekking sites, calling from these sites to passing females. If this is the case, then tree bats may be more attracted to WTG sites after construction. Migrating tree bats are also thought to depend on sight for navigation rather than echolocation, possibly resulting in the bats being unaware of the presence of WTGs during migration (Cryan and Brown 2007). As further support for these hypotheses, the majority of bat fatalities occur mid-summer through fall, approximately the same time frame during which tree bats migrate southward (Arnett et al. 2008). Tree bats tend to be larger species that emit low frequency calls. Bats that use low frequency calls may be more inclined to forage above the treeline where there are few obstructions. Migratory bats may also fly higher to maximize flight efficiency. Thus, tree bats may be more likely to fly in the rotor swept zone of WTGs when compared to smaller bat species that have different foraging and migration strategies.

Although the number of bat fatalities recorded at wind facilities varies regionally, reports of mortality have been highest along forested ridgetops in the eastern U.S. and lowest in open landscapes of Midwestern and western states (Kunz et al. 2007b). However, it is difficult to make direct comparisons among projects due to differences in study length, metrics used for searches, and calculations for compensating bias (Arnett et al. 2008). In the Midwestern U.S., bat fatalities range from 0.2 to 24.6 bats killed/megawatt (MW) generated, but higher fatality rates (up to 53.3 fatalities/MW generated) have been reported in the eastern U.S. (Poulton 2010, Arnett et al. 2008).

1.2. Project Description

The Wildcat Wind Farm (project) is a state-of-the-art wind energy project located in Tipton and Madison County, Indiana just north of the town of Elwood in Sections 31 and 32, T23N, R6E; Sections 5-11, and 13-36 T22N, R6E; Sections 1-2, 5-8 T21N, R6E; Sections 1, 11-12, T21N, R5E; Section 6 T21N R7E (Figure 1).

Currently, Phase I of the project is proposed to be a 200 MW wind farm with 1.6 MW WTGs and associated access roads and collector line system. Steel reinforced concrete foundations will be constructed to anchor each WTG. A pad mount transformer will be installed at the base of each WTG and will collect electricity generated by each turbine through cables routed down the inside of the tower.

An underground power collection system will be trenched in between the pad mount transformers and a collector substation. This power collection system will consist of a series of underground cables ranging from approximately 2 to 5 inches (5 to 13 centimeters) in outside diameter. In addition to the WTGs and power collection system, the project will include construction of service roads allowing access to the turbines during and after construction.

The site is located immediately north of the town of Elwood. Land use throughout much of the project area is dominated by agriculture (i.e., rowcrops and pasture); however, several creeks and unnamed drainageways occur throughout the project area (Figure 2). Forest cover is limited in the project area (Figure 2).

1.3. Purpose and Objectives

The purpose of this report is to summarize general bat use within the project area based on data collected during the 2011 activity season. The process used to evaluate the project area generally follows recommended project siting guidelines of the U.S. Fish and Wildlife Service (USFWS 2010).

The pre-construction bat use surveys have been developed to provide a scientific pre-permitting/pre-construction bat study of sufficient duration and focus to address the potential impact concerns for the project. The survey objective is to characterize general bat use by collecting site-specific baseline data on bat species activity, richness, frequency, and behavior in order to:

1. Estimate the spatial and temporal extent of bat use of the project area; and
2. Determine the spatial and temporal extent of rare bat species use of the project area.

This report includes the results of data collected during the 2011 pre-construction field surveys.

2.0 METHODS

2.1. Pre-Construction Bat Activity Surveys

2.1.1. Acoustic Data Capture

Pre-construction bat activity surveys at the project area incorporated stationary (i.e., passive) echolocation detectors, which have been proven to be an acceptable methodology for bat/wind farm screening (e.g., Kunz et al. 2007a; Redell et al. 2006). These detectors record the real-time ultrasonic calls emitted by echolocating bats. The data produced by these detectors are sonograms of the bat calls recorded by the unit's receiver. In many cases, bat calls can be identified to species group, and tallied. In addition, the number of "bat passes", or times in which a bat was recorded by the receiver, can be determined, which yields a rough estimate of activity or bat use of the area being sampled. Bat activity surveys were conducted at the project area from 8 April through 31 October 2011. Surveys were divided among time periods, or seasons, that are generally recognized as appropriate for pre-construction screening level surveys at wind farms (Table 1).

Stationary detectors were used to determine species presence and relative activity levels at varying heights. One Remote Bat Acoustic Technology System (ReBAT™; Normandeau Associates, Inc., Gainesville, Florida) array was deployed on one 197-ft (60-m) tall meteorological (MET) tower located within the project area (Figure 2).

Table 1. Timing and frequency of 2011 bat surveys conducted at the Wildcat Wind Farm Phase I (Tipton and Madison Counties, Indiana)

Screening Survey Period	2011																											
	April				May				June				July				August				September				October			
Spring Migration																												
Summer																												
Fall Migration																												

Seasonal stationary detector survey periods

Two receivers were deployed on the MET tower at different heights in a vertical transect to capture information about bat species flying at variable altitudes. Based on accepted methodology, receivers were placed at 16.5 ft (5 m) and 190 ft (58 m; within the rotor-swept zone). Acoustic receivers were protected from the elements in weather-resistant aluminum housing units that are raised and lowered on a pulley system attached to the tower. To avoid microphone damage from precipitation, the microphones were positioned within the protective aluminum housing pointing straight down. A plastic reflector plate was attached to the aluminum housing at a 45° angle to allow for maximum bat detectability.

The array was programmed to record bat acoustic data nightly from one hour before sunset to one hour after sunrise. Recordings were triggered based on frequency (kHz) and decibel (dB). Recorded sound files were 1.7 seconds in duration. Data from the acoustic receivers were transmitted to a custom-built computer located at the base of the tower. The data were transmitted via cellular signal to Normandeau Associates, Inc. for storage and then transmitted to Stantec staff for analysis. The entire system was powered through a series of batteries and solar panels. All critical components were secured and stored in weatherproof housing at the base of the portable tower.

2.1.2. Acoustic Data Analysis

2.1.2.1. Call Classification

Qualitative analysis of echolocation calls recorded by the ReBAT™ unit was performed on all operational detector nights using SCAN'R (Binary Acoustic Technology 2007) filtering software to remove noise files. Stantec staff further filtered the files using the Sonobat Batch Scrubber 3 (Sonobat, Arcata, CA).

Data collected were analyzed by trained Stantec staff using SonoBat v. 2.9.5 and v. 3.0.5 acoustic analysis software. Bat activity was measured by the number of "bat passes", or times in which a bat was recorded by the receiver, which yields a rough estimate of activity or bat use of the area being sampled. A "pass" was defined as any file with ≥ 1 echolocation pulse. Bat pass data represent levels of activity rather than numbers of individuals because individuals cannot be distinguished by their calls. The total number of bat passes divided by the number of detector nights (i.e., one detector for one night = one detector night) was used as an index of bat activity.

Bat calls were classified by frequency:

- High frequency (> 40 kHz) – little brown bat *(Myotis lucifugus*), northern myotis (*Myotis septentrionalis*), Indiana bat (*Myotis sodalis*), tri-colored bat (*Perimyotis subflavus*), and eastern red bat[1].
- Mid-frequency (30-40 kHz) – eastern red bat[1] and evening bat (*Nycticeius humeralis*).
- Low frequency (<30 kHz) – big brown bat (*Eptesicus fuscus*), silver-haired bat, and hoary bat.

The Sonobat Batch Scrubber 3 rejects calls less that 2 msec and those with weak signals. As a result, some poor quality, unclassifiable calls will get filtered (scrubbed) out. These unclassifiable calls are the weakest calls and are not classifiable as high, mid- or low frequency or for species identification. However, in order to accurately represent total bat activity at the

[1] Eastern red bat calls can range from the low 30's kHz to above 40 kHz.

site, the number of unclassifiable calls that were scrubbed out (i.e., false negatives) was estimated and added to the total classifiable calls to produce an adjusted total bat activity number.

The number of unclassifiable calls was estimated by analyzing the scrubbed files of a random sample of 25% of the survey nights distributed among the three seasons (i.e., spring, summer, and fall). The scrubbed files for each of the sample nights were visually inspected to determine the number of false negative calls. A correction factor was then calculated by dividing the total number of false negatives in the random sample by the total number of bat calls (false negatives + positives) in the random sample. The total number of classifiable bat passes for the activity season was then multiplied by the correction factor to produce the estimated total unclassifiable bat passes for the activity season.

2.1.2.2. Species Identification

Where possible, attempts were made to identify bat species or species groups (e.g., *Myotis*, big brown/silver-haired group) utilizing high quality bat passes and comparing those calls with the species' known call parameters and with known calls found in established call libraries. Although each bat species has specific call characteristics, there is considerable overlap among call parameters between species. In addition, bats can vary their calls based on habitat conditions (e.g., open vs. cluttered environments). Due to the known overlap in echolocation call characteristics occurring among some sympatric species (i.e., closely related species occurring in the same geographic area) (Barclay 1999), a portion of the acoustic data was classified to species group rather than to individual species. Classification to species or species group was possible only for calls with a low signal-to-noise ratio and minimal echo. If the species or species group could not be determined because of call quality, or if calls were assignable to more than three species due to overlap in echolocation call parameters, the call was categorized as "unknown."

3.0 RESULTS

3.1. Pre-Construction Bat Activity Surveys

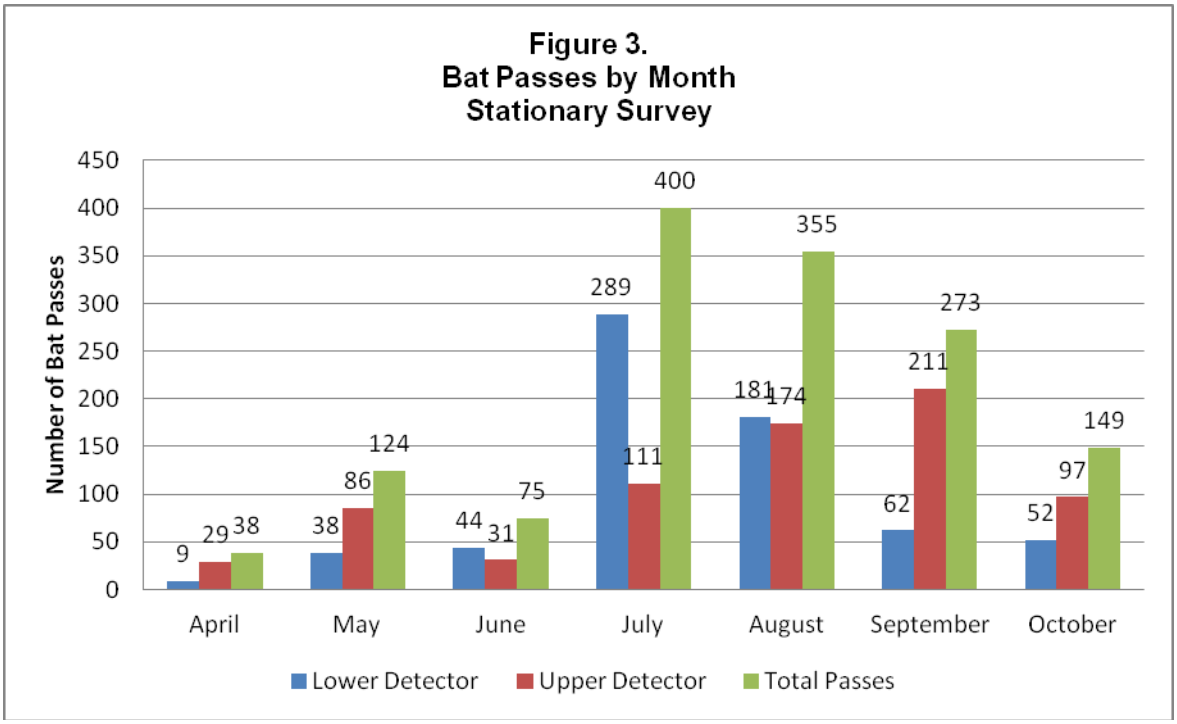
The ReBAT™ array was operational between 8 April and 31 October, for a total of 378 detector nights (one detector for one night = one detector night; therefore, there are two detector nights for each night that both detectors are operational). The MET tower was struck by lightning on two occasions during the survey resulting in technical problems with the ReBAT™ unit for short periods; however, these problems did not significantly affect the results of the survey. Bats were recorded on 140 of 189 (74.1%) survey nights at the tower. A summary of ReBAT™ operational data by season is shown in Table 2.

Table 2. Summary of ReBAT™ operational data by season at Wildcat Wind Farm Phase I (Tipton and Madison Counties, Indiana, 2011)

	No. Survey Nights	No. Detector Nights[1]	No. Survey Nights Bats Recorded	% of Survey Nights bats Recorded
Spring	38	76	17	44.7
Summer	50	100	39	78.0
Fall	101	202	84	83.2
Total	189	378	140	74.1

[1]One detector for one night = one detector night

A total of 1,414 classifiable bat passes (mean = 3.7 passes/detector night) were recorded by the stationary detectors during the activity season (Table 3). It is estimated that 331 unclassifiable passes were removed during the filtering process. Therefore, the adjusted total bat passes for the 2011 activity season at the project area is 1,745 (mean = 4.6 passes/detector night) (Table 3). Bat activity by month is shown in Figure 3. Total bat activity at the MET tower was highest in July followed closely by August and September.



3.1.1. Bat Species and Frequency Groups Detected During Surveys

Using classifiable calls and files that contained high quality bat passes, a species list was developed for the project area. Approximately 75% of the 1,414 classifiable calls recorded during the stationary survey were identifiable to species or species group (e.g., big brown bat/silver-haired bat, *Myotis* sp.). Five bat species were confirmed to be present at the site:

- Big brown bat
- Silver-haired bat
- Eastern red bat
- Hoary bat
- Tri-colored bat

None of the species recorded in the project area are listed as state or federally threatened or endangered. Four species detected during the survey, the silver-haired bat, eastern red bat, hoary bat, and tri-colored bat, are listed as special concern species by the IDNR (IDNR 2009). Two confirmed *Myotis* calls were recorded by the 16.5-ft (5-m) receiver; a single call was recorded on 24 May and 22 August. One confirmed *Myotis* call was recorded on 3 September by the 190-ft (58-m) receiver. All three *Myotis* calls exhibit characteristics found in both little brown bat and Indiana bat calls; due to the overlap in call characteristics between the two species, positive identification of the calls to species was not possible. Based on the detection zone of the receivers, bats recorded by the 16.5-ft (5-m) detector were not within the rotor swept zone (>127 ft [38.75 m]). *Myotis* calls represent 0.2% of the identifiable calls recorded during the stationary survey.

Table 3. Summary of bat passes (mean per detector night) by detector height, season, and frequency group for stationary pre-construction surveys at Wildcat Wind Farm Phase I (Tipton and Madison Counties, Indiana, 2011)

	5 Meter		58 Meter		Total	
Spring						
Low Freq. Bat Passes	12	(0.3)	71	(1.9)	83	(1.1)
Mid Freq. Bat Passes	3	(0.08)	6	(0.2)	9	(0.12)
High Freq. Bat Passes	2	(0.1)	0	(0.0)	2	(0.0)
Total Passes (Spring)*	**21**	**(0.6)**	**77**	**(2.0)**	**98**	**(1.3)**
Summer						
Low Freq. Bat Passes	213	(4.3)	72	(1.4)	285	(2.9)
Mid Freq. Bat Passes	10	(0.2)	8	(0.2)	18	(0.2)
High Freq. Bat Passes	5	(0.1)	3	(0.1)	8	(0.1)
Total Passes (Summer)*	**236**	**(4.7)**	**84**	**(1.7)**	**320**	**(3.2)**
Fall						
Low Freq. Bat Passes	376	(3.7)	454	(4.5)	830	(4.1)
Mid Freq. Bat Passes	11	(0.1)	83	(0.8)	94	(0.5)
High Freq. Bat Passes	24	(0.2)	17	(0.2)	41	(0.2)
Total Passes (Fall)*	**418**	**(4.1)**	**578**	**(5.7)**	**996**	**(4.9)**
Total Low Frequency Passes for Activity Season	**601**	**(3.2)**	**597**	**(3.2)**	**1198**	**(3.2)**
Total Mid Frequency Passes for Activity Season	**24**	**(0.1)**	**97**	**(0.5)**	**121**	**(0.3)**
Total High Frequency Passes for Activity Season	**31**	**(0.2)**	**20**	**(0.1)**	**51**	**(0.1)**
Total Passes for Activity Season*	**675**	**(3.6)**	**739**	**(3.9)**	**1414**	**(3.7)**
Est. Total Unclassifiable Passes for Activity Season			**331**			
Adjusted Total Passes for Activity Season			**1745**	**(4.6)**		

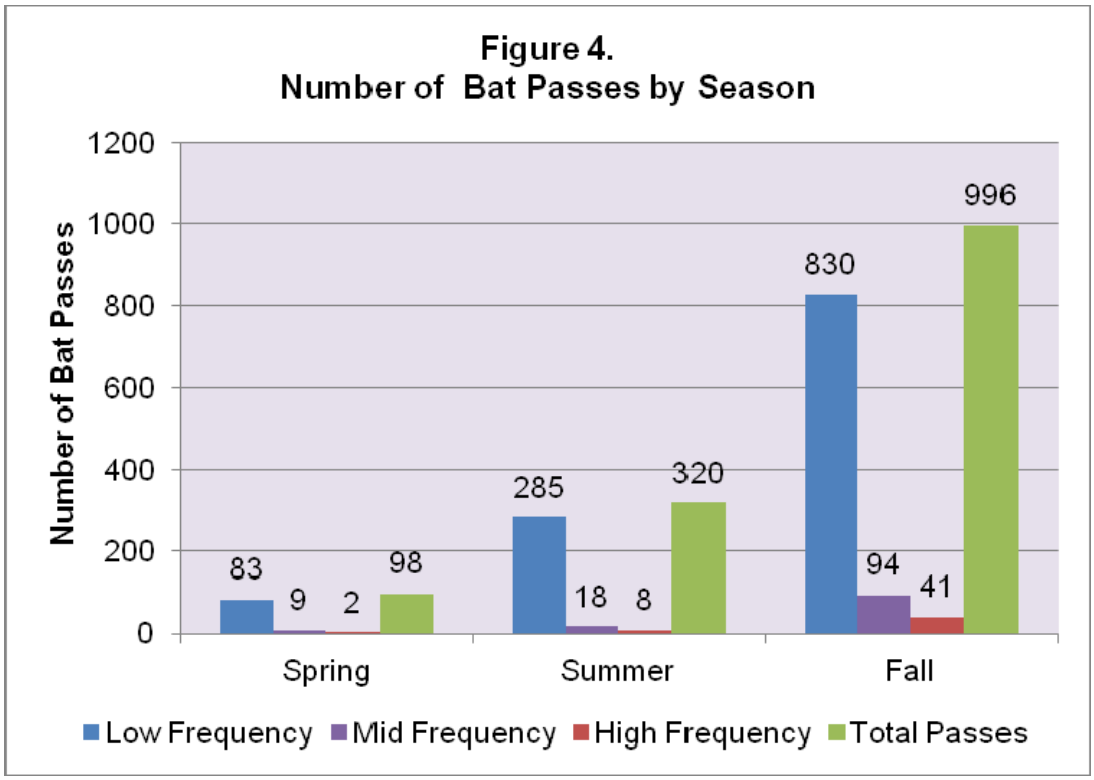
*Some recorded bat sound files were too poor quality to characterize the call by frequency group. Therefore, the sum of bat passes for individual frequency groups may not equal the "Total Passes" recorded.

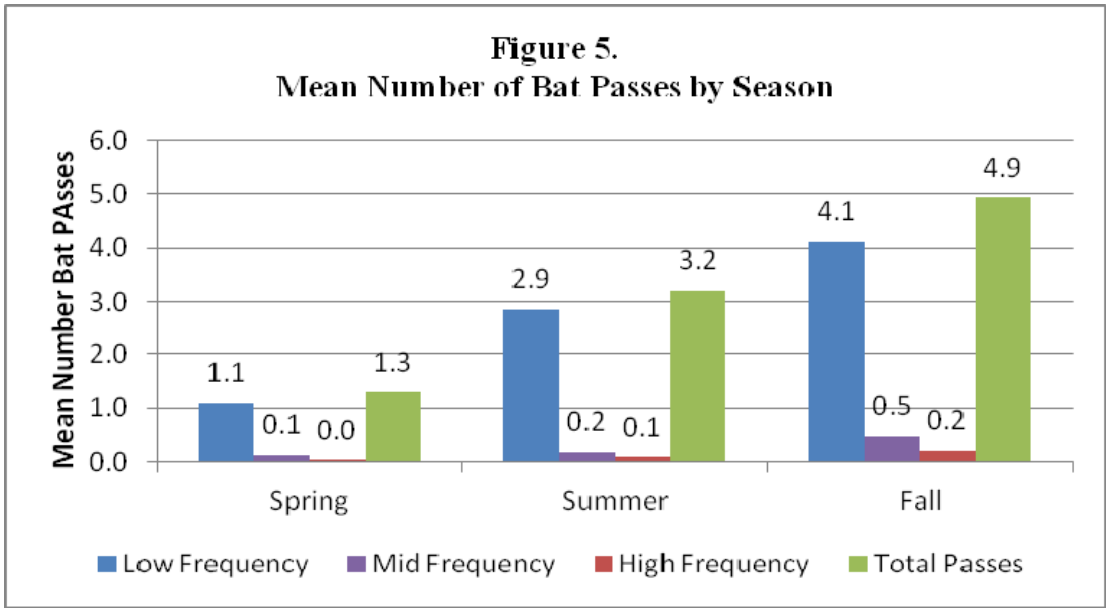
Four additional possible *Myotis* calls were recorded during stationary surveys, all at the lower receiver: one on 31 May; one on 27 July; one on 22 August; and, one on 17 October. All four calls exhibit characteristics found in *Myotis* calls, but were also consistent with red bat calls; therefore, positive identification was not possible.

Low, mid- and high frequency bat species were recorded during the survey. On average, specifically when all receiver heights and time periods are considered together, low frequency species were recorded more often than mid- or high frequency species (mean = 3.2, 0.3, and 0.1 passes/detector night, respectively). The total number of passes per species group was also substantially greater for the low frequency species (1,198 passes) than the mid-frequency species (121 passes) or high frequency species (51 passes) (Table 3).

3.1.2. Seasonal Distribution of Bat Activity

A summary of bat activity by season at the project area is shown in Figures 4 and 5 and a discussion by season is presented below.



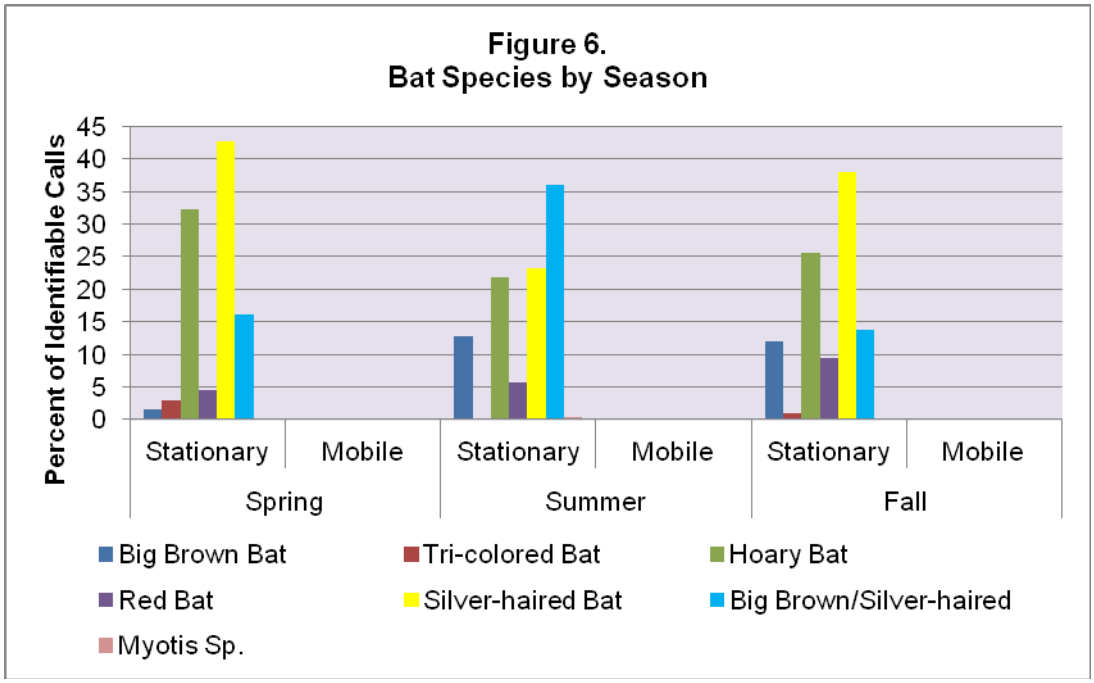


3.1.2.1. Spring (8 April – 15 May)

The total number of bat passes at the stationary detector during the spring season (98) was the lowest among the three seasons; the average number of passes/detector night (1.3) was also lowest in the spring (Table 3; Figures 4 and 5). Low frequency species were recorded substantially more often than mid- or high frequency species (83 total passes, 9 total passes, and 2 total passes, respectively) during the spring survey (Table 3, Figures 4 and 5).

The approximate distribution of the classifiable bat passes recoded during the spring for which species identification was possible is shown below and in Figure 6:

- Silver-haired bat 43.0%
- Hoary bat 32.4%
- Big brown bat/silver-haired bat group 16.1%
- Eastern red bat 4.4%
- Tri-colored bat 2.9%
- Big brown bat 1.5%



3.1.2.2. Summer (16 May – 15 July)

The total number of bat passes at the stationary detector during the summer season (320) increased substantially over what was observed during the spring season (98); the average number of passes/detector night also increased, from 1.3 in the spring to 3.2 in the summer (Table 3; Figures 4 and 5). Low frequency species were recorded considerably more often than mid- or high frequency species (285 total passes, 18 total passes, and 8 total passes, respectively) during the summer survey (Table 3; Figures 4 and 5).

The approximate distribution of the classifiable bat passes recorded during the summer for which species identification was possible is shown below and in Figure 6:

- Big brown bat/silver-haired bat group 36.0%
- Silver-haired bat 23.3%
- Hoary bat 21.9%
- Big brown bat 12.7%
- Eastern red bat 5.7%
- *Myotis* spp. 0.4%

3.1.2.3. Fall (16 July – 31 October)

The total number of bat passes at the stationary detector during the fall season (996) was the highest among the three seasons; the average number of passes/detector night increased from 3.2 in the summer to 4.9 in the fall (Table 3; Figures 4 and 5). Low frequency species were recorded substantially more often than mid- or high frequency species (830 total passes, 94 total passes, and 41 total passes, respectively) during the fall survey, as was also the case in the spring and summer surveys (Table 3; Figures 4 and 5).

The approximate distribution of the classifiable bat passes recorded during the fall for which species identification was possible is shown below and in Figure 6:

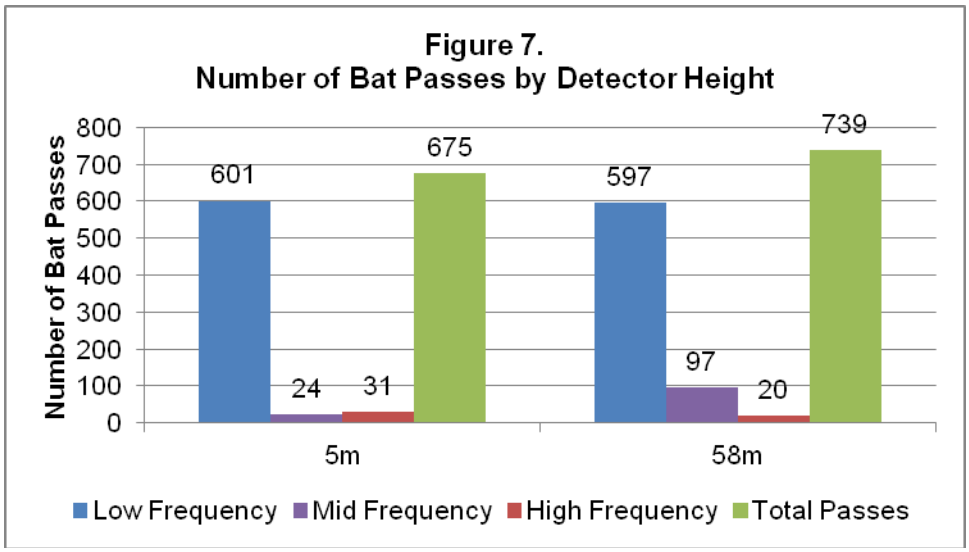
- Silver-haired bat 37.9%
- Hoary bat 25.5%
- Big brown bat/silver-haired bat group 13.8%
- Big brown bat 12.0%
- Eastern red bat 9.5%
- Tri-colored bat 1.1%
- *Myotis* spp. 0.3%

3.1.3. Vertical Distribution of Bat Activity

More total bat calls were recorded at the 190-ft (58-m) detector (rotor-swept zone) (739 total passes; mean = 3.9 passes/detector night) than at the 16.5-ft (5-m) detector (675 total passes; mean = 3.6 passes/detector night) (Table 3; Figure 7). Bat passes at the 190-ft (58-m) detector generally outnumbered those at the 16.5-ft (5-m) detector from the beginning of the survey period (8 April) through 12 June, at which time passes at the 16.5-ft (5-m) detector exceeded those at the 190-ft (58-m) detector until 14 August, when the vertical distribution of passes reversed again and remained higher at the 190-ft (58-m) detector through the end of the survey (31 October) (Figure 8). The increase in activity at the 190-ft (58-m) detector from July through October coincides with the fall migration period.

Low frequency calls substantially outnumbered high frequency calls at both the 16.5-ft (5-m) and 190-ft (58-m) detectors (Table 3; Figure 7). The total number of bat passes on a single day ranged from 0 to 122, with the highest daily total recorded on 4 July. Of the passes recorded on 4 July, 96% were recorded at the 16.5-ft (5-m) detector.

Eastern red bats, hoary bats, silver-haired bats, big brown bats, tri-colored bats, and *Myotis* spp. were all recorded at both detector heights (Figure 9). Silver-haired bats were the most frequently recorded species at both the 16.5-ft (5-m) and 190-ft (58-m) detectors. Within the rotor-swept zone, the migratory, foliage-roosting eastern red bat, hoary bat and silver-haired bat were the most frequently recorded species, accounting for at least 51% of all detections, and 69% of all identifiable calls, at the upper detector.



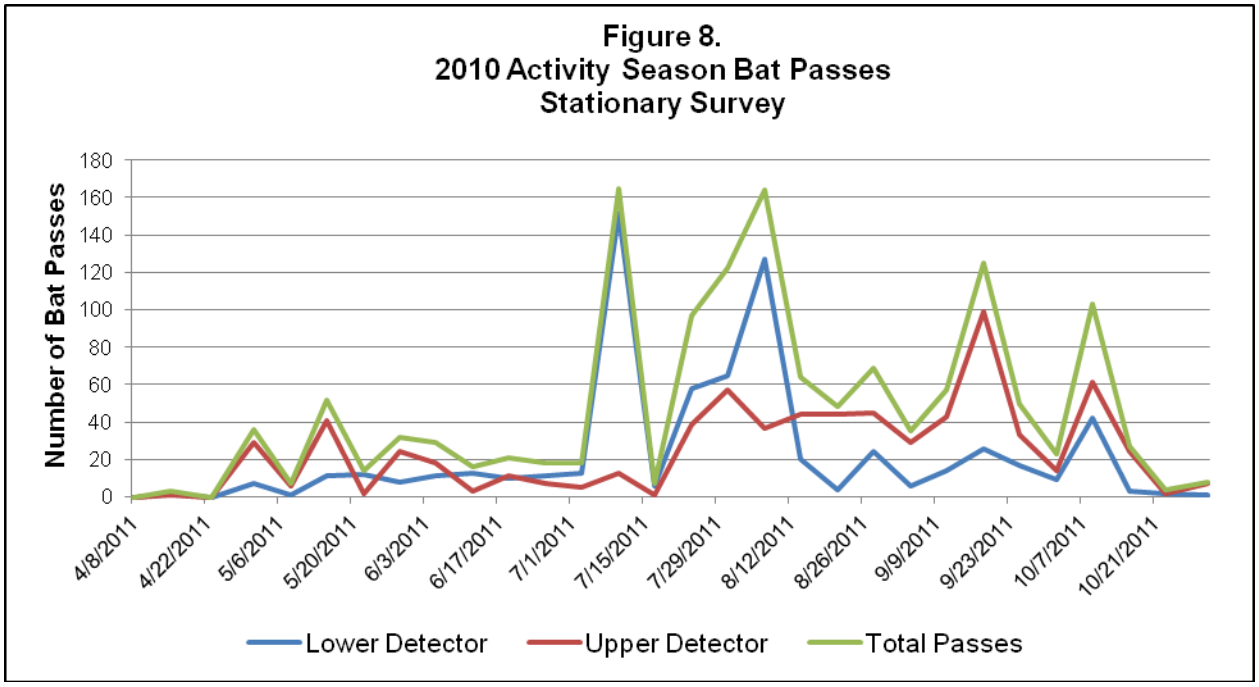


Figure 8.
2010 Activity Season Bat Passes
Stationary Survey
Number of Bat Passes
180
160
140
120
100
80
60
40
20
0
4/8/2011
4/22/2011
5/6/2011
5/20/2011
6/3/2011
6/17/2011
7/1/2011
7/15/2011
7/29/2011
8/12/2011
8/26/2011
9/9/2011
9/23/2011
10/7/2011
10/21/2011
Lower Detector
Upper Detector
Total Passes

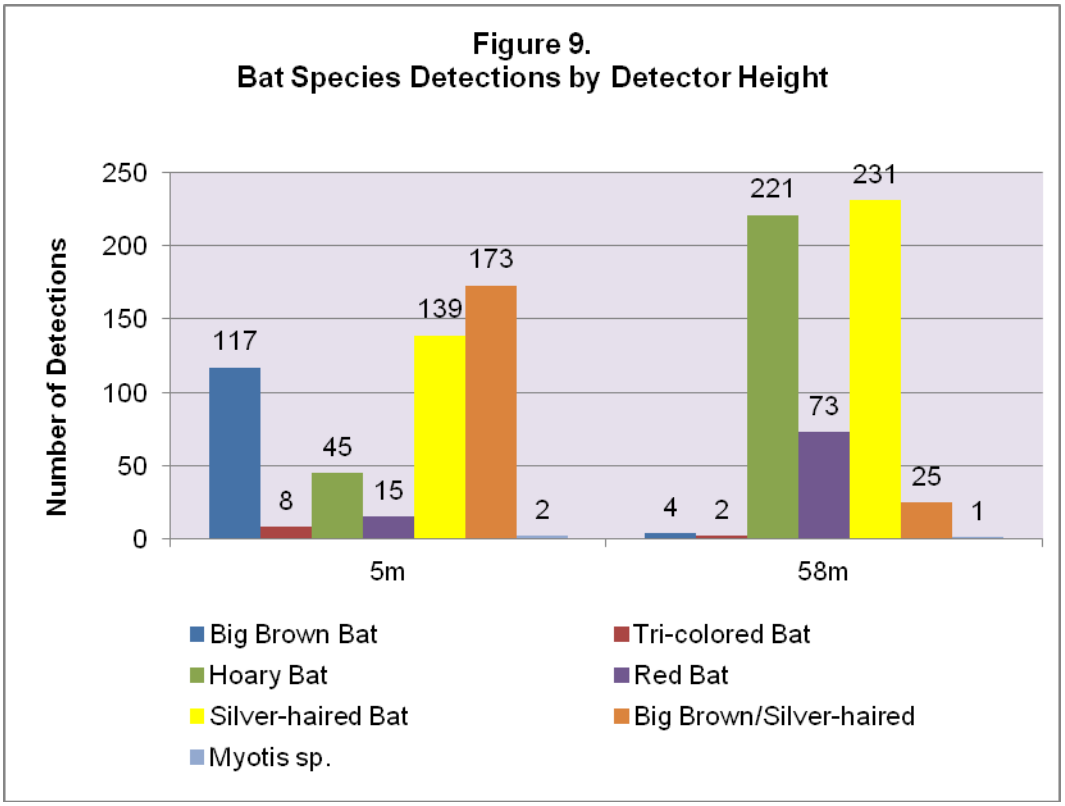


Figure 9.
Bat Species Detections by Detector Height
Number of Detections
250
200
150
100
50
0
117
8
45
15
139
173
2
4
2
221
73
231
25
1
5m
58m
Big Brown Bat
Tri-colored Bat
Hoary Bat
Red Bat
Silver-haired Bat
Big Brown/Silver-haired
Myotis sp.

4.0 DISCUSSION

4.1. Summary and Conclusions

The project area is located in an agricultural setting dominated by farmsteads, livestock operations, pastures, and fields used for rowcrop production. Natural habitat features that typically attract bats, such as woodlands, woodlots, and wooded riparian corridors, are limited within the project area and occur primarily as small habitat fragments. Larger blocks of woodlands are found outside of the project area to the northeast and southeast, including the Ginn Woods, Botany Glen, and Mounds State Park; however, the closest significant woodland is at least 12.5 miles (20 km) from the project area.

The majority of the bat species found in Indiana prefer to roost in woodlands and many species forage along wooded stream corridors or over water (Harvey et al. 1999; Whitaker and Mumford 2008). The project area provides limited roosting or foraging habitat in the form of woodland or open water. Limited information is available on how bats use agricultural areas in the Midwest; however, species such as the big brown bat and little brown bat will roost, and even overwinter, in attics or large buildings. The farmsteads located in the project area, with their farmhouses and large outbuildings, likely provide suitable roosting locations for species such as these. Likewise, buildings in the town of Elwood are also likely to provide suitable roosting and possibly overwintering sites for species such as the big brown bat and little brown bat.

Bat activity at the MET tower, as measured by number of bat passes, was relatively average when compared to other wind farm sites in the Midwest. Table 4 provides a comparison of the bat activity at the Phase 1 project area in 2010 and 2011 and with activity at other wind farm sites surveyed by Stantec in Iowa, Illinois and Wisconsin. Landcover at a project's site, specifically forest cover, likely plays a large role in the amount of bat activity observed at that project.

Table 4. Comparison of bat activity at wind farms in the Midwest surveyed by Stantec.

Wind Farm Site Location	Total # Bat Passes (Mean/Night) Stationary Survey	Total # Bat Passes (Mean/Night) Mobile Survey	Land Use
Northeast Iowa	2313 (6.0)	105 (2.8)	83% Agricultural 2% Forest
Southwest Illinois	1721 (5.1)	26 (0.3)	90% Agricultural 1.2% Forest
Northwest Illinois	1905 (4.8)	196 (2.6)	>90% Agricultural >6% Forest
Wildcat Wind Farm Phase I (2010)	1800 (4.5)	93 (1.0)	93% Agricultural 0.6% Forest
Wildcat Wind Farm Phase I (2011)	1745 (4.6)	N/A	93% Agricultural 0.6% Forest
East Central Wisconsin	1647 (3.9)	95 (1.5)	88% Agricultural 2% Forest
Pioneer Trail Wind Farm	1269 (3.2)	58 (0.6)	96% Agricultural <0.01% Forest
Central Iowa	183 (0.4)	95 (4.5)	81% Agricultural 0.1% Forest

Based on geographic distribution, nine of the 12 bat species known to occur in Indiana have the potential to be found in the project area (Whitaker and Mumford 2008; Batcon.org). Five bat species, the hoary bat, big brown bat, eastern red bat, silver-haired bat, and tri-colored bat, were confirmed to be present during the 2011 acoustic survey. Of these, none are listed as threatened or endangered, but the hoary bat, eastern red bat, silver-haired bat, and tri-colored bat are listed as special concern species by the Indiana DNR (IDNR 2009).

In addition to the species listed above, calls of species within the genus *Myotis* were also recorded in the project area. Three confirmed *Myotis* calls were recorded during the 2011 survey, representing only 0.2% of the total bat passes recorded at the project area. Due to overlap in call characteristics between members of the genus *Myotis*, positive identification to species was not possible. However, based on habitat within the project area, it is likely that many of these calls were little brown bats.

No records of Indiana bats or Indiana bat maternity colonies are known from Tipton or Madison counties (USFWS 2007). A habitat assessment conducted at the Phase I project area in 2010 indicated that no suitable Indiana bat summer habitat is found within the Phase I project area, primarily due to the lack of sufficient forest cover. Nevertheless, habitat-related impacts are not the only potential impacts to Indiana bats posed by wind energy facilities, as risk of collision for migrating individuals could exist anywhere within the species' geographic range.

A total of 1,745 bat passes, representing low, mid- and high frequency species, were recorded during the survey. On average, low frequency bats were recorded substantially more often than mid- or high frequency bats at the detectors. Bats were generally detected less often in the rotor-swept zone (i.e., 190-ft [58-m] detector) during the summer season, but more often in the rotor-swept zone during the spring and fall, particularly between 24 July and 1 November. Eastern red bats, hoary bats, silver-haired bats, and big brown bats were all recorded within the rotor-swept zone, with eastern red bats, hoary bats and silver-haired bats being the most frequently recorded species, accounting for at least 51% of all detections and 69% of all identifiable calls, at that height.

Post-construction and pre-construction data may not fully predict fatality risks (Cryan 2008). Although considerable variation exists in the data among projects, peaks in bat fatalities associated with numerous wind farms have been reported during late summer and fall (reviewed by Arnett et al., 2008). Bat activity at the Wildcat Phase I site was highest during the fall, with a rise in activity at the 58 m height near the end of July through October, coinciding with the fall migration period.

4.1.1. Conclusions

4.1.1.1. Risk to Resident Bats

The results of the 2010 and 2011 surveys suggest that the Wildcat Wind Farm Phase I site may present a relatively low risk to resident and foraging bats for the following reasons:

1. Natural habitat features, such as woodlands, woodlots and wooded riparian corridors that provide roosting and foraging habitat for bats, are minimal within the project area, with 0.6% of the project area consisting of forest.

2. Due to the lack of forest cover, the project area rates as unsuitable Indiana bat summer habitat.

3. Overall bat activity at the site, as measured by number of bat passes, was average when compared to other wind farm sites in the Midwest for which data are available (Table 4).

4. Only 1 confirmed *Myotis* call recorded during the summer season during surveys conducted over two activity seasons (2010 and 2011).

Accordingly, the survey results do not suggest a material risk of impact to Indiana bats from the Wildcat Phase I project. However, it should be noted that currently there are no published reports linking pre-construction activity rates to post-construction fatality rates, and therefore, it is not possible to accurately predict post-construction fatality rates.

4.1.1.2. Risk to Migrating Bats

Little is known about the migration patterns of bats, specifically how they disperse across the landscape during migration. Therefore, it is not possible to accurately predict an individual bat's route during migration. Based on this, migratory risk could exist anywhere within a species' geographic range, and the potential does exist for bats, including Indiana bats, to migrate through the Wildcat Phase I project area. However, the Wildcat Phase I project area is located approximately 75 miles from Lewisburg Mine, the nearest known Indiana bat hibernaculum. The results of the 2011 survey, with only three confirmed *Myotis* calls, and the 2010 survey with only five confirmed *Myotis* calls, none of which could be positively identified as an Indiana bat, do not suggest significant Indiana bat migratory activity within the Wildcat Phase I project area.

4.2. Limitations of Pre-Construction Bat Activity Surveys

The results of the pre-construction bat activity survey should be viewed with the following limitations in mind:

1. Duration of the Survey – The survey included nightly passive survey events along a vertical transect in one location over the course of one activity season. Because annual bat activity can vary due to weather, the results of this one activity season survey may not be representative of the full range of bat activity in the project area.
2. Spatial Limitations of Vertical Transects – Due to resource limitations, vertical transects, which survey bat activity at the height of the rotor-swept zone, were only conducted in one location. This pre-construction survey has only assessed bat activity in a small fraction of the overall rotor-swept zones that will be occupied by WTGs.

The results of this survey should be used as baseline information regarding bat activity in the area and cannot be used to accurately predict what, if any, bat mortality would occur as a result of operation of the project. A standard method of determining impacts to bats resulting from operation of a wind energy facility is to perform post-construction monitoring of bat species' presence, activity, and mortality. If impacts are determined to be significant, then appropriate mitigation measures can be considered.

LITERATURE CITED

Arnett, E.B., W.K. Brown, W.P. Erickson, J.K. Fiedler, B.L. Hamilton, T.H. Henry, A. Jain, G.D. Johnson, J. Kerns, R.R. Koford, C.P. Nicholson, T.J. O'Connell, M.D. Piorkowski, and R.D. Tankersley. 2008. Patterns of bat fatalities at wind energy facilities in North America. Journal of Wildlife Management 72: 61-78.

American Wind Energy Association [AWEA]. 2007. AWEA Wind Energy Fact Sheets [Online]. Available http://awea.org/pubs/factsheets.html accessed August 17, 2007.

Baerwald, E.F., G.H. D'Amours, B.J. Klug, and R.M.R. Barclay. 2008. Barotrauma is a significant cause of bat fatalities at wind turbines. Current Biology 18: R695-R696.

Barclay, R. M. R. 1999. Bats are not birds – A cautionary note on using echolocation calls to identify bats: A comment. Journal of Mammalogy, 80(1):290-296.

Cryan, P. M. 2008. Mating behavior as a possible cause of bat fatalities at wind turbines. Journal of Wildlife Management 72:845-849.

Cryan, P. M., and A. C. Brown. 2007. Migration of bats past a remote island offers clues toward the problem of bat fatalities at wind turbines. Biological Conservation 139:1–11.

Harvey, M.J., J.S. Altenbach, and T.L. Best. 1999. Bats of the United States. Published by the Arkansas Game and Fish Commission, In Cooperation with the Asheville Field Office of the U.S. Fish and Wildlife Service.

Horn, J.W., E.B. Arnett and T. H. Kunz. 2008. Behaviorial responses of bats to operating wind turbines. Journal of Wildlife Management 72(1):123-132.

Indiana Department of Natural Resources. July 2009. Indiana's Species of Greatest Conservation Need. Retrieved December 14, 2010 from http://www.in.gov/dnr/fishwild/files/fw-Indiana_Species_of_Greatest_Conservation_Need.pdf

Johnson, G.D., M.K. Perlik, W.P. Erickson, and M.D. Strickland. 2004. Bat activity, composition, and collision mortality at a large wind plant in Minnesota. Wildlife Society Bulletin 32:1278-1288.

Kerns, J, W. P. Erickson, and E. B. Arnett. 2005. Bat and bird fatality at wind energy facilities in Pennsylvania and West Virginia. Pages 24–95 in E. B. Arnett, editor. Relationships between bats and wind turbines in Pennsylvania and West Virginia: an assessment of bat fatality search protocols, patterns of fatality, and behavioral interactions with wind turbines. A final report submitted to the Bats and Wind Energy Cooperative. Bat Conservation International, Austin, Texas, USA.

Kunz, T.H., E.B. Arnett, B.M. Cooper, W.P. Erickson, R.P. Larkin, T. Mabee, M.L. Morrison, M.D. Strickland, and J.M. Szewczak. 2007a. Assessing impacts of wind-energy development on nocturnally active birds and bats: a guidance document. Journal of Wildlife Management 71:2449-2486.

Kunz, T.H., E.B. Arnett, W.P. Erickson, A.R. Hoar, G.D. Johnson, R.P. Larkin, M.D. Strickland, R.W. Thresher and M.D. Tuttle. 2007b. Ecological impacts of wind energy development on bats: questions, research needs and hypotheses. Frontiers in Ecology and the Environment 5:315-324.

Poulton, V. 2010. Summary of Post-Construction Monitoring at Wind Projects Relevant to Minnesota, Identification of Data Gaps, and Recommendations for Further Research Regarding Wind-Energy Development in Minnesota. State of Minnesota Department of Commerce c/o WEST, Inc. Cheyenne, Wyoming.

Redell, D., E.B. Arnett, J.P. Hayes, and M.M.P. Huso. 2006. Patterns of pre-construction bat activity determined using acoustic monitoring at a proposed wind facility in south-central Wisconsin. A final report submitted to the Bats and Wind Energy Cooperative. Bat Conservation International. Austin, TX, USA.

Simon, T.P., J.O. Whitaker, Jr., J.S. Castrale and S.A. Minton. 2002. Checklist of the Vertebrates of Indiana. Proceedings of the Indiana Academy of Science 101:95-126.

U.S. Fish and Wildlife Service. 2007. Indiana Bat (Myotis sodalis) Draft Recovery Plan: First Revision. Region 3, U.S. Fish and Wildlife Service, Fort Snelling, Minnesota. 258 pp.

U.S. Fish and Wildlife Service [USFWS]. 2010. Wind Turbine Guidelines Advisory Committee Recommendations. Washington, DC. 84 pp.

U.S. Fish and Wildlife Service (USFWS). 2011. Pennsylvania Field Office News. Indiana bat fatality at Pennsylvania wind facility. http://www.fws.gov/northeast/pafo/index.html

Whitaker, Jr., J. O. and R. E. Mumford. 2008. Mammals of Indiana. Indiana University Press, Bloomington, IN. 668 pp.

FIGURES

Figure 1.
Project Location and Topography
Wildcat Wind Farm

Location

Tipton and Madison Counties, IN

0 1 2 Miles

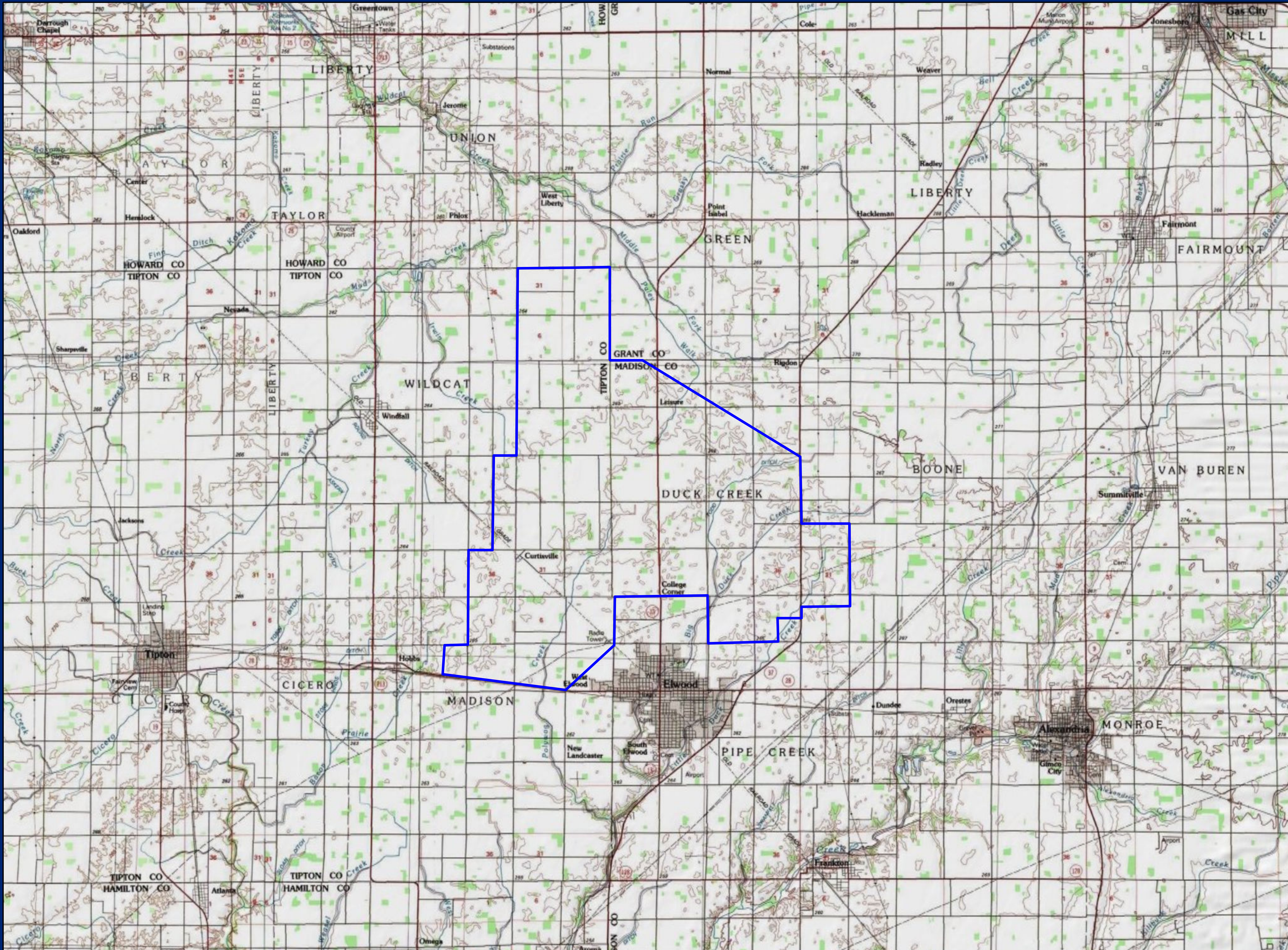
N

Project Information

Project Number : 193700141 Task 206
Modified December 06, 2010

Legend

Approximate Project Location



Data Sources include USGS 30'x60' Topographic Quadrangles; Lafayette and Muncie

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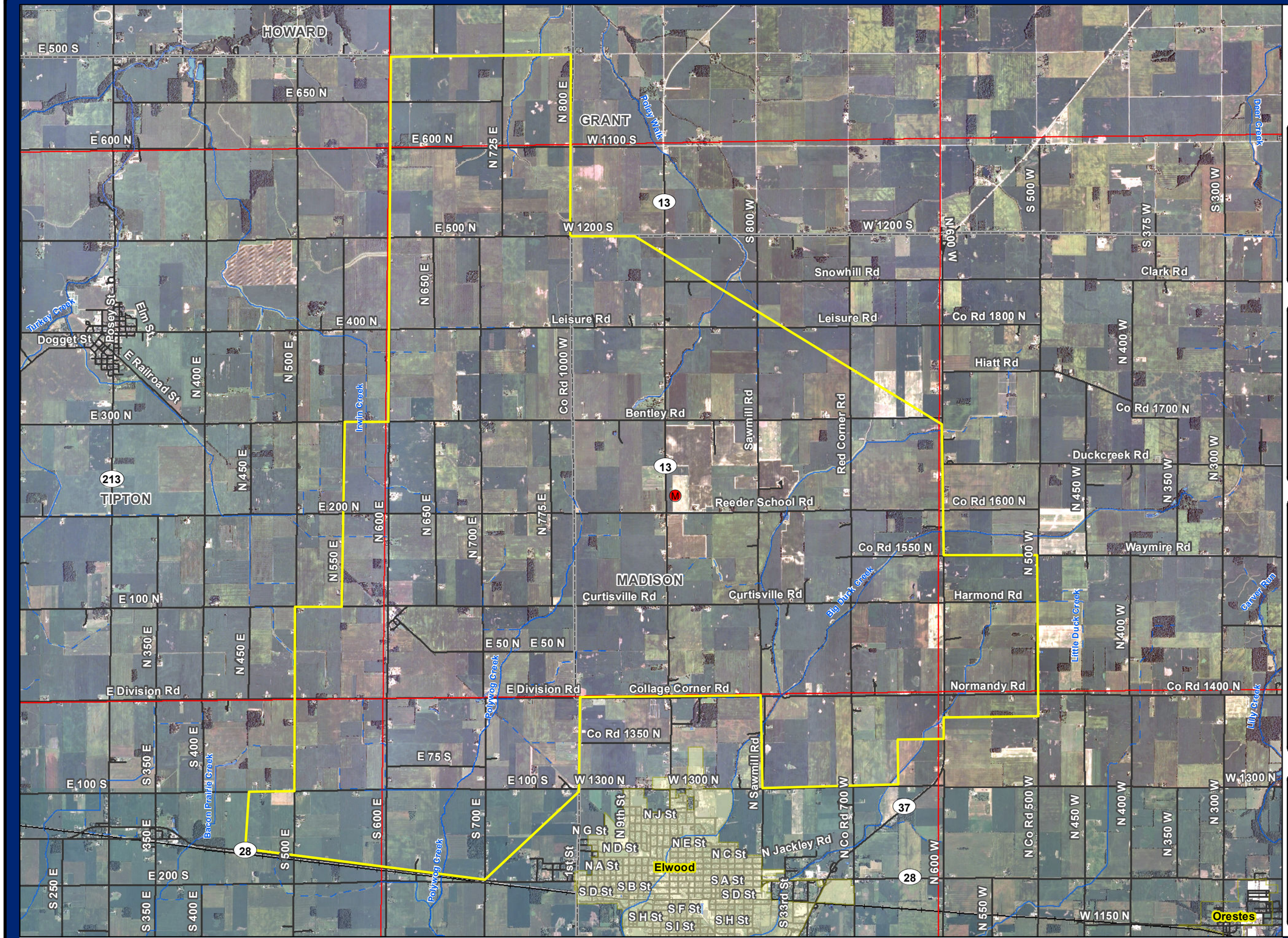
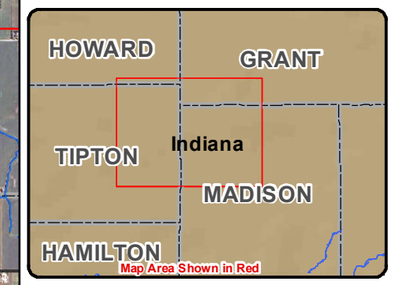
Figure 2.
Met Tower Locations
Wildcat Wind Farm





Location

Tipton and Madison Counties, IN

0 0.5 1 Miles

N

Project Information

Project Number : 193700141 Task 206
Modified December 06, 2010

Legend

- Approximate Project Location
- Met Tower Location
- City
- Town
- Township Line
- County Lines
- Road
- Railroad

National Hydrography Data

- Perennial Stream
- Intermittent Stream
- Waterbody

Data Sources include 2010 USDA NAIP Imagery, USGS, USCB

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Mobile_Bat_Survey_Transects_20101206.mxd Map Created by D. Giblin

APPENDIX F

2013 POST-CONSTRUCTION
BAT STUDY

2013 Post-Construction Bat Study
Wildcat Wind Farm Phase I

Madison and Tipton Counties, Indiana

Project #193702378

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December 19, 2014

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APPENDIX B REPRESENTATIVE CARCASS PHOTOS

1.0 Introduction

1.1 PROJECT DESCRIPTION

The Wildcat Wind Farm Phase I (Project or Wildcat) is located in Madison and Tipton counties, immediately north of the town of Elwood, Indiana. The Project consists of 125 GE 1.6 megawatt (MW) wind turbine generators and associated access roads and collector line system for a total capacity of 200 MWs (Figure 1). Each turbine is anchored in a steel reinforced concrete foundation. A pad mounted transformer is located at the base of each turbine, and collects electricity generated by each turbine through cables routed down the inside of the tower. This transformer raises the voltage of the electricity produced up to the 34.5 kilovolts (kV) of the collection system. The buried collection system connects the individual turbines to the substation, where the voltage is increased to 138 kV to allow connection with the existing transmission line. The Project became operational in December 2012. The Project is located on lands leased from private landowners, who continue their existing use of the land. Land use in the area is predominantly agricultural.

1.2 PURPOSE AND OBJECTIVES OF THE STUDY

A Post-Construction Mortality Minimization and Monitoring Proposal was developed in June 2012 (Stantec 2012), and is consistent with common methodologies and the recommendations of the U.S. Fish and Wildlife Service (USFWS) Land-Based Wind Energy Guidelines (USFWS 2012). The Project is currently operating under the terms of a Technical Assistance Letter dated June 18, 2012 that established an operational scenario under which no take of Indiana bats (*Myotis sodalist*) or northern long-eared bats (*Myotis septentrionalis*) is expected to occur (i.e., 7.0 m/s cut-in speed during the fall migration period [1 August – 15 October]).

The primary objectives of the post-construction study were to:

1. Determine overall bat fatality rates from the Project;
2. Monitor for Indiana and/or northern long-eared bat mortality; and
3. Evaluate the circumstances under which fatalities occur.

The study includes the following components:

1. Standardized carcass searches to systematically search plots at all turbines for bat casualties attributable to the turbines;
2. Searcher efficiency trials to estimate the percentage of bat casualties that were found by the searcher(s); and

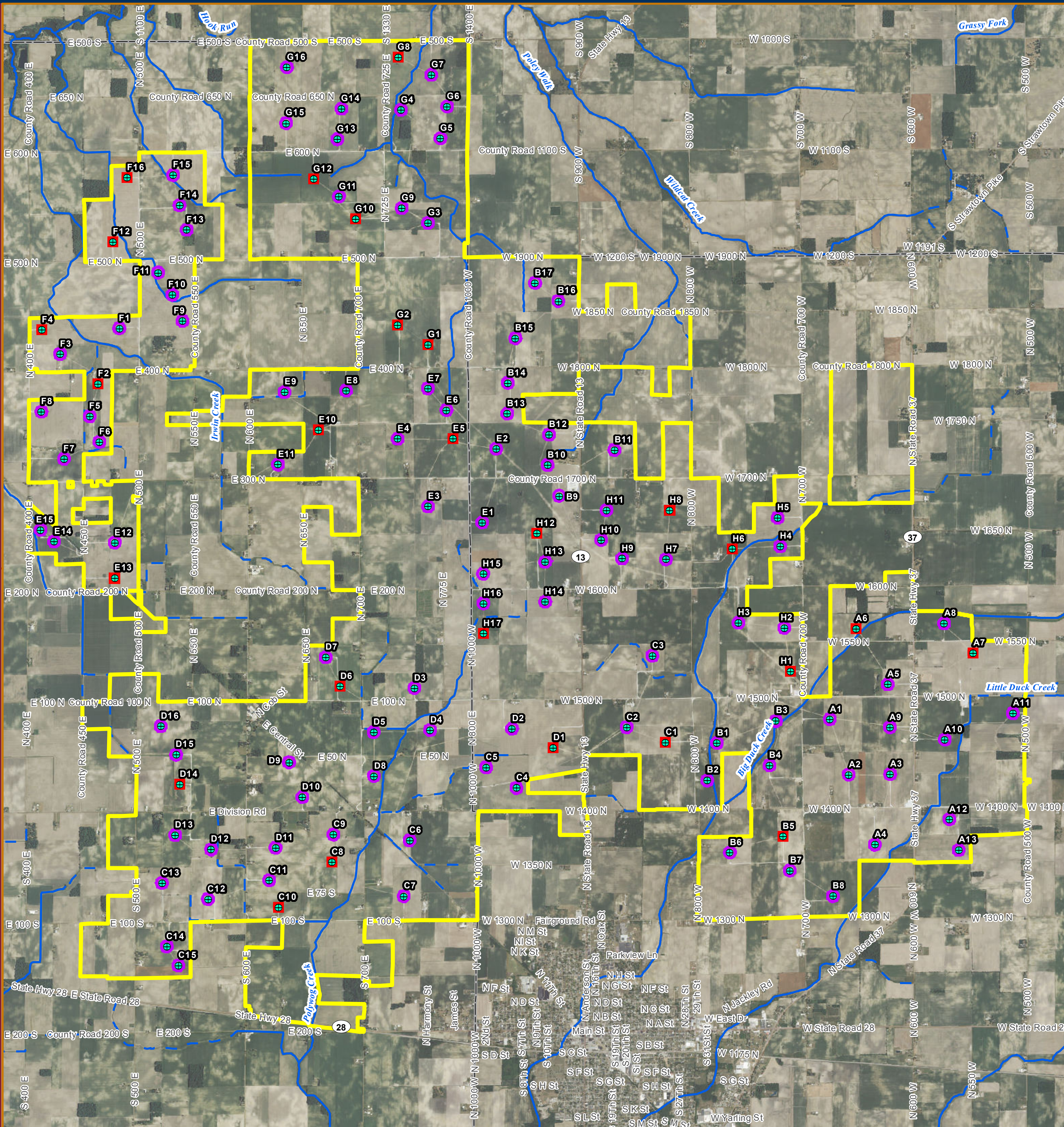
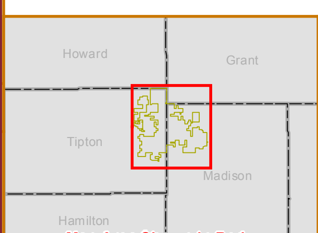


Figure 1. Turbine and Survey Locations

Wildcat Wind Farm



Location

Howard, Grant, Tipton, and Madison Counties
Indiana

Project Information

Project Number: 193702378
Last Modified: December 16, 2013

0 5 10
Miles

Legend

- Phase I Project Boundary
- Phase I As-built Turbine Locations
- Full Plot Survey Turbine
- Road and Pad Search Turbine

National Hydrography Database
- Perennial Stream
- Intermittent Stream

Data Sources include: USGS
Orthophotography: 2012 Imagery

Stantec

	Initials	Date
Prepared by	ACS	12/16/2013
Peer Review by	CP	12/16/2013
Final Review by		

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3. Carcass removal trials to estimate the persistence time of carcasses on-site before they were removed by scavengers.

2.0 Methods

2.1 MORTALITY STUDY

Carcass searches were conducted in spring (3 April to 14 May) and fall (5 August to 17 October) during the first full year of Project operation. This is the first of three years of "preliminary" monitoring during Project operation. The fall surveys were conducted during the period in which the turbines were curtailed at 7.0 m/s (1 August – 15 October) as per the requirements of the Project's Technical Assistance Letter.

2.1.1 Sample Size

Preliminary post-construction monitoring was conducted at 100% of the turbines. This study design provides full coverage of the facility and will serve as a control against which follow-up monitoring results can be compared.

2.1.2 Search Plot Size

At 80% of the turbines (n=100), only the turbine pads and roads out to 262 feet (80 meters[m]) from the turbine were searched. This method targets the areas shown to support the highest searcher efficiency while greatly reducing the financial and logistical restraints associated with clearing and searching large study plots, enabling much broader coverage of the facility. At the remaining 20% of turbines (n=25), 262-foot x 262-foot (80-m x 80-m) plots were cleared and searched using a full-coverage transect methodology. Each 80-m x 80-m plot was centered on a turbine location, and vegetation was periodically mowed as needed to improve searcher efficiency.

Previous studies have indicated that the majority of bat carcasses typically fall within 100 feet (30 m) of the turbine or within 50% of the maximum height of the turbine (Kerns and Kerlinger 2004, Arnett at el. 2005, Young et al. 2009, Jain et al. 2007, Piorkowski and O'Connell 2010, USFWS 2012). The plot size used for this study exceeds one-half the maximum turbine rotor height of the Project turbines (246 feet [75 m]). Turbines remained assigned to either the roads and pads search group or the cleared plot search group across the entire search year (both spring and fall monitoring periods). The subset of full-coverage plots provided a reference for estimating the number of fatalities which may have fallen outside of the search area at the roads and pads search turbines. This mixed sampling methodology is consistent with other post-construction monitoring studies being conducted (e.g., Good et al. 2011) and will enable comparison of study results.

2.1.3 Search Schedule

The search interval for all turbines was once weekly. An individual turbine was searched on the same day each week when conditions allowed. Within a day, the turbine search schedule and order were randomized, so that each turbine's search plot was sampled at differing periods during the day. 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.

2.1.4 Carcass Searches

Carcass searches were conducted by searchers experienced and/or trained in fatality search methods, including proper handling and reporting of carcasses. Searchers were familiar with and able to accurately identify the bat species likely to be found in the Project area, and any unknown bat discovered was sent to an expert for positive identification. During searches, searchers walked at a rate of approximately 2 mph (45 to 60 m per minute) while searching 10 feet (3 m) on either side of each transect.

For each carcass found, the following data were recorded (a sample data form is included in Appendix A):

- 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 photograph of each detected carcass was taken before the carcass was handled and removed. Representative digital photograph are included in Appendix B. All carcasses were labeled with a unique number, bagged, and stored frozen (with a copy of the original data sheet) at the Project Operations and Maintenance building. Bat carcasses were collected and

retained under Indiana Department of Natural Resources Special Purpose Salvage Permit No. 13-049.

Bat carcasses found in non-search areas and any bird carcasses found were coded as incidental finds, and documented as much as possible in a similar fashion to those found in standardized searches. Maintenance personnel were informed of the standardized searches, and were trained in collision event reporting protocol in the case of an incidental find. Bird carcasses were photographed and data collected, but the carcass was left in place and not collected; incidental bat carcasses were collected and stored and frozen with the carcasses found during standardized searches. Incidental finds were included in the survey summary totals, but were not included in the mortality estimates.

2.1.5 Species Identification

Preliminary bird and bat species identifications were made in the field by qualified staff. When carcass condition allowed, data collected also included the sex, age, and reproductive condition of the carcass. For bat carcasses, forearm length was recorded to facilitate in identification. Any unknown bat, or potential *Myotis* species, was identified by a Stantec bat biologist. In addition to the carcass, photographs and data collected for each carcass were used to verify the species identification.

2.2 SEARCHER EFFICIENCY TRIALS

Searcher efficiency trials were used to estimate the probability of bat carcass detection by the searchers. A total of two searcher efficiency trials were conducted: one each during the spring and fall monitoring periods. Searchers did not know when during the monitoring periods the trials were being conducted, at which turbines trial carcasses were placed, or the location or number of trial carcasses placed in any given search plot. Due to the limited number of bat carcasses collected prior to the spring trial, commercially-available brown mouse carcasses were used as trial carcasses to represent bats. Commercially-available mouse carcasses were also used during the fall trials to maintain consistency and comparability among the trials.

All searcher efficiency trial carcasses were randomly placed by the field lead within the search plots the morning of the search prior to the carcass searches for that day. The number of trial carcasses found by searchers during the mortality searches in each plot was recorded and compared to the total number of trial carcasses placed in the plot and not scavenged prior to the mortality search. A sample data form is included in Appendix A.

2.3 CARCASS REMOVAL TRIALS

Carcass removal trials were conducted to estimate the average length of time carcasses remained in the search plots (i.e., were available to find) before being removed by scavengers. Carcass removal trials were conducted following the searcher efficiency trials; one each during the spring and fall monitoring periods. Mouse carcasses used during the searcher efficiency trials were left in place and their locations were discretely marked. Searchers monitored the trial

carcasses over a period of up to 30 days. During each carcass removal trial, carcasses were checked every day for the first week, and then on days 10, 14, 20 and 30.

The condition of each carcass was recorded during each trial check. The conditions recorded were defined as follows:

- Intact – complete carcass with no body parts missing.
- Scavenged – carcass with some evidence or signs of scavenging.
- Feather or fur spot – no carcass, but 10 or more feathers or fur spot remaining.
- Missing – no carcass or fur remaining or fewer than 10 feathers.

A sample data form is included in Appendix A. Any carcasses remaining at the end of the 30-day trial period were removed from the field.

2.4 STATISTICAL METHODS FOR MORTALITY ESTIMATES

In an effort to make results comparable with other post-construction mortality studies, the methodology used to calculate the mortality estimates largely followed the estimator proposed by Erickson et al. (2003), as modified by Young et al. (2009). The estimate of the total number of turbine-related casualties was based on three components: (1) observed number of casualties, (2) searcher efficiency, and (3) carcass removal rates. The 90% confidence intervals were calculated using bootstrapping methods (Erickson et al. 2003 and Manly 1997 as presented in Young et al. 2009).

2.4.1 Mean Observed Number of Casualties (c)

The estimated mean observed number of casualties (c) per turbine per monitoring period was 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 during mortality searches. Incidental carcass finds (those found outside of the searched areas or at times other than during mortality searches) were not included in this calculation, nor in the estimated fatality rate. Mean number of observed casualties was calculated separately for each season (spring, fall) and search type (roads and pads, full plots).

2.4.2 Estimation of Searcher Efficiency Rate (p)

Searcher efficiency (p) represents the average probability that a carcass was detected by searchers. The searcher efficiency rate was calculated by dividing the number of trial carcasses observers found by the total number which remained available during the trial (non-scavenged). Searcher efficiency was calculated separately for each season (spring, fall) and search type (roads and pads, full plots).

2.4.3 Estimation of Carcass Removal Rate (t)

Carcass removal rates were estimated to adjust the observed number of casualties to account for scavenger activity at the site. Mean carcass removal time (t) represents the average length of time a planted carcass remained at the site before it was removed by scavengers. Mean carcass removal time was 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. Any trial carcasses still remaining at 30 days were collected, yielding censored observations at 30 days. Carcass removal rates were calculated separately for each season (spring, fall) and search type (roads and pads, full plots).

2.4.4 Estimation of the Probability of Carcass Availability and Detection (π)

Searcher efficiency and carcass removal rates were combined to represent the overall probability (π) that a casualty incurred at a turbine was reflected in the mortality search results. This probability was calculated as:

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

where I is the interval between searches. For this study, I=7 because searches were conducted weekly. The estimation of the probability of carcass availability and detection was calculated separately for each season (spring, fall) and search type (roads and pads, full plots).

2.4.5 Area Adjustment (A)

Approximation of A, the adjustment for areas which were not searched, was calculated following methods and data collected during post-construction monitoring studies at Fowler Ridge Wind Farm in Indiana (Good et al. 2011). For this study, A_{RP} was calculated to represent the adjustment for the proportion of carcasses which likely fell outside of the area searched at

roads and pads turbines, and A_{FP} was used to represent the adjustment for the proportion of carcasses which likely fell outside of the area searched at full plot turbines. The value for A_{RP} was approximated using the following equation:

$$A_{RP} = \frac{C_{FP}}{\pi_{FP}} \Big/ \frac{C_{RPFP}}{\pi_{RP}} * A_{FP}$$

where π_{FP} is the π value calculated for full plot searches. C_{FP} is the number of observed casualties on full plots, π_{RP} is the π value calculated for roads and pads searches, and C_{RPFP} is the number of observed casualties on roads and pads of the full plot turbines. A_{RP} was calculated separately for spring and fall.

The value for A_{FP} used was equal to the correction factor calculated for the Fowler study (A_{FP}=1.305) as the Fowler study estimated that 23.4% of fatalities fall outside of the 262-foot x 262-foot (80-m x 80-m) square plots.

2.4.6 Estimation of Facility-Related Mortality (m)

Mortality estimates were calculated using the estimator proposed by Erickson et al. (2003), as modified by Young et al. (2009). The estimated mean number of bat and bird casualties/turbine/monitoring period (m) was calculated by dividing the mean observed number of bat and bird casualties/turbine/monitoring period (c) by π, an estimate of the probability a carcass was not removed by scavengers and was detected by searchers, and then multiplying by A, the adjustment for the area within which bats may have fallen but which was not searched.

$$m = \mathrm{A} * \frac{c}{\pi}$$

Mortality estimates were calculated separately for each season (spring, fall) and search type (roads and pads, full plots).

3.0 Results

3.1 SUMMARY OF SEARCHES

A total of 864 carcass searches were conducted over seven weeks in the spring, and 1,370 carcass searches were conducted over 11 weeks in the fall. Due to weather and construction, the average time between searches during the spring monitoring period was 6.66 days, and the average for the fall monitoring period was 6.92 days. A total of 45 individual bat carcasses were found during standardized carcass searches, and four additional bat carcasses were found incidentally, for a total of 49 bat carcasses.

3.1.1 Species Composition

A summary of all bat carcasses found during the post-construction monitoring is shown in Table 1. Of the 49 bat carcasses found at the site, silver-haired bats (*Lasionycteris noctivagans*) and hoary bats (*Lasiurus cinereus*) were the most common species detected, each comprising 30.6% (n=15) of the bat carcasses collected. Eastern red bats (*Lasiurus borealis*) were the next most common, comprising 22.5% (n=11) of the bat carcasses collected. Big brown bats (*Eptesicus fuscus*) comprised 10.2% (n=5) of the bat carcasses collected. There were three unknown bat carcasses found (6.1%); however, although positive identification could not be made, all three were confirmed by a Stantec bat biologist using skull characteristics and dentition to not be a *Myotis* species. No bat species listed as threatened or endangered under the Endangered Species Act of 1973 (ESA), as amended, or the State of Indiana were found during the searches.

Table 1. Summary of all bat carcasses found during the 2013 post-construction monitoring study at the Wildcat Wind Farm Phase I.

Species	Spring	Fall	Total	Percent of All Bats Found
Silver-haired Bat	14	1	15	30.6%
Hoary Bat	4	11	15	30.6%
Eastern Red Bat	5	6	11	22.5%
Big Brown Bat	0	5	5	10.2%
Unknown (not *Myotis*)	1	2	3	6.1%
Total	**24**	**25**	**49**	100%

3.1.2 Age and Sex

A summary of the age and sex of all bat carcasses found during the post-construction monitoring is shown in Table 2. Of the 49 bat carcasses found, there were six adult females (12.2%), nine adult males (18.4%), 18 adults of unknown sex (36.7%) and 16 bats of unknown age and unknown sex (32.6%; Table 2).

Table 2. Sex and age of all bat carcasses found during the 2013 post-construction monitoring study at the Wildcat Wind Farm Phase I. Ages include adults (A), juveniles (J) and unknown (U).

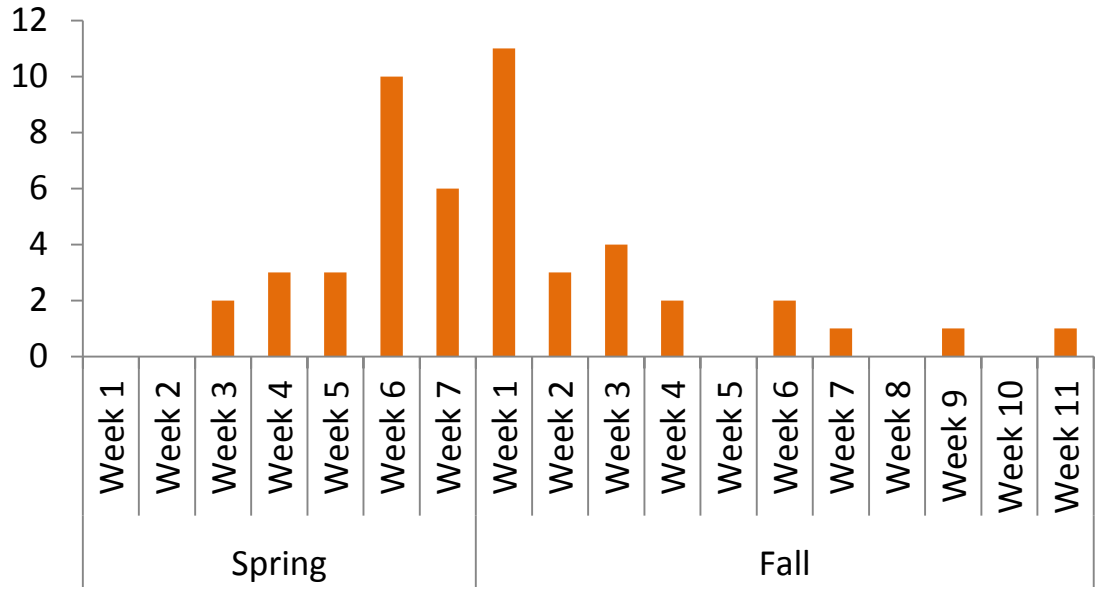
Species	Female			Male			Unknown		
	A	J	U	A	J	U	A	J	U
Silver-haired Bat	**1**	0	0	**4**	0	0	**9**	0	**1**
Hoary Bat	**2**	0	0	**1**	0	0	**6**	0	**6**
Eastern Red Bat	**3**	0	0	**3**	0	0	**2**	0	**3**
Big Brown Bat	0	0	0	**1**	0	0	0	0	**4**
Unknown (not *Myotis*)	0	0	0	0	0	0	**1**	0	**2**
Total	**6**	0	0	**9**	0	0	**18**	0	**16**

3.1.3 Temporal Patterns

Of the 49 bat carcasses found in 2013, 24 were found during the spring monitoring period and 25 were found during the fall monitoring period (Table 1 and Figure 2). In the spring, the most common species found was the silver-haired bat (n=14), and in the fall, the most common species found was the hoary bat (n=11). The big brown bat was found only during the fall monitoring period (n=5); no big brown bats were found in the spring.

The largest number of bat carcasses found in a week (11) was the first week of the fall monitoring period (Figure 2). During the spring monitoring period, the highest number of carcasses found in a week (10) occurred during week six (the week of 6 May). Zero carcasses were found during three weeks in the fall (week 5, week 8 and week 10) and during the first two weeks of spring monitoring.

Figure 2. Number of carcasses found by week in 2013 at the Wildcat Wind Farm Phase I



3.1.4 Spatial Patterns

Bat carcasses were found at a total of 38 of 125 (30.4 %) turbines during the 2013 monitoring periods. The largest number of carcasses found at a single turbine (3) was at turbines C1 (full plot), D10 (roads and pads), and H17 (full plot; Figure 1). At five turbines (A13, A4, D8, F12, and G8; see Figure 1 for locations), a total of two carcasses were found. The remainder of the turbines had either zero or one carcass found over the 18 weeks of fatality monitoring.

During the spring monitoring period, 10 bats were found at the full plot turbines and 13 bats were found at the roads and pads search turbines. Of the 10 bats found at the full plots, four were

found on the roads and pads within the full search plots and six were found off the roads and pads. During the fall monitoring period, eight bats were found at the full plot search turbines, and 14 bats were found at the road and pad search turbines. Of the eight bats found at the full plots, three were found on the roads and pads within the full search plots and five were found off the roads and pads.

3.2 SEARCHER EFFICIENCY TRIALS

Two searcher efficiency trials were conducted during the 2013 survey effort: one each during the spring and fall monitoring periods. A total of 30 mouse carcasses were placed for searcher efficiency trials in the spring monitoring period and again in the fall monitoring period. Scavengers did not remove any of the trial carcasses prior to the searcher efficiency trial. Overall, the searcher efficiency ranged from 60% to 90% (Table 3).

Table 3. Searcher efficiency by season and search type for the 2013 post-construction monitoring study at the Wildcat Wind Farm Phase I.

	Spring Monitoring Period		Fall Monitoring Period	
	Full Plots	**Roads and Pads**	**Full Plots**	**Roads and Pads**
# Carcasses Placed	13	17	15	15
# Carcasses Found	11	16	9	13
(p) Searcher Efficiency Mean (90% CI)	**0.9** (0.7, 1.0)	**0.9** (0.8, 1.0)	**0.6** (0.4, 0.8)	**0.9** (0.7, 1.0)

3.3 CARCASS REMOVAL TRIALS

Mouse carcasses used in the searcher efficiency trials were left for up to 30 days, and checked each day for the first week and then on days 10, 14, 21, and 30 of the trial. Thirty (30) mouse carcasses were used during the spring monitoring period, and 31 carcasses were used during the fall monitoring period. Carcasses persisted for an average of 10.6 to 14.6 days (Table 4).

Table 4. Carcass removal by season during the 2013 post-construction monitoring study at the Wildcat Wind Farm Phase I.

	Spring Monitoring Period		Fall Monitoring Period	
	Full Plots	**Roads and Pads**	**Full Plots**	**Roads and Pads**
# Carcasses Placed	13	17	16	15
# Carcasses Scavenged within 30 days	11	15	13	12
Mean Carcass Persistence time in days (90% CI)	**13.5** (7.7, 22.8)	**10.6** (6.4, 17.6)	**12.5** (6.5, 22.7)	**14.6** (6.9, 30.0)

3.4 ADJUSTED MORTALITY ESTIMATES

Mortality rate estimates were calculated based upon the carcasses found during the mortality searches, and did not include any incidental finds. Observed bat mortality estimates were adjusted to account for searcher efficiency, carcass removal, and an area adjustment using the methodology described in Section 2.4. Results are summarized in Table 5.

Table 5. Bat mortality estimates for the 2013 post-construction monitoring study at the Wildcat Wind Farm Phase I.

	Spring Monitoring Period		Fall Monitoring Period	
	Full Plots	Roads and Pads	Full Plots	Roads and Pads
(c) Observed bats/turbine/season	**0.40**	**0.13**	**0.32**	**0.14**
(π) Probability of Carcass Availability and Detection (90% CI)	**0.7** (0.6, 0.8)	**0.7** (0.6, 0.8)	**0.6** (0.4, 0.8)	**0.8** (0.6, 0.9)
(A) Area Adjustment	**1.305**	**3.20**	**1.305**	**4.37**
(m) Estimated bats/turbine/season	**0.7** (0.4, 1.2)	**0.6** (0.3, 0.9)	**0.7** (0.3, 1.4)	**0.8** (0.5, 1.3)
Estimated Bats/MW/Season	**0.4** (0.3, 0.8)	**0.4** (0.2, 0.6)	**0.4** (0.2, 0.9)	**0.5** (0.3, 0.8)
Estimated Bats/Facility/Season	**88** (50, 150)	**75** (38, 113)	**88** (38, 175)	**100** (63, 163)
Estimated Indiana Bats/Facility/Season[1]	**0.14** (0.08, 0.24)	**0.12** (0.06, 0.18)	**0.14** (0.06, 0.28)	**0.16** (0.10, 0.26)
Estimated Northern long-eared bats/Facility/Season[1]	**0.07** (0.04, 0.12)	**0.06** (0.03, 0.09)	**0.07** (0.03, 0.14)	**0.08** (0.05, 0.13)

[1]Calculated based upon percentage of Indiana bats and northern long-eared bats to all bat carcasses found (0.16% and 0.08%, respectively), based upon research done at Fowler Ridge Wind Farm (Western Ecosystems Technology, Inc. 2013).

3.5 INCIDENTAL FINDS

3.5.1 Bats

During the spring monitoring period, the only incidental bat found was a silver-haired bat found on 2 May 2013 at turbine D16 during a carcass removal trial. During the fall monitoring period, three incidental bats were found during regular searches, but outside the search area (i.e., off the road or pad for road/pad turbines). These included a big brown bat (found at turbine B3 on 8 August 2013), an eastern red bat (found at turbine F7 on 9 September 2013) and a silver-haired bat (found at turbine E4 on 11 September 2013). These incidental finds were included in the summaries of bat carcasses found, but were not included in the calculations of overall mortality since they were not found within the regularly scheduled searches for which carcass removal and searcher efficiency calculations applied.

3.5.2 Birds

A total of 31 bird carcasses were found during the 2013 post-construction studies. Of these 31 birds, only five (16%) were found during the spring monitoring period (average of 0.7 per week). The other 26 bird carcasses (84%) were found during the fall monitoring period (average of 2.4 per week). The bird carcasses found during the survey are summarized in Table 6.

Table 6. Summary of bird carcasses found during the 2013 post-construction monitoring study at the Wildcat Wind Farm Phase I. A feather spot was defined as any pile of ≥ 10 feathers.

Date	Species	Turbine
4 April 2013	Chipping Sparrow (*Spizella passerina*)	C6
10 April 2013	Yellow-bellied Sapsucker (*Sphyrapicus varius*)	E8
29 April 2013	American Kestrel (*Falco sparverius*)	F12
13 May 2013	Unknown Hawk (partial carcass)	D6
14 May 2013	Gray Catbird (*Dumetella carolinensis*)	A5
5 August 2013	Turkey Vulture (*Cathartes aura*)	D3
6 August 2013	Unknown (feather spot)	C1
7 August 2013	Unknown (feather spot)	G10
13 August 2013	Killdeer (*Charadrius vociferous)*	C1
14 August 2013	Unknown (feather spot)	H4
14 August 2013	Horned Lark (*Eremophila alpestris*)	B14
14 August 2013	Unknown (partial carcass)	H10
20 August 2013	Horned Lark (*Eremophila alpestris*)	A13
21 August 2013	Killdeer (*Charadrius vociferous)*	H13
21 August 2013	Unknown (feather spot)	B9
27 August 2013	Unknown (feather spot)	D2
27 August 2013	Unknown (partial carcass)	E10
3 September 2013	Mourning Dove (*Zenaida macroura*)	C8
5 September 2013	Pine Warbler (*Setophaga pinus*)	B1
10 September 2013	Unknown (feather spot)	A3
11 September 2013	Horned Lark (*Eremophila alpestris*)	H17
11 September 2013	Unknown (feather spot)	H16
17 September 2013	Yellow-throated Vireo (*Vireo flavifrons*)	A2
18 September 2013	Ruby-throated Hummingbird (*Archilochus colubris*)	H10
25 September 2013	Red-tailed Hawk (*Buteo jamaicensis*)	G2
25 September 2013	Ruby-throated Hummingbird (*Archilochus colubris*)	G8
30 September 2013	Unknown (feather spot)	C8
30 September 2013	Unknown (feather spot)	C8
30 September 2013	Yellow-bellied Flycatcher (*Empidonax flaviventris*)	E12
15 October 2013	Northern Flicker (*Colaptes auratus*)	C6
17 October 2013	Unknown (feather spot)	A7

4.0 Summary

- A total of 2,234 carcass searches were conducted over 18 weeks encompassing two survey periods in 2013.
- A total of 31 bird carcasses and 49 bat carcasses were found during the study period.
- No bird or bat species listed as threatened or endangered under the ESA or by the State of Indiana were found during the study.
- Bat species found included silver-haired bats (15), hoary bats (15), eastern red bats (11), and big brown bats (5), as well as several bats that were not identifiable to species (3) but were determined to not be a *Myotis* species based on skull morphology and dentition.
- Of the 33 bats able to be aged, all were adults. Of the 15 able to be sexed, 60% were males, consistent with data from other wind farms indicating that bat fatalities at active wind farms are typically skewed towards males (see review by Arnett et al. 2008).
- Estimated bat mortality was higher using the roads and pads method (75-100 bats/season) than using the full plot methodology (88 bats/season), however the two estimates overlapped greatly in their confidence intervals, indicating no significant different between the two estimates.
- No Indiana bat or northern long-eared bat carcasses were found during the 2013 study. Estimated mortality of the endangered Indiana bat ranged from 0.12 to 0.16 Indiana bats per season, and estimated mortality of the proposed endangered northern long-eared bat ranged from 0.06 to 0.08 northern long-eared bats per season.
- Estimated bat mortality was similar between the spring and fall monitoring periods, suggesting that the current curtailment used in the fall (i.e., 7.0 m/s cut-in speed) is effective in reducing overall bat mortality, since bat mortality is generally expected to be higher in the fall (Arnett et al. 2008).

5.0 Literature Cited

Arnett, E.B., W.P. Erickson, J. Kerns, and J. Horn. 2005. Relationships Between Bats and Wind Turbines in Pennsylvania and West Virginia: An Assessment of Fatality Search Protocols, Patterns of Fatality, and Behavioral Interactions with Wind Turbines. Final Report prepared for the Bats and Wind Energy Cooperative. Bat Conservation International, Austin, Texas. June 2005.

Arnett, E.B., W.K. Brown, W.P. Erickson, J.K. Fiedler, B.L. Hamilton, T.H. Henry, A. Jain, G.D. Johnson, J. Kerns, R.R. Koford, C.P. Nicholson, T.J. O'Connell, M.D. Piorkowski, and R.D. Tankersley. 2008. Patterns of bat fatalities at wind energy facilities in North America. Journal of Wildlife Management 72: 61-78.

Erickson, W.P., Gritski, B., and K. Kronner. 2003. Nine Canyon Wind Power Project Avian and Bat Monitoring Report, August 2003. Technical report submitted to energy Northwest and the Nine Canyon Technical Advisory Committee.

Jain, A., P. Kerlinger, R. Curry, and L. Slobodnik. 2007. Annual Report for the Maple Ridge Wind Power Project: Post-Construction Bird and Bat Fatality Study – 2006. Final report. Prepared for PPM Energy and Horizon Energy and Technical Advisory Committee (TAC) for the Maple Ridge Project Study.

Good, R. E., Erickson, W., Merrill, A., Simon, S., Murray, K., Bay, K., & Fritchman, C. 2011. Bat monitoring studies at the Fowler Ridge Wind Energy Facility, Benton County, Indiana, April 13–October 15, 2010. Prepared for Fowler Ridge Wind Farm, by Western EcoSystems Technology, Inc. Cheyenne, WY, USA.

Gruver, J., K. Bay, and W. Erickson. 2009. Post-construction bat and bird fatality study, Blue Sky Green Field Wind Resource Area, Fond du Lac County, Wisconsin. Interim Report prepared for We Energies, Milwaukee, Wisconsin.

Kerns, J., and P. Kerlinger. 2004. A Study of Bird and Bat Collisions at the Mountaineer Wind Energy Center, Tucker County, West Virginia: Annual Report for 2003. Prepared for FPL Energy and the Mountaineer Wind Energy Center Technical Review Committee. Technical report prepared by Curry and Kerlinger, LLC. February 14, 2004. 39 pp. http://www.wvhighlands.org/Birds/MountaineerFinalAvianRpt-%203-15-04PKJK.pdf

Kunz, T.H., E.B. Arnett, B.M. Cooper, W.P. Erickson, R.P. Larkin, T. Mabee, M.L. Morrison, M.D. Strickland, and J.M. Szewczak. 2007. Assessing Impacts of Wind-Energy Development on Nocturnally Active Birds and Bats: A Guidance Document. Journal of Wildlife Management 71:2449-2486.

Manly, B.F.J. 1997. Randomization, Bootstrap, and Monte Carlo Methods in Biology. Second edition. Chapman and Hall, New York. 399 pp.

Piorkowski, M.D., and T. J. O'Connell. 2010. Spatial Pattern of Summer Bat Mortality from Collisions with Wind Turbines in Mixed-grass Prairie. Am. Midl. Nat. 164:260-269.

Stantec. 2012. Wildcat Mortality Minimization and Monitoring Proposal. Prepared for Wildcat Wind Farm Phase 1, E.ON Climate and Renewables.

US Fish and Wildlife Service (USFWS). 2012. Land-based Wind Energy Guidelines. March 2012. 71 pp.

Western Ecosystems Technology, Inc. 2013. Fowler Ridge Wind Farm, Benton County, Indiana: Indiana Bat Habitat Conservation Plan. Prepared for Fowler Ridge Wind Farm LLC, Fowler Ridge II Wind Farm LLC, Fowler Ridge III Wind Farm LLC, Fowler Ridge IV Wind Farm LLC. November 2013.

Young, D. P., Erickson, W.P., Bay, K., Nomani, S., and W. Tidhar. 2009. Mount Storm Wind Energy Facility, Phase I Post-Construction Avian and Bat Monitoring, July-October 2008. Prepared for NedPower Mount Storm, LLC, by Western EcoSystems Technology, Inc. 40pp.

APPENDIX B

Representative Carcass Photos

CARCASS SEARCH DATA SHEET

WILDCAT WIND FARM (193702378)

DATE: _____ BIOLOGIST: _____

LABEL CARCASSES AND PHOTO WITH DATE-TURBINE -CARCASS NUMBER (e.g., 2009Apr01-T04-C07, to describe carcass #7 found at turbine 4 on April 1, 2009).

TURBINE NO.[1]	PLOT TYPE [2]	CARCASS NO. [3]	FROM TURBINE		ON ROAD/PAD?	GPS COORDINATES	SPECIES (scientific name, spell out)[4]	FOREARM LENGTH OF BAT (mm)	AGE[5]	SEX[6]	CAUSE OF DEATH [7]	CONDITION[8]	CHECK IF COMMENTS (write on back)[9]
			DISTANCE (m)	AZIMUTH (DEGREES)									
												/	
												/	
												/	
												/	
												/	
												/	
												/	
												/	
												/	
												/	
												/	
												/	
												/	
												/	
												/	
												/	
												/	
												/	

Turbine No.[1]	Plot Type [2]	Carcass No. [3]	From Turbine		On Road/Pad?	GPS Coordinates	Species (scientific name, spell out)[4]	Forearm length of bat (mm)	Age[5]	Sex[6]	Cause of Death [7]	Condition[8]	Check if Comments (write on back)[9]
			Distance (m)	Azimuth (degrees)									
												/	
												/	
												/	
												/	
												/	
												/	
												/	
												/	

[1] Turbine – Enter Number of Turbine. Also search the turbine pad and access road in addition to the Study Plot.

[2] Plot Type – R=Roads and Pads, F=Full Plot

[3] Carcass No. – Number carcasses in the order they are found.

[4] Species – If Unknown, specify unknown bat or unknown bird.

[5] Age – If identifiable: Adult = A; Juvenile = J; Unknown = U

[6] Sex – If identifiable: Female = F; male = M, Unknown = U

[7] Cause of Death – Collision with turbine = T; Predation = P; Unknown = U (add explanation in comments if necessary).

[8] Condition – enter F=Fresh or D=decomposed AND Whole =W; Most of body with some missing = M; Pieces = P (e.g., wing only); Feather spot = F (example: F/W)

[9] Comments – Including: Reproductive Condition, if identifiable: Pregnant = P; Lactating = L; Post-Lactating = PL; Non-reproductive = NR; Testes descended = T; Unknown = U; B= breeding (birds).

Band Color/No. – If banded, record color of band (or metal), and number.

Other Comments. **INCLUDE CARCASS NUMBER NEXT TO ALL COMMENTS.**

PHOTOS: Where possible, photograph for bats: back, breast, muzzle, tragus, ruler behind ear, ruler next to forearm, foot, toehairs, calcar (if exposed).

for birds: back, breast, head, feet, underside of winds (for raptors).

Additional comments (record carcass number next to associated comment; include any identifiers and bands, if present):

_____

_____

_____

CARCASS SEARCH SUMMARY SHEET

WILDCAT WIND FARM (193702378)

DATE: _____ BIOLOGIST: _____

WEATHER: % CLOUD COVER_____ TEMPERATURE (˚F) _____

PRECIPITATION _____ WIND_____

SITE DESCRIPTION/COMMENTS: _____

_____

_____

TURBINE NUMBER	PLOT TYPE (Full or Roads/Pads)	SURVEY TIME (MILITARY)		CARCASSES FOUND (#BIRD, #BAT, NONE)
		START	END	

Page____of_____

SCAVENGER REMOVAL TRIAL LOG
Wildcat Wind Farm (193702378)

Trial (spring, fall)_____ **Start Date_____**

Carcasses are labeled with date-turbine- carcass number as they were originally found (e.g., 2009Apr01-T04-C07, to describe carcass #7 found at turbine 4 on April 1, 2009).

Carcass ID[1]	Placement				Species (scientific name)			Condition[4] When Checked, Checked By[5]								
	GPS Coordinates	Time (Military)	Turbine[2]	Placed By[3]		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 10	Day 14	Day 20	Day 30

Carcass ID[1]	Placement				Species (scientific name)			Condition[4] When Checked, Checked By[5]								
	GPS Coordinates	Time (Military)	Turbine[2]	Placed By[3]		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 10	Day 14	Day 20	Day 30

[1] Carcass ID – Identification number marked inside carcass.
[2] Turbine – Turbine number where carcass placed.
[3] Placed By – Initials of the person who placed the carcass.
[4] Condition – Record the condition the carcass was in when checked. Intact = I, Signs of scavenging = S, Feather/Fur Spot = F, Missing or < 10 feathers = 0
[5] Checked by – Record the initials of the person who checked on the carcass.

Comments:_____
_____
_____
_____
_____
_____

More data on back? Yes No

SEARCHER EFFICIENCY TRIAL LOG
Wildcat Wind Farm (193702378)

Trial (spring, fall)_____ **Trial Date_____**

Carcasses are labeled with date-turbine- carcass number as they were originally found (e.g., 2009Apr01-T04-C07, to describe carcass #7 found at turbine 4 on April 1, 2009).

Carcass ID[1]	Placement				GPS Coordinates	From Turbine		Species (scientific name)	Trial Result		
	Time (Military)	Turbine[2]	Placed By[3]	On Road/Pad?		Distance (m)	Azimuth (degrees)		Found By[4]	Not Found	Scavenged Prior to Search

Carcass ID[1]	Placement				GPS Coordinates	From Turbine		Species (scientific name)	Trial Result		
	Time (Military)	Turbine[2]	Placed By[3]	On Road/Pad?		Distance (m)	Azimuth (degrees)		Found By[4]	Not Found	Scavenged Prior to Search

Comments (record carcass number next to associated comment, include any identifiers and bands, if present):

_____
_____
_____
_____
_____
_____

[1] Carcass ID – Use carcass ID from when it was originally found. If no ID, just number.
[2] Turbine – Turbine should be labeled with the turbine number where it was placed.
[3] Placed By – Initials of the person who placed the carcass.
[4] Found By – Record the initials of the person who found the carcass.

More data on back? Yes No

APPENDIX A

Sample Data Sheets

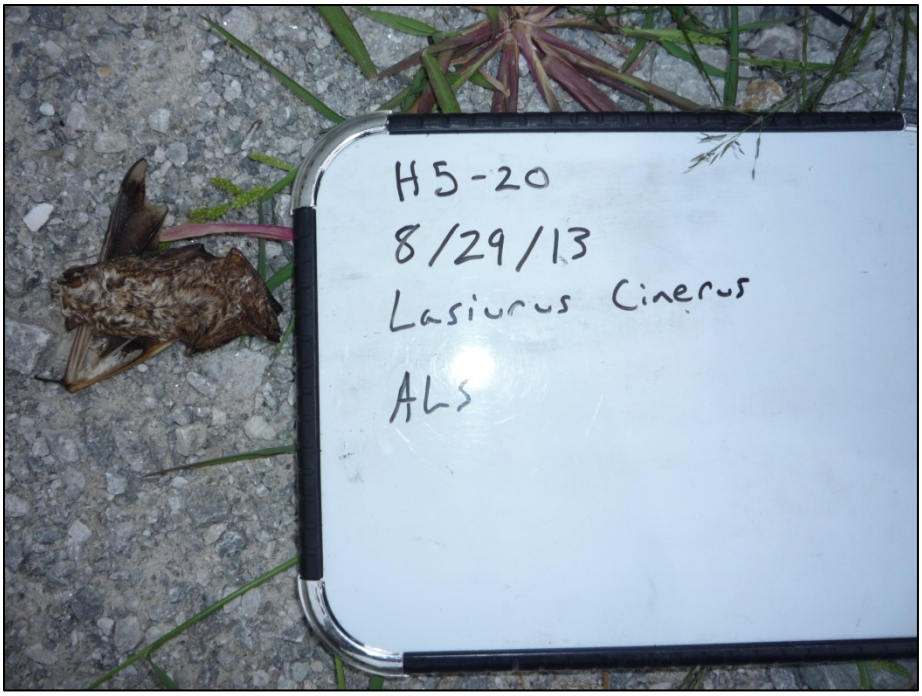


Photo 1. Red bat found at turbine H5 on 8/29/2013.

Photo 2. Red bat found at turbine H5 on 8/29/2013 with calipers for size comparison.

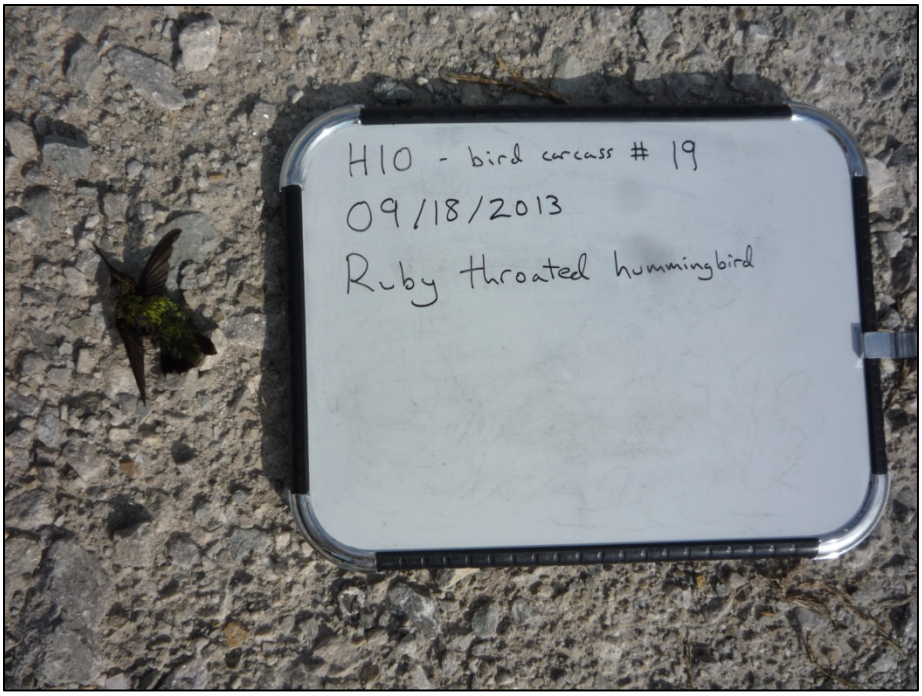


Photo 3. Ruby-throated Hummingbird found at turbine H10 on 9/18/2013.

Photo 4. Ruby-throated hummingbird found at turbine H10 on 9/18/2013 with calipers for size comparison.

Photo 5. Feather spot found at turbine C8 on 9/3/2013.

Photo 6. Unknown hawk found at turbine D6 on 5/13/2013.

APPENDIX G

2014 POST-CONSTRUCTION
BAT STUDY

DRAFT 2014 Post-Construction Bat Study
Wildcat Wind Farm Phase I

Madison and Tipton Counties, Indiana

Project #193702378

Prepared for:
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December 19, 2014

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1.0 Introduction

1.1 PROJECT DESCRIPTION

The Wildcat Wind Farm Phase I (Project or Wildcat) is located in Madison and Tipton counties, immediately north of the town of Elwood, Indiana. The Project consists of 125 GE 1.6 megawatt (MW) wind turbine generators and associated access roads and collector line system for a total capacity of 200 MWs (Figure 1). Each turbine is anchored in a steel reinforced concrete foundation. A pad mounted transformer is located at the base of each turbine, and collects electricity generated by each turbine through cables routed down the inside of the tower. This transformer raises the voltage of the electricity produced up to the 34.5 kilovolts (kV) of the collection system. The buried collection system connects the individual turbines to the substation, where the voltage is increased to 138 kV to allow connection with the existing transmission line. The Project became operational in December 2012. The Project is located on lands leased from private landowners, who continue their existing use of the land. Land use in the area is predominantly agricultural.

1.2 PURPOSE AND OBJECTIVES OF THE STUDY

A Post-Construction Mortality Minimization and Monitoring Proposal was developed in June 2012 (Stantec 2012), and is consistent with common methodologies and the recommendations of the U.S. Fish and Wildlife Service (USFWS) Land-Based Wind Energy Guidelines (USFWS 2012). The Project is currently operating under the terms of a Technical Assistance Letter (TAL) dated June 18, 2012, that established an operational scenario under which no take of Indiana bats (*Myotis sodalis* is expected to occur (i.e., 7.0 m/s cut-in speed during the fall migration period [1 August – 15 October]).

The primary objectives of the post-construction study were to:

1. Determine overall bat fatality rates from the Project;
2. Monitor for Indiana and northern long-eared bat mortality; and
3. Evaluate the circumstances under which fatalities occur.

The study includes the following components:

1. Standardized carcass searches to systematically search plots at all turbines for bat casualties attributable to the turbines;
2. Searcher efficiency trials to estimate the percentage of bat casualties that were found by the searcher(s); and

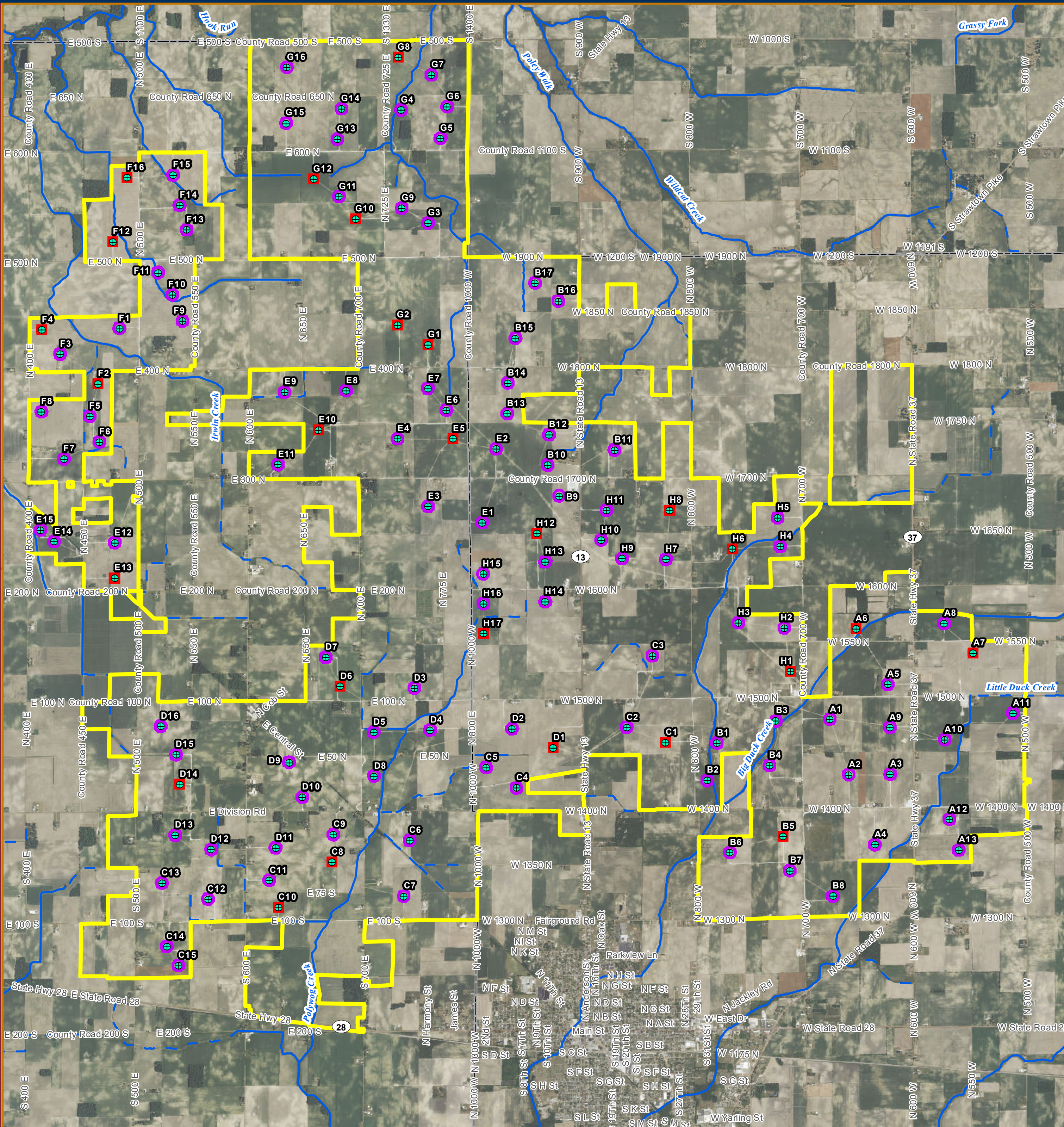
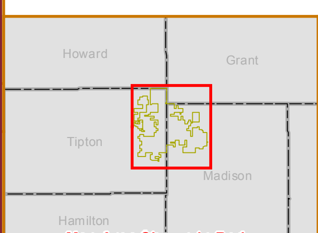


Figure 1. Turbine and Survey Locations

Wildcat Wind Farm



Location

Howard, Grant, Tipton, and Madison Counties
Indiana

Project Information

Project Number: 193702378
Last Modified: December 16, 2013

0 5 10
Miles

Legend

- Phase I Project Boundary
- Phase I As-built Turbine Locations
- Full Plot Survey Turbine
- Road and Pad Search Turbine

National Hydrography Database

- Perennial Stream
- Intermittent Stream

Data Sources include: USGS
Orthophotography: 2012 Imagery

Stantec

	Initials	Date
Prepared by	ACS	12/16/2013
Peer Review by	CP	12/16/2013
Final Review by		

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3. Carcass removal trials to estimate the persistence time of carcasses on-site before they were removed by scavengers.

2.0 Methods

2.1 MORTALITY STUDY

Carcass searches were conducted in spring (1 April to 15 May) and fall (4 August to 16 October) during the 2014 year of Project operation. This is the second of two years of "preliminary" monitoring during Project operation. The fall surveys were conducted during the period in which the turbines were curtailed at 7.0 m/s (1 August – 15 October) as per the requirements of the Project's TAL.

2.1.1 Sample Size

Baseline post-construction monitoring was conducted at 100% of the turbines. This study design provides full coverage of the facility and will serve as a control against which follow-up monitoring results can be compared.

2.1.2 Search Plot Size

At 80% of the turbines (n=100), only the turbine pads and roads out to 262 feet (80 meters[m]) from the turbine were searched. This method targets the areas shown to support the highest searcher efficiency while greatly reducing the financial and logistical restraints associated with clearing and searching large study plots, enabling much broader coverage of the facility. At the remaining 20% of turbines (n=25), 262-foot x 262-foot (80-m x 80-m) plots were cleared and searched using a full-coverage transect methodology. Each 80-m x 80-m plot was centered on a turbine location, and vegetation was periodically mowed as needed to improve searcher efficiency.

Previous studies have indicated that the majority of bat carcasses typically fall within 100 feet (30 m) of the turbine or within 50% of the maximum height of the turbine (Kerns and Kerlinger 2004, Arnett at el. 2005, Young et al. 2009, Jain et al. 2007, Piorkowski and O'Connell 2010, USFWS 2012). The plot size used for this study exceeds one-half the maximum turbine rotor height of the Project turbines (246 feet [75 m]). Turbines remained assigned to either the roads and pads search group or the cleared plot search group across the entire search year (both spring and fall monitoring periods). The subset of full-coverage plots provided a reference for estimating the number of fatalities which may have fallen outside of the search area at the roads and pads search turbines. This mixed sampling methodology is consistent with other post-construction monitoring studies being conducted (e.g., Good et al. 2011) and will enable comparison of study results.

2.1.3 Search Schedule

The search interval for all turbines was once weekly. An individual turbine was searched on the same day each week when conditions allowed. Within a day, the turbine search schedule and order were randomized, so that each turbine's search plot was sampled at differing periods during the day. 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. Additionally, 2013 surveys at Wildcat confirmed that a 7-day search interval was adequate based on the carcass persistence times for both spring and fall.

2.1.4 Carcass Searches

Carcass searches were conducted by searchers experienced and/or trained in fatality search methods, including proper handling and reporting of carcasses. Searchers were familiar with and able to accurately identify the bat species likely to be found in the Project area, and any unknown bat discovered was sent to an expert for positive identification. During searches, searchers walked at a rate of approximately 2 mph (45 to 60 m per minute) while searching 10 feet (3 m) on either side of each transect.

For each carcass found, the following data were recorded (a sample data form is included in Appendix A):

- 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 photograph of each detected carcass was taken before the carcass was handled and removed. Representative digital photograph are included in Appendix B. All carcasses were labeled with a unique number, bagged, and stored frozen (with a copy of the original data sheet) at the Project Operations and Maintenance Building. Bat carcasses were collected and

retained under Indiana Department of Natural Resources Special Purpose Salvage Permit No. 14-027.

Bat carcasses found in non-search areas and any bird carcasses found were coded as incidental finds, and documented as much as possible in a similar fashion to those found in standardized searches. Maintenance personnel were informed of the standardized searches, and were trained in collision event reporting protocol in the case of an incidental find. Bird carcasses were photographed and data collected, but the carcass was left in place and not collected; incidental bat carcasses were collected and stored and frozen with the carcasses found during standardized searches. Incidental finds were included in the survey summary totals, but were not included in the mortality estimates.

2.1.5 Species Identification

Preliminary bird and bat species identifications were made in the field by qualified staff. When carcass condition allowed, data collected also included the sex, age, and reproductive condition of the carcass. For bat carcasses, forearm length was recorded to facilitate in identification. Any unknown bat, or potential Indiana or northern long-eared bat, was identified by a Stantec bat biologist. In addition to the carcass, photographs and data collected for each carcass were used to verify the species identification.

2.2 SEARCHER EFFICIENCY TRIALS

Searcher efficiency trials were used to estimate the probability of bat carcass detection by the searchers. A total of two searcher efficiency trials were conducted: one each during the spring and fall monitoring periods. Searchers did not know when during the monitoring periods the trials were being conducted, at which turbines trial carcasses were placed, or the location or number of trial carcasses placed in any given search plot. Due to the limited number of bat carcasses collected prior to the spring trial, commercially-available brown mouse carcasses were used as trial carcasses to represent bats. Commercially-available mouse carcasses were also used during the fall trials to maintain consistency and comparability among the trials.

All searcher efficiency trial carcasses were randomly placed by the field lead within the search plots the morning of the search prior to the carcass searches for that day. The number of trial carcasses found by searchers during the mortality searches in each plot was recorded and compared to the total number of trial carcasses placed in the plot and not scavenged prior to the mortality search. A sample data form is included in Appendix A.

2.3 CARCASS REMOVAL TRIALS

Carcass removal trials were conducted to estimate the average length of time carcasses remained in the search plots (i.e., were available to find) before being removed by scavengers. Carcass removal trials were conducted following the searcher efficiency trials; one each during the spring and fall monitoring periods. Mouse carcasses used during the searcher efficiency trials were left in place and their locations were discretely marked. Searchers monitored the trial

carcasses over a period of up to 30 days. During each carcass removal trial, carcasses were checked every day for the first week, and then on days 10, 14, 20 and 30.

The condition of each carcass was recorded during each trial check. The conditions recorded were defined as follows:

- Intact – complete carcass with no body parts missing.
- Scavenged – carcass with some evidence or signs of scavenging.
- Feather or fur spot – no carcass, but 10 or more feathers or fur spot remaining.
- Missing – no carcass or fur remaining or fewer than 10 feathers.

A sample data form is included in Appendix A. Any carcasses remaining at the end of the 30-day trial period were removed from the field.

2.4 STATISTICAL METHODS FOR MORTALITY ESTIMATES

In an effort to make results comparable with other post-construction mortality studies, the methodology used to calculate the mortality estimates largely followed the estimator proposed by Erickson et al. (2003), as modified by Young et al. (2009). The estimate of the total number of turbine-related casualties was based on three components: (1) observed number of casualties, (2) searcher efficiency, and (3) carcass removal rates. The 90% confidence intervals were calculated using bootstrapping methods (Erickson et al. 2003 and Manly 1997 as presented in Young et al. 2009).

2.4.1 Mean Observed Number of Casualties (c)

The estimated mean observed number of casualties (c) per turbine per monitoring period was 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 during mortality searches. Incidental carcass finds (those found outside of the searched areas or at times other than during mortality searches) were not included in this calculation, nor in the estimated fatality rate. Mean number of observed casualties was calculated separately for each season (spring, fall) and search type (roads and pads, full plots).

2.4.2 Estimation of Searcher Efficiency Rate (p)

Searcher efficiency (p) represents the average probability that a carcass was detected by searchers. The searcher efficiency rate was calculated by dividing the number of trial carcasses observers found by the total number which remained available during the trial (non-scavenged). Searcher efficiency was calculated separately for each season (spring, fall) and search type (roads and pads, full plots).

2.4.3 Estimation of Carcass Removal Rate (t)

Carcass removal rates were estimated to adjust the observed number of casualties to account for scavenger activity at the site. Mean carcass removal time (t) represents the average length of time a planted carcass remained at the site before it was removed by scavengers. Mean carcass removal time was 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. Any trial carcasses still remaining at 30 days were collected, yielding censored observations at 30 days. Carcass removal rates were calculated separately for each season (spring, fall) and search type (roads and pads, full plots).

2.4.4 Estimation of the Probability of Carcass Availability and Detection (π)

Searcher efficiency and carcass removal rates were combined to represent the overall probability (π) that a casualty incurred at a turbine was reflected in the mortality search results. This probability was calculated as:

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

where I is the interval between searches. For this study, I=7 because searches were conducted weekly. The estimation of the probability of carcass availability and detection was calculated separately for each season (spring, fall) and search type (roads and pads, full plots).

2.4.5 Area Adjustment (A)

Approximation of A, the adjustment for areas which were not searched, was calculated following methods and data collected during post-construction monitoring studies at Fowler Ridge Wind Farm in Indiana (Good et al. 2011). For this study, A_{RP} was calculated to represent the adjustment for the proportion of carcasses which likely fell outside of the area searched at

roads and pads turbines, and A_{FP} was used to represent the adjustment for the proportion of carcasses which likely fell outside of the area searched at full plot turbines. The value for A_{RP} was approximated using the following equation:

$$A_{RP} = \frac{C_{FP}}{\pi_{FP}} \Big/ \frac{C_{RPFP}}{\pi_{RP}} * A_{FP}$$

where π_{FP} is the π value calculated for full plot searches. C_{FP} is the number of observed casualties on full plots, π_{RP} is the π value calculated for roads and pads searches, and C_{RPFP} is the number of observed casualties on roads and pads of the full plot turbines. A_{RP} was calculated separately for spring and fall.

The value for A_{FP} used was equal to the correction factor calculated for the Fowler study (A_{FP}=1.305) as the Fowler study estimated that 23.4% of fatalities fall outside of the 262-foot x 262-foot (80-m x 80-m) square plots.

2.4.6 Estimation of Facility-Related Mortality (m)

Mortality estimates were calculated using the estimator proposed by Erickson et al. (2003), as modified by Young et al. (2009). The estimated mean number of bat and bird casualties/turbine/monitoring period (m) was calculated by dividing the mean observed number of bat and bird casualties/turbine/monitoring period (c) by π, an estimate of the probability a carcass was not removed by scavengers and was detected by searchers, and then multiplying by A, the adjustment for the area within which bats may have fallen but which was not searched.

$$m = \mathrm{A} * \frac{c}{\pi}$$

Mortality estimates were calculated separately for each season (spring, fall) and search type (roads and pads, full plots).

3.0 Results

3.1 SUMMARY OF SEARCHES

A total of 843 carcass searches were conducted over seven weeks in the spring, and 1,356 carcass searches were conducted over 11 weeks in the fall. Due to weather and construction, the average time between searches during the spring monitoring period was 7.04 days, and the average for the fall monitoring period was 7.03 days. A total of 49 individual bat carcasses were found during standardized carcass searches, 27 during the fall searches and 22 during the spring searched. Three additional bat carcasses were found outside of the search plot area, one in the spring search period and two in the fall search period. Total, 52 bat carcasses were found.

3.1.1 Species Composition

A summary of all bat carcasses found during the post-construction monitoring is shown in Table 1. Of the 52 bat carcasses found at the site, silver-haired bats (*Lasionycteris noctivagans*) were the most common species detected, comprising 34.6% (n=18) of the bat carcasses collected. Hoary bats (*Lasiurus cinereus*) were the next most common species, comprising 30.8% (n=16), and eastern red bats (*Lasiurus borealis*) were the next most common, comprising 28.8% (n=15) of the bat carcasses collected. Big brown bats (*Eptesicus fuscus*) comprised 5.8% (n=3) of the bat carcasses collected. No bat species listed as threatened or endangered under the Endangered Species Act of 1973 (ESA), as amended, or the State of Indiana were found during the searches, and all bat carcasses were identified to the species level.

Table 1. Summary of all bat carcasses found during the 2014 post-construction monitoring study at the Wildcat Wind Farm Phase I.

Species	Spring	Fall	Total	Percent of All Bats Found
Silver-haired Bat	16	2	18	34.6%
Hoary Bat	4	12	16	30.8%
Eastern Red Bat	2	13	15	28.8%
Big Brown Bat	1	2	3	5.8%
Total	**23**	**29**	**52**	100%

3.1.2 Age and Sex

A summary of the age and sex of all bat carcasses found during the post-construction monitoring is shown in Table 2. Of the 52 bat carcasses found, there were 12 adult females (23.1%), two adult males (3.8%), one juvenile male (1.9%) , 12 adults of unknown sex (23.1%), three juveniles of unknown sex (5.8%) and 22 bats of unknown age and unknown sex (42.3%; Table 2).

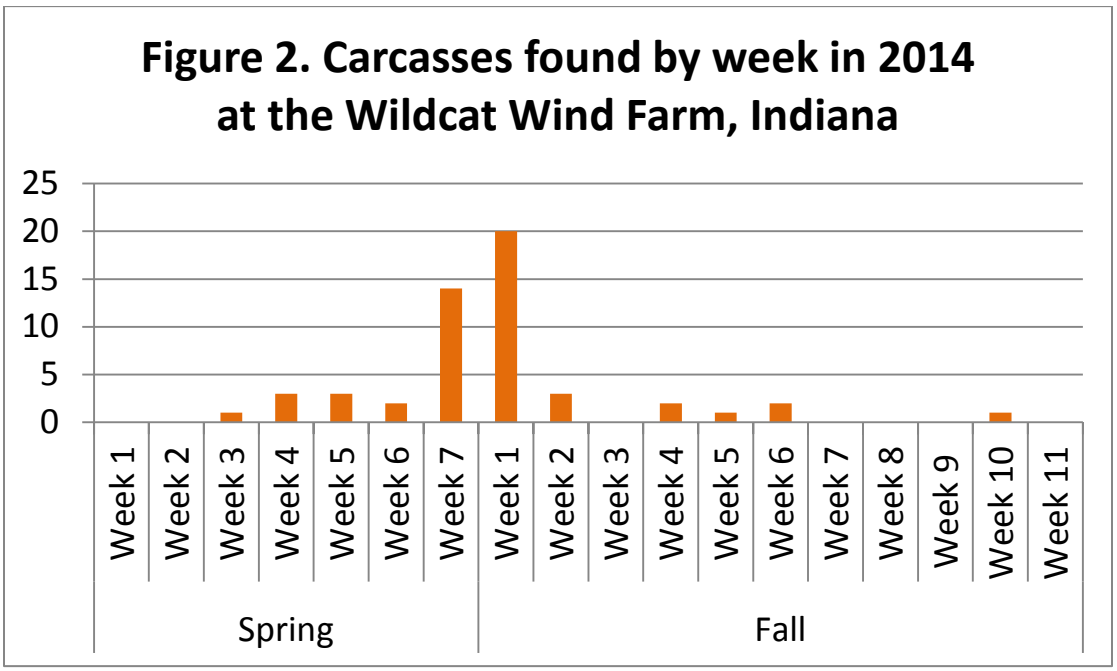
Table 2. Sex and age of all bat carcasses found during the 2014 post-construction monitoring study at the Wildcat Wind Farm Phase I. Ages include adults (A), juveniles (J) and unknown (U).

Species	Female			Male			Unknown		
	A	J	U	A	J	U	A	J	U
Silver-haired Bat	**9**	0	0	**1**	0	0	**6**	0	**2**
Hoary Bat	**2**	0	0	0	0	0	**4**	0	**10**
Eastern Red Bat	0	0	0	**1**	**1**	0	**2**	**3**	**8**
Big Brown Bat	**1**	0	0	0	0	0	0	0	**2**
Total	**12**	0	0	**2**	**1**	0	**12**	**3**	**22**

3.1.3 Temporal Patterns

Of the 52 bat carcasses found in 2014, 23 were found during the spring monitoring period and 29 were found during the fall monitoring period (Table 1 and Figure 2). In the spring, the most common species found was the silver-haired bat (n=16), and in the fall, the most common species found was the eastern red bat (n=13), followed closely by the hoary bat (n=12).

The largest number of bat carcasses found in a week (20) was the first week of the fall monitoring period (Figure 2). During the spring monitoring period, the highest number of carcasses found in a week (14) occurred during week seven (the week of 12 May). Zero carcasses were found during five weeks in the fall (week 3, weeks 7-9 and week 11) and during the first two weeks of spring monitoring.



3.1.4 Spatial Patterns

Bat carcasses were found at a total of 35 of 125 (28.0%) turbines during the 2014 monitoring periods. The largest number of carcasses found at a single turbine (4) was at turbine A5 (full plot; Figure 1). At four turbines (A7, H1, C1, F16; all full plots, see Figure 1 for locations), a total of three carcasses were found. The remainder of the turbines had either zero or one carcass found over the 18 weeks of fatality monitoring.

During the spring monitoring period, 13 bats were found at the full plot turbines and 9 bats were found at the roads and pads search turbines. Of the 13 bats found at the full plots, 3 were found on the roads and pads within the full search plots and 10 were found off the roads and pads. During the fall monitoring period, 14 bats were found at the full plot search turbines, and 13 bats were found at the road and pad search turbines. Of the 14 bats found at the full plots, four were

found on the roads and pads within the full search plots and 10 were found off the roads and pads.

3.2 SEARCHER EFFICIENCY TRIALS

Two searcher efficiency trials were conducted during the 2014 survey effort: one each during the spring and fall monitoring periods. A total of 30 mouse carcasses were placed for searcher efficiency trials in the spring monitoring period and again in the fall monitoring period. Scavengers did not remove any of the trial carcasses prior to the searcher efficiency trial. Overall, the searcher efficiency ranged from 75% to 95% (Table 3).

Table 3. Searcher efficiency by season and search type for the 2014 post-construction monitoring study at the Wildcat Wind Farm Phase I.

	Spring Monitoring Period		Fall Monitoring Period	
	Full Plots	Roads and Pads	Full Plots	Roads and Pads
# Carcasses Placed	8	20	10	20
# Carcasses Found	6	18	8	19
(p) Searcher Efficiency Mean (90% CI)	**0.75** (0.5, 1.0)	**0.9** (0.8, 1.0)	**0.8** (0.6, 1.0)	**0.95** (0.85, 1.0)

3.3 CARCASS REMOVAL TRIALS

Mouse carcasses used in the searcher efficiency trials were left for up to 30 days, and checked each day for the first week and then on days 10, 14, 21, and 30 of the trial. Thirty (30) mouse carcasses were used during the spring monitoring period, and 31 carcasses were used during the fall monitoring period. Carcasses persisted for an average of 4.4 to 16.9 days (Table 4).

Table 4. Carcass removal by season during the 2014 post-construction monitoring study at the Wildcat Wind Farm Phase I.

	Spring Monitoring Period		Fall Monitoring Period	
	Full Plots	Roads and Pads	Full Plots	Roads and Pads
# Carcasses Placed	8	22	10	20
# Carcasses Scavenged within 30 days	7	18	8	19
Mean Carcass Persistence time in days (90% CI)	**10.9** (5.1, 23.2)	**16.9** (11.6, 23.3)	**15.5** (7.3, 30.5)	**4.4** (2.5, 8.2)

3.4 ADJUSTED MORTALITY ESTIMATES

Mortality rate estimates were calculated based upon the carcasses found during the mortality searches, and did not include any incidental finds. Observed bat mortality estimates were adjusted to account for searcher efficiency, carcass removal, and an area adjustment using the methodology described in Section 2.4. Results are summarized in Table 5.

Table 5. Bat mortality estimates for the 2014 post-construction monitoring study at the Wildcat Wind Farm Phase I.

	Spring Monitoring Period		Fall Monitoring Period	
	Full Plots	Roads and Pads	Full Plots	Roads and Pads
(c) Observed bats/turbine/season	**0.52**	**0.09**	**0.56**	**0.13**
(π) Probability of Carcass Availability and Detection (90% CI)	**0.6** (0.4, 0.8)	**0.8** (0.7, 0.9)	**0.7** (0.5, 0.9)	**0.5** (0.3, 0.7)
(A) Area Adjustment	**1.305**	**6.9**	**1.305**	**4.03**
(m) Estimated bats/turbine/season	**1.1** (0.6, 2.0)	**0.8** (0.4, 1.3)	**1.0** (0.5, 1.7)	**1.1** (0.6, 1.9)
Estimated Bats/MW/Season	**0.7** (0.4, 1.3)	**0.5** (0.3, 0.8)	**0.6** (0.3, 1.1)	**0.7** (0.4, 1.2)
Estimated Bats/Facility/Season	**137.5** (75, 250)	**100** (50, 162.5)	**125** (62.5, 212.5)	**137.5** (75, 237.5)
Estimated Indiana Bats/Facility/Season[1]	**0.22** (0.12, 0.4)	**0.16** (0.08, 0.26)	**0.20** (0.10, 0.34)	**0.22** (0.12, 0.38)
Estimated northern long-eared bats/Facility/Season[1]	**0.11** (0.06, 0.2)	**0.08** (0.04, 0.13)	**0.10** (0.05, 0.17)	**0.11** (0.06, 0.19)

[1]Calculated based upon percentage of Indiana and northern long-eared bats to all bat carcasses found (0.16% and 0.08%, respectively), based upon research done at Fowler Ridge Wind Farm (Western Ecosystems Technology, Inc. 2013).

3.5 INCIDENTAL FINDS

3.5.1 Bats

During the week of 11 May, two live bats were found. On 12 May an adult silver-haired bat was found lying on the cement pad under the turbine transformer at turbine D5. The bat appeared to be healthy and uninjured, and flew away unassisted. On 13 May, an adult female big brown bat was found hanging on the cement pad at ground level at turbine B2. The bat appeared to be healthy with the exception of an injured right wrist area. The Indiana DNR was contacted as per permit requirements and the bat was transferred to Rick Hutson, a certified wildlife rehabilitator, in Greenfield, Indiana. It was understood at the time that the bat would later be transferred to Tracy A. Eads, a rehabilitator in Hancock County with bat experience. Tracy was

contacted a week after the incident, and Stantec staff were informed that the bat was doing well, and it was hoped that it would recover and heal on its own. If the bat should not recover the ability to fly, Tracy indicated that it would become an educational animal for nature shows and outreach. No additional updates have been received at this time.

The live silver-haired bat which flew away was not included in the summaries or calculations since it did not appear to have suffered any injury. The injured big brown bat transported to the rehabber was considered a mortality for the purposes of this study, and was included in both the summaries and the calculations of overall mortality since it was effectively removed from the local population when transported to a rehabber.

During the 2014 spring monitoring period, a single incidental bat was found on 22 April at turbine B2. The turbine is a road-and-pad turbine, and the carcass was found outside of the search area. During the fall monitoring period, two incidental bats were found during regular searches, but outside the search area (i.e., off the road or pad for road/pad turbines). These included a big brown bat (found at turbine F16 on 5 August 2014), and a hoary bat (found at turbine A1 on 7 August 2014).

These incidental finds were included in the summaries of bat carcasses found, but were not included in the calculations of overall mortality since they were not found within the regularly scheduled searches for which carcass removal and searcher efficiency calculations applied.

3.5.2 Birds

A total of 41 bird carcasses were found during the 2014 post-construction studies. Of these 41 birds, 14 (34%) were found during the spring monitoring period (average of 2.0 per week). The other 27 bird carcasses (66%) were found during the fall monitoring period (average of 2.5 per week). The bird carcasses found during the survey are summarized in Table 6.

Table 6. Summary of bird carcasses found during the 2014 post-construction monitoring study at the Wildcat Wind Farm Phase I. A feather spot was defined as any pile of ≥ 10 feathers.

Date	Species	Turbine
31 March 2014	European Starling (*Sturnus vulgaris*)	F4
31 March 2014	Unknown Hawk	E13
1 April 2014	Golden-crowned Kinglet (*Regulus satrapa*)	E9
1 April 2014	Unknown Passerine	B5
2 April 2014	Killdeer (*Charadrius vociferous*)	H17
7 April 2014	Brown Creeper (*Certhia americana*)	H11
10 April 2014	Unknown (skull only)	G2
10 April 2014	Tree Swallow (*Tachycineta bicolor*)	H1
14 April 2014	Golden-crowned Kinglet	F4
15 April 2014	Killdeer	F16

Date	Species	Turbine
23 April 2014	Horned Lark (*Eremophila alpestris*)	H15
5 May 2014	Ruby-crowned Kinglet (*Regulus calendula*)	D13
6 May 2014	Ruby-crowned Kinglet	A11
7 May 2014	Gray Catbird (*Dumetella carolinensis*)	B11
4 August 2014	Horned Lark	D6
6 August 2014	Horned Lark	G12
6 August 2014	Brown Thrasher (*Toxostoma rufum*)	B12
6 August 2014	Vesper Sparrow (*Pooecetes gramineus*)	G5
7 August 2014	Unknown Gull (feather spot)	A6
7 August 2014	Sora (*Porzana carolina*)	A1
13 August 2014	Horned Lark	G6
14 August 2014	Horned Lark	H5
18 August 2014	Horned Lark	D6
20 August 2014	Horned Lark	H11
26 August 2014	Unknown Bird (wing only)	F16
28 August 2014	Horned Lark	H12
3 September 2014	Unknown Bird (feather spot)	B12
9 September 2014	Horned Lark	C1
9 September 2014	Tennessee Warbler (*Oreothlypis peregrine*)	C7
11 September 2014	Unknown Bird (head only)	H12
12 September 2014	Horned Lark	H1
15 September 2014	Red-eyed Vireo (*Vireo olivaceus*)	F4
17 September 2014	Unknown Flycatcher (*Empidonax* sp.)	G2
18 September 2014	Unknown Bird (feather spot)	H1
22 September 2014	Unknown Bird (feather spot)	D15
23 September 2014	Tennessee Warbler	C1
23 September 2014	Horned Lark	F12
30 September 2014	European Starling	A5
30 September 2014	Horned Lark	C13
1 October 2014	Swainson's Thrush (*Catharus ustulatus*)	E2
8 October 2014	Unknown Bird (feather spot)	G9

4.0 Summary

- A total of 2,199 carcass searches were conducted over 18 weeks encompassing two survey periods in 2014.
- A total of 41 bird carcasses and 52 bat carcasses were found during the study period.

- No bird or bat species listed as threatened or endangered under the ESA or by the State of Indiana were found during the study.
- Bat species found included silver-haired bats (18), hoary bats (16), eastern red bats (15), and big brown bats (3).
- Of the 30 bats able to be aged, 26 were adults and 4 were juveniles. Of the 15 able to be sexed, 80% were females, contrary with data from other wind farms indicating that bat fatalities at active wind farms are typically skewed towards males (see review by Arnett et al. 2008).
- Estimated bat mortality between the two estimate types (roads and pads versus full plots) overlapped greatly in their confidence intervals, indicating no significant difference between the two estimates.
- No Indiana bat or northern long-eared bat carcasses were found during the 2014 study. Estimated mortality of the endangered Indiana bat ranged from 0.16 to 0.22 Indiana bats per season, and estimated mortality of the proposed endangered northern long-eared bat ranged from 0.08 to 0.11 northern long-eared bats per season.
- Estimated bat mortality was similar between the spring and fall monitoring periods, suggesting that the current curtailment used in the fall (i.e., 7.0 m/s cut-in speed) is effective in reducing overall bat mortality, since bat mortality is generally expected to be higher in the fall (Arnett et al. 2008).

5.0 Literature Cited

Arnett, E.B., W.P. Erickson, J. Kerns, and J. Horn. 2005. Relationships Between Bats and Wind Turbines in Pennsylvania and West Virginia: An Assessment of Fatality Search Protocols, Patterns of Fatality, and Behavioral Interactions with Wind Turbines. Final Report prepared for the Bats and Wind Energy Cooperative. Bat Conservation International, Austin, Texas. June 2005.

Arnett, E.B., W.K. Brown, W.P. Erickson, J.K. Fiedler, B.L. Hamilton, T.H. Henry, A. Jain, G.D. Johnson, J. Kerns, R.R. Koford, C.P. Nicholson, T.J. O'Connell, M.D. Piorkowski, and R.D. Tankersley. 2008. Patterns of bat fatalities at wind energy facilities in North America. Journal of Wildlife Management 72: 61-78.

Erickson, W.P., Gritski, B., and K. Kronner. 2003. Nine Canyon Wind Power Project Avian and Bat Monitoring Report, August 2003. Technical report submitted to energy Northwest and the Nine Canyon Technical Advisory Committee.

Jain, A., P. Kerlinger, R. Curry, and L. Slobodnik. 2007. Annual Report for the Maple Ridge Wind Power Project: Post-Construction Bird and Bat Fatality Study – 2006. Final report. Prepared

for PPM Energy and Horizon Energy and Technical Advisory Committee (TAC) for the Maple Ridge Project Study.

Good, R. E., Erickson, W., Merrill, A., Simon, S., Murray, K., Bay, K., & Fritchman, C. 2011. Bat monitoring studies at the Fowler Ridge Wind Energy Facility, Benton County, Indiana, April 13–October 15, 2010. Prepared for Fowler Ridge Wind Farm, by Western EcoSystems Technology, Inc. Cheyenne, WY, USA.

Gruver, J., K. Bay, and W. Erickson. 2009. Post-construction bat and bird fatality study, Blue Sky Green Field Wind Resource Area, Fond du Lac County, Wisconsin. Interim Report prepared for We Energies, Milwaukee, Wisconsin.

Kerns, J., and P. Kerlinger. 2004. A Study of Bird and Bat Collisions at the Mountaineer Wind Energy Center, Tucker County, West Virginia: Annual Report for 2003. Prepared for FPL Energy and the Mountaineer Wind Energy Center Technical Review Committee. Technical report prepared by Curry and Kerlinger, LLC. February 14, 2004. 39 pp. http://www.wvhighlands.org/Birds/MountaineerFinalAvianRpt-%203-15-04PKJK.pdf

Kunz, T.H., E.B. Arnett, B.M. Cooper, W.P. Erickson, R.P. Larkin, T. Mabee, M.L. Morrison, M.D. Strickland, and J.M. Szewczak. 2007. Assessing Impacts of Wind-Energy Development on Nocturnally Active Birds and Bats: A Guidance Document. Journal of Wildlife Management 71:2449-2486.

Manly, B.F.J. 1997. Randomization, Bootstrap, and Monte Carlo Methods in Biology. Second edition. Chapman and Hall, New York. 399 pp.

Piorkowski, M.D., and T. J. O'Connell. 2010. Spatial Pattern of Summer Bat Mortality from Collisions with Wind Turbines in Mixed-grass Prairie. Am. Midl. Nat. 164:260-269.

Stantec. 2012. Wildcat Mortality Minimization and Monitoring Proposal. Prepared for Wildcat Wind Farm Phase 1, E.ON Climate and Renewables.

US Fish and Wildlife Service (USFWS). 2012. Land-based Wind Energy Guidelines. March 2012. 71 pp.

Western Ecosystems Technology, Inc. 2013. Fowler Ridge Wind Farm, Benton County, Indiana: Indiana Bat Habitat Conservation Plan. Prepared for Fowler Ridge Wind Farm LLC, Fowler Ridge II Wind Farm LLC, Fowler Ridge III Wind Farm LLC, Fowler Ridge IV Wind Farm LLC. November 2013.

Young, D. P., Erickson, W.P., Bay, K., Nomani, S., and W. Tidhar. 2009. Mount Storm Wind Energy Facility, Phase I Post-Construction Avian and Bat Monitoring, July-October 2008. Prepared for NedPower Mount Storm, LLC, by Western EcoSystems Technology, Inc. 40pp.

APPENDIX A

Sample Data Sheets

CARCASS SEARCH DATA SHEET

WILDCAT WIND FARM (193702378)

DATE: _____ BIOLOGIST: _____

LABEL CARCASSES AND PHOTO WITH DATE-TURBINE -CARCASS NUMBER (e.g., 2009Apr01-T04-C07, to describe carcass #7 found at turbine 4 on April 1, 2009).

TURBINE NO.[1]	PLOT TYPE [2]	CARCASS NO. [3]	FROM TURBINE		ON ROAD/PAD?	GPS COORDINATES	SPECIES (scientific name, spell out)[4]	FOREARM LENGTH OF BAT (mm)	AGE[5]	SEX[6]	CAUSE OF DEATH [7]	CONDITION[8]	CHECK IF COMMENTS (write on back)[9]
			DISTANCE (m)	AZIMUTH (DEGREES)									
												/	
												/	
												/	
												/	
												/	
												/	
												/	
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												/	
												/	

Turbine No.[1]	Plot Type [2]	Carcass No. [3]	From Turbine		On Road/Pad?	GPS Coordinates	Species (scientific name, spell out)[4]	Forearm length of bat (mm)	Age[5]	Sex[6]	Cause of Death [7]	Condition[8]	Check if Comments (write on back)[9]
			Distance (m)	Azimuth (degrees)									
												/	
												/	
												/	
												/	
												/	
												/	
												/	
												/	

[1] Turbine – Enter Number of Turbine. Also search the turbine pad and access road in addition to the Study Plot.

[2] Plot Type – R=Roads and Pads, F=Full Plot

[3] Carcass No. – Number carcasses in the order they are found.

[4] Species – If Unknown, specify unknown bat or unknown bird.

[5] Age – If identifiable: Adult = A; Juvenile = J; Unknown = U

[6] Sex – If identifiable: Female = F; male = M, Unknown = U

[7] Cause of Death – Collision with turbine = T; Predation = P; Unknown = U (add explanation in comments if necessary).

[8] Condition – enter F=Fresh or D=decomposed AND Whole =W; Most of body with some missing = M; Pieces = P (e.g., wing only); Feather spot = F (example: F/W)

[9] Comments – Including: Reproductive Condition, if identifiable: Pregnant = P; Lactating = L; Post-Lactating = PL; Non-reproductive = NR; Testes descended = T; Unknown = U; B= breeding (birds).

Band Color/No. – If banded, record color of band (or metal), and number.

Other Comments. **INCLUDE CARCASS NUMBER NEXT TO ALL COMMENTS.**

PHOTOS: Where possible, photograph for bats: back, breast, muzzle, tragus, ruler behind ear, ruler next to forearm, foot, toehairs, calcar (if exposed).

for birds: back, breast, head, feet, underside of winds (for raptors).

Additional comments (record carcass number next to associated comment; include any identifiers and bands, if present):

_____

_____

_____

CARCASS SEARCH SUMMARY SHEET

WILDCAT WIND FARM (193702378)

DATE: _____ BIOLOGIST: _____

WEATHER: % CLOUD COVER_____ TEMPERATURE (˚F) _____

PRECIPITATION _____ WIND_____

SITE DESCRIPTION/COMMENTS: _____

_____

_____

TURBINE NUMBER	PLOT TYPE (Full or Roads/Pads)	SURVEY TIME (MILITARY)		CARCASSES FOUND (#BIRD, #BAT, NONE)
		START	END	

Page____of_____

SCAVENGER REMOVAL TRIAL LOG
Wildcat Wind Farm (193702378)

Trial (spring, fall)_____ **Start Date_____**

Carcasses are labeled with date-turbine- carcass number as they were originally found (e.g., 2009Apr01-T04-C07, to describe carcass #7 found at turbine 4 on April 1, 2009).

Carcass ID[1]	Placement				Species (scientific name)			Condition[4] When Checked, Checked By[5]								
	GPS Coordinates	Time (Military)	Turbine[2]	Placed By[3]		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 10	Day 14	Day 20	Day 30

Carcass ID[1]	Placement				Species (scientific name)			Condition[4] When Checked, Checked By[5]								
	GPS Coordinates	Time (Military)	Turbine[2]	Placed By[3]		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 10	Day 14	Day 20	Day 30

[1] Carcass ID – Identification number marked inside carcass.
[2] Turbine – Turbine number where carcass placed.
[3] Placed By – Initials of the person who placed the carcass.
[4] Condition – Record the condition the carcass was in when checked. Intact = I, Signs of scavenging = S, Feather/Fur Spot = F, Missing or < 10 feathers = 0
[5] Checked by – Record the initials of the person who checked on the carcass.

Comments:_____
_____
_____
_____
_____
_____

More data on back? Yes No

SEARCHER EFFICIENCY TRIAL LOG
Wildcat Wind Farm (193702378)

Trial (spring, fall)_____ **Trial Date_____**

Carcasses are labeled with date-turbine- carcass number as they were originally found (e.g., 2009Apr01-T04-C07, to describe carcass #7 found at turbine 4 on April 1, 2009).

Carcass ID[1]	Placement				GPS Coordinates	From Turbine		Species (scientific name)	Trial Result		
	Time (Military)	Turbine[2]	Placed By[3]	On Road/Pad?		Distance (m)	Azimuth (degrees)		Found By[4]	Not Found	Scavenged Prior to Search

Carcass ID[1]	Placement				GPS Coordinates	From Turbine		Species (scientific name)	Trial Result		
	Time (Military)	Turbine[2]	Placed By[3]	On Road/Pad?		Distance (m)	Azimuth (degrees)		Found By[4]	Not Found	Scavenged Prior to Search

Comments (record carcass number next to associated comment, include any identifiers and bands, if present):

_____
_____
_____
_____
_____
_____

[1] Carcass ID – Use carcass ID from when it was originally found. If no ID, just number.
[2] Turbine – Turbine should be labeled with the turbine number where it was placed.
[3] Placed By – Initials of the person who placed the carcass.
[4] Found By – Record the initials of the person who found the carcass.

More data on back? Yes No

APPENDIX B

Representative Carcass Photos

Photo 1. Hoary bat found at turbine F3 on 8/4/2014 with calipers for size comparison.

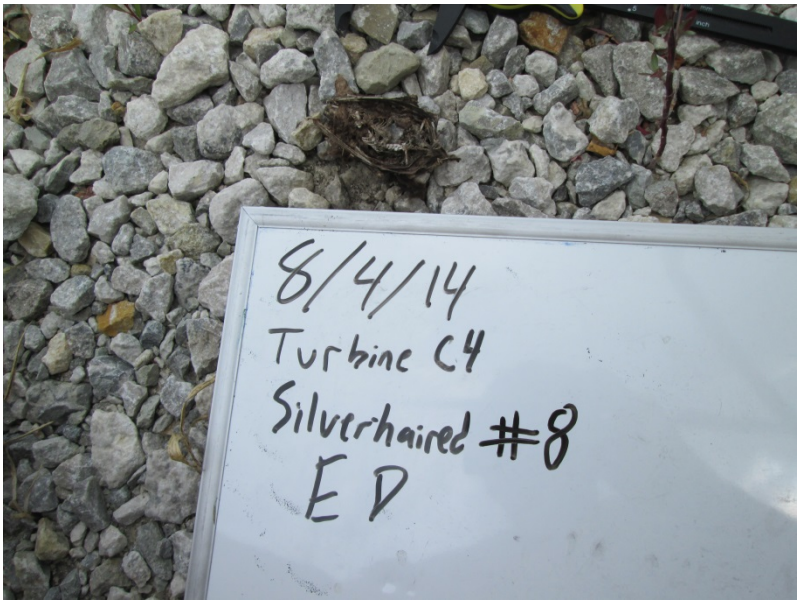

Photo 2. Silver-haired bat found at turbine C4 on 8/4/2014

Photo 3. Horned lark found at turbine H11 on 8/20/2014.

Photo 4. Unknown bird (feather spot) found at turbine A6 on 8/7/2014

APPENDIX H

2015 POST-CONSTRUCTION
BAT MORTALITY
MONITORING REPORT

2015 Post-Construction Bat Mortality Monitoring Report
Wildcat Wind Farm

Madison and Tipton Counties, Indiana

Project #193702378

Prepared for:
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c/o E.ON Climate and Renewables
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Prepared by:
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Independence, Iowa 50644

December 15, 2015

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1.0 Introduction

1.1 PROJECT DESCRIPTION

The Wildcat Wind Farm (Project or Wildcat) developed by Wildcat Wind Farm, LLC (WWF) is located in Madison and Tipton counties, immediately north of the town of Elwood, Indiana. The Project consists of 125 GE 1.6 megawatt (MW) wind turbine generators and associated access roads and collector line system for a total capacity of 200 MWs (Figure 1). Each turbine is anchored in a steel reinforced concrete foundation. A pad mounted transformer is located at the base of each turbine, and collects electricity generated by each turbine through cables routed down the inside of the tower. This transformer raises the voltage of the electricity produced up to the 34.5 kilovolts (kV) of the collection system. The buried collection system connects the individual turbines to the substation, where the voltage is increased to 138 kV to allow connection with the existing transmission line. The Project became operational in December 2012. The Project is located on lands leased from private landowners, who continue their existing use of the land. Land use in the area is predominantly agricultural.

Wildcat is located within the range of both the federally endangered Indiana bat (*Myotis sodalis*) and federally threatened northern long-eared bat (*Myotis septentrionalis*). A Post-Construction Mortality Minimization and Monitoring Proposal (MMMP) was developed in June 2012 and revised in June 2015 (Stantec 2015), and is consistent with common methodologies and the recommendations of the U.S. Fish and Wildlife Service (USFWS) Land-Based Wind Energy Guidelines (USFWS 2012). Historically, the project operated under the terms of a Technical Assistance Letter (TAL) dated June 18, 2012 that established an operational scenario under which no take of Indiana bats was expected to occur (i.e. 6.9 m/s cut-in speed during the fall migration period [1 August – 15 October]). The Project is currently operating under the terms of a second TAL secured on July 2, 2015, that established a revised operational scenario under which no take of Indiana bats or northern long-eared bats is expected to occur. This second TAL requires curtailment to 6.9 m/s during the fall migration period (1 August – 15 October) and 5.0 m/s during the spring migration period (March 15 – May 15).

1.2 PURPOSE AND OBJECTIVES OF THE STUDY

The MMMP for the Project outlines the following measures required as a condition of the TAL:

1. Avoidance measures to avoid take of listed species;
2. Minimization measures to minimize take of all bats; and
3. Post –construction monitoring protocols to measure effectiveness of the avoidance and minimization measures.

The primary objectives of the post-construction study were to:

1. Determine overall bat fatality rates from the Project;
2. Monitor for Indiana and northern long-eared bat mortality; and
3. Evaluate the circumstances under which fatalities occur.

The study included the following components:

1. Standardized carcass searches to systematically search plots at all turbines for bat casualties attributable to the turbines;
2. Searcher efficiency trials to estimate the percentage of bat casualties that were found by the searcher(s); and
3. Carcass removal trials to estimate the persistence time of carcasses on-site before they were removed by scavengers.

2.0 Methods

2.1 MORTALITY STUDY

Carcass searches were conducted in spring (30 March to 14 May) and fall (3 August to 16 October) during the 2015 year of Project operation. This is the third year of monitoring during Project operation. The fall surveys were conducted during the period in which the turbines were curtailed at 6.9 m/s (1 August – 15 October) as per the requirements of the Project's TAL. Because the revised MMMP and second TAL were not in place until after 2015 spring surveys were completed, the Project turbines were not curtailed to 5.0 m/s for the 2015 spring survey period.

2.1.1 Sample Size

Baseline post-construction monitoring was conducted at 100% of the turbines. This study design provides full coverage of the facility and will serve as a control against which subsequent monitoring results can be compared.

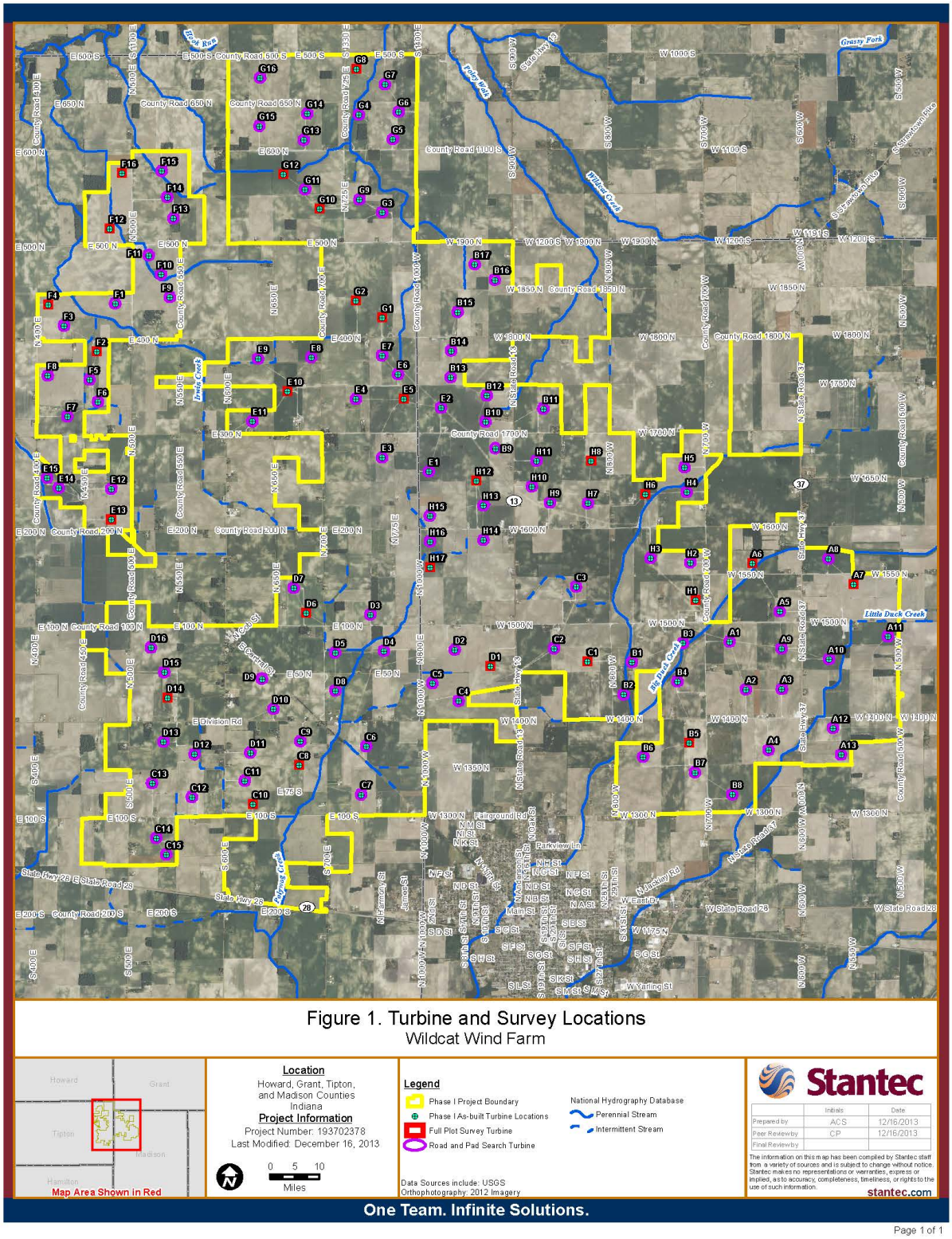


Figure 1. Turbine and Survey Locations
Wildcat Wind Farm
Location
Howard, Grant, Tipton, and Madison Counties Indiana
Project Information
Project Number: 193702378
Last Modified: December 16, 2013
Map Area Shown in Red
Legend
Phase I Project Boundary
Phase I As-built Turbine Locations
Full Plot Survey Turbine
Road and Pad Search Turbine
National Hydrography Database
Perennial Stream
Intermittent Stream
Data Sources include: USGS
Orthophotography: 2012 Imagery
Stantec
Prepared by ACS 12/16/2013
Peer Reviewby CP 12/16/2013
stantec.com
One Team. Infinite Solutions.
Page 1 of 1

2.1.2 Search Plot Size

At 80% of the turbines (n=100), only the turbine pads and roads out to 262 feet (80 meters[m]) from the turbine were searched. This method targets the areas shown to support the highest searcher efficiency while greatly reducing the financial and logistical restraints associated with clearing and searching large study plots, enabling much broader coverage of the facility. At the remaining 20% of turbines (n=25), 262-foot x 262-foot (80-m x 80-m) plots were cleared and searched using a full-coverage transect methodology. Each 80-m x 80-m plot was centered on a turbine location, and vegetation was periodically mowed as needed to improve searcher efficiency.

Previous studies have indicated that the majority of bat carcasses typically fall within 100 feet (30 m) of the turbine or within 50% of the maximum height of the turbine (Kerns and Kerlinger 2004, Arnett at el. 2005, Young et al. 2009, Jain et al. 2007, Piorkowski and O'Connell 2010, USFWS 2012). The plot size used for this study exceeds one-half the maximum turbine rotor height of the Project turbines (246 feet [75 m]). Turbines remained assigned to either the roads and pads search group or the cleared plot search group across the entire search year (both spring and fall monitoring periods). The subset of full-coverage plots provided a reference for estimating the number of fatalities which may have fallen outside of the search area at the roads and pads search turbines. This mixed sampling methodology is consistent with other post-construction monitoring studies being conducted (e.g., Good et al. 2011) and will enable comparison of study results.

2.1.3 Search Schedule

The search interval for spring surveys at all turbines was once weekly. An individual turbine was searched on the same day each week when conditions allowed. Within a day, the turbine search schedule and order were randomized, so that each turbine's search plot was sampled at differing periods during the day. 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.

For the fall surveys, full plot turbines were searched once a week, on the same day each week when conditions allowed. All turbines that were roads and pads plots were searched twice weekly, approximately three or four days between searches when conditions allowed. This change was implemented based on the 2014 fall monitoring results, which indicated a carcass persistence of less than 7 days on roads and pads for the fall. Additionally, prior to the fall monitoring period, all search plots (full plots and roads and pads) were cleared of carcasses the last week of July, and all bats found that week were coded as incidental finds, as they were not found during either the spring or fall monitoring periods.

2.1.4 Carcass Searches

Carcass searches were conducted by searchers experienced and/or trained in fatality search methods, including proper handling and reporting of carcasses. Searchers were familiar with and able to accurately identify the bat species likely to be found in the Project area, and any unknown bat discovered was sent to an expert for positive identification. During searches, searchers walked at a rate of approximately 2 mph (45 to 60 m per minute) while searching 10 feet (3 m) on either side of each transect.

For each carcass found, the following data were recorded (a sample data form is included in Appendix A):

- 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 photograph of each detected carcass was taken before the carcass was handled and removed. Representative digital photograph are included in Appendix B. All carcasses were labeled with a unique number, bagged, and stored frozen (with a copy of the original data sheet) at the Project Operations and Maintenance Building. Bat carcasses were collected and retained under Indiana Department of Natural Resources Special Purpose Salvage Permit No. 14-027.

Bat carcasses found in non-search areas and any bird carcasses found were coded as incidental finds, and documented as much as possible in a similar fashion to those found in standardized searches. This included carcasses found during non-search times, including the week prior to the fall monitoring period when all survey plots were searched for any carcasses that had occurred between the spring and fall monitoring periods. Maintenance personnel were informed of the standardized searches, and were trained in collision event reporting protocol in the case of an incidental find. Bird carcasses were photographed and data collected, but the carcass was left in place and not collected; incidental bat carcasses were collected and stored

frozen with the carcasses found during standardized searches. Incidental finds were not included in the mortality estimates.

2.1.5 Species Identification

Preliminary bird and bat species identifications were made in the field by qualified staff. When carcass condition allowed, data collected also included the sex, age, and reproductive condition of the carcass. For bat carcasses, forearm length was recorded to facilitate in identification. Any unknown bat, or potential Indiana or northern long-eared bat, was identified by a Stantec bat biologist. In addition to the carcass, photographs and data collected for each carcass were used to verify the species identification.

2.2 SEARCHER EFFICIENCY TRIALS

Searcher efficiency trials were used to estimate the probability of bat carcass detection by the searchers. A total of four searcher efficiency trials were conducted: one each during the spring and fall monitoring periods for the main searcher, and two additional trials in the fall for two additional searchers who were needed to conduct the twice weekly road and pad searches. Searchers did not know when during the monitoring periods the trials were being conducted, at which turbines trial carcasses were placed, or the location or number of trial carcasses placed in any given search plot. Commercially-available brown mouse carcasses were used as trial carcasses to represent bats.

All searcher efficiency trial carcasses were randomly placed by the field lead within the search plots the morning of the search prior to the carcass searches for that day. The number of trial carcasses found by searchers during the mortality searches in each plot was recorded and compared to the total number of trial carcasses placed in the plot and not scavenged prior to the mortality search. A sample data form is included in Appendix A.

2.3 CARCASS REMOVAL TRIALS

Carcass removal trials were conducted to estimate the average length of time carcasses remained in the search plots (i.e., were available to find) before being removed by scavengers. Carcass removal trials were conducted following the searcher efficiency trials; one each during the spring and fall monitoring periods. Mouse carcasses used during the searcher efficiency trials were left in place and their locations were discretely marked. Searchers monitored the trial carcasses over a period of up to 30 days. During each carcass removal trial, carcasses were checked every day for the first week, and then on days 10, 14, 20 and 30.

The condition of each carcass was recorded during each trial check. The conditions recorded were defined as follows:

- Intact – complete carcass with no body parts missing.
- Scavenged – carcass with some evidence or signs of scavenging.

- Feather or fur spot – no carcass, but 10 or more feathers or fur spot remaining.
- Missing – no carcass or fur remaining or fewer than 10 feathers.

A sample data form is included in Appendix A. Any carcasses remaining at the end of the 30-day trial period were removed from the field.

2.4 STATISTICAL METHODS FOR MORTALITY ESTIMATES

In an effort to make results comparable with other post-construction mortality studies, the methods used to calculate the mortality estimates largely followed the estimator proposed by Erickson et al. (2003), as modified by Young et al. (2009). The estimate of the total number of turbine-related casualties was based on three components: (1) observed number of casualties, (2) searcher efficiency, and (3) carcass removal rates. The 90% confidence intervals were calculated using bootstrapping methods (Erickson et al. 2003 and Manly 1997 as presented in Young et al. 2009).

2.4.1 Mean Observed Number of Casualties (c)

The estimated mean observed number of casualties (c) per turbine per monitoring period was 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 during mortality searches. Incidental carcass finds (those found outside of the searched areas or at times other than during mortality searches) were not included in this calculation, or in the estimated fatality rate. Mean number of observed casualties was calculated separately for each season (spring, fall) and search type (roads and pads, full plots).

2.4.2 Estimation of Searcher Efficiency Rate (p)

Searcher efficiency (p) represents the average probability that a carcass was detected by searchers. The searcher efficiency rate was calculated by dividing the number of trial carcasses observers found by the total number which remained available during the trial (non-scavenged). Searcher efficiency was calculated separately for each season (spring, fall) and search type (roads and pads, full plots).

2.4.3 Estimation of Carcass Removal Rate (t)

Carcass removal rates were estimated to adjust the observed number of casualties to account for scavenger activity at the site. Mean carcass removal time (t) represents the average length

of time a planted carcass remained at the site before it was removed by scavengers. Mean carcass removal time was 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. Any trial carcasses still remaining at 30 days were collected, yielding censored observations at 30 days. Carcass removal rates were calculated separately for each season (spring, fall) and search type (roads and pads, full plots).

2.4.4 Estimation of the Probability of Carcass Availability and Detection (π)

Searcher efficiency and carcass removal rates were combined to represent the overall probability (π) that a casualty incurred at a turbine was reflected in the mortality search results. This probability was calculated as:

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

where I is the interval between searches. For this study, I=7 because searches were conducted weekly. The estimation of the probability of carcass availability and detection was calculated separately for each season (spring, fall) and search type (roads and pads, full plots).

2.4.5 Area Adjustment (A)

Approximation of A, the adjustment for areas which were not searched, was calculated following methods and data collected during post-construction monitoring studies at Fowler Ridge Wind Farm in Indiana (Good et al. 2011). For this study, A_{RP} was calculated to represent the adjustment for the proportion of carcasses which likely fell outside of the area searched at roads and pads turbines, and A_{FP} was used to represent the adjustment for the proportion of carcasses which likely fell outside of the area searched at full plot turbines. The value for A_{RP} was approximated using the following equation:

$$A_{RP} = \frac{C_{FP}}{\pi_{FP}} \Big/ \frac{C_{RPFP}}{\pi_{RP}} * A_{FP}$$

where π_{FP} is the π value calculated for full plot searches. C_{FP} is the number of observed casualties on full plots, π_{RP} is the π value calculated for roads and pads searches, and C_{RPFP} is the number of observed casualties on roads and pads of the full plot turbines. A_{RP} was calculated separately for spring and fall.

The value for A_{FP} used was equal to the correction factor calculated for the Fowler study (A_{FP}=1.305) as the Fowler study estimated that 23.4% of fatalities fall outside of the 262-foot x 262-foot (80-m x 80-m) square plots.

2.4.6 Estimation of Facility-Related Mortality (m)

Mortality estimates were calculated using the estimator proposed by Erickson et al. (2003), as modified by Young et al. (2009). The estimated mean number of bat and bird casualties/turbine/monitoring period (m) was calculated by dividing the mean observed number of bat and bird casualties/turbine/monitoring period (c) by π, an estimate of the probability a carcass was not removed by scavengers and was detected by searchers, and then multiplying by A, the adjustment for the area within which bats may have fallen but which was not searched.

$$m = \mathrm{A} * \frac{c}{\pi}$$

Mortality estimates were calculated separately for each season (spring, fall) and search type (roads and pads, full plots).

3.0 Results

3.1 SUMMARY OF SEARCHES

A total of 857 carcass searches were conducted over seven weeks in the spring, and 2,395 carcass searches were conducted over 11 weeks in the fall. Due to weather and maintenance at turbines, the average time between searches during the spring monitoring period was 6.97 days. During the fall monitoring period, average time between searches at full plot turbines was 6.92 days, while average time between roads and pad turbines was 3.51 days (i.e., the search interval was twice weekly for roads and pads in the fall).

A total of 36 individual bat carcasses were found during standardized carcass searches, 20 during the spring searches and 16 during the fall searches. A total of 19 incidental bat carcasses were found while clearing the plots for the fall searches during the last week of July.

3.1.1 Species Composition

A summary of all bat carcasses found during the post-construction monitoring is shown in Table 1. Of the 36 bat carcasses found at the site, silver-haired bats (*Lasionycteris noctivagans*) were the most common species detected (n=17; 47.2% of all bat carcasses found). Hoary bats (*Lasiurus cinereus*) were the next most common species (n=10; 27.8%), followed by eastern red bats (*Lasiurus borealis*; n=6; 16.7%), big brown bats (*Eptesicus fuscus*; n=2; 5.6%) and an evening bat (*Nycticeius humeralis*; n=1; 2.7%). Species composition did vary by season, with silver-haired bats comprising 75% of all spring fatalities, and only 12.5% of all fall fatalities. Fall fatalities were

dominated by the hoary bat, comprising 50% of all fatalities in the fall and only 10% of spring fatalities.

No bat species listed as threatened or endangered under the Endangered Species Act of 1973 (ESA), as amended, were found during the searches, and all bat carcasses were identified to the species level. The evening bat is listed as endangered by the State of Indiana, and was the only state-listed species found.

Table 1. Summary of all bat carcasses found in standardized searches during the 2015 post-construction monitoring study (March 30 through May 14 and August 3 through October 16) at the Wildcat Wind Farm, Tipton and Madison counties, Indiana.

Species	Spring	Fall	Total	Percent of All Bats Found
Silver-haired Bat	15	2	17	47.2%
Hoary Bat	2	8	10	27.8%
Eastern Red Bat	1	5	6	16.7%
Big Brown Bat	1	1	2	5.6%
Evening Bat	1	0	1	2.7%
Total	**20**	**16**	**36**	100%

3.1.2 Age and Sex

A summary of the age and sex of all bat carcasses found during the post-construction monitoring is shown in Table 2. Of the 36 bat carcasses found, there were nine adult females (25.0%), four adult males (11.1%), one female of unknown age (2.8%), two males of unknown age (5.6%), two adults of unknown sex (5.6%), and 18 bats of unknown age and unknown sex (50.0%; Table 2).

Table 2. Sex and age of all bat carcasses found in standardized searches during the 2015 post-construction monitoring study (March 30 through May 14 and August 3 through October 16) at the Wildcat Wind Farm Phase I, Tipton and Madison counties, Indiana.

Ages include adults (A), juveniles (J) and unknown (U).

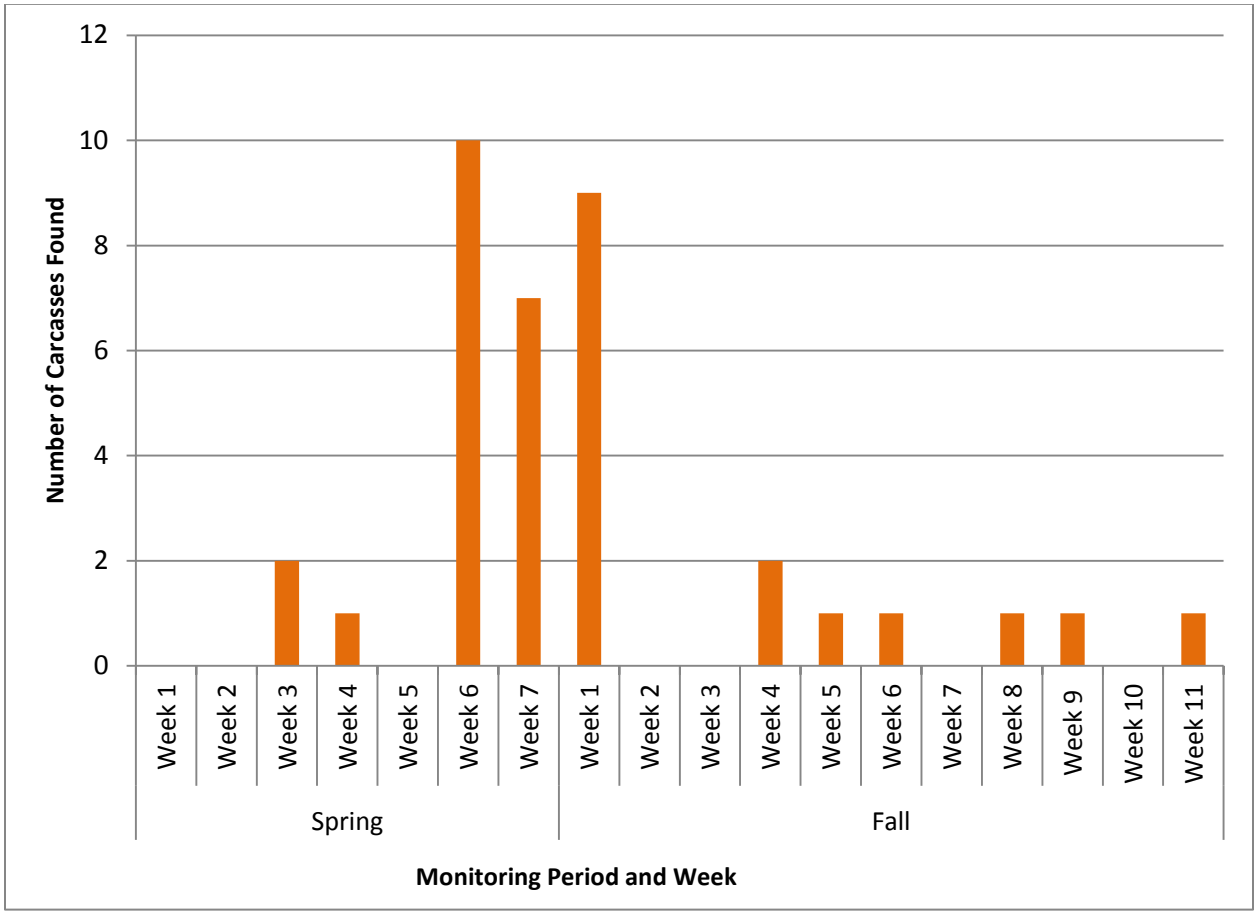
Species	Female			Male			Unknown		
	A	J	U	A	J	U	A	J	U
Silver-haired Bat	**7**	0	**1**	**2**	0	**1**	0	0	**6**
Hoary Bat	**1**	0	0	0	0	0	**2**	0	**7**
Eastern Red Bat	**1**	0	0	**1**	0	0	0	0	**4**
Big Brown Bat	0	0	0	**1**	0	**1**	0	0	**0**
Evening Bat	0	0	0	0	0	0	0	0	**1**
Total	**9**	0	**1**	**4**	0	**2**	**2**	0	**18**

3.1.3 Temporal Patterns

Of the 36 bat carcasses found in 2015, 20 were found during the spring monitoring period and 16 were found during the fall monitoring period (Table 1 and Figure 2). In the spring, the most common species found was the silver-haired bat (n=15), and in the fall, the most common species found was the hoary bat (n=8), followed by the eastern red bat (n=5).

The largest number of bat carcasses found in a single week (10) was the sixth week of the spring monitoring period (the week of May 6) (Figure 2). During the fall monitoring period, the largest number of carcasses found in a single week (9) occurred during the first week of the fall monitoring period (the week of August 3). Zero carcasses were found during three weeks in the spring (weeks 1, 2, and 5) and four weeks during fall monitoring (weeks 2, 3, 7, and 10).

Figure 2. Bat carcasses found in standardized searches by week in 2015 (March 30 through May 14 and August 3 through October 16) at the Wildcat Wind Farm Phase 1, Tipton and Madison counties, Indiana.



3.1.4 Spatial Patterns

Bat carcasses were found at a total of 35 of 125 (28.0%) turbines during the 2015 monitoring periods. The largest number of carcasses found at a single turbine (n=2) was at turbine G16 (roads and pad search; Figure 1). The remainder of the turbines had either zero or one carcass found over the 18 weeks of fatality monitoring.

During the spring monitoring period, 6 bats were found at the full plot turbines and 14 bats were found at the roads and pads search turbines. Of the six bats found at the full plots, all were located in the full plot area, and none were found on the roads and pads. Due to this, the average area correction factor from previous spring monitoring periods (2013 and 2014) was used to correct the data for the mortality estimate[1].

During the fall monitoring period, 4 bats were found at the full plot search turbines, and 12 bats were found at the road and pad search turbines. Of the four bats found at the full plots, two were found on the roads and pads within the full search plots and two were found off the roads and pads.

3.2 SEARCHER EFFICIENCY TRIALS

A total of four searcher efficiency trials were conducted: one each during the spring and fall monitoring periods for the main searcher, and two additional trials in the fall for two additional searchers who were needed to conduct the twice weekly road and pad searches.

Four searcher efficiency trials were conducted during the 2015 survey effort: one each during the spring and fall monitoring periods and two additional trials in the fall for two additional searchers who were needed to conduct the twice weekly road and pad searches. A total of 26 mouse carcasses were placed for searcher efficiency trials in the spring monitoring period. The additional four carcasses were not placed in the spring due to time and weather constraints. In the fall period, 50 mouse carcasses were placed for searcher efficiency trials. The additional 20 carcasses were placed strictly on roads and pads to coincide with the additional weekly searches and additional searchers. Scavengers did not remove any of the trial carcasses prior to the searcher efficiency trial in the spring, and two were removed by scavengers in the fall. Overall searcher efficiency was approximately 80% in the spring and fall (80.8% spring and 79.2% fall). Searcher efficiency at full plots ranged from 30% to 60% while roads and pads were much higher at 90% to 100% (Table 3).

[1] Because no bats were found on the roads and pads of the full plot turbines, the area adjustment calculation would not work (there would be a zero in the denominator). The 2013 area adjustment for spring was 6.9, and the area adjustment for spring 2014 was 3.2, resulting in an average of 5.05.

Table 3. Searcher efficiency by season (Spring: March 30 through May 14 and Fall: August 3 through October 16) and search type (full 80x80m plots or roads and pads) for the 2015 post-construction monitoring study at the Wildcat Wind Farm Phase I, Tipton and Madison counties, Indiana.

	Spring Monitoring Period		Fall Monitoring Period	
	Full Plots	Roads and Pads	Full Plots	Roads and Pads
# Carcasses Placed	8	18	12	36
# Carcasses Found	5	16	3	35
(p) Searcher Efficiency Mean (90% CI)	**0.6** (0.4, 0.9)	**0.9** (0.8, 1.0)	**0.3** (0.1, 0.5)	**1.0** (0.9, 1.0)

3.3 CARCASS REMOVAL TRIALS

Mouse carcasses used in the searcher efficiency trials were left for up to 30 days, and checked each day for the first week and then on days 10, 14, 21, and 30 of the trial. Thirty (30) mouse carcasses were used during the spring monitoring period, and 30 carcasses were used during the fall monitoring period. Carcasses persisted for an average of 5.8 to 7.3 days (Table 4).

Table 4. Carcass removal by season (Spring: 30 March through 14 May and Fall: August 3 through October 16) during the 2015 post-construction monitoring study at the Wildcat Wind Farm Phase I, Tipton and Madison counties, Indiana.

	Spring Monitoring Period		Fall Monitoring Period	
	Full Plots	Roads and Pads	Full Plots	Roads and Pads
# Carcasses Placed	8	22	14	16
# Carcasses Scavenged within 30 days	8	21	13	15
Mean Carcass Persistence time in days (90% CI)	**7.3** (4.1, 11.0)	**7.0** (4.6, 10.8)	**6.7** (3.8, 12.7)	**5.8** (2.6, 11.1)

3.4 ADJUSTED MORTALITY ESTIMATES

Mortality rate estimates were calculated based upon the carcasses found during the mortality searches, and did not include any incidental finds. Observed bat mortality estimates were adjusted to account for searcher efficiency, carcass removal, and an area adjustment using the methods described in Section 2.4. Results are summarized in Table 5.

Table 5. Bat mortality estimates by season (Spring: March 30 through May 14 and Fall: August 3 through October 16) and search type (full 80x80m plots or roads and pads) for the 2015 post-construction monitoring study at the Wildcat Wind Farm Phase I, Tipton and Madison counties, Indiana.

	Spring Monitoring Period		Fall Monitoring Period	
	Full Plots	Roads and Pads	Full Plots	Roads and Pads
(c) Observed bats/turbine/season	**0.24**	**0.14**	**0.16**	**0.16**
(π) Probability of Carcass Availability and Detection (90% CI)	**0.5** (0.2, 0.6)	**0.6** (0.5, 0.7)	**0.2** (0.1, 0.4)	**0.7** (0.5, 0.9)
(A) Area Adjustment	**1.305**	**5.05**	**1.305**	**9.135**
(m) Estimated bats/turbine/season by search type	**0.7** (0.3, 1.5)	**1.2** (0.7, 1.9)	**1.0** (0.3, 4.8)	**2.0** (1.2, 3.1)
(m) Estimated bats/turbine/season[1]	**0.95** (0.10, 1.80)		**1.5** (-0.93, 3.93)	
Estimated Bats/MW/Season	**0.6** (0.1, 1.1)		**0.9** (-0.6, 2.5)	
Estimated Bats/Facility/Season	**118.8** (12.5, 225.0)		**187.5** (-116.3, 491.3)	
Estimated Indiana Bats/Facility/Season[2]	**0.19** (0.02, 0.4)		**0.3** (-0.19, 0.79)	
Estimated northern long-eared bats/Facility/Season[2]	**0.10** (0.01, 0.18)		**0.15** (-0.09, 0.39)	
(m) Estimated bats/turbine[3]	**2.45** (-0.23, 5.13)			
Total Estimated Bats/Facility	**306.3** (-28.8, 641.3)			

[1]Averaged value using pooled variance.
[2]Calculated based upon percentage of Indiana and northern long-eared bats to all bat carcasses found (0.16% and 0.08%, respectively), based upon research done at Fowler Ridge Wind Farm (Western Ecosystems Technology, Inc. 2013). Actual mortality is expected to be zero for both species given that fatalities are expected to occur only in the fall, and the Project is currently curtailed at 6.9 m/s during fall migration.
[3]Summed value using pooled variance.

3.5 INCIDENTAL FINDS

3.5.1 Bats

During the 2015 spring and fall monitoring periods, no incidental bats were discovered during surveys. All bats found were located during weekly or twice weekly searches of turbines. A total

of 19 incidental bats were found during the last week of July while clearing the plots prior to the fall monitoring period. These consisted of 10 hoary bats, 8 eastern red bats, and 1 big brown bat.

3.5.2 Birds

A total of 16 bird carcasses were found during the 2015 post-construction studies. Of these 16 birds, 9 (56.3%) were found during the spring monitoring period (average of 2.3 per week). The other seven bird carcasses (43.7%) were found during the fall monitoring period (average of 0.6 per week). The bird carcasses found during the survey are summarized in Table 6.

Table 6. Summary of bird carcasses found during the 2015 post-construction monitoring study (March 3 through May 14 and August 3 through October 16) at the Wildcat Wind Farm Phase I, Tipton and Madison counties, Indiana.

Date	Species	Turbine
31 March 2015	Red-tailed hawk (*Buteo jamaicensis*)	H16
1 April 2015	Unknown Sparrow	G12
6 April 2015	Horned Lark (*Eremophila alpestris*)	D6
10 April 2015	Brown-headed Cowbird (*Molothrus ater*)	H2
13 April 2015	Horned Lark	D3
13 April 2015	Chipping Sparrow (*Spizella passerina*)	F11
15 April 2015	Golden-crowned Kinglet (*Regulus satrapa*)	G16
28 April 2015	Hairy woodpecker (*Picoides villosus*)	C6
28 April 2015	Cooper's Hawk (*Accipiter cooperii*)	C7
6 May 2015	Killdeer (*Charadrius vociferus*)	E6
3 August 2015	Horned Lark	E9
18 August 2015	Killdeer	B8
27 August 2015	European starling (*Sturnus vulgaris*)	E2
4 September 2015	Black-throated green warbler (*Dendroica virens*)	B7
10 September 2015	Killdeer	E9
28 September 2015	Red-eyed vireo (*Vireo olivaceus*)	H15

4.0 Summary

- A total of 3,252 carcass searches were conducted over 18 weeks encompassing two survey periods in 2015.
- A total of 36 bat carcasses were found during the study period, with incidental finds including an additional 19 bat carcasses and 16 bird carcasses.
- No bird or bat species listed as threatened or endangered under the ESA were found during this study.

- One bat species listed as endangered by the State of Indiana (an evening bat) was found during the study. The evening bat was found on 14 May 2015, and the identification was confirmed via genetic testing through USFWS.

- Bat species found during standardized searches included silver-haired bat (17), hoary bat (10), eastern red bat (6), big brown bat (2) and evening bat (1).

- Of the 15 bats able to be aged, all 15 were adults. Of the 16 able to be sexed, 62.5% were females, contrary to data collected at other wind farms indicating that bat fatalities at active wind farms are typically skewed towards males (see review by Arnett et al. 2008).

- Estimated bat mortality was 118.8 bats during the spring and 187.5 bats in the fall, for an overall bat mortality of 306.3 bats during fall and spring of 2015.

- No Indiana bat or northern long-eared bat carcasses were found during the 2015 study. Estimated mortality of the endangered Indiana bat was 0.19 Indiana bat in the spring and 0.30 Indiana bat in the fall. Estimated mortality of the threatened northern long-eared bat was 0.10 northern long-eared bat in the spring and 0.15 northern long-eared bat in the fall. However, given that the Project is currently curtailed at 6.9 m/s during the fall migratory period, when Indiana and northern long-eared bat mortalities are expected to occur, it is assumed that actual take of both species is not occurring. USFWS considers 6.9 m/s cut-in speeds to be avoidance (USFWS 2014).

- Estimated bat mortality was similar between the spring and fall monitoring periods, suggesting that the current curtailment used in the fall (i.e., 6.9 m/s cut-in speed) is effective in reducing overall bat mortality, since bat mortality is generally expected to be higher in the fall (Arnett et al. 2008).

5.0 Literature Cited

Arnett, E.B., W.P. Erickson, J. Kerns, and J. Horn. 2005. Relationships Between Bats and Wind Turbines in Pennsylvania and West Virginia: An Assessment of Fatality Search Protocols, Patterns of Fatality, and Behavioral Interactions with Wind Turbines. Final Report prepared for the Bats and Wind Energy Cooperative. Bat Conservation International, Austin, Texas. June 2005.

Arnett, E.B., W.K. Brown, W.P. Erickson, J.K. Fiedler, B.L. Hamilton, T.H. Henry, A. Jain, G.D. Johnson, J. Kerns, R.R. Koford, C.P. Nicholson, T.J. O'Connell, M.D. Piorkowski, and R.D. Tankersley. 2008. Patterns of bat fatalities at wind energy facilities in North America. Journal of Wildlife Management 72: 61-78.

Erickson, W.P., Gritski, B., and K. Kronner. 2003. Nine Canyon Wind Power Project Avian and Bat Monitoring Report, August 2003. Technical report submitted to energy Northwest and the Nine Canyon Technical Advisory Committee.

Jain, A., P. Kerlinger, R. Curry, and L. Slobodnik. 2007. Annual Report for the Maple Ridge Wind Power Project: Post-Construction Bird and Bat Fatality Study – 2006. Final report. Prepared for PPM Energy and Horizon Energy and Technical Advisory Committee (TAC) for the Maple Ridge Project Study.

Good, R. E., Erickson, W., Merrill, A., Simon, S., Murray, K., Bay, K., & Fritchman, C. 2011. Bat monitoring studies at the Fowler Ridge Wind Energy Facility, Benton County, Indiana, April 13–October 15, 2010. Prepared for Fowler Ridge Wind Farm, by Western EcoSystems Technology, Inc. Cheyenne, WY, USA.

Gruver, J., K. Bay, and W. Erickson. 2009. Post-construction bat and bird fatality study, Blue Sky Green Field Wind Resource Area, Fond du Lac County, Wisconsin. Interim Report prepared for We Energies, Milwaukee, Wisconsin.

Kerns, J., and P. Kerlinger. 2004. A Study of Bird and Bat Collisions at the Mountaineer Wind Energy Center, Tucker County, West Virginia: Annual Report for 2003. Prepared for FPL Energy and the Mountaineer Wind Energy Center Technical Review Committee. Technical report prepared by Curry and Kerlinger, LLC. February 14, 2004. 39 pp. http://www.wvhighlands.org/Birds/MountaineerFinalAvianRpt-%203-15-04PKJK.pdf

Kunz, T.H., E.B. Arnett, B.M. Cooper, W.P. Erickson, R.P. Larkin, T. Mabee, M.L. Morrison, M.D. Strickland, and J.M. Szewczak. 2007. Assessing Impacts of Wind-Energy Development on Nocturnally Active Birds and Bats: A Guidance Document. Journal of Wildlife Management 71:2449-2486.

Manly, B.F.J. 1997. Randomization, Bootstrap, and Monte Carlo Methods in Biology. Second edition. Chapman and Hall, New York. 399 pp.

Piorkowski, M.D., and T. J. O'Connell. 2010. Spatial Pattern of Summer Bat Mortality from Collisions with Wind Turbines in Mixed-grass Prairie. Am. Midl. Nat. 164:260-269.

Stantec. 2015. Wildcat Mortality Minimization and Monitoring Proposal. Prepared for Wildcat Wind Farm, E.ON Climate and Renewables.

US Fish and Wildlife Service (USFWS). 2012. Land-based Wind Energy Guidelines. March 2012. 71 pp.

USFWS. 2014. Northern Long-Eared Bat Interim Conference and Planning Guidance. USFWS Regions 2, 3, 4, 5, & 6. January 6, 2014.

Western Ecosystems Technology, Inc. 2013. Fowler Ridge Wind Farm, Benton County, Indiana: Indiana Bat Habitat Conservation Plan. Prepared for Fowler Ridge Wind Farm LLC, Fowler Ridge II Wind Farm LLC, Fowler Ridge III Wind Farm LLC, Fowler Ridge IV Wind Farm LLC. November 2013.

Young, D. P., Erickson, W.P., Bay, K., Nomani, S., and W. Tidhar. 2009. Mount Storm Wind Energy Facility, Phase I Post-Construction Avian and Bat Monitoring, July-October 2008. Prepared for NedPower Mount Storm, LLC, by Western EcoSystems Technology, Inc. 40pp.

APPENDIX A

Sample Data Sheets

CARCASS SEARCH DATA SHEET

WILDCAT WIND FARM (193702378)

DATE: _____ BIOLOGIST: _____

LABEL CARCASSES AND PHOTO WITH DATE-TURBINE -CARCASS NUMBER (e.g., 2009Apr01-T04-C07, to describe carcass #7 found at turbine 4 on April 1, 2009).

TURBINE NO.[1]	PLOT TYPE [2]	CARCASS NO. [3]	FROM TURBINE		ON ROAD/PAD?	GPS COORDINATES	SPECIES (scientific name, spell out)[4]	FOREARM LENGTH OF BAT (mm)	AGE[5]	SEX[6]	CAUSE OF DEATH [7]	CONDITION[8]	CHECK IF COMMENTS (write on back)[9]
			DISTANCE (m)	AZIMUTH (DEGREES)									
												/	
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Turbine No.[1]	Plot Type [2]	Carcass No. [3]	From Turbine		On Road/Pad?	GPS Coordinates	Species (scientific name, spell out)[4]	Forearm length of bat (mm)	Age[5]	Sex[6]	Cause of Death [7]	Condition[8]	Check if Comments (write on back)[9]
			Distance (m)	Azimuth (degrees)									
												/	
												/	
												/	
												/	
												/	
												/	
												/	
												/	

[1] Turbine – Enter Number of Turbine. Also search the turbine pad and access road in addition to the Study Plot.

[2] Plot Type – R=Roads and Pads, F=Full Plot

[3] Carcass No. – Number carcasses in the order they are found.

[4] Species – If Unknown, specify unknown bat or unknown bird.

[5] Age – If identifiable: Adult = A; Juvenile = J; Unknown = U

[6] Sex – If identifiable: Female = F; male = M, Unknown = U

[7] Cause of Death – Collision with turbine = T; Predation = P; Unknown = U (add explanation in comments if necessary).

[8] Condition – enter F=Fresh or D=decomposed AND Whole =W; Most of body with some missing = M; Pieces = P (e.g., wing only); Feather spot = F (example: F/W)

[9] Comments – Including: Reproductive Condition, if identifiable: Pregnant = P; Lactating = L; Post-Lactating = PL; Non-reproductive = NR; Testes descended = T; Unknown = U; B= breeding (birds).

Band Color/No. – If banded, record color of band (or metal), and number.

Other Comments. **INCLUDE CARCASS NUMBER NEXT TO ALL COMMENTS.**

PHOTOS: Where possible, photograph for bats: back, breast, muzzle, tragus, ruler behind ear, ruler next to forearm, foot, toehairs, calcar (if exposed).

for birds: back, breast, head, feet, underside of winds (for raptors).

Additional comments (record carcass number next to associated comment; include any identifiers and bands, if present):

_____

_____

_____

SEARCHER EFFICIENCY TRIAL LOG
Wildcat Wind Farm (193702378)

Trial (spring, fall)_____ **Trial Date_____**

Carcasses are labeled with date-turbine- carcass number as they were originally found (e.g., 2009Apr01-T04-C07, to describe carcass #7 found at turbine 4 on April 1, 2009).

Carcass ID[1]	Placement				GPS Coordinates	From Turbine		Species (scientific name)	Trial Result		
	Time (Military)	Turbine[2]	Placed By[3]	On Road/Pad?		Distance (m)	Azimuth (degrees)		Found By[4]	Not Found	Scavenged Prior to Search

Carcass ID[1]	Placement				GPS Coordinates	From Turbine		Species (scientific name)	Trial Result		
	Time (Military)	Turbine[2]	Placed By[3]	On Road/Pad?		Distance (m)	Azimuth (degrees)		Found By[4]	Not Found	Scavenged Prior to Search

Comments (record carcass number next to associated comment, include any identifiers and bands, if present):

_____
_____
_____
_____
_____
_____

[1] Carcass ID – Use carcass ID from when it was originally found. If no ID, just number.
[2] Turbine – Turbine should be labeled with the turbine number where it was placed.
[3] Placed By – Initials of the person who placed the carcass.
[4] Found By – Record the initials of the person who found the carcass.

More data on back? Yes No

SCAVENGER REMOVAL TRIAL LOG
Wildcat Wind Farm (193702378)

Trial (spring, fall)_____ **Start Date_____**

Carcasses are labeled with date-turbine- carcass number as they were originally found (e.g., 2009Apr01-T04-C07, to describe carcass #7 found at turbine 4 on April 1, 2009).

Carcass ID[1]	Placement				Species (scientific name)			Condition[4] When Checked, Checked By[5]								
	GPS Coordinates	Time (Military)	Turbine[2]	Placed By[3]		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 10	Day 14	Day 20	Day 30

Carcass ID[1]	Placement				Species (scientific name)			Condition[4] When Checked, Checked By[5]								
	GPS Coordinates	Time (Military)	Turbine[2]	Placed By[3]		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 10	Day 14	Day 20	Day 30

[1] Carcass ID – Identification number marked inside carcass.
[2] Turbine – Turbine number where carcass placed.
[3] Placed By – Initials of the person who placed the carcass.
[4] Condition – Record the condition the carcass was in when checked. Intact = I, Signs of scavenging = S, Feather/Fur Spot = F, Missing or < 10 feathers = 0
[5] Checked by – Record the initials of the person who checked on the carcass.

Comments:_____
_____
_____
_____
_____
_____

More data on back? Yes No

CARCASS SEARCH SUMMARY SHEET

WILDCAT WIND FARM (193702378)

DATE: _____ BIOLOGIST: _____

WEATHER: % CLOUD COVER_____ TEMPERATURE (˚F) _____

PRECIPITATION _____ WIND_____

SITE DESCRIPTION/COMMENTS: _____

_____

_____

TURBINE NUMBER	PLOT TYPE (Full or Roads/Pads)	SURVEY TIME (MILITARY)		CARCASSES FOUND (#BIRD, #BAT, NONE)
		START	END	

Page____of_____

APPENDIX B

Representative Carcass Photos

Photo 1. Evening bat found at turbine A13 on 5/14/2015.

Photo 2. Hoary bat found at turbine F9 on 8/3/2015 with calipers for size comparison.

Photo 3. Red-eyed Vireo found at turbine H15 on 9/28/2015.

Photo 4. Red-tailed Hawk found at turbine H16 on 3/31/2015.